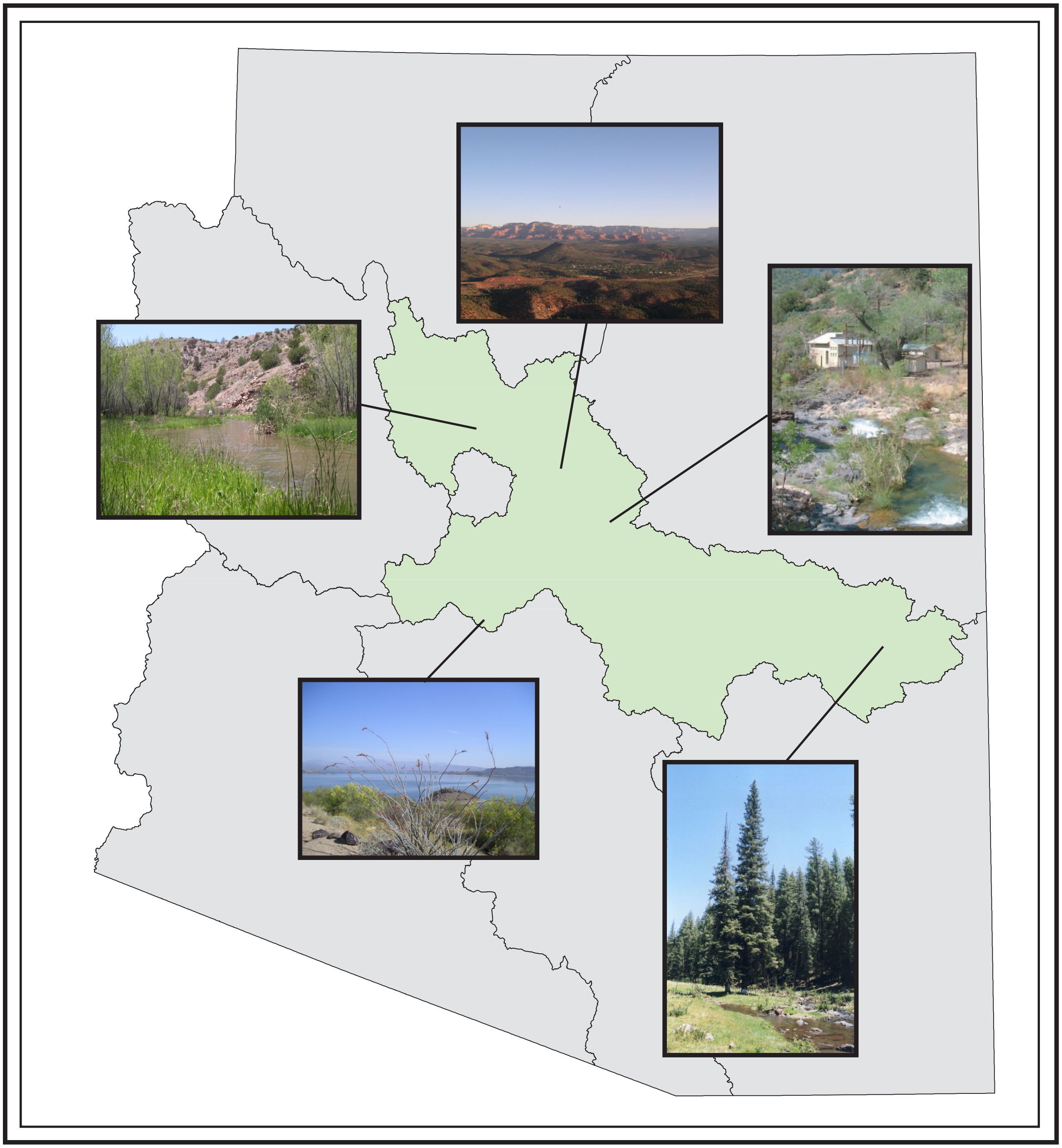
ARIZONA WATER ATLAS
VOLUME 5
CENTRAL HIGHLANDS PLANNING AREA



Arizona Department of Water Resources

DRAFT

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ARIZONA WATER ATLAS
VOLUME 5 - CENTRAL HIGHLANDS PLANNING AREA

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Preface

Volume 5, the Central Highlands Planning Area, is the fifth 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 5.0-1). There is a separate Atlas volume for each planning area, an introductory volume composed of background information, and an executive summary volume. "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.

There are additional, more detailed data available to those presented in this volume. They may be obtained by contacting the Arizona Department of Water Resources (Department).

5.0 Overview of the Central Highlands Planning Area

The Central Highlands Planning Area is composed of five groundwater basins oriented east-west in central Arizona. This planning area contains areas of higher elevation compared to many other parts of the state and is characterized by narrow valleys separated by steep mountain ranges. Elevation ranges from 1,500 feet to over 12,600 feet. Parts of nine counties are located within the planning area including parts of Apache, Coconino, Gila, Graham, Greenlee, Maricopa, Navajo, Pinal, and Yavapai counties. There are four Indian reservations within the planning area including the Fort Apache, San Carlos Apache, Tonto-Apache, and Yavapai-Apache Indian Reservations.

The 2000 Census planning area population was approximately 145,850. Basin population ranged from about 7,500 in the Tonto Creek Basin to over 88,000 in the Verde River Basin. Payson is the largest metropolitan area with about 13,600 residents in 2000. Other population centers include Camp Verde, Cottonwood/Verde Village/Clarkdale, Globe/Miami and Sedona.

An average of about 77,700 acre-feet of water is used annually in the planning area for agricultural, municipal and industrial uses (cultural water demand). Of this total, approximately 61% is groundwater, 38% is surface water and 1% is effluent. The agricultural demand sector is the largest with approximately 38,000 acre-feet of demand a year - 49% of the total demand. The municipal sector demand is about 22,600 acre-feet a year and industrial demand is about 17,100 acre-feet a year.

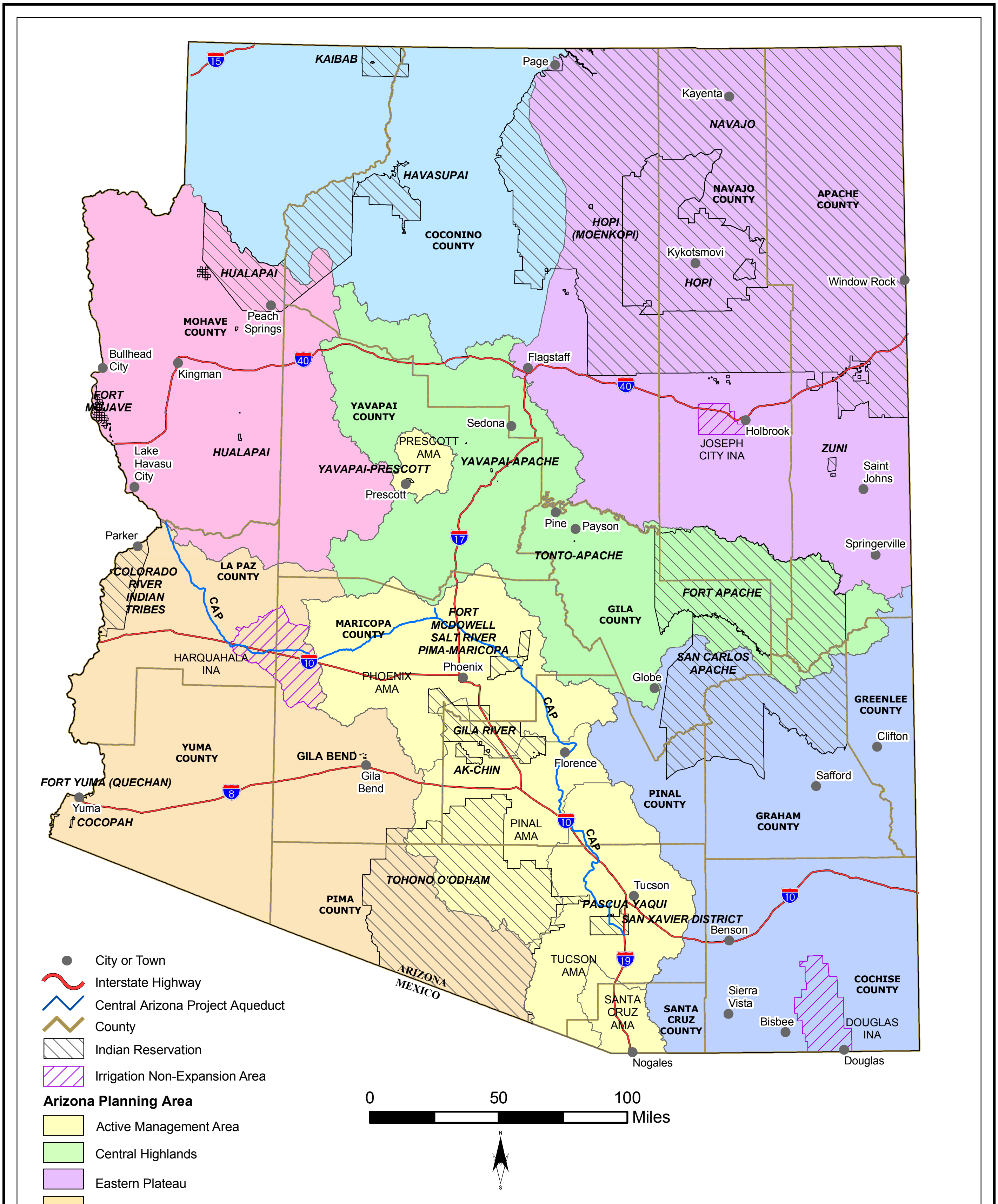


Figure 5.0-1
Arizona Planning Areas

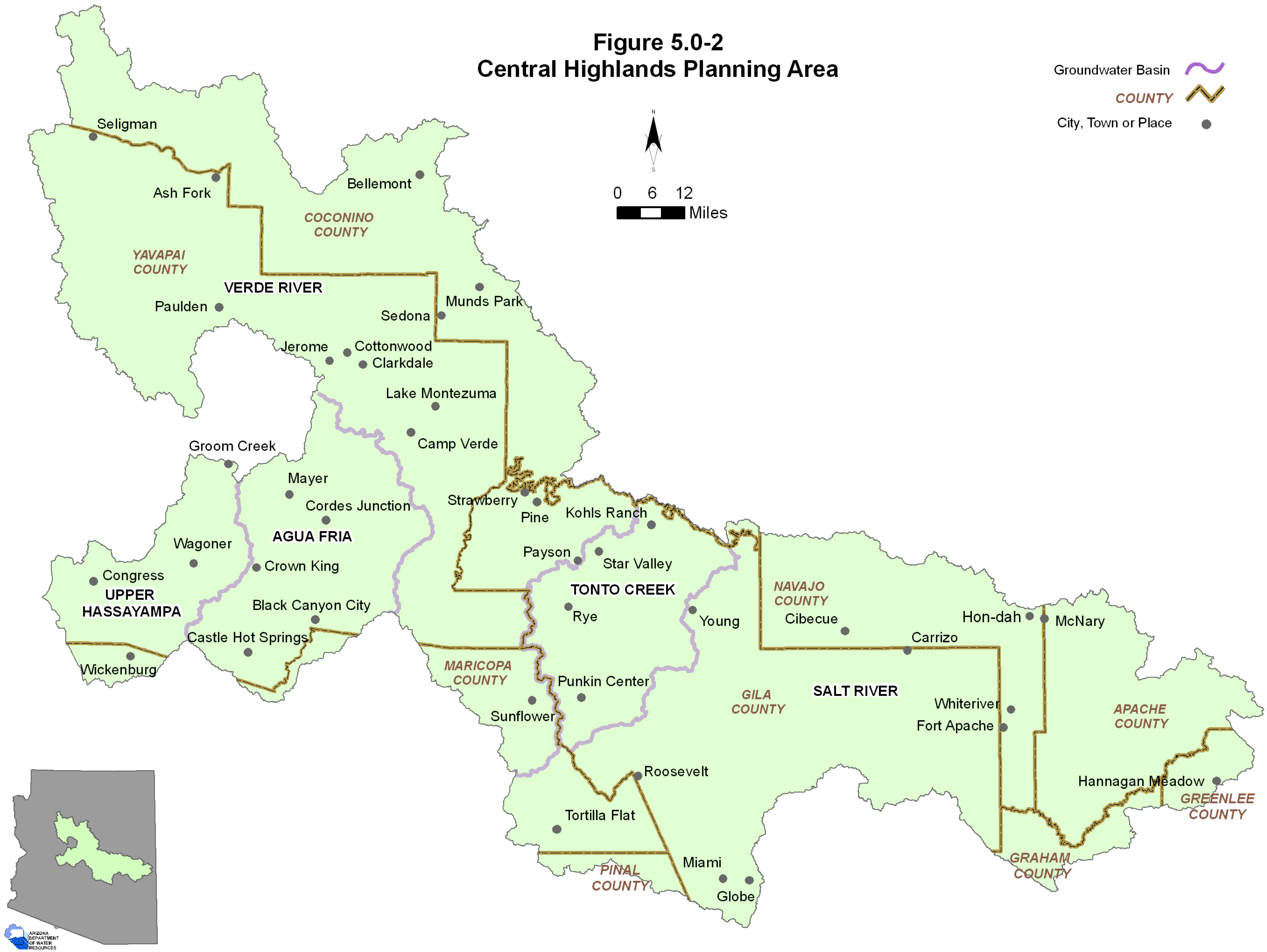
5.0.1 Geography

The Central Highlands Planning Area encompasses about 13,900 square miles and includes the Agua Fria, Salt River, Tonto Creek, Upper Hassayampa and Verde River basins. Basin boundaries, counties and prominent cities, towns and places are shown in Figure 5.0-2. The planning area is bounded on the north by the Coconino Plateau Basin in the Western Plateau Planning Area, on the east by the Eastern Plateau Planning Area, on the south by the Southeastern Arizona Planning Area and the Phoenix Active Management Area (AMA), and on the west by the Prescott AMA and the Upper Colorado River Planning Area (Figure 5.0.1). The planning area includes all or part of three watersheds, which are discussed in section 5.0.2. Within the planning area, the Fort Apache Indian Reservation encompasses about 2,500 square miles and the San Carlos Apache Indian Reservation, most of which is within the Southeastern Arizona Planning Area, encompasses about 500 square miles. The two other reservations are relatively small, totaling only about 740 acres or 1.2 square miles.

Most of the planning area is within the Central Highlands physiographic province, characterized by rugged mountains of igneous, metamorphic and sedimentary rocks. This province is the smallest in terms of area in Arizona and is a transition zone between the Basin and Range Lowlands and Plateau Uplands Provinces (See Volume 1, Figure 1-2). The extreme southwestern part of the planning area extends into the Basin and Range Lowlands physiographic province, which is characterized by northwest-southeast trending mountain ranges separated by broad alluvial valleys. The southern portions of the Agua Fria and Upper Hassayampa basins are indicative of this province. The northwestern part of the planning area falls within the Plateau Uplands physiographic province which is characterized by high desert plateaus and incised canyons. Included in this province are the northern part of the Verde River Basin, and the northern edge of the Tonto Creek and Salt River basins. Elevation ranges from 1,500 feet at Saguaro Lake in the Salt River Basin to 12,633 feet at Humphreys Peak in the San Francisco Mountains at the northeastern edge of the Verde River Basin. High-elevation mountains are also found in the White Mountains in the eastern portion of the Salt River Basin where Mt. Baldy, at 11,403 feet is the highest point.

A unique geographic feature of the planning area is the Mogollon Rim, an escarpment that defines the southern boundary of the Colorado Plateau. The rim is approximately 7,000 feet in elevation with sheer drops of 2,000 feet at some locations. The rim stretches for over a hundred miles and forms much of the northeastern boundary of the planning area. The planning area contains diverse topography and a large elevational range, resulting in a wide diversity of vegetation types and ecosystems, the greatest of any planning area in the state. Topography varies from desert basins in the Hassayampa Basin to deeply incised canyons along the Mogollon Rim and high mountain peaks. Because of the high elevations and associated higher rainfall and snowfall, this planning area contains the state's most important water producing watersheds, the Salt River and the Verde River. These watersheds contain the greatest concentration of perennial streams found in the state, which in turn support extensive riparian habitat.

Figure 5.0-2
Central Highlands Planning Area



5.0.2 Hydrology[1]

Groundwater Hydrology

The Central Highlands Planning Area is characterized by a band of mountains consisting of igneous, metamorphic and sedimentary rocks. High elevations, steep topography, and extensive bedrock result in relatively small water storage capabilities and high runoff in the planning area as compared to the alluvial basins in the State.

Anderson, Freethey and Tucci (1992) divided the alluvial basins in south-central Arizona into five categories based on similar hydrologic and geologic characteristics. One of these, the "Highland Basins", covers most of the planning area with the exception of the Upper Hassayampa Basin, categorized as a "West" basin, and the southern half of the Agua Fria Basin, categorized as a "Central" Basin.

Highland Basins
The Highland basins include the Salt River, Tonto Creek and Verde River basins, and the northern half of the Agua Fria Basin. Basin fill aquifers in the highlands are limited in areal extent and are hydrologically-connected with stream alluvium. Consolidated rock aquifers surround and underlie the basin fill aquifers and contribute underflow. Basin fill aquifers also receive inflow from stream infiltration and mountain front recharge. Where the basin fill aquifers are discontinuous, underflow between them may be restricted (Anderson, et al., 1992)

Agua Fria Basin (northern half)
Groundwater occurs in four geologic units in the Agua Fria Basin: basin fill sands and gravels, volcanic rocks, conglomerates and igneous and metamorphic rocks. Groundwater occurs in volcanic rocks in the northeastern section of the basin that yield relatively small volumes of water. Conglomerates are found throughout the basin and contain the largest volumes of groundwater of any of the rock units. Due to faulting, this unit is separated into smaller discrete basins separated by low permeability crystalline rocks.

Salt River Basin
The Salt River Basin is bounded on the west and southwest by the Sierra Ancha and Superstition Mountains, on the south by the Natanes Plateau and on the east by the White Mountains (see Figure 5.2-1). The Mogollon Rim, a 2,000-foot high escarpment, forms a natural groundwater divide along much of the basin's northern boundary. The Salt River Basin contains four sub-basins: Salt River Lakes, Salt River Canyon, Black River and White River. Figures 5.2-6 and 5.2-8 show the location of the sub-basins. Principal aquifers differ between the sub-basins, with basin fill and alluvial aquifers found in the western portion of the basin and limestone and volcanic aquifers in the eastern portion. Groundwater conditions in each sub-basin, from west to east, are discussed below.

[1] Except as noted, much of the information in this section is taken from the Arizona Water Resources Assessment, Volume II, ADWR August, 1994.

- Salt River Lakes Sub-basin

The Salt River Lakes Sub-basin occupies the western part of the Salt River Basin. Within the sub-basin groundwater is found in igneous granitic, metamorphic, and sedimentary rocks. A basin fill aquifer underlies a large part of the sub-basin including the area around Globe, lower Tonto Creek, the Salt River reservoirs and Pinto Valley west of Miami. Unconsolidated sands and gravels within the floodplains of streams and washes form an alluvial aquifer that is generally the most productive aquifer. Along the Salt River and around Roosevelt Lake, the basin fill is up to 2,000 feet thick (ADWR, 1992). Recharge to the basin fill aquifer occurs primarily along mountain fronts and from streams and lake infiltration.

In the Globe-Miami area the Gila Conglomerate, composed of semi-consolidated to consolidated basin fill sediments, forms a local aquifer. The Gila Conglomerate is up to 4,000 feet thick in this area and provides most of the area's municipal and industrial water supply. A limestone aquifer also supplies water in the Globe-Miami area, and west of Globe several small basin fill deposits form isolated groundwater aquifers (ADWR, 1992). Well yields are generally low in the southeast part of the sub-basin near Globe, and higher north of Globe. Igneous granitic rocks provide small amounts of water for domestic and stock use in the sub-basin.

Mining activities in the Globe-Miami area have impacted water quality in the alluvial aquifer along Pinal Creek and Miami Wash including elevated concentrations of sulfate and metals. Drinking water standards for cadmium, chromium, fluoride, lead, other metals and for total dissolved solids have been equalled or exceeded in a number of wells in the area.

- Salt River Canyon Sub-basin

In the western portion of the Salt River Canyon Sub-basin, sedimentary and igneous granitic rocks are found similar to those in the adjacent Salt River Lakes Sub-basin. The groundwater flow system is complex with disconnected recharge areas and many water-bearing zones located beneath sedimentary and igneous rocks (USGS, 2005a). The rest of the sub-basin is composed primarily of sedimentary rocks, including limestones, sandstones, siltstones, shales and thin conglomerates. These rocks are exposed along the Mogollon Rim and at other locations in the sub-basin. The Natanes Plateau, located along the southern boundary of the sub-basin, is composed of volcanic rock. There is little aquifer data for the area, but based on similar rock units in other areas, there may be useable amounts of water in the Supai Formation, Redwall Limestone, Coconino Sandstone and the undivided sandstones in the sub-basin. These formations may yield moderate amounts of water, up to 100 gpm, however yields can vary widely depending on sub-surface geology (ADWR, 1992). Recharge to the sedimentary rocks occurs mainly along the Mogollon Rim.

Significant basin fill and floodplain alluvial deposits are present along Cherry Creek near the western boundary of the sub-basin. The depth of basin fill deposits in this sub-basin was estimated to be less than 400 feet thick (ADWR, 1992).

- White River Sub-basin

The eastern portion of the White River Sub-basin is covered with volcanics and the western portion contains consolidated sedimentary rocks similar to those found in the Salt River Canyon

Sub-basin. Groundwater occurs in fracture zones and the various volcanic flows, including cinder beds. Groundwater flow in the volcanic aquifer is discontinuous and well yields and water levels may vary widely over short distances. Precipitation in the area is relatively high and recharges the volcanic aquifer through infiltration into the fractured rock. Groundwater discharged from the volcanic aquifer contributes to the baseflow of the White River.

- Black River Sub-basin

The Black River Sub-basin is covered almost entirely by volcanics that include basalt flows, rhyolitic ash flows, tuffs and tuffaceous agglomerates that form layers over 3,000 feet thick in some areas. Wells in this area are low-yield and well depths of 400 to 800 feet are common. As in the White River Sub-basin, the volcanic aquifer is recharged through infiltration of precipitation. Discharge from the aquifer contributes to baseflow in the Black River.

Tonto Creek Basin

In the Tonto Creek Basin, groundwater is found in stream alluvium, basin fill sands and gravel, Paleozoic sedimentary rocks and Precambrian igneous, metamorphic and sedimentary rocks. The primary aquifer occurs in basin fill which underlies a large portion of the basin, from near Rye to the southern basin boundary. The basin fill consists of coarse-grained conglomerate in the lower part of the basin and along the basin margins and locally is overlain by fine-grained mudstone in the center of the basin. The conglomerate may be up to 500 feet thick. Groundwater is also found in the floodplain alluvium which may be as much as 65 feet thick along Tonto Creek. Along the Creek, the basin fill and alluvial aquifers are recharged primarily by stream infiltration.

A limestone aquifer is utilized along the Mogollon Rim where groundwater movement and well yield are dependent on faults, fractures and solution cavities. Wells in the limestone aquifer generally yield less than 100 gpm. The aquifers within the sedimentary rocks are recharged from precipitation on the southern edge of the Colorado Plateau (USGS, 2005a). Fractured bedrock yields small volumes of water to wells east of Payson (ADWR, 1992). Since most of the land in the basin is National Forest land, there has been little groundwater development and aquifer characteristics are not well defined. Groundwater quality is generally good although drinking water standards for arsenic, radionuclides, nitrate/nitrite and organics have been equalled or exceeded in some wells.

Verde River Basin

The Verde River Basin encompasses part of the Coconino Plateau in its northern portion while the Mogollon Rim defines its eastern boundary. It is characterized by steep canyons, rugged mountains and broad alluvial valleys in the north and west-central portions of the basin. The basin is divided into the Big Chino, Verde Valley and Verde Canyon sub-basins, which are discussed from north to south below. A number of hydrogeologic studies of the Big Chino and Verde Valley sub-basins, and to a lesser extent the Verde Canyon sub-basin, have been conducted and are briefly referenced here. These studies, many of them very recent, contain detailed information about the groundwater system as well as the surface water system of the Verde River Basin. Figures 5.5-6 and 5.5-8 show the locations of the sub-basins.

- Big Chino Sub-basin

The Big Chino Sub-basin has an area of about 1,850 square miles. The principal aquifer consists of basin fill sediments interbedded with volcanic rocks of Cenozoic age that fill the sub-basin. This basin fill aquifer is commonly referred to as the Chino Valley Unit and is the major source of water for irrigation and domestic purposes. Chino Valley runs northwest to southeast from Seligman to Paulden. Well yields in Chino Valley wells are commonly greater than 1,000 gpm to greater than 2,000 gpm. A carbonate aquifer comprised of Paleozoic rocks underlies most of the Big Chino Valley Sub-basin and the area north of the Verde River near Paulden. It is assumed that there is a hydraulic connection between the two aquifers in the Big Chino Valley and the Williamson Valley, which runs north-south along the southeastern sub-basin boundary.

In the basin fill aquifer, groundwater occurs under unconfined and confined (artesian) conditions. Artesian conditions occur primarily where buried lava flows and coarse-grained sediments are interbedded with clays and volcanic ash. Recharge occurs from mountain front recharge and from runoff in major washes. In the northwesternmost part of the sub-basin, basin fill deposits may be as much as 2,500 feet thick. Further south and west of Paulden in the Williamson Valley, the thickness of the alluvium is estimated at 2,000 feet. In the eastern part of the Big Chino Sub-basin, the carbonate aquifer is the primary regional aquifer. This aquifer is dry west of the Mesa Butte Fault and between Williams and the Big Chino Valley (USGS, 2006). Alluvial sands and gravels along the major washes also yield water to wells and are utilized as a local water supply in the sub-basin. Water quality is generally good in the sub-basin with some occurrence of arsenic at levels that equal or exceed the drinking water standard in wells in the Paulden area.

Aquifer recharge occurs along the Juniper and Santa Maria Mountains on the west side of the sub-basin, from Granite Mountain on the south and from Big Black Mesa and Bill Williams Mountain on the east side of Chino Valley. Recharge also occurs via groundwater inflow from the Little Chino Sub-basin (Prescott AMA) north of Del Rio Springs. In 1999, this inflow was estimated at 1,800 acre-feet per year (Nelson, 2002). Groundwater outflow from the Big Chino Sub-basin occurs as base flow in the Verde River and is currently estimated at about 17,700 acre-feet/year. Base flow at the Verde River near Paulden (gage number 9503700, see Figure 5.5-4) has declined at an annual rate of about 380 acre-feet per year since the mid-1990s (USGS, 2006).

- Verde Valley Sub-basin

The Verde Valley Sub-basin has an area of about 2,500 square miles. The principal aquifer in the sub-basin is the Verde Formation, which consists of a thick sequence of limestones and sandstones. The estimated depth of the formation is 4,200 feet based on aeromagnetic and gravity data (USGS, 2006). Other aquifers include the carbonate aquifer and an alluvial aquifer located along the Verde River. Groundwater occurs primarily under unconfined conditions although confined conditions occur locally within the Verde Formation. All three aquifers are hydraulically connected. The main groundwater supply for Sedona is in sandstone of the Supai Formation and the underlying Redwall and Martin limestones (carbonate aquifer). Locally perched groundwater in fractured or decomposed granite and in volcanic rocks provide small amounts of water in many locations. Groundwater is generally of good quality at most locations, although the drinking water standard for arsenic has been equaled or exceeded in several wells (see Table 5.5-7).

Most groundwater enters the sub-basin from the Coconino Plateau. Groundwater moves through the carbonate aquifer and discharges at springs and seeps along tributaries of the Verde River, or flows into the Verde Formation and stream-channel alluvium (USGS, 2006). The Oak Creek Fault system is an important influence on the transmission of water between aquifers and to the surface, as evidenced by the large number of major springs along Oak Creek (see Figure 5.5-5). Groundwater primarily flows toward the Verde drainage and exits the sub-basin in the southeast through alluvium and volcanic rocks along the river.

Recharge to the Verde Formation aquifer is from high elevation precipitation along the Mogollon Rim and on the Coconino Plateau with additional contributions from stream infiltration. The carbonate aquifer also receives recharge from high altitudes along the Mogollon Rim, and from an area between the San Francisco Peaks and Bill Williams Mountain (USGS, 2006). Most recharge comes from winter precipitation.

- Verde Canyon Sub-basin

There is relatively little groundwater development in the Verde Canyon Sub-basin. Basalt flows, conglomerates and semi-consolidated silt units cover a large part of the sub-basin. The groundwater system is complex with disconnected recharge areas and multiple water-bearing zones. Because of its complexity our understanding of the groundwater system is often limited to local analysis of spring and well data. Recharge to the groundwater system originates primarily along the crest of the Mogollon Rim where precipitation and snowmelt percolate through permeable volcanic, limestone or sandstone units (USGS 2005a). Spring discharge and stream base flow appear to be the largest components of aquifer outflow. Water quality is generally good in the sub-basin although the drinking water standards for arsenic, beryllium, cadmium, lead, selenium and organics have been equaled or exceeded in wells in the Payson area and for arsenic in Pine.

In Payson, groundwater is withdrawn primarily from fractured and faulted granite. Most wells are shallow, although the town of Payson has conducted exploratory drilling north of the town where deep water-bearing zones were found. A recent study suggests that a segment of the Diamond Rim fault system northeast of Payson may have groundwater supply potential (Gæaorama, 2006). The shallow water-bearing zones around Payson depend on winter recharge and are therefore very sensitive to drought. Water in deeper fracture systems in the area may be fed from the Mogollon Rim and less affected by droughts. Well yields in the area are typically less than 500 gpm.

In Strawberry, most wells are completed in the Schnebly Hill Formation, a sandstone unit that is the major component of the "Red Rocks" of Sedona. Well yields in the area typically range from 20 to 80 gpm. An exploratory well drilled near Strawberry in 2000 encountered water in the Redwall Limestone at about 1,380 feet (Corkhill, 2000). At nearby Pine, most wells are completed in the Supai Formation, which is composed of sandstone, siltstone, and mudstone with some interbedded limestone. Well yields in Pine are typically lower than Strawberry and range from 10 to 30 gpm. These relatively low well yields suggest a more localized groundwater system (USGS, 2005a). There is little water use in the southern half of the sub-basin where unconsolidated sediments are found.

West Basins
The Upper Hassayampa Basin was defined by Anderson, Freethey and Tucci (1992) as a "West" basin. These basins are generally arid and groundwater inflow and outflow are relatively small with little or no stream baseflow. The main aquifer in the Upper Hassayampa Basin is basin fill deposits found along valleys between the mountains. These deposits consist of gravel, sand, silt and clay. In the mountainous portions of the basin, fractured crystalline and consolidated sedimentary rocks yield small amounts of water to wells. North of the Vulture Mountains in the southwestern part of the basin, the basin fill varies from a few tens of feet thick to over 1,000 feet thick near the middle of the valley. Near Wagoner, stream deposits overlying crystalline rock are up to 135 feet thick. Groundwater quality is generally good in the basin although drinking water standards for arsenic and other metals have been equaled or exceeded in wells near Wickenburg.

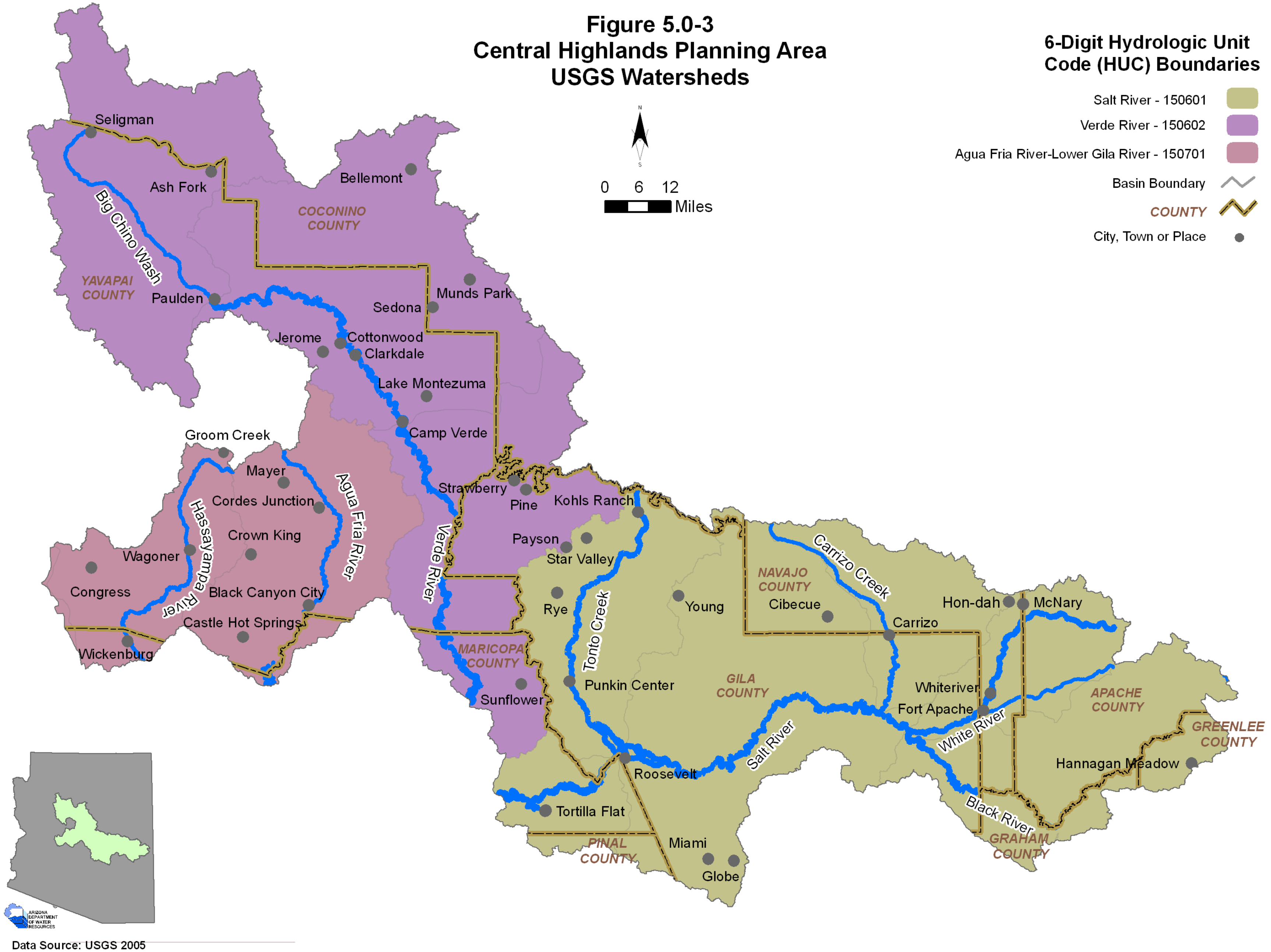
Central Basins
The southern half of the Agua Fria Basin was categorized by Anderson, Freethey and Tucci (1992) as a central basin. Central basins are characterized by deep alluvial sediments with small to moderate amounts of mountain front recharge and streamflow infiltration. The principal aquifers in the Agua Fria Basin are upper basin fill, which occurs under unconfined conditions, and sedimentary rock (conglomerate), which is found throughout the basin and contains the largest volume of groundwater. Castle Hot Springs, located in the southwest part of the basin, discharge 340 gpm from Precambrian rocks. By comparison, wells in Precambrian schist near Black Canyon City have relatively low yields. Arsenic and fluoride concentrations at levels that equal or exceed drinking water standards have been detected in springs and wells near Black Canyon City and in Castle Hot Springs.

Surface Water Hydrology

The U.S. Geological Survey (USGS) divides and subdivides the United States into successively smaller hydrologic units based on hydrologic features. These units are classified into four levels. From largest to smallest these are: regions, subregions, accounting units and cataloging units. A hydrologic unit code (HUC) consisting of two digits for each level in the system is used to identify any hydrologic area (Seaber et al., 1987). A 6-digit code corresponds to accounting units, which are used by the USGS for designing and managing the National Water Data Network. There are portions of three watersheds in the planning area at the accounting unit level; the Agua Fria River-Lower Gila River, the Salt River and the Verde River. (Figure 5.0-3).

The Agua Fria-Lower Gila River
The Agua Fria-Lower Gila River watershed extends from near Prescott to south of Gila Bend in the Lower Colorado River Planning Area. It includes the drainage areas of the Agua Fria River, the Hassayampa River and the Gila River from below its confluence with the Salt River Basin to Painted Rock Dam. Within the planning area, this watershed covers the Agua Fria Basin and the

Figure 5.0-3
Central Highlands Planning Area
USGS Watersheds



Upper Hassayampa Basin.

The Agua Fria River drains an area of about 2,700 square miles with elevations ranging from 7,800 feet in the Bradshaw Mountains, which define part of its western boundary, to 1,570 feet at Lake Pleasant, which is impounded by New Waddell Dam at the southern boundary of the Agua Fria Basin. The Agua Fria River only flows below the dam when water is released during major flood events. It is tributary to the Gila River a short distance downstream of the confluence of the Salt and Gila Rivers near Goodyear in the Phoenix AMA. The Agua Fria River is perennial at several reaches within the Agua Fria Basin: above Lake Pleasant south of Black Canyon City; through portions of the Agua Fria National Monument; and in the northern part of the basin (see Figure 5.1-5). Tributaries to the Agua Fria River with perennial reaches include Little Ash, Sycamore, and Silver creeks. Other tributaries to the river are generally intermittent or ephemeral.

The Hassayampa River originates in the northern Bradshaw Mountains and flows through the Upper Hassayampa Basin and the Phoenix AMA to its confluence with the Gila River. The river drains a total of about 1,470 square miles. It is perennial in the northern portion of the Upper Hassayampa Basin in the vicinity of Groom Creek, and in the reach south of Wickenburg. A major fault crosses the river seven miles downstream from Wickenburg at "the Narrows", which forms the southern boundary of the basin. At this point, the entire flow of the river sinks into the streambed. The only other perennial reaches within the basin are short reaches of Minnehaha, Ash, Weaver and Antelope creeks (AGFD, 1993).

There are three currently operating streamflow gages in the watershed, all located in the Agua Fria Basin. These include real-time gages on the Agua Fria River near Humboldt, Mayer and Rock Springs. The maximum recoded annual flow in the watershed was 360,541 acre-feet at the Rock Springs Gage in 1992. The median annual flow at this location is 19,692 acre-feet and the minimum annual flow was 1,528 acre-feet in 1975 (see Table 5.1-2). There are currently no operating streamflow gages in the Hassayampa River drainage of the watershed. The gage with the longest record (35 years), was located north of Wickenburg and was discontinued in 1982. During its period of operation, the highest annual flow recorded was 123,076 acre-feet in 1980, and its median flow was 7,457 acre-feet (see Table 5.4-2).

There are approximately 460 total springs located in the watershed. Only five springs with a discharge of 10 gpm or greater have been reported and all are located in the Agua Fria Basin. Discharges from those springs were last measured during or prior to 1982, therefore these rates may not be indicative of current conditions. The largest spring is Castle Spring, with a reported discharge of 340 gpm and a temperature of 131°F. It is located northwest of Lake Pleasant at Castle Hot Springs, reportedly Arizona's first resort which opened in 1896. The four other large springs have discharge rates less than 100 gpm and are located in the northeastern portion of the basin (see Figure 5.1-5). There are 14 minor springs (discharge of 1-10 gpm) in the watershed, also located in the Agua Fria Basin. While there are no large or small springs in the Upper Hassayampa Basin, there are approximately 164 to 166 springs with a discharge of less than 1gpm.

Within the watershed, reaches of Turkey Creek in the Agua Fria Basin, and Cash Mine Creek, French Gulch and the Hassayampa River in the Upper Hassayampa Basin have surface waters with impaired water quality. Parameters of concern include cadmium, copper, zinc, pH and lead due to mining activities in the area.

The Salt River

The surface water characteristics of the Salt River watershed are influenced by precipitation patterns, topography and geology. The Salt River and Tonto Creek basins comprise most of the watershed with the exception of the westernmost part, which extends to the confluence of the Salt and Gila rivers in the Phoenix AMA. The Salt River is the largest tributary of the Gila River, with a drainage area of about 5,980 square miles. Its headwaters are the White and Black rivers that originate in the high elevations of the Salt River Basin where winter snow accumulation is critical to downstream water supplies. This area is the most prolific producer of surface water in Arizona with unit runoff values of as much as 674 acre-feet/square mile (12.6 inches) in the drainage of the East Fork of the White River (ADWR, 1992) (See Figure 5.2-4). By comparison, the Tonto Creek Basin has a unit runoff of about 165 acre-feet/square mile (3.1 inches). Within the planning area, the elevation of the watershed ranges from near 11,400 feet in the White Mountains to 1,500 feet at Saguaro Lake.

There are many perennial streams in the watershed, particularly in the Salt River Basin (see Figures 5.2-5 and 5.3-5). The Salt River and Tonto Creek are both perennial throughout their lengths in the planning area. Numerous small streams that begin along the Mogollon Rim and the White Mountains feed tributaries of the Salt River and Tonto Creek. Perennial flow in these streams is primarily due to geologic features (e.g. joints and fractures) that cause groundwater to surface and discharge to streams.

Surface water from the watershed flows into Theodore Roosevelt Lake, and is subsequently released to a series of three downstream reservoirs along the Salt River; Apache Lake, Canyon Lake and Saguaro Lake. These reservoirs and their associated dams are operated by the Salt River Project (SRP) for the benefit of agricultural, municipal and industrial users in the Phoenix metropolitan area. Figure 5.0-4 shows the capacity of the SRP reservoir system on both the Salt and the Verde systems. Also shown is C.C. Cragin Reservoir, formerly known as Blue Ridge Reservoir. Water stored at C.C. Cragin, located in the Eastern Plateau Planning Area, is diverted by pipeline to the East Verde River in the Verde Watershed. Surface water stored in this reservoir and in the Salt and Verde system is not generally available for use in the Central Highlands Planning Area.

The Salt River system dams were constructed beginning in 1911 with completion of Roosevelt Dam. Mormon Flat Dam was completed in 1926, followed by Horse Mesa in 1927 and Stewart Mountain in 1930. Prior to dam construction, the flow in the Salt River was heaviest in the spring and early summer. Flow is now regulated in response to flood control and downstream water demand. As a result, flows below the reservoirs are generally highest during June-August when water demand is greatest in the Phoenix metropolitan area or when high inflow to the reservoirs necessitates release of water from the dams. In February 1980, a wet winter combined with a storm that dropped up to ten inches of rainfall on the watershed resulted in the largest controlled flood ever to go down the Salt River. Releases from Roosevelt Dam peaked at 180,000 cfs and the water level behind the dam was inches from overflowing the crest (SRP, 2007).

Figure 5.0-4. SRP Reservoir System Capacity

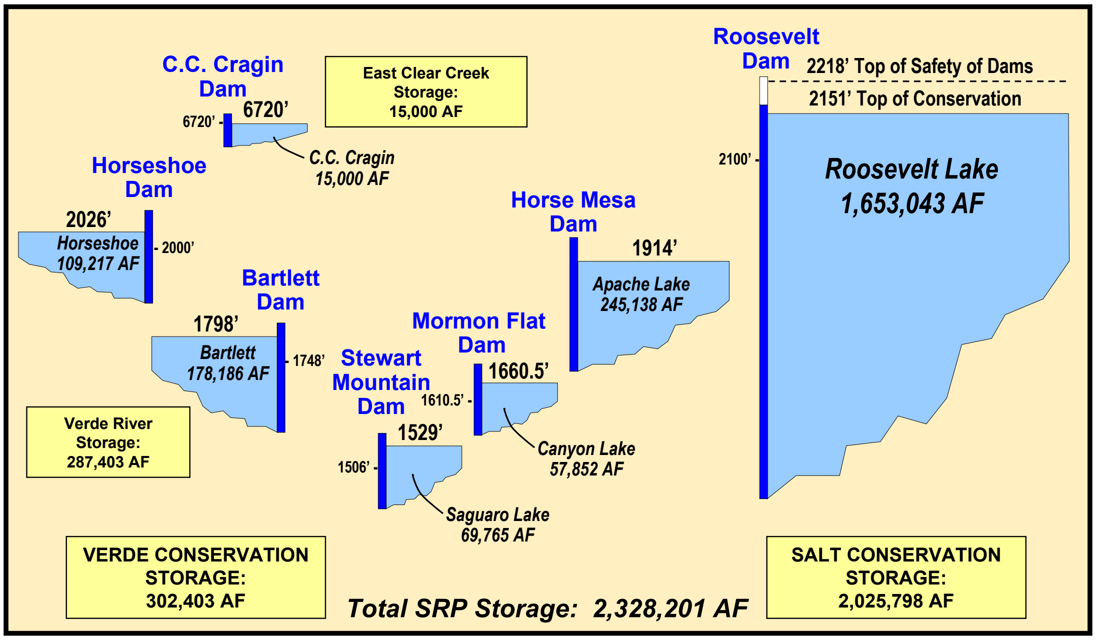


Figure Courtesy of SRP

Annual streamflow of the Salt River fluctuates widely. The nearest gage upstream from Roosevelt Lake, with a contributing drainage area of 4,306 mi², has been in operation since 1913. The maximum annual flow was over 2.4 maf in 1916, median annual flow has been 518,499 acre-feet and mean annual flow 644,942 acre-feet. In 2002, an extreme drought year, flow into Roosevelt Lake was at its minimum, about 153,000 acre-feet (Table 5.2-2). Except for changes due to timber harvesting and beaver removal, the upstream reaches of the river have not been significantly altered (Tellman et al., 1997). Typically, timber harvesting and fire in mature forests increases watersehd yields due to elimination of the plant cover. As woody and herbaceous vegetation becomes established, streamflows decline. Recent severe fires in the basin resulted in significant increases in peak flow at several locations. (Neary, et al., 2003)

In the Tonto Creek Basin there is one currently operating, real-time gage located near the community of Roosevelt north of Gun Creek. The maximum annual flow at this point was more than 469,000 acre-feet in 1978. The median annual flow has been about 66,000 acre-feet. Similar to the record low flow in the Salt River, the minimum annual flow was about 2,900 acre-feet in 2002 (Table 5.3-2).

There are a relatively large number of major springs in the Salt River watershed. In the Tonto Creek Basin, several major springs are located below the Mogollon Rim where groundwater is discharged from southward dipping rocks of a limestone aquifer. Tonto Spring at the headwaters of Tonto Creek is the largest spring in the Tonto Creek Basin with a measured discharge of 1,291 gpm. Its flow has been relatively stable, and its isotopic and specific-conductance data are similar to those for Fossil Springs in the Verde River Watershed. This suggests that the same limestone aquifer supplies both springs, which are located approximately 20 miles apart (USGS, 2005b). In the Salt River Basin, there is a high concentration of major springs near McNary, where springs emanate from fractured basalt. Alchesay Spring, which issues from the Supai Formation along the

North Fork of the White River, has the greatest reported discharge measurement in the watershed (over 9,000 gpm). Travertine deposition due to high concentrations of calcium carbonate in source waters occurs at this spring and at Warm Spring along the Salt River (ADWR, 1992).

Several lakes and streams in the watershed have impaired water quality. Reaches of Tonto Creek and Christopher Creek in the Tonto Creek Basin have exceeded standards for E. coli and nitrate/nitrite. The entire reach of Pinto Creek in the Salt River Basin has exceeded the standard for copper due to mining activities in the area. Two lakes in the Salt River Basin have impaired waters including Canyon Lake (dissolved oxygen) and Crescent Lake (high pH) (see Tables 5.2-7 and 5.3-7).

Verde River

Most of the Verde River watershed, and its major watercourse, the Verde River, is located within the boundaries of the Verde River Basin. Within the planning area, the elevation of the Verde River watershed ranges from about 12,600 feet at Humphrey's Peak to about 1,750 feet at Bartlett Dam. The entire watershed encompasses about 6,188 square miles and extends into the Phoenix AMA to the confluence of the Verde River with the Salt River. The upper parts of the watershed include Big Chino Wash, which originates east of the Aubrey Cliffs northwest of Seligman, and Oak Creek which originates on the Coconino Plateau in the northeastern part of the watershed. Big Chino Wash is an ephemeral stream that flows southeasterly to Sullivan Lake while Oak Creek is a perennial stream that merges with the Verde River south of Cottonwood.

The Verde River originates in a steep-walled volcanic rock canyon near Paulden below Sullivan Lake Dam (now almost entirely filled with sediment). Springs feed the headwaters near the upper end of Stillman Lake. The lake has been formed from sediment deposited in the river at the Granite Creek confluence, which causes the river to back-up in its channel. The lake is a narrow, 3,900 feet-long, 20-acre impoundment (USFWS, 2007). Just below the confluence with Granite Creek, a large diffuse spring network, including Big Chino Spring and Sullivan Lake Spring, sustain perennial flow in the river. A USGS study found that discharge from the springs below Sullivan Dam are derived from three groundwater sources; the western part of the Coconino Plateau, the Big Chino Sub-basin and the Little Chino Sub-basin (the Prescott AMA) (USGS, 2006). Another USGS study used geochemistry and tracer-study data to estimate the various base flow contributions to the Verde River. It reported that 80-86% of the base flow is from the Big Chino Sub-basin, 14% from the Little Chino Sub-basin, 10-15% from the Devonian-Cambrian zone of the regional carbonate aquifer and <6% from the Mississippi-Devonian sequence of the regional carbonate aquifer (USGS, 2005c).

Below Granite Creek, the Verde River flows eastward to Perkinsville, southeastward to Fossil Creek, then southward through two reservoirs, Horseshoe and Bartlett, before its confluence with the Salt River. Bartlett Dam was constructed between 1936-1939 to store water for irrigation and other uses in the Phoenix metropolitan area. Ten miles upstream, Horseshoe Dam was completed in 1946 by Phelps Dodge for the Salt River Valley Water Users' Association under a water exchange agreement. Both reservoirs are operated by SRP.

The Verde River is perennial throughout its length from just below Sullivan Lake Dam. Almost all the major perennial tributaries to the river drain areas to the north and east. In addition to Oak Creek, other major tributaries are Wet Beaver Creek, West Clear Creek, Sycamore Creek (at Fort McDowell) and East Verde River. Stream flows in the watershed can be substantial given the high elevation and associated high rainfall and snowfall. Several stream gages on the Verde and its tributaries have reported annual maximum flows exceeding one million acre-feet a year. These gages are the Oak Creek gage near Cornville, the Verde River below Tangle Creek above Horseshoe Dam, and the Verde River at Bartlett Reservoir near Cave Creek. The median flows at these gages are about 531,000 acre-feet, 131,000 acre-feet and 245,000 acre-feet, respectively (see Table 5.5-2). The lowest flow reported at the Oak Creek gage was about 214,500 acre-feet in 1956.

There are many major and minor springs in the Verde River Basin (see Table 5.5-5) including Fossil Springs, near Strawberry, with a total discharge of 21,647 gpm. Fossil Springs consist of several dozen discharge points with most of the flow emanating from about a half dozen points. The largest of the springs reportedly issues from the Fossil Springs fault while other springs issue from the Naco Formation near the contact with the underlying Redwall limestone (Gæaorama Inc., 2006). The Naco Formation consists of interbedded grayish limestone and limey claystone and is located between the overlying Supai Formation and the Redwall limestone in this area (Corkhill, 2000). The chemistry of the springs below the Mogollon Rim is characteristic of water from the Coconino Aquifer, suggesting its source. Fossil Springs contain elevated concentrations of calcium, magnesium, and bicarbonate as well as chloride and sulfate (USGS, 2005a). Calcium carbonate precipitates out below the springs and forms travertine dams along Fossil Creek.

Major springs also occur along upper and lower Oak Creek. In the north half of Oak Creek Canyon, water moves along fractured rock of the Oak Creek fault zone to discharge at springs along the creek (Owen-Joyce, 1983). Concentrations of springs are also found along lower Oak Creek, south of Camp Verde and below the Mogollon Rim north of Payson. Here, water infiltrating through sedimentary rocks discharges at springs along the face of the rim at fractures or at the interface of permeable and less permeable rocks.

Impaired surface waters in the Verde Watershed occur along the East Verde River (selenium), Oak Creek (E. coli), Pecks Lake (dissolved oxygen, high pH and nutrients), Stoneman Lake (dissolved oxygen, high pH and nutrients), Whitehorse Lake (dissolved oxygen) and along reaches of the Verde River (turbidity). (See Table 5.5-7 and Figure 5.5-9).

5.0.3 Climate[2]

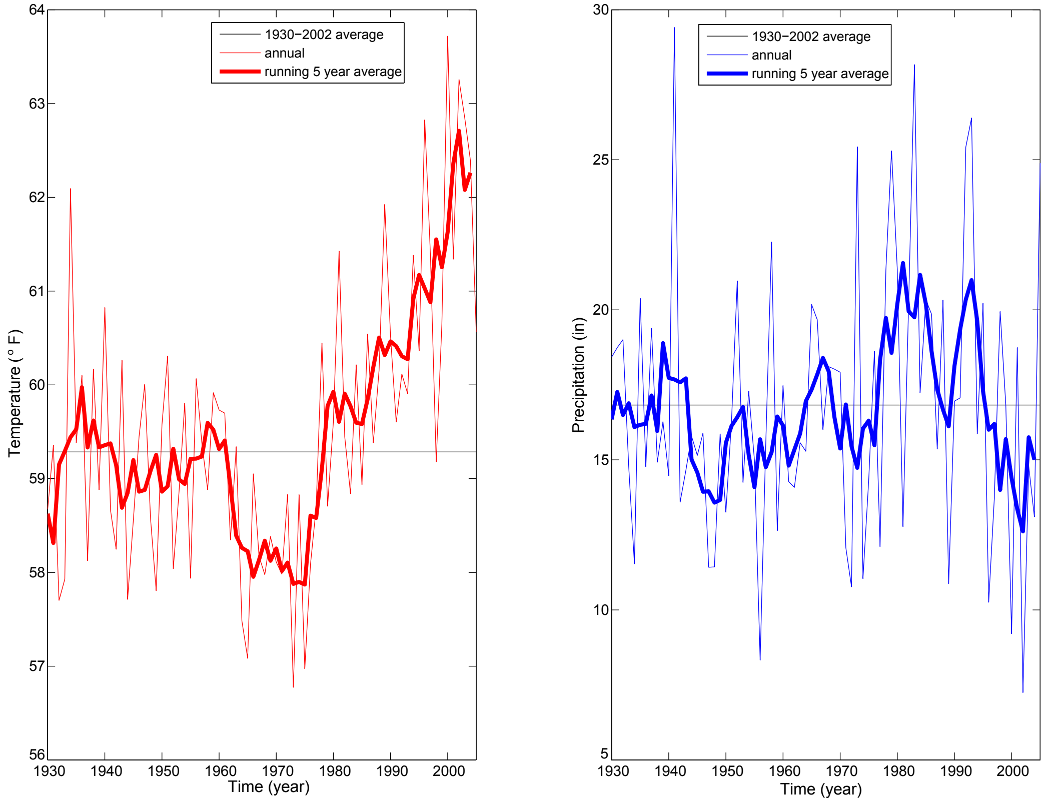
The high country of the Mogollon Rim is a significant topographic barrier to regional airflow, making the climate of the Central Highlands Planning Area wetter and cooler than the rest of the state. The area-weighted average of water-year precipitation for Arizona Climate Divisions 3 and 4 (Yavapai and Gila counties, respectively) is 16.8 inches, which is significantly wetter than the statewide average of 12.1 inches. A climate division is a region within a state that is generally

[2] Information in this section was provided by Institute for the Study of Planet Earth, Climate Assessment for the Southwest (CLIMAS), University of Arizona, May, 2007.

climatically homogeneous. Arizona is divided into seven climate divisions. The area-weighted average water-year temperature is 59.3°F (Figure 5.0-5), which is slightly cooler than the statewide average of 59.9°F.

While average temperatures are slightly cooler than the statewide average, they have been warming during the last 70+ years (Figure 5.0-5). Recent studies show an observed increase, throughout much of the West, in the fraction of winter precipitation falling as rain, rather than snow, at low-to-middle elevations (up to around 8000'). If this trend continues, the timing, amount and distribution of spring runoff is likely to be affected.

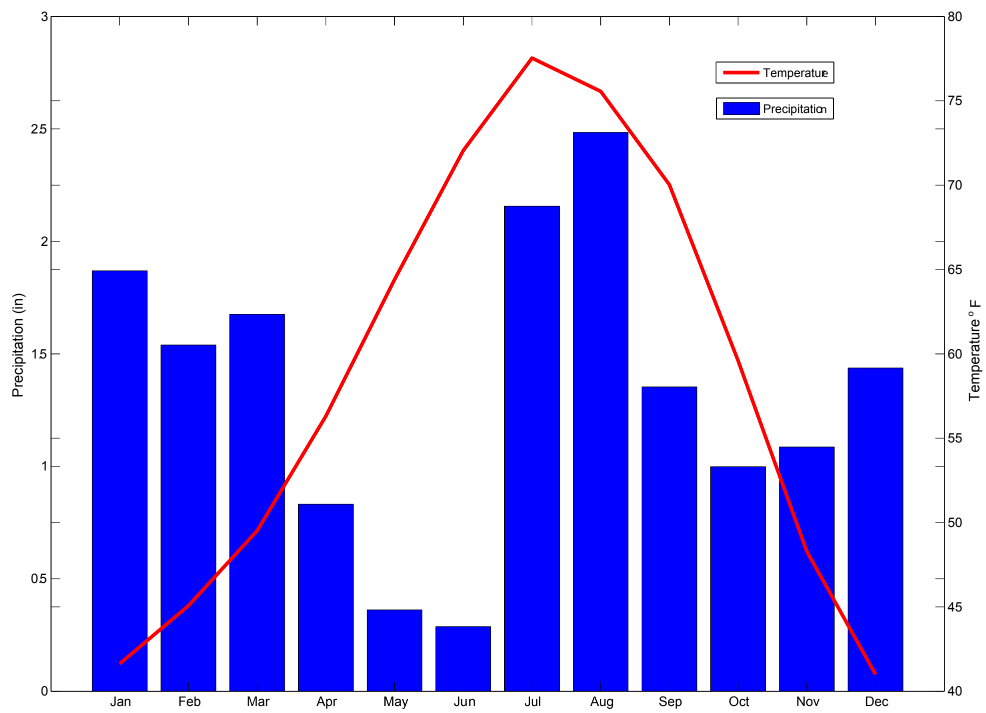
Figure 5.0-5 Average temperature and total precipitation in the Central Highlands Planning area from 1930-2002



Horizontal lines are average temperature and precipitation, respectively. Light lines are yearly values and highlighted lines are 5-year moving average values, Data are from U.S. Historical Climatology Network. Figure author: Ben Crawford, CLIMAS

Precipitation in the Central Highlands has a bi-modal pattern (both winter *and* summer precipitation peaks) characteristic of Arizona (Figure 5.0-6); however, the planning area receives a greater fraction of its precipitation during the winter months than, for example, southeastern Arizona. During winter, precipitation comes during the passage of frontal storm systems moving west-to-east guided by the jet stream, typically located north of Arizona, but occasionally traversing the state. As moist air masses encounter the Mogollon Rim they are lifted and cooled, which condenses water vapor and enhances precipitation along the Rim. Winter precipitation stored as snow is important for planning area water resources. Cooler temperatures and less intense sunlight during winter combine to reduce evaporation, and, in most years, allow snow cover to persist until spring, when gradually melting snow replenishes surface water supplies.

Figure 5.0-6 Average monthly precipitation and temperature in the Central Highlands Planning Area 1930-2002

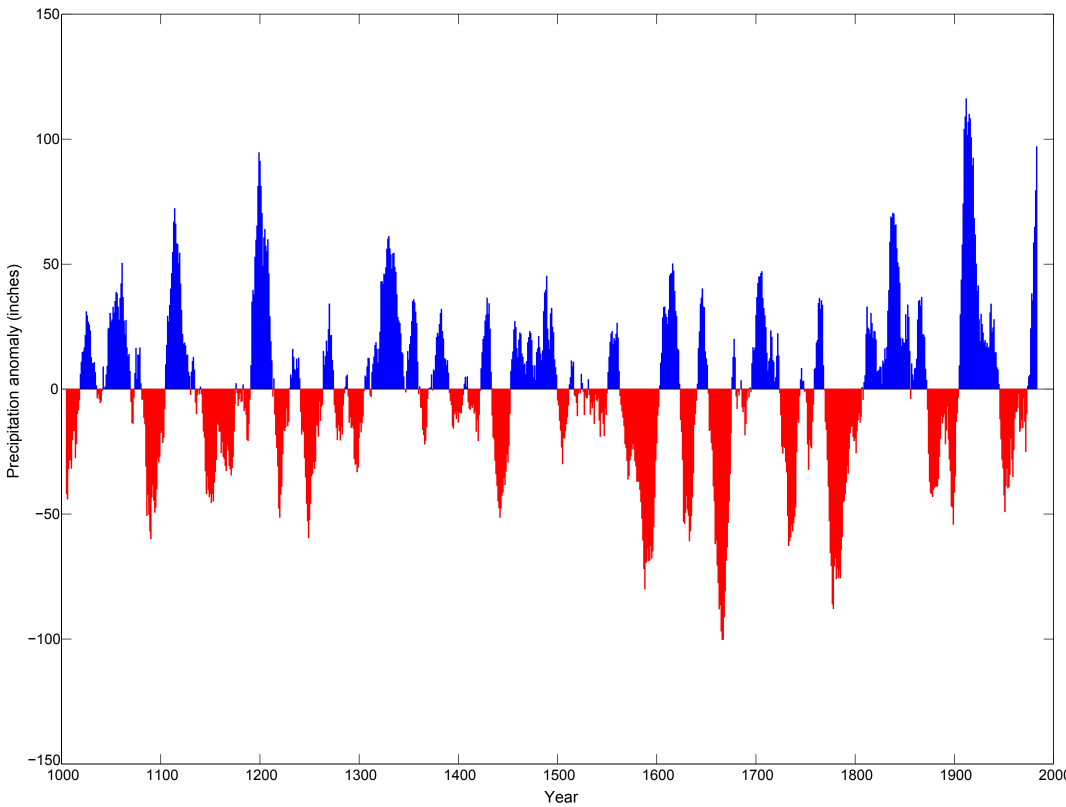


Data are from the U.S. Historical Climatology Network. Figure author: Ben Crawford, CLIMAS

During the summer monsoon thunderstorm season, atmospheric circulation shifts and brings moisture from the south and east to the planning area. Storms during this season are driven primarily by convection (heat-driven upward motion), aided by topography, which can force air parcels upward to heights where water vapor condenses. Summer convective thunderstorms tend to occur in spatially scattered cells. Many storms originate over the high elevations in the Central Highlands Planning Area and move downwards and outwards over the deserts. The planning area receives over 37% of its annual precipitation during July-September, which helps replenish streamflow and recharge groundwater aquifers, especially in the shallow fractured aquifers near Payson. However, summer precipitation is generally less hydrologically effective than winter precipitation because of greater evaporation rates and the spatial discontinuity of the storms.

An area-weighted average of tree-ring reconstructed winter (November-April) precipitation for Arizona Climate Division 3 (Yavapai County) and Arizona Climate Division 4 (Gila County) is representative of multi-year winter precipitation variations across the area (Figure 5.0-7). The record shows recurrent drought in each century, with notable winter dry periods in the mid-1100s, late 1500s, late 1670s, and late 1770s. Notable winter wet periods include the early 1200s, the late-1800s, and early 1900s. Precipitation variability on time scales of 10-30 years is likely related to shifts in Pacific Ocean circulation patterns, though recent research also points to the influence of the North Atlantic Ocean. Shorter-term variations (Figure 5.0-5) can be attributed to ocean-atmosphere variations related to the El Niño-Southern Oscillation. During El Niño episodes, there are greater chances for above-average winter precipitation, as storm tracks across North America are shifted farther south than normal. La Niña conditions are reliably associated with below-average winter precipitation.

Figure 5.0-7 Arizona NOAA Climate Divisions 3 & 4 winter (November-April) precipitation departures from average, 1000-1988, reconstructed from tree rings



Data are presented as a 20-year moving average to show variability on decadal time scales. Data: Fenbiao Ni, The University of Arizona Laboratory of Tree-Ring Research and CLIMAS. Figure author: Ben Crawford, CLIMAS

5.0.4 Environmental Conditions

Environmental conditions reflect the impacts of geography, climate and cultural activities and may be a critical consideration in water resource management and supply development. Discussed in this section is vegetation, riparian protection through the Arizona Water Protection Fund Program, instream flow claims, threatened and endangered species, public lands protected from development as national monuments, wilderness areas and preserves and unique and other managed waters.

Vegetation[3]

Three of Arizona's five ecoregions are included in the planning area: the Apache Highlands (north), which covers most of the area, the Sonoran Desert in the south, and the Arizona-New Mexico Mountains ecoregion stretching east-west at higher elevations along the Mogollon Rim, White Mountains and Flagstaff area. Because of the wide elevation range in the planning area, there are many biotic communities, ranging from Mohave desertscrub in the Upper Hassayampa Basin to subalpine grassland and subalpine conifer forest in the high elevations of the Salt River Basin and a very small area of alpine tundra above 12,000 feet on the San Francisco Peaks in the Verde River Basin. Much of the planning area is covered by interior chaparral and by great basin conifer woodlands.

The high elevation subalpine and montane conifer forests, consisting of dense stands of fir, spruce and aspen trees, receive much of their annual precipitation as snow. Because of the forest density, sunlight reaches the ground and snow melts slowly, releasing snowmelt gradually to streams. Snowfall accumulations in this area of the state are critical to the Phoenix metropolitan area water supply. Annual precipitation amounts are about 25 to over 30 inches a year in these areas.

Conifer woodlands consisting primarily of ponderosa pine occur at elevations between 6,000 and 9,000 feet that receive about 18 to 26 inches of annual precipitation. Piñon-juniper woodlands cover large areas below the ponderosa pine forest at elevations between 5,500 and 7,000 feet that receive 12 to 20 inches of precipitation. Below 6,800 feet there are more junipers than piñon pine and they may occur in pure stands.

Great Plains grasslands occur in several parts of the planning area at elevations between 5,000 and 7,000 feet that receive between 11 and 18 inches of annual precipitation. These areas are located primarily in Chino Valley and in small areas on the Fort Apache Indian reservation south of Fort Apache. The piñon-juniper woodland is often intermixed with this grassland.

At lower elevations (4,000-6,000 feet), interior chaparral is found in areas that receive 13 to 23 inches of annual precipitation. Chaparral consists of dense shrubs that grow around the same height with occasional taller shrubs or small trees. Chaparral communities typically are a mix of several shrubby species such as mountain mahogany, shrub live oak, and manzanita and commonly include cactus, agave, and yucca. Chaparral plants are well adapted to drought conditions.

Semi-desert grasslands occur in valleys between the desert and woodlands or chaparral at elevations

[3] Except as noted, information in this section is from Brown, D. and Lowe, C., 1980 and from AZGF, 2004.

between 3,500 and 5,000 feet that receive annual precipitation of 10 to 15 inches. Semi-desert grasslands are found in the Upper Hassayampa and Agua Fria basins and south of Payson in the Tonto Creek Basin. Desert grasslands often contain a mixture of grasses, shrubs and small trees.

Upper Sonoran desertscrub covers parts of the planning area below about 3,500 feet in the Upper Hassayampa, Agua Fria, Tonto Creek and Salt River basins. Typical vegetation includes palo verde, mesquite, creosote, and cacti, including Saguaro cacti.

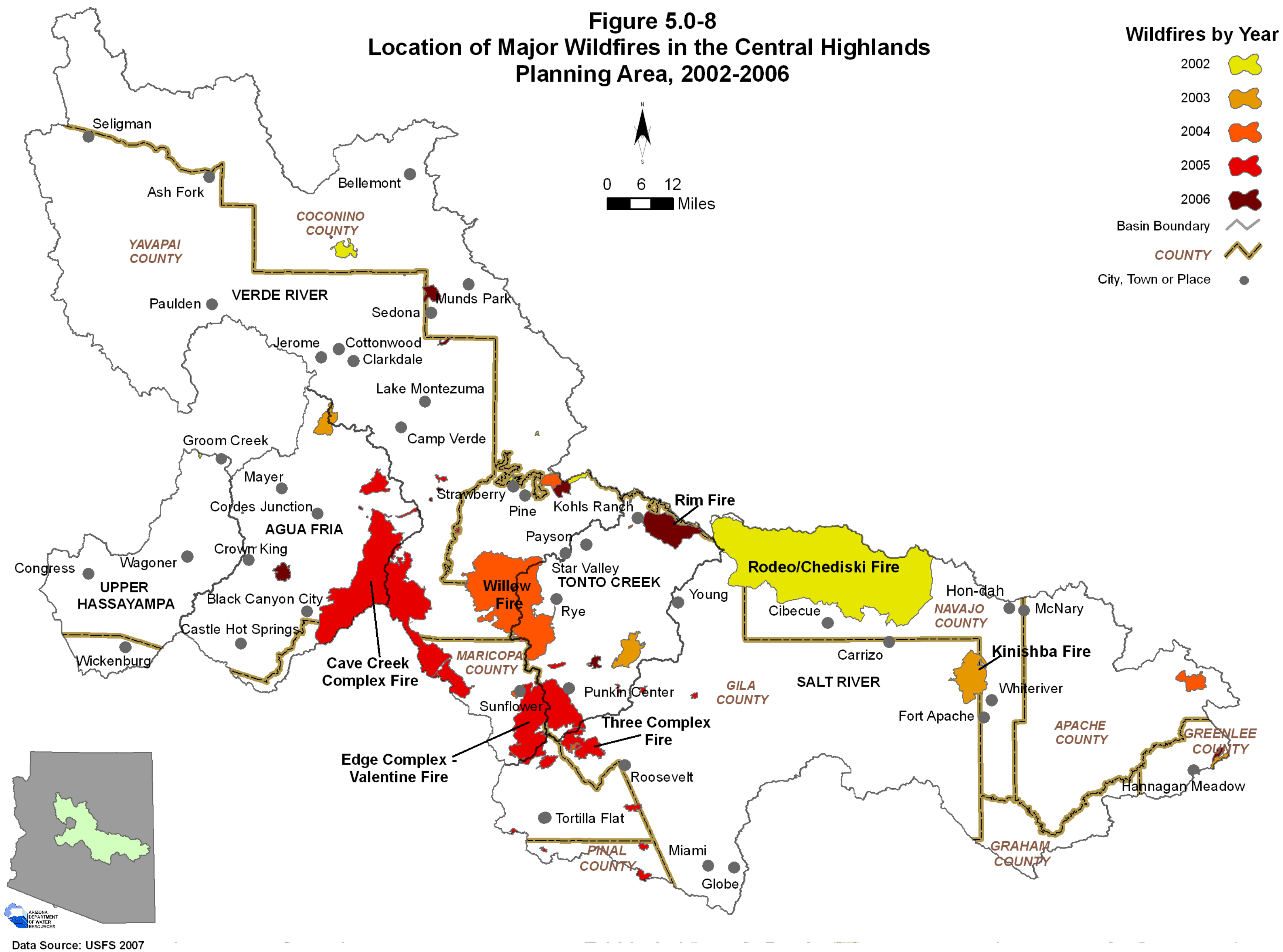
There are extensive reaches of riparian vegetation throughout the planning area. Along the Verde River and several tributary streams, riparian vegetation is composed of mixed broadleaf, cottonwood-willow, mesquite and strand vegetation (riparian obligate plants adapted to periodic flooding, scouring, or soil deposition). Conifer-Oak riparian obligate habitat is found at higher elevations in West Clear Creek and the East Verde River. Mixed broadleaf, mesquite and strand vegetation is found along the three perennial reaches of the Agua Fria River. Two tributaries to the Agua Fria River, Little Ash Creek and Sycamore Creek contain significant amounts of mixed broadleaf vegetation (NEMO, 2006). In the high elevation headwaters area of the Black River, riparian habitat is composed of wet meadow, mountain scrub and conifer-oak vegetation. Mixed broadleaf and strand vegetation are found along the Black River at lower elevations. Along the Salt River, riparian vegetation is composed of mesquite, strand and tamarisk at Roosevelt Lake. In the Tonto Creek Basin, mixed broadleaf, cottonwood-willow, strand and mesquite vegetation are found along Tonto Creek. Along the Hassayampa River at Wickenburg, riparian vegetation consists of cottonwood-willow, mesquite and strand while conifer-oak and mixed broadleaf are found at the Hassayampa River headwaters.

Several years of drought combined with high tree densities resulted in the largest outbreak of pine bark beetle populations ever recorded in Arizona during 2002 – 2004. This outbreak has killed millions of piñon and ponderosa pine trees. In 2003, bark beetle mortality was detected on about 763,000 acres in Arizona and New Mexico, with most of the mortality occurring in Arizona (USFS, 2003). Areas most affected were trees at the lower end of their elevational range. Drought conditions improved in 2004 and 2005, and mortality decreased substantially as a result of both higher precipitation and because many of the trees in the most susceptible areas were already dead.

Based on aerial surveys conducted in 2004 by the U.S. Forest Service, there were several areas of ponderosa pine infestation in the planning area. Areas with substantial bark beetle-caused ponderosa pine mortality occurred on parts of the Fort Apache Indian reservation, on lands west and north of the reservation, areas southwest of Bellemont, and areas west of Interstate 17 in the vicinity of Crown King. Data from aerial surveys recorded 2.1 million acres of piñon-juniper woodland and 1.3 million acres of ponderosa pine were affected in Arizona and New Mexico during 2002 – 2004 (USDA, 2007).

Wildfire risk increases with the number of dead trees in the landscape, which provide fuel for fires. There were several major wildfires in the Central Highlands Planning Area during the severe drought years between 2002 and 2005 (see Figure 5.0-8). The Rodeo-Chediski fire in 2002, Arizona's largest-ever, consumed about 462,600 acres, much of it in the north-central part of the Salt River Basin. The Willow Fire (2004) burned almost 120,000 acres southwest of Payson in the

Figure 5.0-8
Location of Major Wildfires in the Central Highlands Planning Area, 2002-2006



Tonto Creek and Verde River basins and the Cave Creek Complex (2005) burned 243,800 acres in the east-central part of the Agua Fria Basin and adjacent areas in the Verde River Basin and Phoenix AMA.

In the Southwest, fire can be among the most significant watershed disturbance agents, particularly to peak stream flows. In areas severely burned by the Rodeo-Chedeski Fire, peak flows were as much as 2,350 times greater than previously measured peak flows, the highest known post-fire peak flow in the Southwest. Increased peak flows can degrade stream channels and make them unstable, increase sediment production and cause flood damage. (Neary, D. et al, 2003) Drought, wildfire and long-term climate change involving warmer temperatures with earlier Springs and less snow cover could result in vegetative changes in the planning area with implications on runoff, infiltration and water supplies.

Arizona Water Protection Fund Programs

The objective of the Arizona Water Protection Fund Program (AWPF) program is to provide funds for protection and restoration of Arizona's rivers and streams and associated riparian habitats. Twenty-six riparian restoration projects in the Central Highlands Planning Area have been funded by the AWPF through 2005. Seventeen of these projects were funded in the Verde River Basin, primarily involving research, fencing and stream restoration on the Verde River. Four projects were funded in the Salt River Basin including restoration projects on Cherry Creek, Canyon Creek and at Lofer Cienega. Two stream restoration projects in the Agua Fria Basin on Ash Creek and Lynx Creek, and an erosion research and fencing and revegetation project in Dakini Valley in the Tonto Creek Basin have also been funded. In the Upper Hassayampa Basin, one project has been funded involving a constructed wetland. A list of projects and project types funded in the Central Highlands Planning Area through 2005 is found in Appendix A of this volume. A description of the program, a complete listing of all projects funded, and a reference map is found in Appendix C of Volume 1.

Instream Flow Claims

An instream flow water right is a non-diversionary appropriation of surface water for recreation and wildlife use. Thirty-six applications for instream flow claims have been filed in the Central Highlands Planning Area. The applications are listed in Table 5.0-1 and shown on Figure 5.0-9. Claims have been filed in all the basins in the planning area and eight certificates have been issued. Certificates have been issued for claims on Ash Creek in the Agua Fria Basin, Christopher Creek in the Tonto Creek Basin, the East Verde River, Sycamore Creek near Sunflower and the Verde River in the Verde River Basin, the Hassayampa River in the Upper Hassayampa River Basin, and Pinto Creek and Reynolds Creek in the Salt River Basin. Some of the certificates cover extensive reaches of rivers and streams as shown on Figure 5.0-9.

Table 5.0-1 Instream flow claims in the Central Highlands Planning Area

Map Key	Stream	Applicant	Application No.	Permit No.	Certificate No.	Filing Date
1	Apache Creek	Prescott National Forest	33-96801.0	Pending	Pending	7/22/2005
2	Ash Creek	BLM (Phoenix)	33-96411.0	96411	96411	1/5/1995
3	Big Bug Creek	Prescott National Forest	33-96802.0	Pending	Pending	7/22/2005
4	Canyon Creek	Tonto National Forest	33-96816.0	Pending	Pending	9/30/2005
5	Cherry Creek	Tonto National Forest	33-96609.0	Pending	Pending	6/30/1999
6	Christopher Creek	Tonto National Forest	33-96575.0	96575	96575	4/23/1998
7	Cienega Creek	Prescott National Forest	33-96803.0	Pending	Pending	7/22/2005
8	Coon Creek	Tonto National Forest	33-96742.0	Pending	Pending	6/18/2003
9	East Verde River	Tonto National Forest	33-90310.0	90310	90310	11/26/1985
10	Fossil Creek	Tonto National Forest	33-96622.0	Pending	Pending	12/1/1999
11	Foster Creek	Coconino National Forest	33-95370.0	Pending	Pending	2/2/1990
12	Haigler Creek	Tonto National Forest	33-96571.0	Pending	Pending	10/31/1997
13	Hassayampa River	Nature Conservancy	33-92304.0	92304	92304	1/20/1987
14	Jones Creek	Coconino National Forest	33-95371.0	Pending	Pending	2/2/1990
15	Oak Creek	Coconino National Forest	33-90106.0	Pending	Pending	7/29/1985
16	Pinto Creek	Tonto National Forest	33-89109.0	89109	89109	12/14/1983
17	Rarick Canyon	Coconino National Forest	33-90109.0	Pending	Pending	7/29/1985
18	Red Creek	Tonto National Forest	33-96743.0	Pending	Pending	6/18/2003
19	Reynolds Creek	Tonto National Forest	33-96570.0	96570	96570	10/31/1997
20	Sheepshead Creek	Coconino National Forest	33-90111.0	Pending	Pending	7/29/1985
21	Spring Creek	Coconino National Forest	33-90114.0	Pending	Pending	7/29/1985
22	Spring Creek	Tonto National Forest	33-96815.0	Pending	Pending	9/28/2005
23	Sycamore Creek	Coconino National Forest	33-90113.0	Pending	Pending	7/29/1985
24	Sycamore Creek	Tonto National Forest	33-96509.0	96509	96509	5/15/1996
25	Sycamore Creek	Prescott National Forest	33-96804.0	Pending	Pending	7/22/2005
26	Tonto Creek	Tonto National Forest	33-96684.0	Pending	Pending	11/15/2000
27	Turkey Creek	Prescott National Forest	33-96708.0	Pending	Pending	1/29/2002
29	Verde River	Tonto National Forest	33-90309.0	90309	90309	11/26/1985
30	Verde River	Prescott National Forest	33-94374.0	Pending	Pending	12/2/1988
28	Verde River	Phelps Dodge Corp.	33-96760.0	Pending	Pending	6/3/2004
31	Walker Creek	Coconino National Forest	33-90108.0	Pending	Pending	7/29/1985
32	Walnut Creek	Prescott National Forest	33-96800.0	Pending	Pending	7/22/2005
33	West Clear Creek	Coconino National Forest	33-90110.0	Pending	Pending	7/29/1985
34	West Clear Creek	Johnson, James A.	33-96178.0	Pending	Pending	3/20/1992
35	Wet Beaver Creek	Coconino National Forest	33-90112.0	Pending	Pending	7/29/1985
36	Workman Creek	Tonto National Forest	33-96618.0	Pending	Pending	10/26/1999

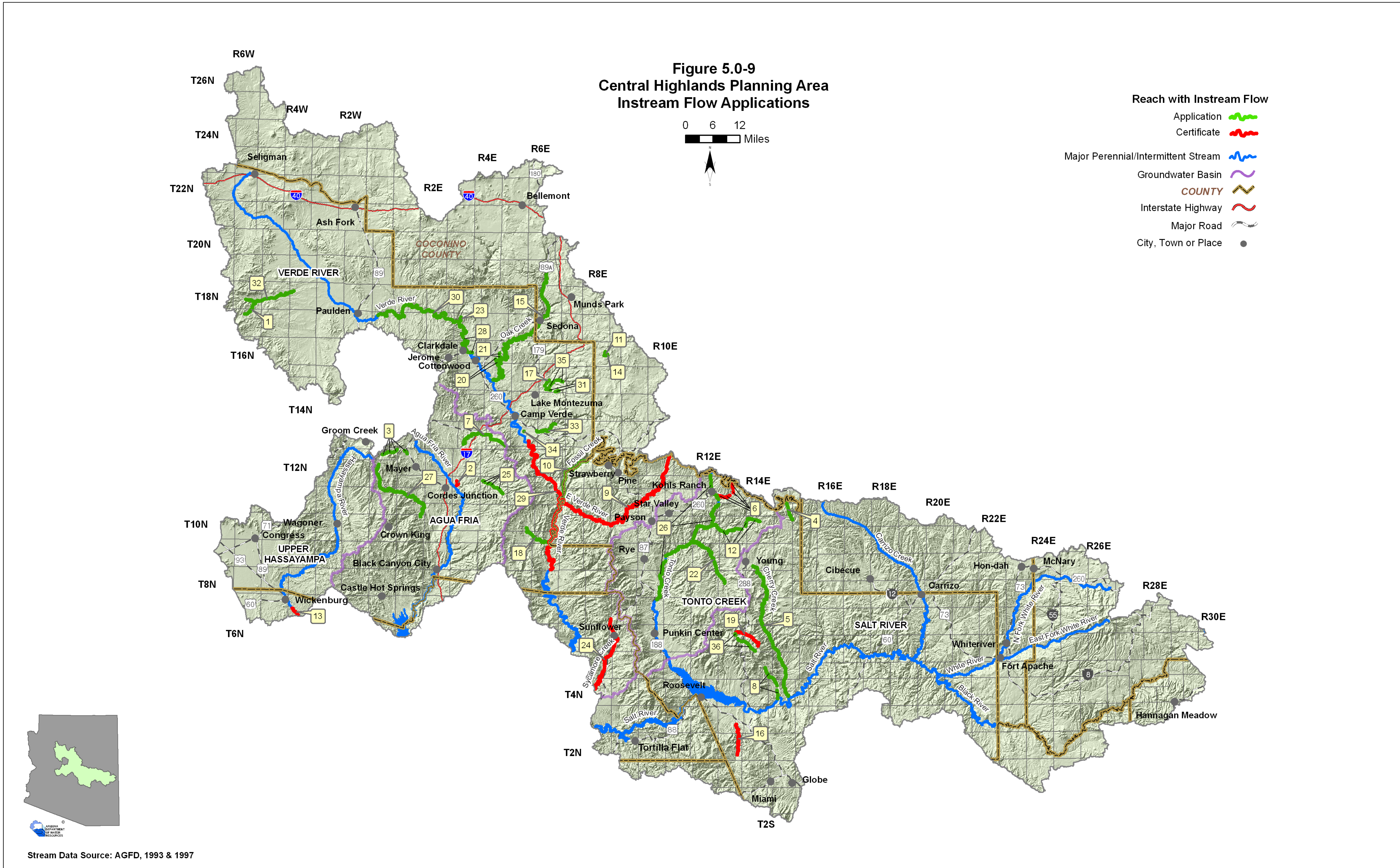


Figure 5.0-9
Central Highlands Planning Area
Instream Flow Applications
0 6 12
Miles
Reach with Instream Flow
Application
Certificate
Major Perennial/Intermittent Stream
Groundwater Basin
COUNTY
Interstate Highway
Major Road
City, Town or Place
COCONINO COUNTY
VERDE RIVER
AGUA FRIA
UPPER HASSAYAMPA
TONTO CREEK
SALT RIVER
Seligman
Ash Fork
Paulden
Bellemont
Munds Park
Sedona
Clarkdale
Jerome
Cottonwood
Lake Montezuma
Camp Verde
Groom Creek
Mayer
Cordes Junction
Crown King
Black Canyon City
Castle Hot Springs
Wagoner
Congress
Wickenburg
Strawberry
Pine
Kohls Ranch
Star Valley
Payson
Rye
Young
Cibecue
Carrizo
Hon-dah
McNary
Whiteriver
Fort Apache
Hannagan Meadow
Sunflower
Punkin Center
Roosevelt
Tortilla Flat
Globe
Miami
Stream Data Source: AGFD, 1993 & 1997

Threatened and Endangered Species

A number of listed threatened and endangered species may be present in the Central Highlands Planning Area. Those listed by the U.S. Fish and Wildlife Service (USFWS) as of May 2006 are shown in Table 5.0-2.[4] 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.

Table 5.0.2 Listed threatened and endangered species in the Central Highlands Planning Area

Common Name	Threatened	Endangered	Elevation/Habitat
Apache (Arizona) Trout	X		>5000 ft./cold mountain streams
Arizona Agave		X	3,000 ft, steep, rocky granite slopes, or level hilltops, near chaparral; New River and Sierra Ancha Mountains
Arizona Cliff-rose		X	<4,000 ft./white soils of tertiary limestone lakebed deposits
Arizona hedgehog cactus		X	3,700-5,200 ft./ecotone between interior chapparal and madrean evergreen woodland
Bald Eagle	X		Varies/large trees or cliffs near water
California Brown Pelican		X	Varies/lakes and rivers
Chiricahua Leopard Frog	X		3,300-8,900ft./streams, rivers, backwaters, ponds stock tanks
Desert pupfish		X	<5,000 ft./shallow springs, small streams and marshes. Tolerates saline and warm water
Gila Chub		X	2,000-5,500 ft./pools, springs, cienegas and streams
Gila topminnow		X	<4,500 ft./small streams, springs and cienegas vegetated shallows

[4] 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.”

Table 5.0.2 Listed threatened and endangered species in the Central Highlands Planning Area (Con't)

Common Name	Threatened	Endangered	Elevation/Habitat
Gila trout	X		5,000-10,000 ft./small, high mountain streams
Lesser long-nosed bat		X	<6,000 ft./desert scrub with agave and columnar cacti
Loach Minnow	X		<8,000ft./benthic species of small to large perennial streams
Mexican Gray Wolf		X	4,000-12,000 ft. /chapparal, woodland, forests
Mexican Spotted Owl	X		4,100-9,000 ft./canyons, dense forests with multi-layered foliage structure
Razorback sucker		X	<6,000 ft./riverine and lacustrine areas, not in fast moving water
San Francisco Peaks groundsel	X		>10,900 ft./Alpine tundra
Southwestern Willow Flycatcher		X	<8,500 ft./cottonwood-willow and tamarisk along rivers and streams
Spikedace	X		<6,000 ft./moderate to large perennial streams with gravel cobble substrates
Yuma Clapper Rail		X	<4,500 ft./Fresh water and brackish marshes

Source: USFWS 2006, CPC, 2007

In the Salt River watershed, SRP has developed the Roosevelt Habitat Conservation Plan (Plan) to minimize and mitigate the impacts of operation of Roosevelt Dam and Lake to the southwestern willow flycatcher, bald eagle, Yuma clapper rail, and western yellow-billed cuckoo (a candidate for ESA protection). Under the plan, SRP will acquire and protect at least 1,500 acres of riparian habitat in perpetuity along the San Pedro, Verde, and Gila rivers, or other river systems in Arizona, and implement other conservation measures to protect up to 750 additional acres of habitat. The Plan also includes rescue of bald eagle eggs and nestlings whose nests are threatened by inundation, monitoring of the species and habitat at Roosevelt Lake and in the mitigation areas, and other measures. Following SRPs commitment to implementation of the Plan, the U.S. Fish and Wildlife Service issued a 50-year permit to SRP to "take" endangered southwestern willow flycatchers, threatened bald eagles, endangered Yuma clapper rails, and candidate yellow-billed cuckoos incidental to operation of Roosevelt Dam and Lake. SRP is also working on a Habitat Conservation Plan for operation of Horseshoe and Bartlett dams and reservoirs but the plan is still in production and under negotiation.

National Monuments, Wilderness Areas and Preserves

Four national monuments that protect prehistoric dwellings are located in the planning area. Montezuma Castle, Tonto and Tuzigoot National Monuments are small sites containing cliff dwellings or pueblos. Tonto National Monument is located along Tonto Creek in the Salt River Basin while the others are located in the Verde Valley in the Verde River Basin. Agua Fria National Monument, administered by the Bureau of Land Management, covers 71,700 acres in the Agua Fria Basin (see Figure 5.1-2). It contains at least 450 prehistoric sites, four major settlement areas, and the Agua Fria River canyon, which contains a perennial reach of the river.

All or portions of 21 Wilderness Areas, encompassing 788,000 acres, are found within the planning area. Wilderness Areas are designated under the 1964 Wilderness Act to preserve and protect the designated area in its natural condition. Designated areas, their size, basin location and a brief description of the area are listed in Table 5.0-3. All wilderness areas are located on National Forest Service lands with the exception of the Hassayampa River Canyon Wilderness which is administered by the Bureau of Land Management. Most of the wilderness areas protect riparian habitat, rivers and streams and are located in the Verde River Basin.

The Hassayampa River Preserve in the Upper Hassayampa Basin just south of Wickenburg, was established in 1986 by The Nature Conservancy. The preserve protects spring-fed Palm Lake, a four-acre pond and marsh habitat that attracts water birds and provides habitat for endangered fish. The Hassayampa River is perennial within the preserve and supports lush streamside habitat.

Unique and Other Managed Waters

Several "unique waters", designated by the Arizona Department of Environmental Quality (ADEQ) pursuant to A.C.C. R18-11-112, as having exceptional recreational or ecological significance and/or providing habitat for threatened or endangered species, have been identified in the planning area. These include:

- Oak Creek, including the West Fork of Oak Creek in the Verde River Basin
- Snake Creek, from its headwaters to its confluence with the West Fork of the Black River in the Salt River Basin
- Hay Creek, from its headwaters to its confluence with the West Fork of the Black River in the Salt River Basin
- Stinky Creek, from the Fort Apache Indian Reservation boundary to its confluence with the West Fork of the Black River in the Salt River Basin
- Bear Wallow Creek, from its headwaters to the boundary of the San Carlos Indian Reservation in the Salt River Basin.

Table 5.0-3 Wilderness Areas in the Central Highlands Planning Area

Wilderness Area	Acres	Basin	Description
Apache Creek	5,488	Verde River	Three springs and important riparian area including Apache Creek
Bear Wallow	11,336	Salt River (part)	Alpine forest of mixed conifers and aspens. Bear Wallow drainage with rich streamside habitat.
Castle Creek	25,536	Agua Fria	Bradshaw Mountains, prominent granite peaks, vegetation range from saguaro to pine
Cedar Bench	16,127	Verde River	Located along Verde Rim, borders portion of Verde Wild and Scenic River
Fossil Creek	10,400	Verde River	Extremely diverse riparian area, 1,600 foot deep canyon, travertine deposits, springs
Granite Mountain	9,747	Verde River	Mountain characterized by granite boulders, some the size of a house, stacked one atop the other to elevations that exceed 7,600 feet.
Hassayampa River Canyon	11,840	Upper Hassayampa	Includes several miles of the Hassayampa River and riparian habitat.
Hellsgate	37,399	Tonto Creek	Major canyon, Tonto Creek with deep pools of water and impassable falls
Juniper Mesa	7,708	Verde River	Flat topped mesa, great variety of wildlife
Mazatzal	250,053	Verde River, Tonto Creek	Mazatzal mountains, chaparral and pine vegetation with narrow, vertical walled canyons. Includes portion of Verde Wild and Scenic river
Munds Mountain	18,069	Verde River	Munds and Lee mountains, Jacks, Woods and Rattlesnake canyons, Courthouse Butte and Bell Rock
Pine Mountain	20,100	Agua Fria, Verde River	Island of tall timber, surrounded by brush-covered desert mountains with hot, dry mesas and deep canyons.
Red Rock Secret Mountain	48,263	Verde River	Red rock pinnacles, arches and slot canyons, rock art and prehistoric dwellings
Salome	18,515	Salt River	Upper/perennial reaches of Salome Creek and Workman Creek
Salt River Canyon	32,088	Salt River	Portions of the Salt River and spectacular canyon
Sierra Ancha	21,007	Salt River	Box canyons, high cliffs, prehistoric dwellings
Superstition	160,135	Salt River (part)	Rugged mountains, rock formations, large vegetation range, prehistoric dwellings, riparian habitat.
Sycamore Canyon	57,916	Verde River	Large canyon with desert riparian area. Extends from near Williams to Verde Valley
West Clear Creek	15,267	Verde River	Deep, narrow canyon with many pools of water
Wet Beaver Creek	6,178	Verde River	Major canyon in red rock rim country
Woodchute	5,553	Agua Fria	Views, ponderosa pine, pinon and juniper
Total Acres in Planning Area	788,000		

Source: BLM 2006, USFS 2007

In 2004, Arizona Public Service Company surrendered a license from the Federal Energy Regulatory Commission to operate hydroelectric power plants at Irving and Childs on Fossil Creek in the Verde River Basin near Strawberry. As part of the decommissioning they agreed to remove project features and restore the landscape. These two historic power plants were constructed beginning in 1908 and operated by turbines driven by water diverted from Fossil Creek. This diversion captured most of the natural spring fed flow of the creek and fundamentally changed the character of the stream. The springs that supply the base flow of Fossil Creek are rich in calcium carbonate that precipitates out and forms travertine dams. Absent the natural flow and travertine deposition, the stream was no longer a series of pools impounded by travertine dams. Following restoration of flow, native fish were removed and non-native fish eradicated from the stream in order to reestablish fish native to the system.

Stillman Lake is a narrow 20-acre impoundment located above a natural sediment dam at the headwaters of the Verde River south of Paulden and below Sullivan Dam in the Verde River Basin. The Arizona Game and Fish Department, U.S. Fish and Wildlife Service, and the Bureau of Reclamation are working together to manage Stillman Lake for native fish by eliminating non-native species. Arizona Game and Fish currently owns and manages several parcels of river bottom land downstream from Sullivan Dam to maintain habitat for sensitive species of fish and wildlife (USFWS, 2007).

Congress adopted the Wild and Scenic Rivers Act in October 1968 to preserve selected rivers that possess "outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values" in their free-flowing condition for the benefit of present and future generations. About 40 miles of the 170-mile long Verde River has been designated a National Wild and Scenic River, the only one in Arizona. The Scenic River Area begins about six miles south of Camp Verde and extends to the boundary of the Mazatzal Wilderness in T11N, R6E; a reach of 18.3 miles. The Wild River Area begins below the Scenic River Area and continues for 22.2 miles to its confluence with Red Creek within section 34, T9½N, R6E (see Figure 5.5-4). Under the Act the river area must be managed in a manner that protects and enhances its "outstandingly remarkable values" (NWSR, 2007)

5.0.5 Population

Census data for 2000 show about 145,850 residents in the Central Highlands Planning Area. Arizona Department of Economic Security (DES) population projections forecast that the planning area population will almost double by 2050, to about 264,600 residents. Historic, current and projected basin population is shown in the basin cultural water demand tables.

The most populous basin by far as reported in the 2000 Census is the Verde River Basin with more than 88,000 residents or 62% of the planning area total. The 2003 estimated population of the Verde River Basin is over 93,000 residents. The 2000 Census populations for each basin and Indian reservation, listed from highest to lowest, are shown in Table 5.0-4.

Table 5.0-4 2000 Census population of basins and Indian reservations in the Central Highlands Planning Area

Basin/Reservation	2000 Census Population
Verde River	88,242
Yavapai-Apache	*743*
Salt River	31,381
Fort Apache	*10,385*
San Carlos Apache	*Unk* [1]
Upper Hassayampa	10,479
Agua Fria	8,210
Tonto Creek	7,537
Tonto Apache	*132*

[1] Almost the entire San Carlos Apache Reservation population is located in the Southeastern Arizona Planning Area.

Shown in Table 5.0-5 are incorporated and unincorporated communities in the planning area with 2000 Census populations greater than 1,000 and growth rates for two time periods. Communities are listed from highest to lowest population in 2000 and their location is shown on Figure 5.0-10. The planning area population grew by 35% between 1990 and 2000. A number of communities lack data for 1990, but it appears that there has been considerable growth in smaller communities in the planning area. Of note is the large number of communities in this planning area with populations between 1,000 and 5,000. Many of these smaller communities are "satellite" communities of nearby incorporated areas; e.g. Kachina Village, Munds Park, Parks and Mountainaire are all located near Flagstaff, just outside of the planning area. There were eight incorporated communities within the planning area in 2000. The community of Star Valley, east of Payson, incorporated in 2005 due to concerns that the Town of Payson would take water from the Star Valley area to serve new developments (Payson Roundup, 2005). Payson is the largest community in the planning area with 13,620 residents, followed by Sedona, Camp Verde, Cottonwood, Globe, Wickenburg, and Miami.

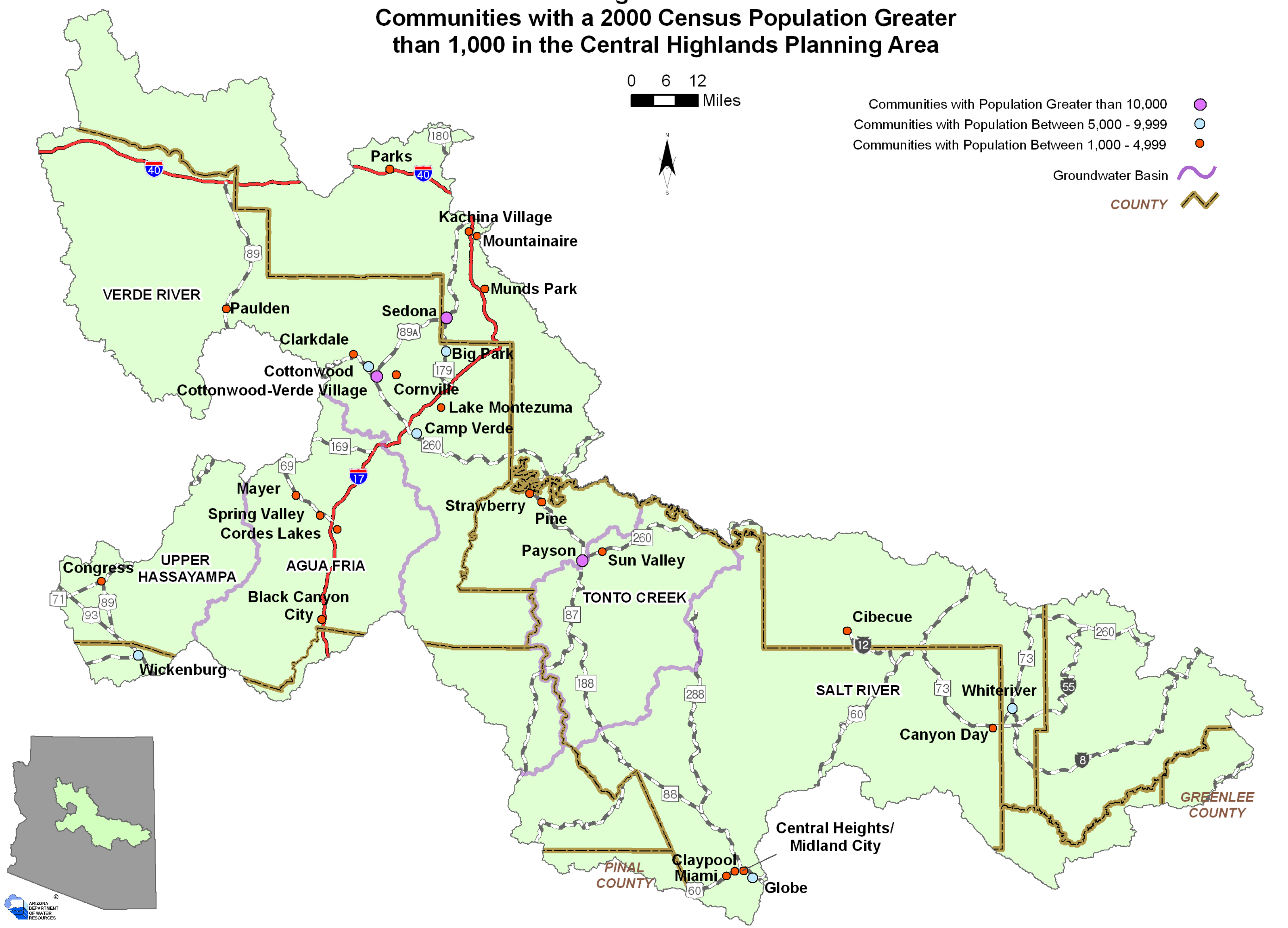
Rapid growth is occurring in several areas including near Prescott and Flagstaff, Sedona, Payson and the Verde Valley communities of Cottonwood, Camp Verde, Clarkdale and Cornville. The Verde Valley area population represents about 32% of the population of Yavapai County (Dava & Associates, 2003). Between 2000 and 2005, the community of Wickenburg grew by 30%, the fastest growth rate reported in the planning area. Population projections for 2050 are not currently available for a number of communities, including Wickenburg, however, the population of the planning area is projected to increase by at least 85% by 2050. The median age in many

Table 5.0-5 Communities in the Central Highlands Planning Area with a 2000 Census population greater than 1,000

Communities	Basin	1990 Census Pop.	2000 Census Pop.	Percent Change 1990-2000	2005 Pop. Estimate	Percent Change 2000-2005	Projected 2050 Pop.
Payson*	Verde River	8,377	13,620	63	15,430	13	29,444
Cottonwood-Verde Village	Verde River	7,037	10,610	51	NA	NA	10,905
Sedona*	Verde River	7,720	10,192	32	10,935	7	19,591
Camp Verde*	Verde River	6,243	9,451	51	10,730	14	19,300
Cottonwood*	Verde River	5,918	9,179	55	10,860	18	24,109
Globe*	Salt River	6,062	7,486	23	7,495	0	9,827
Big Park	Verde River	3,034	5,245	73	NA	NA	11,363
Whiteriver	Salt River	3,775	5,220	38	NA	NA	9,181
Wickenburg*	Upper Hassayampa	4,515	5,082	13	6,590	30	NA
Clarkdale*	Verde River	2,144	3,422	60	3,680	8	6,571
Paulden	Verde River	NA	3,420	NA	NA	NA	NA
Lake Montezuma	Agua Fria	1,841	3,344	82	NA	NA	4,969
Cornville	Verde River	2,089	3,335	60	NA	NA	7,300
Black Canyon City	Agua Fria	1,811	2,697	49	NA	NA	4,939
Central Hts./Midland City	Salt River	2,969	2,694	-9	NA	NA	4,339
Kachina Village	Verde River	1,711	2,664	56	NA	NA	4,397
Cordes Lakes	Agua Fria	NA	2,058	NA	NA	NA	NA
Miami*	Salt River	2,018	1,936	-4	1,955	NA	2,196
Pine	Verde River	NA	1,931	NA	NA	NA	NA
Claypool	Salt River	1,942	1,794	-8	NA	NA	2,226
Congress	Upper Hassayampa	NA	1,717	NA	NA	NA	NA
Mayer	Agua Fria	NA	1,408	NA	NA	NA	2,286
Sun Valley	Tonto Creek	NA	1,536	NA	NA	NA	NA
Cibecue	Salt River	1,254	1,331	6	NA	NA	2,873
Munds Park	Verde River	NA	1,250	NA	NA	NA	2,802
Parks	Verde River	NA	1,137	NA	NA	NA	2,701
Canyon Day	Salt River	857	1,092	27	NA	NA	1,299
Strawberry	Verde River	NA	1,028	NA	NA	NA	NA
Spring Valley	Agua Fria	NA	1,019	NA	NA	NA	NA
Mountainaire	Verde River	NA	1,014	NA	NA	NA	1,646
Total >1,000		71,317	117,912	65	NA	---	
Other		34,110	24,938	-27	NA	---	
Total		**105,427**	**142,850**	35	NA	---	**264,648**

Source: DES, 2005: www.workforce.az.gov, U.S. Census Bureau, 2006
Notes: 2005 population estimates not available for unincorporated communities
NA = not available
* = incorporated communities

Figure 5.0-10
Communities with a 2000 Census Population Greater than 1,000 in the Central Highlands Planning Area



communities is considerably older than the state average of 34.2 years. Sedona, Congress, Big Park, Black Canyon City, and Clarkdale have median ages of over 45.

Population Growth and Water Use

The state has limited mechanisms to address the connections between land use, population growth and water supply. A legislative attempt to link growth and water management planning is the Growing Smarter Plus Act of 2000 (Act) which requires that counties with a population greater than 125,000 (2000 Census) include planning for water resources in their comprehensive plans. Yavapai, Maricopa and Pinal counties fit the population criteria. There is relatively little population or water development within the Maricopa and Pinal county sections of the planning area. About 4,800 square miles (35%) of Yavapai County is located within the planning area, the largest area of any of the nine counties located within it. The Yavapai County water resources element includes an overview of the watersheds in the county, a statement of goals and objectives regarding water supply, water quality and protection of water resources, and an evaluation of existing water use data. Also included is a discussion of the Yavapai County Water Advisory Committee (WAC), a group tasked with development of a regional water management strategy which helps support the water resource goals in the general plan. (Dava & Associates, Inc., 2003).

The Act also requires that twenty-three communities outside AMAs include a water resources element in their general plans. In the Central Highlands Planning Area this requirement applies to the communities of Camp Verde, Clarkdale, Cottonwood, Globe, and Sedona. As of June, 2007, all communities but Globe had completed a water resource element. Plans must consider water demand and water resource availability in conjunction with growth, land use and infrastructure. References to completed plans are listed in basin references in this volume and may contain useful information for water resource planning.

Beginning in 2007, all community water systems in the state are required to submit Annual Water Use Reports and System Water Plans. The reports and plans are intended to reduce community water systems' vulnerability to drought, and to promote water resource planning to ensure that water providers are prepared to respond to water shortage conditions. In addition, the information will allow the State to provide regional planning assistance to help communities prepare for, mitigate and respond to drought. An Annual Water Use Report will be submitted each year by the systems, beginning June 1, 2007, and include information on water pumped or diverted, water received, water delivered to customers, and effluent used or received. The System Water Plan will be updated and submitted every five years and will consist of three components, a Water Supply Plan, a Drought Preparedness Plan and a Water Conservation Plan. Systems that serve populations greater than 1,850 were required to submit plans by January 1, 2007. Systems that serve populations less than 1,850 are required to submit plans by January 1, 2008. Plans have been submitted by most of the larger systems in the planning area and were used to prepare this document.

The Department's Water Adequacy Program also connects water supply and demand to growth to some extent, but does not control growth. Developers of subdivisions outside of AMAs are required to obtain a determination of whether there is sufficient water of adequate quality available for 100 years. If the supply is inadequate, lots may still be sold, but the condition of the water supply must be disclosed in promotional materials and in sales documents. Legislation adopted in June, 2007 (SB 1575), authorizes a county board of supervisors to adopt a provision, by unanimous vote, which requires a new subdivision to have an adequate water supply in order for the subdivision to be approved by the platting authority. If the county does not adopt the provision, the legislation allows a city or town to adopt a local adequacy ordinance that requires a demonstration of adequacy. Subdivision adequacy determinations (Water Adequacy Reports), including the reason for the inadequate determination, are provided in the basin sections of this volume and are summarized for each basin in Table 5.0-6.

Table 5.0-6 Water Adequacy Determinations in the Central Highlands Planning Area as of 5/2005

Basin	Number of Subdivisions	Number of Lots[1]	Adequate	Inadequate	Approx. Percent Inadequate
Agua Fria	15	>1,177	>973	204	17%
Salt River	17	>968	106	>862	89%
Tonto Creek	54	>3,686	>352	>3,334	90%
Upper Hassayampa	26	>1564	>1,225	339	22%
Verde River	375	>29,505	>22,578	>6,927	23%
TOTAL	**487**	**>36,900**	**>25,234**	**>11,666**	**48%**

Source: ADWR 2006a
Notes:
[1] Data on number of lots are missing for some subdivisions; actual number is larger

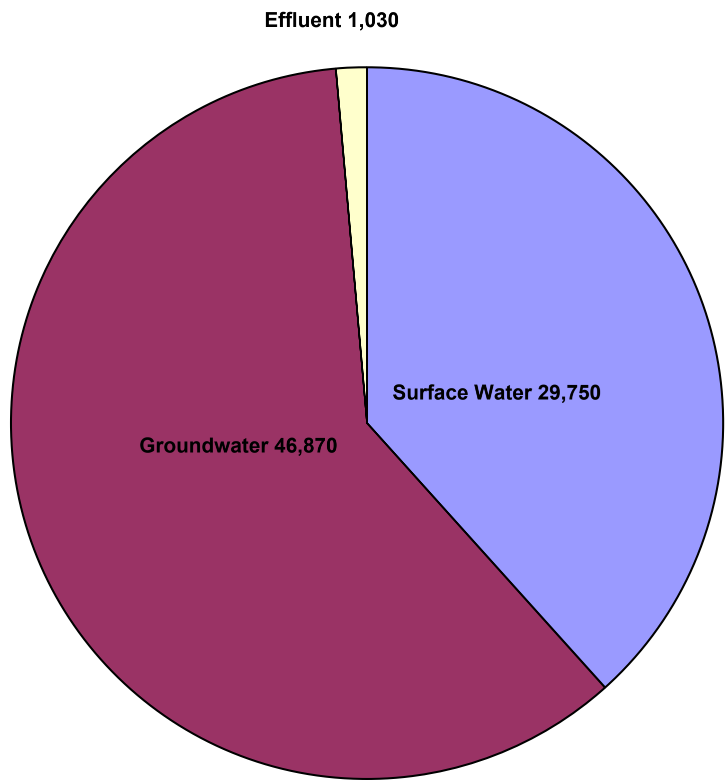
The service areas of six water providers in the planning area have been designated as having an adequate water supply. If a subdivision is served by one of these designated water providers, a separate adequacy determination is not required. As of January 1, 2007 these included:

- City of Globe
- Town of Wickenburg
- Little Park Water Company-Village of Oak Creek
- Big Park Water Company-Village of Oak Creek
- American Ranch Domestic Water Improvement District – American Ranch Development near Prescott
- Verde Santa Fe Water Company-Verde Santa Fe Development at Cornville

5.0.6 Water Supply

Water supplies in the Central Highlands Planning Area include groundwater, surface water and effluent. Central Arizona Project (CAP) water diverted from the Colorado River via the CAP canal is stored in the planning area but is not utilized within it. Groundwater is the primary water supply, accounting for about 61% of the demand. Surface water is used extensively for agricultural irrigation in the Verde River Basin and to some extent in the Salt River Basin where it is also used to meet mining demand. It is estimated that about 38% of the total water demand is met with surface water. Effluent is utilized for golf course irrigation in the Tonto Creek and Verde River basins, contributing 1% of the planning area's water supply. For purposes of the Atlas, water diverted from a watercourse or spring is considered surface water and if it is pumped from wells, it is accounted for as groundwater. This is reflected in the cultural water demand tables in each basin section.

Figure   5.0-11 Water Supplies Utilized in the Central Highlands Planning Area in acre-feet (average annual use 2001-2003)



Central Arizona Project Water

New Waddell Dam, located on the Agua Fria River in the Phoenix Active Management Area, stores Central Arizona Project (CAP) water in Lake Pleasant located in the Agua Fria Basin. This water is not a direct supply for the planning area. The dam also stores Agua Fria River water and provides flood control. In the winter, water is pumped from the CAP canal to Lake Pleasant. When demand increases in the summer, water is released through the same canal to downstream CAP contractors within the Central Arizona Water Conservation District service area, Maricopa, Pima and Pinal counties.

Six municipal and industrial water providers and/or water users and three Indian tribes located in the Central Highlands Planning Area, listed in Table 5.0-7, were allocated an entitlement of CAP water. To physically acquire water under their respective subcontracts, it was anticipated that subcontractors located outside of the CAP service area would exchange their CAP entitlement for a locally available surface water supply that was held by a downstream senior water right holder located within the CAP service area. The CAP entitlements held by Indian Tribes could also be included in any future, potential water settlement.

Due to environmental issues associated with the potential exchange of its CAP entitlement for East Verde River water rights held by SRP, the town of Payson chose to sell its CAP entitlement to the City of Scottsdale. The transfer process was completed in 1994. The money acquired from the sale was deposited into a trust fund managed by the U.S. Bureau of Reclamation for the purpose of developing alternative water supplies for Payson.

In response to the proposed transfer of Payson's CAP subcontract to Scottsdale, the Department developed a transfer policy to govern the transfer of a CAP entitlement from a subcontractor located outside of the CAP service area. Subsequent to the adoption of this policy, Camp Verde Water System, Inc., Cottonwood Water Works, Inc., and the Mayer Domestic Water Improvement District decided to transfer their subcontracts to Scottsdale. Monies resulting from the sale of these entitlements were also placed in separate trust fund accounts for each entity. Table 5.0-7 identifies the entitlement volumes that were eventually transferred to Scottsdale and the gross proceeds that resulted from the respective transactions.

Table 5.0-7. CAP Subcontractors and Transferred Entitlements in the Central Highlands Planning Area

CAP Subcontractor	CAP Entitlement (Acre-Feet)	CAP Entitlement Transfered	Gross Proceeds from Transfer[1]
Camp Verde Water System, Inc.	1,443	1,443	1,443,000
Cottonwood Water Works Inc.	1,789	1,789	1,789,000
Mayer Domestic Water Improvement District	332	332	332,000
Town of Payson	4,995	4,995	4,995,000
Phelps Dodge Miami, Inc.	2,916		
Pine Water Co.	161		
San Carlos Apache Tribe	61,645		
Tonto Apache - Indian Tribe	128		
Yavapai-Apache Tribe	1,200		

[1] Does not reflect the reduction associated with equivalency charges and capital costs due to CAWCD or other fees associated with the entitlement transfer actions.

In accordance with each trust fund agreement, the Department provides oversight regarding expenditures from these accounts to ensure that trust fund monies are used to defray expenses associated with "designing, constructing, acquiring and/or developing an alternative water supply in an amount which may include, but is not limited to, a combined net increase" in the subcontractor's "water system capacity to replace the CAP allocation" that it sold.

Plans regarding the CAP entitlements held by Phelps Dodge Miami, Inc and Pine Water Company are not known. The San Carlos Apache Tribe leases a portion of its CAP allocation to the City of Scottsdale and as exchange water for use by Phelps Dodge at Morenci in the Southeastern Arizona Planning Area. The Tonto-Apache Tribe and the Yavapai-Apache have no current uses or exchanges.

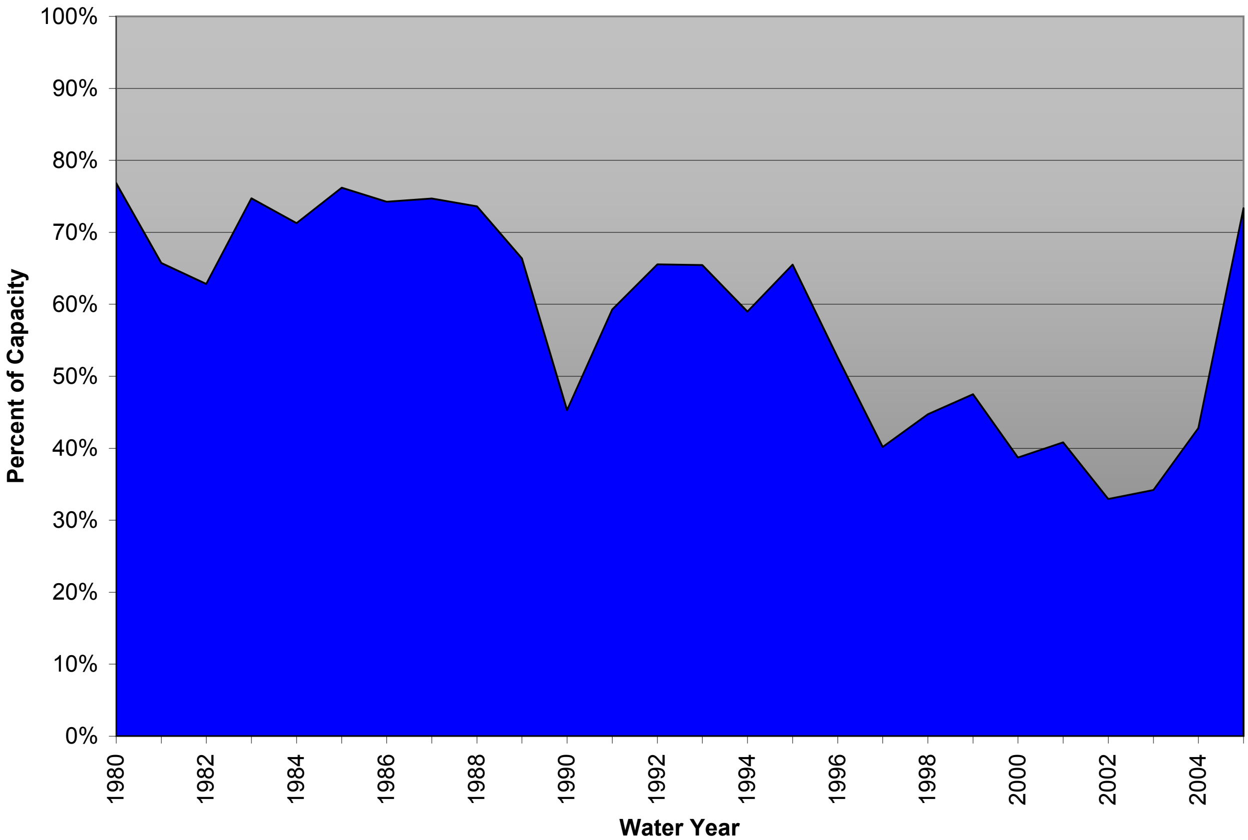
Of interest to the Central Highlands Planning Area are the CAP entitlements held by Prescott and the Yavapai-Prescott Indian Tribe that were transferred to Scottsdale under the Yavapai-Prescott Indian Tribe Water Rights Settlement Act of 1994 (Act). The proceeds acquired from the entitlement transfer actions were deposited into the Verde River Basin Fund. In accordance with Section 106.c of the Act, the Secretary of the Interior (Secretary) is directed to make payments from the fund to Prescott "for the exclusive purpose of acquiring, investigating and developing an alternative water supply consistent with the goal of the Prescott AMA and preservation of the riparian habitat, flows and biota of the Verde River and its tributaries". Section 107.a of the Act states that monies can be used by Prescott "for purposes of defraying expenses associated with the investigation, acquisition or development of alternative source of water to replace the CAP water relinquished under this title. Alternative sources shall be understood to include, but not be limited to, retirement of agricultural land and acquisition of associated water rights, development of groundwater resources outside of the PAMA [Prescott AMA] and artificial recharge…".

Surface Water

The Salt and Verde Rivers, and the Gila River to the south, are the primary in-state sources of surface water in Arizona. Relatively high elevations along the Mogollon Rim and in the White Mountains with associated high amounts of rainfall and snowfall make the Salt and Verde watersheds extremely productive. However, because flows in the Salt and Verde Rivers are strongly influenced by precipitation and topography, surface water flows and water levels in reservoirs along the rivers can fluctuate widely due to climate variations. Surface water is an important supply for cultural water uses in the Salt River, Tonto Creek and Verde River basins where it also supports extensive riparian habitat.

The Salt and Verde River reservoirs and dams are operated by SRP to store and release water for the benefit of agricultural, municipal and industrial users in the Phoenix metropolitan area. These supplies are generally not available for use in the planning area except for small amounts used for recreation and other purposes at each reservoir. The water stored in the Salt River reservoir system illustrates the relationship between downstream water demand and precipitation and snowfall in the watershed. As shown in Figure 5.0-12, storage has fluctuated widely over the past ten years as water is collected or released to meet water demands. Shown is the impact of severe drought conditions during 2002 and storage recovery in 2005 following a wet winter. As of June 1, 2007, storage in the Salt system was 60% of capacity.

Figure 5.0-12 Water Stored in Salt River System Reservoirs, 1980-2005



Source: USGS 2007

Upstream of the reservoirs, surface water is primarily diverted for irrigation from Tonto Creek and its tributaries and along the Salt River. At elevations above 4,000 feet, surface water from springs and streams supply small irrigated parcels (ADWR, 1992). It is not known if surface water availability has been an issue for surface water users upstream of Roosevelt Dam during periods of drought.

A relatively small amount of surface water is diverted from Pinal Creek for operations at the Miami Mine in the Salt River Basin. Surface water may be diverted from Pinto Creek to support future mining operations at the nearby Pinto Valley Mine, slated to reopen in Fall, 2007. The Carlota Mine located north of the Pinto Valley Mine along Pinto Creek is projected to open in 2008. It is not known whether surface water will be used to supply the operation.

Pursuant to complex exchange agreements with the San Carlos Apache Tribe, SRP and the Central Arizona Project, Phelps Dodge diverts surface water from the Black River in the Salt River Basin for use at the Morenci Mine in the Southeastern Arizona Planning Area. To compensate downstream water users for diversions from the Black River, Phelps Dodge historically diverted water into the

Central Highlands Planning Area from two locations in the Little Colorado River Basin, Show Low Lake and Blue Ridge Reservoir (now C.C. Cragin). Water demand tables in Volume 5 take into account both the water removed from and replaced into the Salt River Basin. Because water diverted from Blue Ridge Reservoir passes through the Verde River Basin (via East Verde River) and is not used in the basin, it is not reflected in the surface water use estimated for the Verde River Basin.

The Phelps Dodge surface water diversions to the Morenci Mine are located at the Black River Pump Station and conveyed over the Natanes Plateau and into Willow Creek. In 2003, approximately 6,450 acre-feet were diverted from the Black River for this purpose.

C.C. Cragin reservoir, located in the Eastern Plateau Planning Area 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 (Act). The reservoir satisfies obligations to the Gila River Indian Community, and will be used to supplement SRP's water supply and to assist in improving the water supply situation in northern Gila County in accordance with the Act (SRP, 2007). The Town of Payson is pursuing a long-term agreement with SRP to utilize a portion of the water stored at C.C. Cragin Reservoir as a water supply for the town. This will require construction of a pipeline and a water storage mechanism.

The Verde River system reservoirs are smaller that those on the Salt with average annual inflows exceeding their storage capacity. Consequently, the 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). Storage volumes in the Verde River reservoirs, particularly in Horseshoe Lake, have been reduced to almost zero at times during recent drought years. As of June 1, 2007, storage in Horseshoe Lake was 3% of capacity and storage in the total Verde system was 27% of capacity.

Surface water is diverted from the Verde River for agricultural use primarily in the Verde Valley Sub-basin of the Verde River Basin. Most farming occurs within the younger alluvium along the river. There are currently about 30 irrigation diversions in the Verde Valley. During periods of drought, surface water shortfalls are met by groundwater pumping. Reportedly, a small volume of surface water is utilized at higher elevations in the Big Chino Valley. (ADWR, 2000)

Arizona Revised Statutes (A.R.S. 45-555) allow the transportation of groundwater pumped from the Big Chino Sub-basin into the Prescott AMA. There are concerns that increased groundwater withdrawals in this sub-basin may contribute to reduced flows in the headwaters of the Verde River and affect availability of surface water as a supply. The relative contribution of the proposed pumping to Verde River flow is the matter of considerable debate (see Groundwater section below).

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, and in basin tables that contain data on streamflow, flood ALERT equipment, reservoirs, stockponds and springs in the Water Resource Characteristics sections for each basin.

Groundwater

Compared to the deep alluvial basins found in the southern part of Arizona, high elevations, steep topography and extensive areas of bedrock in the Central Highlands Planning Area translate into relatively minimal groundwater storage capabilities and high runoff. These conditions result in limited, drought-sensitive water supplies for some communities, such as Pine, Strawberry, Payson, Black Canyon City and Mayer. Areas of unconsolidated sediments are relatively limited as shown on the groundwater conditions maps for each basin in sections 5.1-5.5. Many basin fill aquifers in the planning area are narrow and surrounded by low water yielding consolidated rocks. Areas of relatively high water yield include basin fill deposits in the Big Chino Sub-basin, Verde Valley Sub-basin, north of Globe in the Salt River Lakes Sub-basin, and near Wickenburg in the Upper Hassayampa Basin.

In much of the northern half of the Agua Fria Basin, parts of the Salt River Basin including the entire eastern portion, and the Verde Canyon Sub-basin, groundwater occurs in volcanic rocks that yield relatively small volumes of water. These conditions pose groundwater supply challenges for Payson and other communities in the planning area. In Pine, Strawberry and near Globe, groundwater is found in relatively low yield sedimentary rocks. Sedimentary rocks with moderate yields are found in the southern half of the Agua Fria Basin, while Precambrian schist near Black Canyon City yields relatively small volumes of water to wells.

Although groundwater supplies may be limited in some areas, it is the primary water supply in the planning area. Groundwater pumpage averaged about 46,700 acre-feet a year during the period 2001 to 2003.

In order to better understand the water supply situation in areas of the state where data are lacking, the Department has established automated groundwater monitoring sites that record water levels in wells. This information is available through an interactive map on the Department's website to allow access to local information for planning, drought mitigation and other purposes. (www.azwater.gov/dwr/). These devices were located based on areas of growth, subsidence, type of land use, proximity to river/stream channels, proximity to water contamination sites or areas affected by drought.

Figure 1-18 of Volume 1 of the Atlas shows the location of automatic water-level recording sites as of 2005. At that time there were 13 sites in the planning area, ten of which were USGS sites. There are currently five automated Department-operated sites in the planning area (three in the Verde River Basin, one in the Agua Fria Basin and one in the Upper Hassayampa Basin) for which current water level data are available. Index well hydrographs, which display historic water level behavior in more than 150 index wells in the planning area (particularly in the Verde River Basin) are also available at the same web location through an interactive map. Information on major aquifers, well yields, estimated natural recharge, estimated water in storage, aquifer flow direction, and water level changes are found in groundwater data tables, groundwater conditions maps, hydrographs and well yield maps for each basin in the Water Resource Characteristics sections.

Transportation of groundwater between groundwater basins is prohibited in Arizona unless allowed in statute. In 1991, the Arizona statutes recognized a volume of groundwater that can be transported into the Prescott AMA from the Big Chino Sub-basin. Under A.R.S. 45-555(E), the City of Prescott can withdraw an amount not to exceed 14,000 acre-feet per year. The Director of ADWR has issued an advisory opinion that the amount that may be withdrawn by the City of Prescott is 8,717 acre-feet[5]. Additionally, the statute allows for cities and towns to withdraw groundwater associated with historically irrigated acres (HIA) for transportation into the Prescott AMA. The Department has currently identified 3,307.58 acres of HIA in the Big Chino Sub-basin[6]. The Department will make a determination regarding the volume of water that can be transported from HIA lands after a request is submitted. In general, the allotment associated with HIA is 3 acre-feet per acre per year (ADWR, 2006).

An important issue facing the Central Highlands Planning Area is the potential for additional groundwater withdrawals from the Big Chino Sub-basin to reduce flows in the headwaters area of the Verde River, and environmental impacts associated with reduced flows and impacts associated with construction of pipelines and other infrastructure to transport groundwater. Although a number of studies have been conducted to investigate the connection of Big Chino Sub-basin groundwater with the headwaters of the Verde River, the relative contribution of the various potential sources is still a matter of speculation (McGavock, 2003).

Effluent

Effluent is a water supply for golf course irrigation in the Tonto Creek Basin and the Verde River Basin, totaling 1,030 acre-feet within the planning area. The Town of Clarkdale wastewater treatment plant discharges effluent onto mine tailings for dust control (USBOR, 2003). Effluent used in the Tonto Creek Basin is actually generated in the Verde River Basin. The volume of effluent generated by every facility in the planning area was not available to the Department, as shown on the effluent generation tables in each basin section. From data that were available it appears that limited volumes of effluent are produced in the Agua Fria and Tonto Creek basins. Approximately 2,600 acre-feet are generated in the Salt River Basin, primarily on the White Mountain Apache reservation and at Globe and Miami. In the Upper Hassayampa Basin, the Wickenburg wastewater treatment plant generates about 560 acre-feet of effluent a year. About 6,650 acre-feet of effluent is generated annually in the Verde River Basin, primarily at facilities located in Cottonwood, Munds Park, Payson and Sedona. In total, about 9,900 acre-feet of effluent are generated annually within the planning area.

Contamination Sites

Sites of environmental contamination may impact the use of some water supplies. An inventory of Department of Defense (DOD), Resource Conservation and Recovery Act (RCRA), Superfund (Environmental Protection Agency designated sites), Water Quality Assurance Revolving Fund (WQARF, state designated sites), Voluntary Remediation Program (VRP) and Leaking

[5] This volume is not a final determination and may be adjusted.
[6] See the Department's report "Identification of Historically Irrigated Acres in the Big Chino Sub-basin and Discussion Regarding Transportation of Groundwater into the Prescott AMA"

Underground Storage Tank (LUST) sites was conducted for the planning area. Of these various contaminated sites, DOD, LUST, RCRA, VRP and WQARF sites are found in the planning area. Table 5.0-8 lists the contaminant and affected media and the basin location of each site except LUST sites. The location of all contamination sites is shown on Figure 5.0-13.

There is one DOD site, Camp Navajo, located near Bellemont in the Verde River Basin. This site was used for over 50 years for land disposal of excess, obsolete and unserviceable munitions where they were destroyed by burning or by detonation. The site is being cleaned up according to RCRA standards under the DOD's Installation Restoration Program. There is also a RCRA site at Bellemont. The RCRA program regulates the management of hazardous waste handlers which includes generators, transporters and facilities for treatment, storage and disposal (ADEQ, 2002).

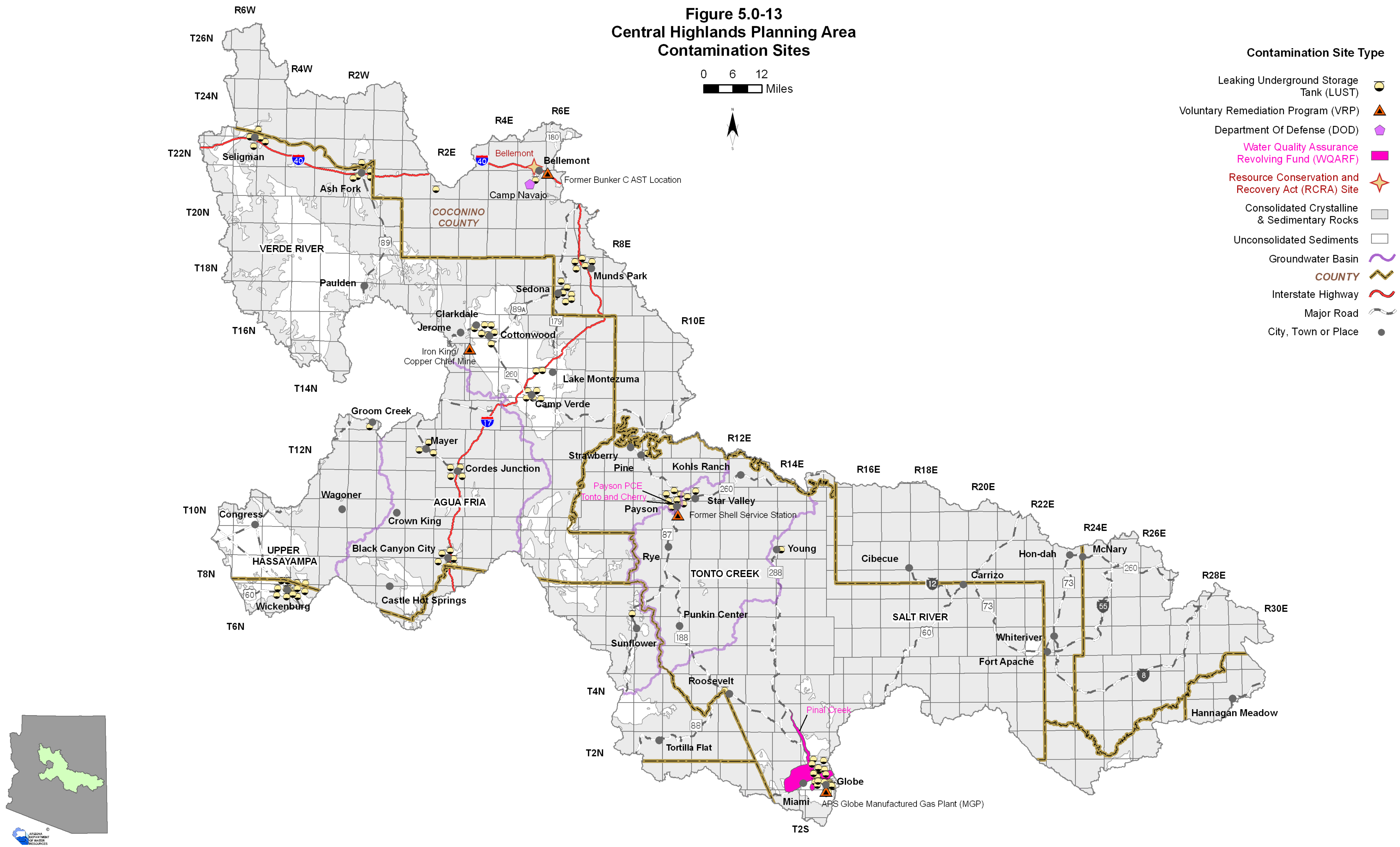
The Pinal Creek WQARF Site, located in the vicinity of Miami-Globe, is contaminated from mining and mineral processing in the area that began in 1878. Groundwater contamination was first observed in the 1930s in the alluvial aquifer of Miami Wash. By the time the first area-wide investigation of groundwater and surface water was conducted in 1979-81, there was widespread contamination. As of April 2006, approximately 105 million pounds of heavy metals had been removed from area aquifers. Site-wide monitoring is on-going including monthly sampling of 80-100 wells, four surface water sites and treated effluent at the Lower Pinal Creek treatment plant (ADEQ, 2006c).

Table 5.0-8 Active contamination sites in the Central Highlands Planning Area

SITE NAME	MEDIA AFFECTED AND CONTAMINANT	GROUNDWATER BASIN
Department of Defense Sites/Resource Recovery and Conservation Act (RCRA) Sites		
Camp Navajo, Bellemont	Soil, Groundwater - Metals, Volatile Organic Compounds, Solvents, White Phosphorous, Unexploded Ordnance	Verde River
WQARF Sites		
Payson PCE	Groundwater - Tetrachloroethene (PCE)	Verde River
Tonto/Cherry	Groundwater - Tetrachloroethene (PCE) and Methyl Tertiary Butyl Ether (MTBE)	Verde River
Pinal Creek	Groundwater, Surface Water - Metals, Radiochemicals, TDS, Acidity	Salt River
Voluntary Remediation Sites		
APS Globe Manufactured Gas Plant	Soil, Groundwater - Hydrocarbons, Cyanide, Arsenic, Lead	Salt River
Former Bunker C AST Location	Soil - Total petroleum hydrocarbons, Polycyclic aromatic hydrocarbons	Verde River
Former Shell Service Station	Soil, Groundwater - Total petroleum hydrocarbons, Polycyclic aromatic hydrocarbons, Ethyl Benzene, Total Xylene, Metals	Verde River
Iron King Copper Chief Mine	Surface Water - Metals	Verde River

Sources: ADEQ 2002, ADEQ 2006a, ADEQ 2006b

Figure 5.0-13
Central Highlands Planning Area
Contamination Sites



There are also two WQARF sites in the Payson area. At the Payson PCE site, groundwater is contaminated with tetrachloroethene (PCE). Two groundwater treatment systems capture and treat the contaminated water, which following treatment is delivered to the town as drinking water. The treated water comprises about a sixth of the town's total drinking water supply. PCE also contaminates groundwater at the Tonto and Cherry site but cleanup procedures will not commence until a Remedial Investigation Report is completed. A number of assessments and response actions have been conducted at this site including well monitoring and soil gas surveys (ADEQ, 2007).

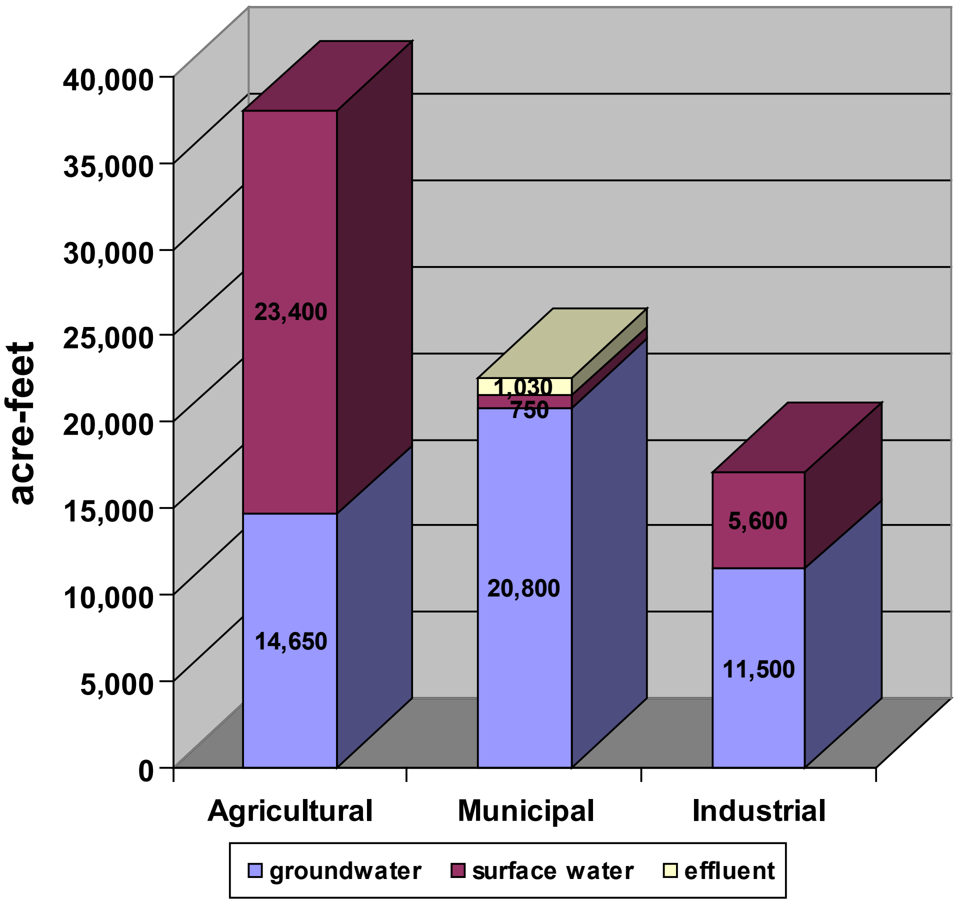
Four active VRP sites are located in the planning area with hydrocarbon and metal contamination of soil, groundwater and surface water. The VRP is a state administered and funded voluntary cleanup program. Any site that has soil and/or groundwater contamination, provided that the site is not subject 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 143 active LUST sites in the planning area. Thirty one sites are located near Globe in the Salt River Basin, 22 sites are located in and around Wickenburg in the Upper Hassayampa Basin, 21 sites occur in the vicinity of Payson and Star Valley in the Verde River and Tonto Creek basins, and there are ten sites near Clarkdale and Cottonwood in the Verde River Basin. Ash Fork, Black Canyon City, Camp Verde, Munds Park, Sedona and Seligman each contain between 5 and 10 sites.

5.0.7 Cultural Water Demand

Total cultural water demand in the Central Highlands Planning Area averaged approximately 77,650 acre-feet per year during the period from 2001-2003. In 2003, total demand was about 79,100 acre-feet. As shown in Figure 5.0-14, the agricultural demand sector is the largest use sector with approximately 38,000 acre-feet of demand, 49% of the total. Most agricultural demand is located in the Verde River and Salt River basins. About 61% of the agricultural demand is met by surface water diverted primarily from the Verde and Salt Rivers and from Tonto Creek. Municipal demand represents about 29% of the total planning area demand with an average of 22,580 acre-feet during the period 2001-2003. Municipal demand is primarily met by groundwater and the municipal sector is apparently the only sector that utilizes effluent. Industrial demand, mainly related to mining, accounted for 17,070 acre-feet, 22% of the total demand during this period. However, almost all the surface water diverted for industrial purposes, about 5,500 acre-feet on average during 2001-2003, was transported out of the planning area for use at the Morenci Mine in the Southeastern Arizona Planning Area.

Figure 5.0-14 Central Highlands Planning Area average cultural water demand by sector, 2001-2003 in acre-feet



Note: effluent demand is from 2006

Several recent studies provide detailed information on irrigation and other water uses in the Verde River Basin. The Verde River Watershed Study Report (ADWR, 2000) contains information on water demand for most of the Basin. The Yavapai County Water Advisory Committee (WAC) completed a water use study of the Big Chino Sub-basin in 2004 and participated in a USBOR study of the Verde Valley in 2003 that are valuable sources of information.

Tribal Water Demand

The largest Indian reservation in the planning area is the Fort Apache, the fourth largest reservation in terms of size in Arizona. The northern part of the San Carlos Apache Indian Reservation is also within the planning area and directly south of the Fort Apache Indian Reservation, however almost all its population and water demand is in the Southeastern Arizona Planning Area (see discussion in Arizona Water Atlas Volume 3, Section 3.0.7).

Water demand on the Fort Apache Indian Reservation is associated with domestic and agricultural uses as well as a number of tribal enterprises including timber industries, a ski resort, and a casino/hotel at Hon-dah. There are approximately 12,000 tribal members residing on the reservation with about 2,500 residents at Whiteriver, the tribal capital. Other residents reside in smaller communities and on rural lands. Water service is provided to an unknown number of customers by the Whiteriver Regional System. Water demand on the San Carlos Apache Reservation portion within the planning area is assumed to be primarily due to agricultural irrigation of orchard crops (ADWR, 1992). Using agricultural and industrial demand estimates in the Hydrographic Survey Report for the Upper Salt River Watershed, and per capita assumptions derived from a 2005 study by Truini et al. on other reservations, it is estimated that the annual demand of the two largest tribes in the planning area is about 4,500 acre-feet (Table 5.0-9).

Table 5.0-9 Estimated Water Demand on the Fort Apache and San Carlos Apache Indian Reservations

	Agricultural (surface water)	Municipal (groundwater/ surface water)
Fort Apache	3,690	700/60[1]
San Carlos Apache	70	0
Total	3,760	700/60

[1] Assumes 94 gpcd at Whiteriver and 40 gpcd elsewhere. Commercial demand outside of Whiteriver not included. Sixty acre-feet of surface water is used at Cedar Creek
Sources: ADWR, 1992; Truini et al., 2005

The Tonto Apache and Yavapai-Apache Indian Reservations and tribal populations are relatively small and demand estimates were not available to the Department. The Tonto Apache Indian Reservation is the smallest land base reservation in Arizona at 85 acres. Principal water demands are associated with the Mazatzal Casino and restaurant, and tribal offices. Water service is provided by the Tonto Apache Water System. The 656-acre Yavapai-Apache Indian Reservation is located on five separate parcels with its tribal headquarters at Middle Verde. This parcel is served water by the Middle Verde Indian Water System while other parcels are served by private water companies that also serve adjacent, non-reservation lands. Tribal lands include irrigated farmland, residences and commercial businesses. The tribe operates the Cliff Castle Casino and motel north of Camp Verde (see Figure 5.5-2). (ITCA, 2003)

Municipal Demand

Municipal demand is summarized by groundwater basin and water supply in Table 5.0-10. Average annual demand from 2001 to 2003 was 22,580 acre-feet. Ninety-two percent of the municipal demand is met by groundwater. A small amount of surface water is used in the Salt River Basin at facilities located at the Salt River lakes and on the Fort Apache Indian Reservation at Cedar

Creek, a small community located southeast of Carrizo. In the Verde River Basin surface water is used at several locations including by Beaver Valley Water Company, Bonita Water Company (Payson), Camp Navajo, Kohl's Ranch, Pine Water Association, Stoneman Lake Water Company and the Town of Jerome, which uses about 400 acre-feet per year from Big and Little Allen Springs (USBOR, 2003). Effluent is used for turf irrigation in the Verde River and Tonto Creek basins and for dust control on mine tailings by the Town of Clarkdale.

Table 5.0-10 Average annual municipal water demand in the Central Highlands Planning Area (2001-2003) in acre-feet

Basin	Groundwater	Surface Water	Effluent[1]	Total
Agua Fria	1,800			1,800
Salt River	4,000	<300[2]		<4150
Tonto Creek	2,200		200	2,400
Upper Hassayampa	2,800			2,800
Verde River	10,000	600	830	11,430
Total Municipal	20,800	750	1,030	22,580

Sources: USGS 2005d, ADWR 2005b

[1] Effluent figures are for golf course and other turf irrigation in 2006

[2] Assume 150 acre-feet for computation purposes

Primary municipal demand centers are located around Cottonwood, Globe-Miami, Payson, Sedona, and Wickenburg. Municipal demand in the Verde River Basin accounts for 51% of the total municipal demand in the planning area. There is relatively little municipal water demand in the Agua Fria Basin. It is estimated that about eleven percent of the planning area population is not served by a municipal water provider.

Eight water providers in the planning area served 450 acre-feet of water or more in 2003. These providers and their demand in 1991, 2000 and 2003 are shown in Table 5.0-11. In 2003, municipal utilities served Globe, Payson and Wickenburg. Beginning in 2005, the City of Cottonwood began acquisition of the four private water companies serving the town; Clemenceau Water Company, Cordes Lakes Water Company, Cottonwood Water Works and the Verde Santa Fe Water Company. Municipally-owned systems have more flexible water rate-setting ability than private water companies, which are regulated by the Arizona Corporation Commission. In addition, municipal utilities have the authority to enact water conservation ordinances. These authorities may enable municipal utilities to better manage water resources within water service areas. Water provider issues are discussed in section 5.0.8.

The towns of Miami-Claypool are served by Arizona Water Company. About 87% of the approximately 3,250 connections are residential. The system also serves water for turf irrigation. The Miami water system is served by 17 wells and has a two-way emergency interconnection with the City of Globe. Water levels in wells ranged from 109 feet to 860 feet below land surface in 2006. (Arizona Water Company, 2007a)

The City of Globe has an adequate water supply designation and serves about 7,700 customers from five active wells. Four of these wells are located in the Safford Basin in the Southeastern Arizona Planning Area. About two-thirds of the water demand is residential and one-third is non-residential. The City has a water conservation plan that it credits with helping to keep water demand in check. Water levels in wells ranged from 40 feet to 650 feet below land surface in 2005. (City of Globe, 2005) The Wickenburg municipal water system serves groundwater to about 5,100 residents.

Table 5.0-11 Water providers serving 450 acre-feet or more of water per year in 2003, excluding effluent, in the Central Highlands Planning Area

Basin/Water Provider	1991 (acre-feet)	2000 (acre-feet)	2003 (acre-feet)
Salt River			
Arizona Water Company-Miami	1,031	1,194	1,068
City of Globe	1,446	1,558	1,550
Upper Hassayampa			
Town of Wickenburg	1,249	1,717	1,774
Verde River			
Arizona Water Company - Sedona	1,764	2,816	3,375
Big Park Water Company - Village of Oak Creek	539	799	873
Cottonwood Water Works - Cottonwood & Clarkdale	1,321	2,065	2,050
Cordes Lakes Water Company - Cottonwood	590	1128	1,385
Town of Payson	1,089	1,550	1,683

Sources: ADWR 2007 and 2004
Notes: Cordes Lakes Water Company also serves the community of Cordes Lakes; the amount shown here is for City of Cottonwood alone. City of Cottonwood purchased Cordes Lakes Water Company and Cottonwood Water Works after 2003.

Arizona Water Company serves the town of Sedona. It has 14 active wells, and about 5,500 connections, 78% of which are residential. Sedona has a high percentage of seasonal residents, and daily visitors contribute to a relatively high gallons per capita per day (gpcd) rate of 244 (USBOR, 2003). The system serves commercial customers and turf facilities. The service area includes central Sedona from Red Rock Loop Road to east of downtown. The Valley Vista "sub-system" serves an area south of Verde Valley School Road, mostly west of Highway 179. Arizona Water Company maintains an emergency two-way interconnection with the Oak Creek Water Company. Groundwater depth is about 220 feet in utility wells. (Arizona Water Company, 2007b)

Big Park Water Company serves the Village of Oak Creek, an unincorporated community south of Sedona along Highway 179. It has about 2,800 connections, of which 91% are residential, and a per capita rate of about 198 gpcd (USBOR, 2003). It does not serve turf facilities. Depth to water in the seven system wells is about 390 feet and water levels are reportedly stable. Big Park Water Company has an interconnection with Little Park Water Company. (BPWC and LPWC, 2007) Both companies have designations of Adequate Water Supply.

Prior to 2005, Cottonwood Water Works and Cordes Lakes Water Company were the two large private water companies serving the City of Cottonwood. The Old Cottonwood Water Works system served the communities of Cottonwood and Clarkdale and consisted of about 4,600 connections of which 97% were residential. The combined Cordes Lakes Water Company Systems serve a population of almost 7,700 consisting of six separate systems in the Verde Village area. (A separate Cordes Lakes Water Company System serves the community of Cordes Lakes in the Agua Fria Basin). The estimated gpcd rate of Cottonwood is about 148 gpcd and Clarkdale is about 193 gpcd (USBOR, 2003).

The four systems that are now owned by the City of Cottonwood (Clemenceau, Cordes Lakes, Cottonwood Water Works and Verde Santa Fe) pumped a total of about 3,150 acre-feet of water in 2006. The City of Cottonwood currently operates the Clarkdale system (formerly part of Cottonwood Water Works), which served about 3,000 people and pumped about 400 acre-feet in 2006. (Cottonwood Water Works, 2007)

The Town of Payson pumps groundwater from the surrounding granite aquifer from 32 active wells to about 14,000 residents. Most wells are located in the Verde River Basin and some are in the Tonto Creek Basin. The town estimates that there are also about 300 to 400 domestic wells operating within its service area. It also supplies water to the Tonto Apache Indian Reservation. Because of the aquifer's limited storage capacity, Payson is a drought-sensitive area dependent on sufficient rainfall and snowmelt for an adequate drinking water supply (City of Payson, 2007). Payson monitors water levels in its wells regularly to gauge water supply availability and has aggressive water conservation, effluent reuse and drought programs. Water levels in wells trigger the town's drought response. Payson's water demand declined by 7% between 2002 and 2003, which it attributes to conservation efforts including implementation of a water conservation ordinance, March 2003. (Maguire, 2005)

About 80% of Payson's population is connected to the Northern Gila County Sanitary District sewer system that provides wastewater treatment for Payson and much of the surrounding area. Current system inflows are about 800,000 gallons daily, or 50% of capacity. The District's effluent is used for a variety of irrigation projects and ground water recharge, including the Green Valley Lake project. The 48-acre Green Valley Park was developed jointly by the Town of Payson Water Department and the Sanitary District. Treated effluent from the district's water treatment plant fills a 10.5-acre lake used for boating and fishing and adjacent irrigated areas and recreational facilities. (Payson Regional Economic Development Corporation, 2006) Another effluent recharge project, Rumsey Park, is in the pilot phase.

Municipal water providers served about 1,400 acre-feet of groundwater to golf courses in 2006. Most golf courses are located in the Verde River Basin. Golf courses with their own facility wells, considered "industrial users", used about 2,200 acre-feet of groundwater and about 800 acre-feet of surface water in 2006. Most golf courses in the planning area are industrial facilities and their demand is included in the industrial category. A number of the industrial facilities also receive "municipal" effluent. Effluent is delivered to the Payson-area courses of Chaparral Pines, Rim and Payson. Pinewood Golf Course at Munds Park, Talking Rock, near Prescott and Verde Santa Fe at Cornville also use effluent for irrigation although no courses use 100% effluent. About 1,050 acre-feet of effluent, 19% of total golf course demand, is used for golf course irrigation. In total, golf course demand is about 5,400 acre-feet, about 7% of the total planning area demand. Golf course demand by municipal and industrial facilities, basin location and source of water is shown in Table 5.0-12.

Table 5.0-12 Golf course demand in the Central Highlands Planning Area (c.2006)

Facility	Basin	# of Holes	Demand (acre-feet)	Water Supply
Cobre Valley Country Club - Globe*	Salt River	9	211	Groundwater
Chaparral Pines Golf Course - Payson	Tonto Basin	18	108/107	Groundwater/Effluent
Rim Golf Course - Payson	Tonto Basin	18	108/108	Groundwater/Effluent
Los Caballeros Golf Club - Wickenburg	Upper Hassayampa	18	423	Groundwater
Wickenburg Country Club	Upper Hassayampa	9	211	Groundwater
Beaver Creek Country Club - Lake Montezuma*	Verde River	18	490	Surface Water
Canyon Mesa Golf Course - Sedona*	Verde River	9	113	Groundwater
Oak Creek Country Club - Village of Oak Creek*	Verde River	18	701	Groundwater
Payson Golf Course - Payson	Verde River	18	132/309	Groundwater/Effluent
Pine Shadows - Cottonwood*	Verde River	9	98	Groundwater
Pinewood Country Club - Munds Park*	Verde River	18	270/269	Surface Water/Effluent
Poco Diablo Golf Course - Sedona*	Verde River	9	34	Surface Water
Sedona Golf Resort - Sedona*	Verde River	18	456	Groundwater
Seven Canyons Four Seasons Golf Course - Sedona	Verde River	18	423	Groundwater
Talking Rock - Northwest of Prescott*	Verde River	18	200/200	Groundwater/Effluent
Verde Santa Fe - Cottonwood*	Verde River	18	401/55	Groundwater/Effluent

Source: ADWR 2000, ADWR 2005b
Notes:
* These golf courses are served by their own wells and considered to be industrial users

Agricultural Demand

Agricultural demand in the planning area is about 38,000 acre-feet a year, or 49% of the total cultural demand. Most irrigation is for pasture. As shown in Table 5.0-13, there is agricultural demand in all basins but most (72%) is located in the Verde River Basin.

An estimated 6,400 acres are in agricultural production in the Verde River Basin, primarily in the Big Chino and Verde Valley sub-basins. The predominant crop grown is pasture, which is typically deficit irrigated. Groundwater is the primary supply in the Big Chino Sub-basin while surface water is predominantly utilized in the Verde Valley Sub-basin. Detailed maps showing current and historic irrigation in the Big Chino and Verde Valley sub-basins and much of the Verde Canyon Sub-basin are found in the Verde River Watershed Study Report (ADWR, 2000). This study also includes a description of each of the irrigation associations including information on acreage, water supply and facilities. In addition, maps of irrigated lands are also found in the WAC/USBOR Reports.

Most current irrigation in the Big Chino Sub-basin is located along Big Chino Wash about 15 miles northwest of Paulden, along Williamson Valley Wash and near Paulden. A smaller number of acres are irrigated in the Walnut Creek area near the western sub-basin boundary. Irrigation methods are predominantly flood or sprinkler irrigation. Pasture is the most prevalent crop as well as alfalfa, small grains and corn. (Yavapai County Water Advisory Committee, 2004)

Table 5.0-13 Agricultural Demand in the Central Highlands Planning Area

	1991-1995 (acre-feet)	1996-2000 (acre-feet)	2001-2003 (acre-feet)
Agua Fria			
Groundwater	1,300	1,300	1,600
Total	1,300	1,300	1,600
Salt River			
Groundwater	<1,000	<1,000	<1,000
Surface Water	6,400	6,400	6,400
Total	6,900	6,900	6,900
Tonto Creek			
Groundwater	<1,000	<1,000	<1,000
Surface Water	1,000	1,000	1,000
Total	1,500	1,500	1,500
Upper Hassayampa			
Groundwater	<1,000	<1,000	<1,000
Total	<1,000	<1,000	<1,000
Verde River			
Groundwater	8,100	8,400	11,500
Surface Water	11,500	12,500	16,000
Total	19,600	20,900	27,500

Source: USGS 2005d, ADWR 2005d
Notes: Volumes <1,000 acre-feet assumed to be 500 acre-feet for computational purposes

About 30 irrigation associations divert surface water in the Verde Valley Sub-basin. Most of the irrigated lands in the sub-basin are located along the Verde River or its major tributaries. During drought, approximately 1,200 irrigation wells in the Verde Valley may be used to meet irrigation demands. Agricultural lands are located primarily along the Verde River north and south of Camp Verde, where a number of ditch companies serve water to about 2,800 acres. Irrigated lands are also located near the communities of Cornville and Page Springs. Pasture is grown on about two-thirds of the irrigated land. Other crops include alfalfa, corn, wheat, vegetables and orchards. (ADWR, 2000)

Small areas of irrigated acreage are located in the Agua Fria Basin north of Cordes Junction and in the Upper Hassayampa Basin north of Wagoner (see Figures 5.1-10 and 5.4-10). In the Tonto Creek Basin the Gisela Community Ditch Association delivers surface water diverted from Tonto Creek through a 3-mile long ditch to about 144 acres near the community of Gisela, east of Rye (see Figure 5.3-10). Reportedly, much more water is diverted than used due to system configuration but the excess is assumed to return to the creek. Agricultural lands consist of pasture and orchard. Some acreage may be supplemented with groundwater. (ADWR, 1992) A relatively small amount of groundwater-supplied irrigation occurs in the lower reaches of Tonto Creek. The

USGS estimates that about 270 acres are being actively farmed in the Tonto Creek Basin (USGS 2005d).

Annual agricultural demand in the Salt River Basin is about 6,900 acre-feet primarily associated with pasture irrigation for livestock raising operations. Most of the irrigated areas are in Pleasant Valley near Young and near the community of Fort Apache. An estimated 3,200 acre-feet of demand is located on non-reservation lands with about 650 acres in production. Approximately 2,700 acre-feet of surface water and 500 acre-feet of groundwater are used. Historically, small tracts of irrigated land were located throughout the basin including along the Salt River upstream of Roosevelt Lake, north of Globe and in the White Mountains. Recent field investigations have not been conducted in this basin and the USGS National Gap Analysis Program did not identify irrigated acreage in these areas (see Figure 5.2-10). Agricultural demand on the Fort Apache Indian Reservation is estimated to be about 3,600 acre-feet of surface water with 1,050 acres in production. Only about 20 acres are irrigated with surface water on the portion of the San Carlos Apache Indian Reservation located in the planning area, with an associated demand of about 70 acre-feet. (ADWR, 1992)

Although agricultural demand estimates are uncertain in parts of the planning area due to a lack of reporting and recent field studies, it does appear that agricultural demand has declined in the Verde River Basin compared with demand prior to 1990. Agricultural demand may continue to decline in part due to groundwater transportation activities. In 2004, the City of Prescott, in partnership with the Town of Prescott Valley, purchased the JWK Ranch in the Big Chino Sub-basin for the anticipated purpose of retiring agricultural use and pumping groundwater to the Prescott Active Management Area pursuant to A.R.S.§ 45-555. The final determination of the allowable pumpage and transportation volume has not been made.

Industrial Demand

Industrial demand in the planning area averaged about 17,100 acre feet annually during the period 2001-2003. As shown in Table 5.0-14, industrial demand in the planning area consists of mining, golf course irrigation served by facility water systems and a dairy. These same use categories that are served by a municipal water system are accounted for as municipal demand. There is likely additional industrial demand in the planning area not reflected in Table 5.0-14.

Most of the industrial demand is due to mining-related operations in the Salt River Basin and to surface water exported from the Black River to the Morenci Mine in the Southeastern Arizona Planning Area. Mining demand increased from 2000 to 2003 due to an increase in surface water exports to the Morenci Mine. In 2003, groundwater use was approximately 6,400 acre-feet at the Phelps Dodge Miami Copper Mine, 350 acre-feet at the BHP Pinto Valley Copper Mine and 50 acre-feet at sand and gravel facilities. In 2003, about 100 acre-feet of surface water was used at the Miami mine and about 6,500 acre-feet was transported to the Morenci mine. In 1991 and 2000 all the surface water use was at the Morenci mine.

Mining operations have ceased at the Miami Mine where current activity involves smelter operations, an electrorefinery, and a copper rod mill that produces continuous-cast copper rod used as the feedstock for the wire and cable industry (Arizona Mining Association, 2006). With rising copper prices, Phelps Dodge is continuing to evaluate reopening the Miami Mine.

Table 5.0-14 Industrial demand in selected years in the Central Highlands Planning Area

	1991	2000	2003
Type	**Water Use (acre-feet)**		
Mining Total	**16,200**	**12,900**	**14,900**
Salt River			
Groundwater	10,000	8,000	7,000
Surface Water[2]	5,000	3,700	6,600
Verde River			
Groundwater	1,200	1,200	1,300
Golf Course Total	**2,400**	**2,600**	**2,800**
Salt River			
Groundwater	200	200	200
Verde River[1]			
Groundwater	1,400	1,600	1,800
Surface Water	800	800	800
Dairy/Feedlot Total	**800**	**800**	**800**
Upper Hassayampa			
Groundwater	800	800	800

Source: ADEQ 2005, ADMMR 2005, ADWR 2000, ADWR 2005b, USGS 2005d

[1] Three golf courses also receive effluent, see Table 5.0.9 for more information.

[2] Most of the surface water diverted for mining in the Salt River Basin is water transported to the Southeastern Arizona Planning Area for use at the Morenci Mine.

Full copper mining operations are expected to resume at the Pinto Valley mine in 2007. Also, there are plans to open the Carlota Copper Mine about six miles west of Miami in 2008. This project will involve open pit mining and a heap leach operation with a nine year mine life. Up to 75 million pounds per year of copper may be produced (Quadra Mining LTD., 2005).

Mining activity has declined from historic levels but it continues to be an important industry in the planning area as it has been for many years. Historically significant mines include the Vulture Gold Mine near Wickenburg that was in production sporadically for about a hundred years beginning in 1864, and the United Verde Mine at Jerome/Clarkdale, which operated from 1876 to 1953. The United Verde Mine was at one time the largest copper mine in Arizona, producing 3 million pounds of copper per month. A number of smaller mining operations were located around Crown King and north of Castle Hot Springs in the Agua Fria Basin. While some existing mines have been out of production in recent years, mining may resume at some sites (e.g. Miami) if determined to be economically feasible.

In addition to metal mining, sand and gravel and cement operations are included in the mining category. In 2003 about 1,300 acre-feet of groundwater was used in the Verde River Basin by several sand and gravel operations and Phoenix Cement, a manufacturer of Portland Cement located near Clarkdale. A cement plant has been proposed near Drake, northwest of Paulden, that could use about 80 acre-feet of water per year (Wirt, 2005).

Ten of the sixteen known golf courses in the planning area are "industrial" courses located primarily in the Verde River Basin. Industrial courses receive at least some water from facility wells and not from a municipal water provider. Industrial groundwater demand is about 2,800 acre-feet a year and three of the courses also use a total of about 524 acre-feet of municipal effluent a year. (See Table 5.0-12).

The Parker Dairy, located east of Congress in the Upper Hassayampa Basin, commenced operation in 1987. It houses over 7,000 dairy cows with an estimated annual groundwater demand of about 800 acre-feet.

5.0.8 Water Resource Issues in the Central Highlands Planning Area

A number of complex water resource issues exist in the Central Highlands Planning Area. Issues have been identified in water resource studies, by community watershed groups, through the distribution of surveys, and from other sources. Issues and planning, conservation and research activities are discussed in this section.

Planning and Conservation

Many communities in the planning area are facing rapid population growth in a region of the state where physical and legal access to water supplies creates significant challenges. These challenges have resulted in the formation of several community watershed groups, water resource studies and planning, and drought response and water conservation efforts. Yavapai County is a major governmental entity in the planning area with the largest county land base. Because the County had a population of over 125,000 in the 2000 Census, it is required to include a water resource element in its General Plan. Its plan recognizes the need for public education and sees the county's role as a facilitator of sound water resource management practices. The Yavapai County Board of Supervisors, along with cities, towns, tribes and the Department of Water Resources created the Yavapai County Water Advisory Committee (WAC) to provide a water management strategy for Yavapai County. The goals of the county's general plan as they compare with the activities of the WAC are included in Yavapai County's General Plan.

By acquiring private water companies serving the town, Cottonwood is seeking more water resource management authority. The town is a participant in the WAC as are a number of communities in the Verde River Basin including Sedona, Clarkdale and Camp Verde.

The Town of Payson is the largest community in the planning area. Because its water system is drought sensitive and the community faces rapid population growth, the Town has undertaken a variety of water resource management activities. It has adopted ordinances that place conservation and no-impact requirements on new developments including prohibitions on swimming pools, turf and evaporative coolers in buildings over 3,000 square feet. It also imposes a water-development impact fee on new development. New residential subdivisions are limited to 20 lots and builders must provide their own sources of water without impacting Payson's water supplies (Maguire, 2005). Payson has a conservation water rate structure, a water conservation education program and a drought plan. Supply augmentation activities include using effluent for turf irrigation and groundwater recharge, and development of a program to transport 3,000 acre-feet of water from C.C. Cragin reservoir to Payson as provided for under the Arizona Water Rights Settlement Act.

Local Drought Impact Groups (LDIGs) are being formed in all counties across Arizona. LDIGs are voluntary groups that will 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.

To support the efforts of the LDIGs, professionals and residents are asked to provide monthly feedback on drought conditions throughout their county. Citizens may also participate with the LDIG by assisting with education and outreach efforts and recommending actions for drought mitigation and response. More information on LDIGs may be found at http://www.azwater.gov/dwr/drought/LDIG.html.

Watershed Groups and Studies

Several groups have formed in the planning area to address water resource issues. The most active groups in the planning area are the Citizens Water Advocacy Group, Citizens for Responsible Development, Northern Arizona Municipal Water Users Association, Upper Agua Fria Watershed Partnership, Verde River Basin Partnership, Verde Valley Water Users Association, Inc., Verde Watershed Association and the Yavapai County Water Advisory Committee. In 2005, Congress passed the Northern Arizona Land Exchange and Verde River Partnership Act, but to date this partnership has not formed. A description of those groups that are part of the Department's Rural Watershed Initiative Program, including participants, activities and issues, is found in Appendix B. Two of the groups listed in Appendix B encompass more than one planning area. Primary issues identified by these groups that pertain to the Central Highlands Planning area are summarized as follows:

Growth:

- Unregulated lot splits
- Proposed growth in Mayer, Bensch Ranch and Spring Valley
- 25,000 to 30,000 approved lots remain in Prescott AMA
- Thousands of private domestic wells and more pending
- Significant projected growth

Water Supplies and Demand:

- Limited and deep groundwater supplies
- Access to water development on public lands
- Limited groundwater data

- Limited supplies to meet projected demands
- Limited water resources to meet current demands
- Environmental, supply, treatment, transportation and financing costs associated with augmentation from C.C. Cragin reservoir
- Seasonal demand/peaking problems
- Potential impacts resulting from the transfer of Big Chino water to Prescott and Prescott Valley

Legal:
- Private water companies and domestic water improvement district conflicts
- Interbasin transfer conflicts resulting from Payson's ability to pump from two separate basins
- Unresolved Indian Water Rights settlements
- Subflow decision and impact on legal access to water
- Yavapai Ranch land exchange and Title II implementation
- Senior water right holders on the Verde River are landowners within the SRP boundaries

Water Quality:
- Water quality issues in Verde Valley
- Potential impacts from septic systems
- Ability to meet new Arsenic standard

Funding:
- Limited funding resources for planning, projects, infrastructure and studies
- High cost of water augmentation projects
- Costs associated with hauling water
- Infrastructure needs for private water companies

Drought:
- Drought sensitive groundwater and surface water supplies
- Drought sensitivity in Mayer, Spring Valley, Black Canyon City

Environmental:
- ESA issues involving groundwater usage impacts on perennial streams
- Environmental issues pertaining to Fossil Creek
- Verde River Wild and Scenic River status
- Proposed critical habitat area in Verde Valley for willow flycatcher
- Invasive species

Other:
- Poorly constructed and maintained infrastructure in some areas
- Political and philosophical differences between the Verde Valley and the Prescott AMA

A number of studies have been conducted in parts of the planning area, particularly in the Verde Basin. Many of these studies were undertaken as a result of initiatives by watershed groups and communities. Some of the noteworthy regional studies have been mentioned in previous sections and an extensive list of studies are included in the references and suggested reading sections found at the end of each basin section in this volume. Not included are studies under development. The USBOR is in the process of drafting a report of findings for the Mogollon Rim Water Resource Appraisal Study, which covers the Payson, Pine and Strawberry area. Recently, Northern Arizona University used USGS geophysical data to construct a 3-D geologic model that represents the subsurface geologic framework within the Big Chino Sub-basin and Prescott AMA. The model aids in understanding how groundwater flows within and between these areas. This work is being incorporated into a USGS numeric groundwater model being developed for the Verde Watershed and portions of the Coconino Plateau and Little Colorado River Watershed.

Issue Surveys

The Department conducted a rural water resources survey in 2003 to compile information for the public and help identify the needs of growing communities. This survey was also intended to gather information on drought impacts to incorporate into the Arizona Drought Preparedness Plan, adopted in 2004. Questionnaires were sent to almost 600 water providers, jurisdictions, counties and tribes. A report of the findings from the survey was completed in 2004 (ADWR, 2004).

There were 36 water provider and jurisdiction respondents in the Central Highlands Planning Area, but only 24 numerically ranked issues. Respondents were asked to rank 18 issues, which can be grouped into three categories: infrastructure, water supply and water quality. In the planning area, issues related to water quality and infrastructure were ranked among the top five issues by a majority of respondents; 66% in both categories. Water supply issues were considered key issues by 46% of the respondents. Table 5.0-15 shows the four specific issues that ranked highest in the planning area.

Table 5.0-15 Water resource issues ranked by 2003 survey respondents in the Central Highlands Planning Area (19 water providers and 5 jurisdictions)

Issue	Ranked as one of the top 5 issues (out of 18)	Percent of respondents
Lowering water tables near wells	6	25
Ability to meet new arsenic standards	8	33
Aging infrastructure in need of replacement	5	21
Inadequate captial for infrastructure improvement	8	33

Source: ADWR 2004

The Department conducted another, more concise survey of water providers in 2004. This was done to supplement the information gathered in the previous year in support of developing the Arizona Water Atlas, and to reach a wider audience by directly contacting each water provider. Through this effort, 74 water providers in the Central Highlands Planning Area, with a total of approximately 60,600 service connections, were willing to participate and provide information on water supply, demand, and infrastructure and to rank a list of seven issues.

In regard to the question of groundwater level trends in their service area, 59 respondents reported as follows: 25 stable, 21 falling, 9 did not know the condition of water levels in their service area, 3 reported variable water levels and 1 respondent in the Verde River Basin reported rising water levles. Responses are shown by basin with the number of respondents in Table 5.0-16.

Table 5.0-16 Groundwater level trends reported by 2004 survey respondents by groundwater basin (59 respondents)

Basin	Rising	Stable	Falling	Variable	Don't Know
Agua Fria		1	5		
Salt River		3			
Tonto Creek			1		2
Upper Hassayampa		6			
Verde River	1	15	15	3	7

Source: ADWR 2005c

As part of the 2004 survey, water providers were asked to rank 7 issues from 0 to 4 with 0 = no concern, 1 = minor concern, 2 = moderate concern and 3 = major concern. Of the 74 water providers that responded to the survey, 66 ranked issues. Water quality was not included as an issue in this survey. Although responses to the 2003 questionnaire are not directly comparable to the 2004 survey due to differences in the form and wording of the surveys, infrastructure issues ranked high, similar to the 2003 survey. In addition, concerns about drought related water supplies and supplies to meet future needs also rated high as shown in Table 5.0-17.

Table 5.0-17 Water resource issues ranked by 2004 survey respondents in the Central Highlands Planning Area (66 water providers)

Issue	Moderate concern	Major concern	Total	Percent of respondents reporting issue was a major or moderate concern
Inadequate storage capacity to meet peak demand	6	3	9	13
Inadequate well capacity to meet peak demand	5	7	12	18
Inadequate supplies to meet current demand	4	6	10	15
Inadequate supplies to meet future demand	4	17	21	32
Infrastructure in need of replacement	12	12	24	36
Inadequate capital to pay for infrastructure improvements	6	19	25	38
Drought related water supply problems	6	19	25	38

Source: ADWR 2005c

Table 5.0-18 shows how respondents to the 2004 survey within individual basins ranked issues. Inadequate capital for infrastructure improvements was a moderate or major concern for most respondents in all the basins while drought related water supply problems were identified as key issues for respondents in the Agua Fria and Verde River basins.

Table 5.0-18 Number of 2004 survey respondents, by groundwater basin, that ranked the survey water resource issues a moderate or major concern (66 water providers total)

Issue	Agua Fria (7)	Salt River (4)	Tonto Creek (5)	Upper Hassayampa (8)	Verde River (42)
Inadequate storage capacity to meet peak demand	1	2	1	2	7
Inadequate well capacity to meet peak demand	2		1		10
Inadequate supplies to meet current demand	1		1		12
Inadequate supplies to meet future demand	3	1	5	2	18
Infrastructure in need of replacement	3	2	3	3	16
Inadequate capital to pay for infrastructure improvements	4	2	4	3	21
Drought related water supply problems	5		4	2	25

Source: ADWR 2005c

5.0.9 Groundwater Basin Water Resource Characteristics

Sections 5.1 through 5.5 present data and maps on water resource characteristics of the groundwater basins in the Central Highlands 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 5.1 through 5.5.

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 has 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 purpose with 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 (Arizona State Land Department, 2006).

Climate

Climate data including temperature, rainfall, evaporation rates and snow 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.

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.

Criteria for including stream gage stations in the basin 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.

Perennial and Intermittent Streams and Major Springs

A map of perennial and intermittent streams is provided for each basin. For some basins, 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.

Groundwater Conditions

Several indicators of groundwater conditions are presented for each basin. 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 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 typically the least well known component of a water budget. Many of the estimates in the Atlas are derived from studies of larger geographic areas and all deserve further study. Similarly, estimates of storage are based on rough estimates and considerably more studies are needed in most basins. Components of storage include aquifer depth and specific yield.

Water level data is from measured wells, usually collected during the period when the wells were not actively being pumped or only minimally pumped. Depth to water measurements are shown on mapped wells if there was a measurement taken during 2003-2004. The basin hydrographs show water-level trends for selected wells over the 30-year period from January 1975 to January 2005. Not all basins have a sufficient number of representative hydrographs.

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 basins indicate how localized pumping has altered regional flow patterns.

Water Quality

Water quality conditions impact the availability of water supplies. Water quality data was compiled from a variety of sources as described in Volume 1 Section 1.3. 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.

Cultural Water Demand

Cultural water demand is an important component of a water budget. However, without mandatory metering and reporting of water uses, accurate demand data is difficult to acquire. Municipal demand includes water company and domestic (self-supplied) demand estimates. Basin demand information is 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.

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 was 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 both logistically and economically since a potential user may be far from the wastewater treatment plant.

Water Adequacy Determinations

Information on water adequacy and inadequacy determinations for subdivisions, with the reason for the inadequacy determination provides information on the number and status of subdivision lots. Listing the reason for the inadequacy identifies which subdivisions have a demonstrated physical or legal lack of water or may have elected not to provide the necessary information to the Department. Briefly, developers of subdivisions outside of AMAs are required to obtain a determination of whether there is sufficient water of adequate quality available for 100 years. If the supply is determined to be inadequate, lots may still be sold, but the condition of the water supply must be disclosed in promotional materials and in sales documents.

In addition to these subdivision determinations for which a water adequacy report is issued, water providers may apply for adequacy designations for their entire service area. There are six Designations of Adequate Water Supply in the planning area. (See Section 5.0.5). If a subdivision is to be served water from one of these water providers, then a separate adequacy determination is not required. (See Appendix A, Volume 1 for more information about the Adequacy Program).

REFERENCES

Anderson, T.W., Freethey, G.W. and Tucci, P, 1992, Geohydrology and Water Resources of Alluvial Basins in South-Central Arizona and Parts of Adjacent States-Regional Aquifer-System Analysis: USGS Professional Paper 1406.B.

Arizona Department of Economic Security (DES), 2005, Workforce Informer: Accessed August 2005 at www.workforce.az.gov

Arizona Department of Environmental Quality (ADEQ), 2007, Site Update, Payson PCE/Tonto and Cherry Water Quality Assurance Revolving Fund Sites – March 2007; Publication Number FS 07-09

_____, 2006a, Active DOD, Superfund, WQARF, and LUST contamination sites in Arizona: GIS cover, received February 2006.

_____, 2006b, Brownfield Tracking System: Accessed June 2006 at www.azdeq.gov/ databases/ brownsearch.html.

_____, 2006c, Pinal Creek Water Quality Assurance Revolving Fund (WQARF) factsheet; Accessed June, 2007 at http://www.azdeq.gov/environ/waste/sps/state.html

_____, 2005, Active dairy farms & feedlots: Data file, received October 2005.

_____, 2002, The Status of Water Quality In Arizona – 2002: Volume 1. Arizona's Integrated 305(b) Assessment and 303(b) Listing Report

Arizona Department of Mines and Mineral Resources (ADMMR), 2005, Database of active mines in Arizona: Available at www.admmr.state.az.us

Arizona Department of Water Resources (ADWR), 2007, Cultural Water Demand in the Central Highlands Planning Area: Unpublished analysis by Office of Resource Assessment Planning

_____, 2006a, Assured and adequate water supply applications: Project files, ADWR Water Management Division

_____, 2006b, Identification of Historically Irrigated Acres in the Big Chino Sub-Basin and Discussion Regarding Transportation of Groundwater into the Prescott AMA

_____, 2005a, Database of instream flow applications: ADWR Office of Water Management.

_____, 2005b, Water use by golf courses in rural Arizona: Unpublished analysis by ADWR Office of Regional Strategic Planning.

_____, 2005c, Data from 2004 rural water provider questionnaire: ADWR Office of Resource Assessment Planning.

_____, 2005d, Agricultural surface water use estimates: Unpublished analysis by ADWR Office of Resource Assessment Planning.

_____, 2005e, Water Protection Fund database: ADWR Office of Drought, Conservation and Riparian Planning.

_____, 2004, Rural Water Resources Study-Rural Water Resources 2003 Questionnaire Report.

_____, 2000, Verde River Watershed Study

_____, 1994a, Arizona Water Resources Assessment, Vol. II Hydrologic Summary.

_____, 1994b, Arizona Water Resources Assessment, Vol. I. Inventory and Analysis.

_____, 1992. Preliminary HSR for the Upper Salt River Watershed Volume 1: Assessment In Re: The General Adjudication of the Gila River System and Source

Arizona Game and Fish (AZGF), 2004, Explore Arizona: Accessed January 2007 at http://explore.azgfd.gov

_____, 1997 & 1993, Statewide riparian inventory and mapping project: GIS cover.

Arizona Mining Association, 2006, AZCU Profile: Phelps Dodge Mining Company; Accessed June, 2007 at http://www.azcu.org/viewNews.php?item=2

Arizona State Land Department, 2006, Historical overview-Land Grant and Designation of Beneficiaries: Accessed February 2006 at http://www.land.state.az.us/history.htm.

Arizona Water Company, 2007a, System Water Plan Miami Water System, submitted to ADWR

Arizona Water Company, 2007b, System Water Plan Sedona Water System, submitted to ADWR

Big Park Water Company (BPWC) and Little Park Water Company (LPWC), 2007, Water Supply Plan, submitted to ADWR

Brown, D. and Lowe, C., 1980, Biotic Communities of the Southwest: GIS Cover digitized by Arizona Game and Fish Department: Accessed in 2007 at http://www.dot.co.pima.az.us/gis/maps/mapguide

Center for Plant Conservation (CPC), 2007; Plant species information: Accessed April, 2007 at www.centerforplantconservation.org

City of Globe, 2005, ADWR Designation of Adequate Water Supply Annual Report

City of Payson, 2007; Payson Water System: Accessed June, 2007 at http://www.ci.payson.az.us/Departments/water/system.htm

Corkhill, 2000, Report on the Drilling of an exploratory Borehole near Strawberry, Arizona (May 18-June 2, 2000. A Hydrogeologic Investigation for the Northern Gila County Water Plan Alliance.

Cottonwood Water Works, 2007, Community Water System Report, submitted to ADWR.

Dava & Associates, Inc., 2003, Yavapai County General Plan, Section VI. Water Resources Element

Environmental Law Institute, 2002, An Analysis of State Superfund Programs: 50 State Study, 2001 Update.

Ester, Charlie and Reigle, Dallas, 2001; The Role of the SRP Verde Reservoirs in Water Resources Management at the Salt River Project, *In* Proceedings of the Verde Watershed Symposium-State of the Watershed in 2001, May 17-19, 2001.

Gæaorama Inc., 2006, Geology and Structural Controls of Groundwater, Mogollon Rim Water Resources Management Study. Draft. Prepared for the Bureau of Reclamation.

Intertribal Council of Arizona (ITCA), 2003, White Mountain Apache Tribe, Tonto Apache Tribe, Yavapai-Apache Tribe: Accessed April 2007 at www.itcaonline.com

Maguire, Rita P., 2005, An Analysis of the Water Budgets of Buckeye, Payson and Prescott Valley, ThinkAZ.

McGavock, Ed, 2003, Big Chino Aquifers: Knowns, Unknowns, and Conflicting Interpretations. Tri-City Water Forum 2003

National Wild & Scenic Rivers System (NWSR), 2007, Verde River Arizona: Accessed April 2007 at www.rivers.gov

Neary, Daniel G., Gerald J. Gottfried, and Peter F. Ffolliott, 2003, Post-Wildfire Watershed Flood Responses, Proceedings of the 2nd International Fire Ecology Conference, American Meteorological Society, Orlando FL, Paper 65982, 8p.

Nelson, Keith, 2002, Application of the Prescott Active Management Area groundwater flow model, planning scenario 1999-2025, Modeling Report No. 12: Arizona Department of Water Resources Hydrology Division, September 2002.

NEMO (Non-point Education for Municipal Officials), 2006, NEMO Watershed Based Plan for the Upper Agua Fria Watershed

Payson Regional Economic Development Corporation, 2006, Utilities; Accessed June, 2007 at http://www.paysonecon.org/relocation.htm

Payson Roundup, 2005, Supervisors approve Diamond Star incorporation, Nov. 4, 2005

Quadra Mining, Ltd.. 2005, Carlota Project; Accessed June, 2007 at http://www.quadramining.com/s/Carlota.asp

Owen-Joyce, Sandra J. and C. K. Bell, 1983, Appraisal of Water Resources in the Upper Verde River Area, Yavapai and Coconino Counties, Arizona

Salt River Project (SRP), 2007; SRP system information: Accessed April, 2007 at http://www.srpnet.com/about/history/water.aspx

______, 2007, C.C. Cragin Dam and Reservoir; Accessed May, 2007 at http://www.srpnet.com/water/dams/cragin.aspx

Seaber, P.R., Kapinos, E.P. and Knapp, G.L., 1987, Hydrologic Unit Maps; U.S. Geological Survey Water-Supply Paper 2294, 63 pp.

Tellman, B., Yarde, R., and Wallace, M., 1997, Arizona's changing rivers: How people have affected rivers: Water Resources Research Center, University of Arizona, Tucson, Arizona

Truini, M., Macy, J. P., Porter, T. J., 2005. Ground-water, surface-water, and water-chemistry data, Black Mesa area, northeastern Arizona, 2003-04.; prepared in cooperation with the Bureau of Indian Affairs and the Arizona. Dept. of Water Resources. USGS

U.S. Bureau of Land Management (BLM), 2006, Arizona Wilderness Areas: Accessed December 2006 at www.blm.gov/az/wildarea.htm

U.S. Bureau of Reclamation (USBOR), 2003, Draft Water Use Projections Verde Valley Arizona

U.S. Census Bureau, 2006, on-line data files: Accessed January 2006 at www.census.gov

U.S. Department of Agriculture (USDA), 2007, USDA Forest Service - Southwestern Region: Accessed April, 2007 at http://www.fs.fed.us/r3/resources/health/beetle/index.shtml
U.S. Forest Service (USFS), 2007, Wilderness Areas: Accessed March, 2007 at http://www.fs.fed.us/r3/

______, 2003, Arizona Bark Beetle Epidemics-Fact Sheet and Bulletin, Southwestern Region

U.S. Fish and Wildlife Service (USFWS), 2007; News release: Comments Sought on Proposal to

Renovate Stillman Lake, March 15, 2007

______, 2006, Endangered Species List by County: Accessed July 2006 at www.fws.gov/arizonaes/documents/countylists and www.fws.gov/ifw2es/ endangered species/lists/default.cfm.

U.S. Geological Survey (USGS), 2006, Hydrogeology of the Upper and Middle Verde River Watersheds, Central Arizona

______, 2005a, Hydrogeology of the Mogollon Highlands, Central Arizona: Scientific Investigations Report 2004-5294, 87 pg.

______, 2005b, 1:2,000,000-Scale Hydrologic Unit Boundaries: GIS Cover, accessed in 2007 at http://nationalatlas.gov/atlasftp.html?openChapters=chpwater#chpwater

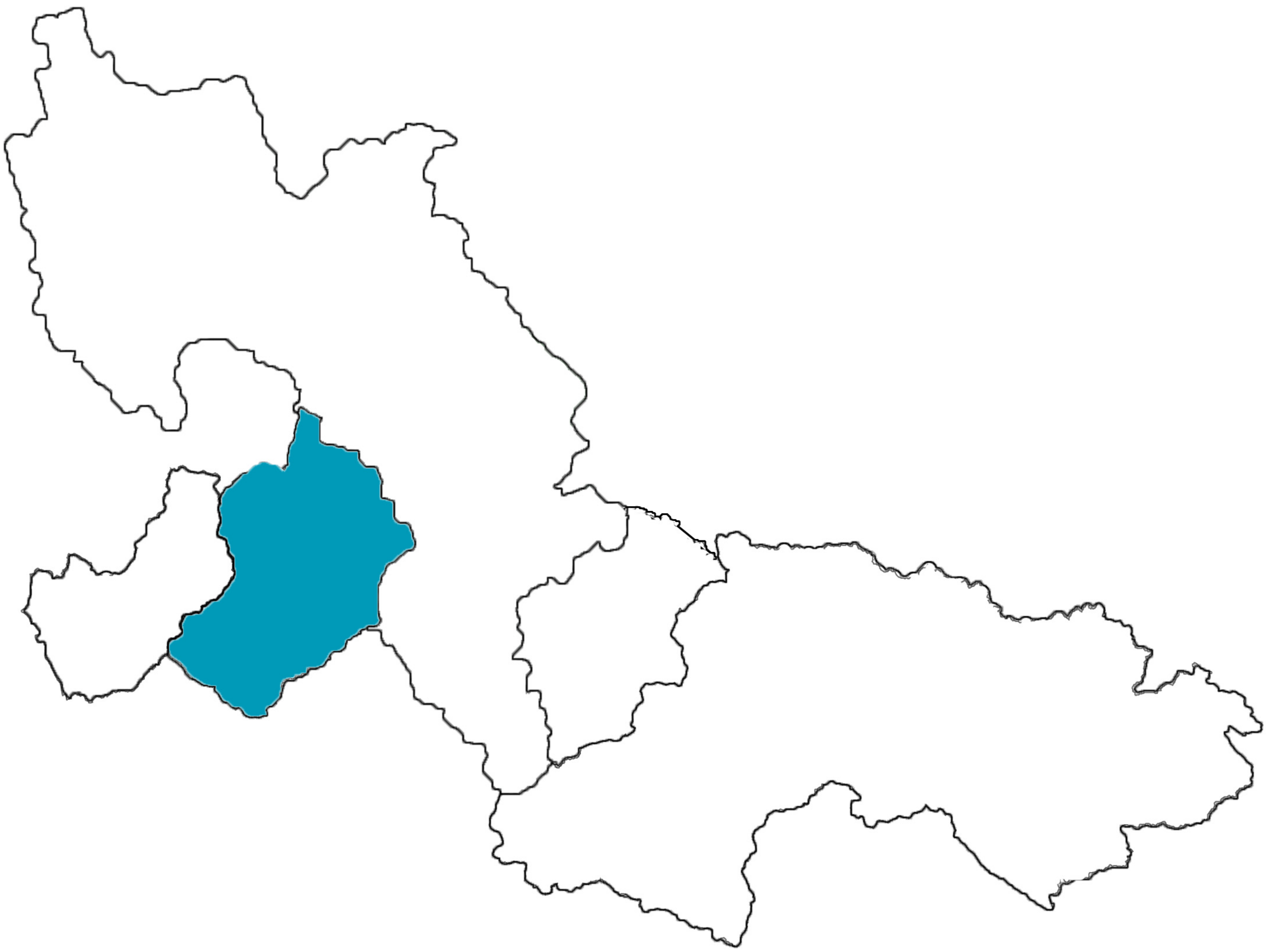
______, 2005c, Geologic Framework of Aquifer Units and Ground-water Flowpaths, Verde River Headwaters, North-Central Arizona: Open-File Report 2004-1141.

_____, 2005c, Water withdrawals for irrigation, municipal, mining, thermoelectric-power, and drainage uses in Arizona outside of the active management areas, 2000-2005: Data file, received December 2005.

Wirt, L., 2005, Hydrogeoloic Review of the Drake Cement Project, Yavapai County, Arizona, USGS Open-File Report 2004-1439.

Yavapai County Water Advisory Committee, 2004, Draft Big Chino Sub-basin Historical and Current Water Uses and Water Use Projections

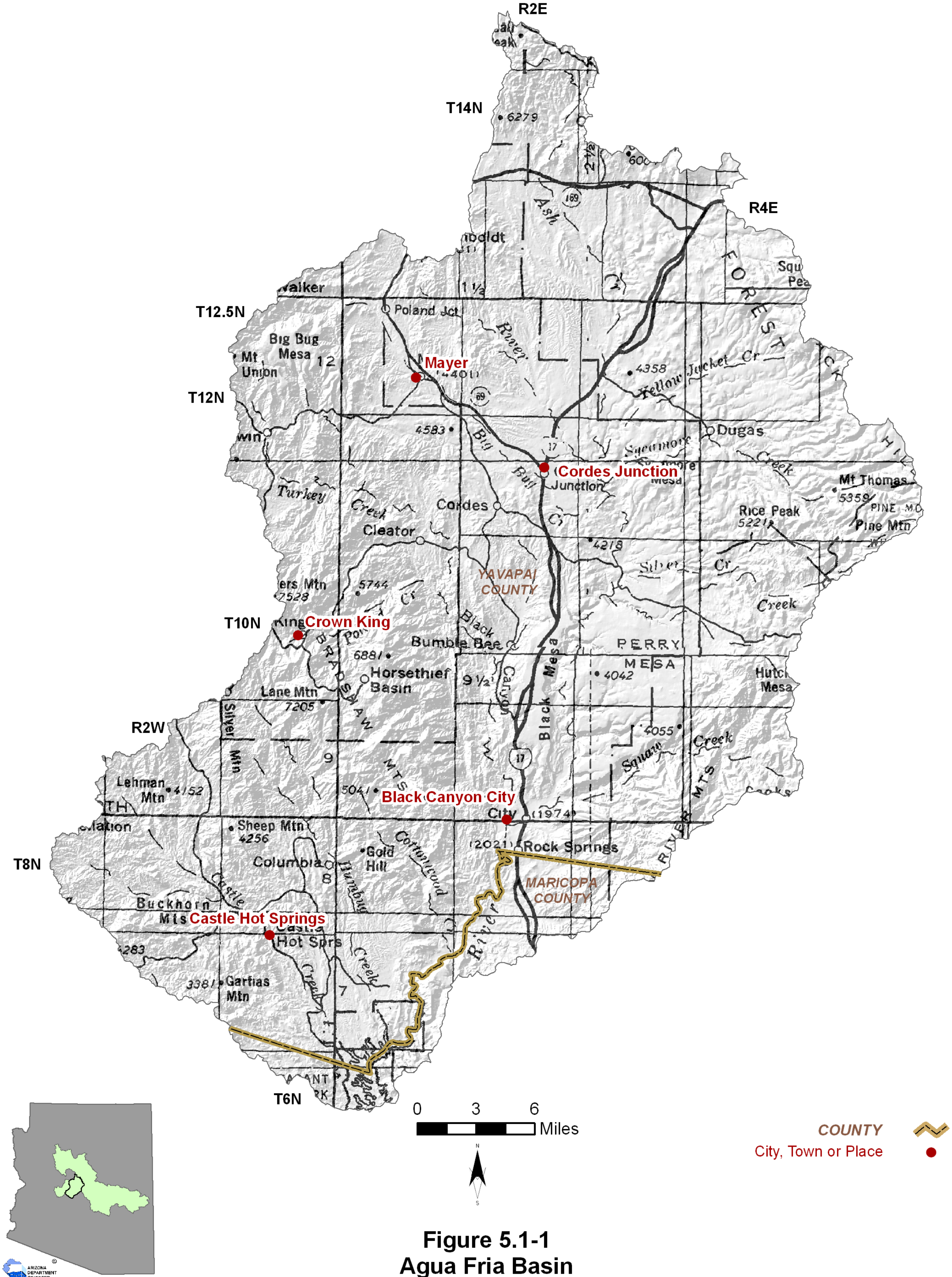
Section 5.1
Agua Fria Basin



5.1.1 Geography of the Agua Fria Basin

The Agua Fria Basin, located in the west central part of the planning area is 1,263 square miles in area. Geographic features and principal communities are shown on Figure 5.1-1. The basin is characterized by mid-elevation mountain ranges and mesas. Vegetation types include Sonoran desertscrub, semidesert grassland, chaparral and montane conifer forests. Riparian vegetation is found along the Agua Fria River including mixed broadleaf and cottonwood/willow.

- Principal geographic features shown on Figure 5.1-1 are:
    - Principal basin communities of Black Canyon City and Cordes Junction
    - Other communities of Castle Hot Springs, Crown King and Mayer
    - Agua Fria River running north to south through the center of the basin
    - The lowest point in the basin is about 3,700 feet along the Agua Fria River
    - Numerous creeks that flow into the Agua Fria River. In the southern half of the basin these creeks include Castle Creek, Humbug Creek, Cottonwood Creek, Black Canyon Creek and Squaw Creek. In the northern half of the basin these creeks include Turkey Creek, Silver Creek, Sycamore Creek, Yellow Jacket Creek and Ash Creek
    - Horsethief Basin southeast of Crown King
    - Perry Mesa to the east of Interstate 17 north of Black Canyon City
    - Black Mesa along Interstate 17 west of Perry Mesa
    - Big Bug Mesa on the western basin boundary northwest of Mayer
    - Buckhorn Mountains in the southwestern portion of the basin
    - Bradshaw Mountains west of Interstate 17, which contain the highest point in the basin, Mt. Union at 7,528 feet
- Not well shown on Figure 5.1-1 are the New River Mountains in the southeastern portion of the basin



Base Map: USGS 1:500,000, 1981

Figure 5.1-1
Agua Fria Basin
Geographic Features

5.1.2 Land Ownership in the Agua Fria Basin

Land ownership, including the percentage of ownership by category, for the Agua Fria Basin is shown in Figure 5.1-2. Principal features of land ownership in this basin are the diversity of land ownership types and the large contiguous parcels of forest service lands. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

National Forest and Wilderness

- 46.7% of the land is federally owned and managed as National Forest and Wilderness.
- Forest lands in the basin are part of the Prescott and Tonto National Forests.
- The basin contains two wilderness areas, the 25,536-acre Castle Creek Wilderness and the 20,100-acre Pine Mountain Wilderness. Both areas are in the Prescott National Forest.
- There are numerous small private in-holdings in the Prescott National Forest.
- National forest land is located in the northern, eastern and western portions of the basin, divided by Interstate 17 and other land uses in the central part of the basin.
- Land uses include recreation, grazing and timber production.

U.S. Bureau of Land Management (BLM)

- 16.7% of the land is federally owned and managed by the Hassayampa Field Office Bureau of Land Management.
- Most BLM lands are interspersed with private and state trust lands in the southern and central portions of the basin.
- Primary land uses are recreation and grazing.

State Trust Land

- 14.6% of the land in this basin is held in trust for the public schools and four other beneficiaries under the State Trust Land system.
- State land is interspersed with private and BLM lands and is found in the southern and north-central portions of the basin.
- Primary land use is grazing.

National Parks, Monuments and Recreation Areas

- 12.1% of the land (71,000 acres) is federally owned and managed by the BLM as the Agua Fria National Monument located in the center of the basin.
- Primary land use is recreation.

Private

- 7.1% of the land is private.
- Private land is found throughout the basin with the majority of the private land interspersed with state trust, national forest and BLM lands.
- The largest contiguous area of private lands is in the vicinity of Castle Hot Springs.
- Land uses include domestic, commercial and ranching.

Other (Game and Fish, County and Bureau of Reclamation Lands)

- 2.6% of the land is owned and managed by two counties.
- The largest portion of “other” land is owned and managed by Maricopa County as the Lake Pleasant Regional Park. This park is located at the southernmost tip of the basin.
- A small portion of land northeast of Cordes Junction is owned by Yavapai County, its use is unknown.
- Primary land use at the Lake Pleasant Regional Park is recreation.

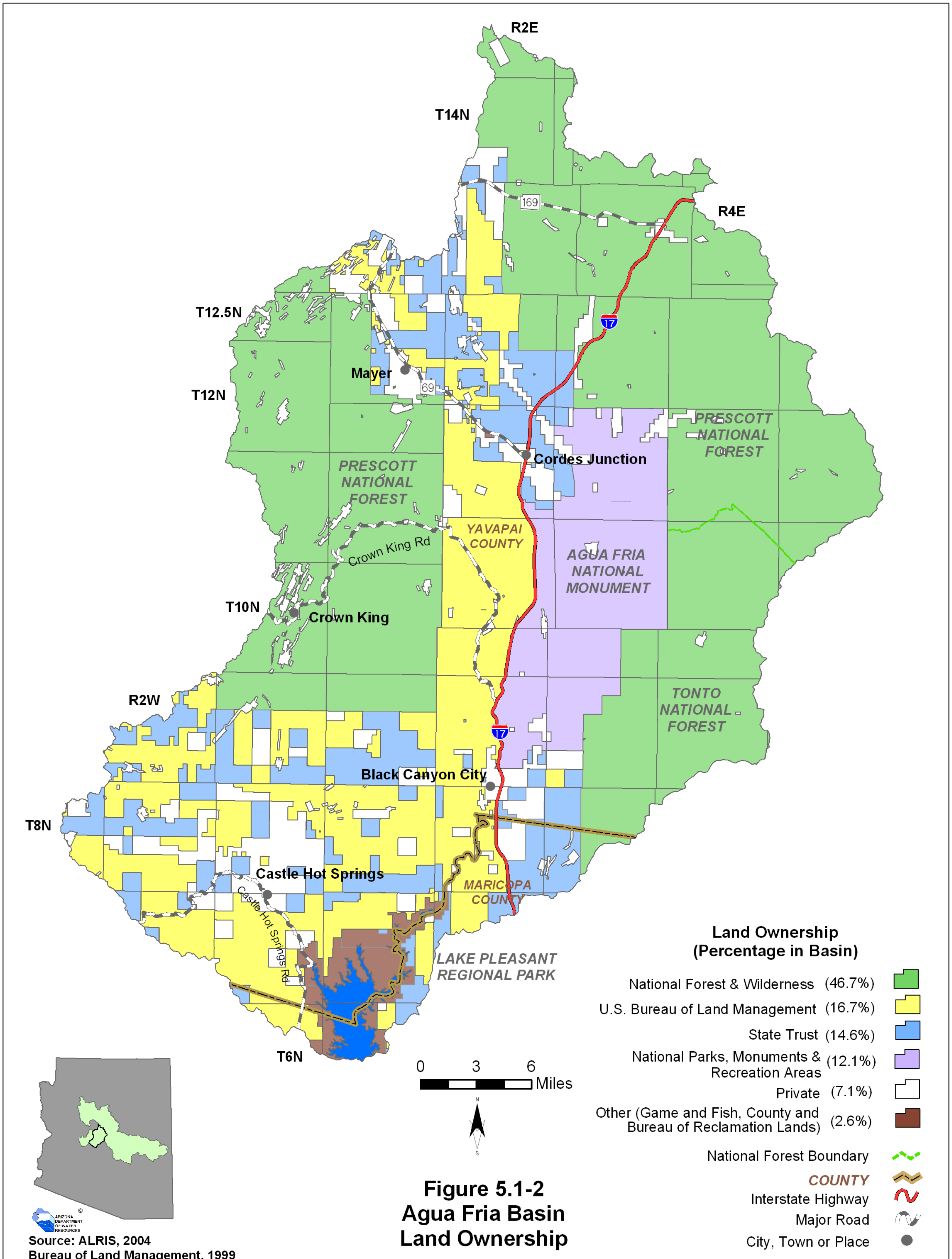


Figure 5.1-2
Agua Fria Basin
Land Ownership

5.1.3 Climate of the Agua Fria Basin

Climate data from NOAA/NWS Co-op Network stations are complied in Table 5.1-1 and the locations are shown on Figure 5.1-3. Figure 5.1-3 also shows precipitation contour data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Agua Fria Basin does not contain Evaporation Pan, AZMET or SNOTEL/Snowcourse stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 5.1-1A
- Elevations at the three NOAA/NWS Co-op network climate stations range from 1,990 feet to 5,920 feet.
- Minimum average temperature ranges from 37.4°F at Crown King to 53.2°F at Castle Hot Springs.
- Maximum average temperature ranges from 88.8°F at Castle Hot Springs to 72.6°F at Crown King.
- Station precipitation is similar at the Castle Hot Springs and Cordes stations with an average annual precipitation of 15.47 inches and 16.21 inches respectively. Annual average precipitation is 28.41 inches at Crown King.
- All stations report highest average seasonal rainfall in the winter season (January - March) and lowest seasonal rainfall in the spring.

SCAS Precipitation Data

- See Figure 5.1-3
- Additional precipitation data shows rainfall as high as 32 inches south of Crown King and as low as 10 inches at the southernmost tip of the basin.
- In general, precipitation increases as altitude increases in this basin. The range of 22 inches between areas of highest and lowest precipitation is common for the planning area.

Table 5.1-1 Climate Data for the Agua Fria Basin

A.NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Castle Hot Springs	1,990	1971 - 2000	88.8/Jul	53.2/Jan	6.23	1.03	4.52	3.69	15.47
Cordes	3,770	1971 - 2000	80.1/Jul	45.3/Jan	5.29	1.31	5.87	3.74	16.21
Crown King	5,920	1971 - 2000	72.6/Jul	37.4/Jan	11.39	2.13	8.62	6.27	28.41

Source: WRCC, 2003.

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (N*umber of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan.	Feb.	March	April	May	June
None								

Source: NRCS, 2005

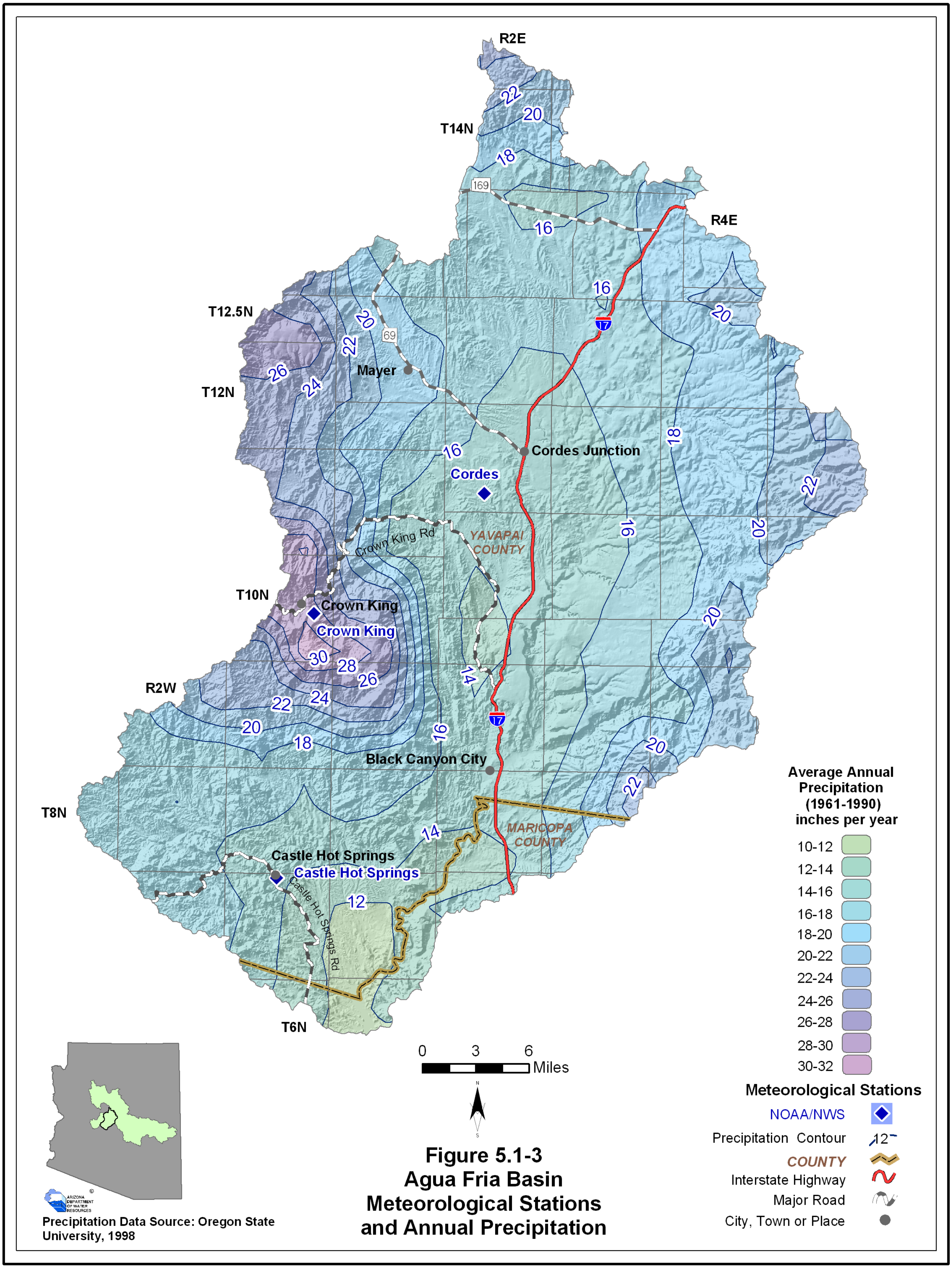


Figure 5.1-3
Agua Fria Basin
Meteorological Stations and Annual Precipitation

5.1.4 Surface Water Conditions in the Agua Fria Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 5.1-2. Flood ALERT equipment in the basin is shown in Table 5.1-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 5.1-4. The location of streamflow gages identified by USGS number, flood ALERT equipment and USGS runoff contours are shown on Figure 5.3-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 5.1-2.
- Data from seven stations located at five watercourses including the Agua Fria River, Turkey Creek, Boulder Creek, Humbug Creek and Cottonwood Creek, are shown in the table and on Figure 5.1-4. Four of the seven stations were discontinued between 1992-1994. The remaining three stations, all located on the Agua Fria River, are real-time stations.
- The average seasonal flow at six stations is highest in the winter (January-March) when between 52% and 82% of the annual average annual flow occurs. The average seasonal flow at the Agua Fria near Humbolt station is highest in the summer (July-September) when 40% of the average annual flow occurs. Lowest average seasonal flow is in the spring (April-June) or summer (July-Sept).
- Maximum annual flows range from 360,541 acre-feet (1992, Agua Fria near Rock Springs) to 1,166 acre-feet (1992, Cottonwood Creek near Waddell Dam).
- Minimum annual flows range from 12 acre-feet (1989, Cottonwood Creek near Waddell Dam) to 1,528 acre-feet (1975, Agua Fria River near Rock Springs).

Flood ALERT Equipment

- Refer to Table 5.1-3.
- As of October 2005 there were 14 stations in the basin. All stations are located in Yavapai County, however, all but two stations are the responsibility of the Maricopa County Flood Control District.
- Of the 14 stations, 11 are precipitation only stations, two are weather stations and one is a repeater/weather station.

Reservoirs and Stockponds

- Refer to Table 5.1-4.
- The basin contains one large reservoir with a maximum capacity of 1,108,600 acre-feet. Lake Pleasant, created by the New Waddell Dam, is used for flood control, hydroelectric power generation, recreation and water supply purposes.
- Surface water is stored or could be stored in four small reservoirs in the basin.
- Total maximum storage for the two small reservoirs with greater than 15 acre-feet and less than 500 acre-feet capacity is 63 acre-feet. The total surface area for the remaining two small reservoirs is 13 acres.
- There are 527 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 5.1-4.
- Average annual runoff is one inch per year in most of the basin and increases to two inches per year in the northeast portion of the basin.

Table 5.1-2 Streamflow Data for Agua Fria Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	Years of Record
9512450	Agua Fria River near Humboldt	Undetermined	NA	1/2000-current (real-time)	19	9	40	32	1,332 (2003)	1,354	2,013	3,352 (2002)	3
9512500	Agua Fria River near Mayer	585	5,000	1/1940-current (real-time)	52	9	22	17	976 (1962)	9,197	16,327	103,555 (1993)	63
9512600	Turkey Creek near Cleator	89	5,360	10/1979 - 9/1992, (discontinued)	68	10	9	12	239 (1981)	4,164	8,154	33,882 (1980)	12
9512800	Agua Fria River near Rock Springs	1,111	4,770	1/1970-current (real-time)	75	7	7	11	1,528 (1975)	19,692	57,664	360,541 (1992)	31
9512830	Boulder Creek near Rock Springs	38	NA	5/1983-9/1993 (discontinued)	80	9	3	9	14 (1989)	701	1,186	3,869 (1992)	9
9512860	Humbug Creek near Castle Hot Springs	60	NA	5/1983-9/1994 (discontinued)	81	7	5	7	333 (1989)	1,948	5,334	34,896 (1993)	10
9512970	Cottonwood Creek near Waddell Dam	9	NA	4/1983-3/1993 (discontinued)	82	1	13	4	12 (1989)	94	252	1,166 (1992)	9

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Notes:
Statistics based on Calendar Year
Annual Flow statistics based on monthly values
Summation of Average Annual Flows may not equal 100 due to rounding.
Period of record may not equal Years of Record used for annual Flow/Year statistics due to only using years with a 12 month record

Table 5.1-3 Flood ALERT Equipment in the Agua Fria Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
3755	Brooklyn Peak	Precipitation	8/3/2005	Yavapai County FCD
3780	Black Canyon City	Repeater/Weather Station	8/1/2005	Yavapai County FCD
5335	Minnehaha	Precipitation	6/16/1981	Maricopa County FCD
5660	Lake Pleasant North	Weather Station	NA	Maricopa County FCD
5670	Garfias Mountain	Precipitation	8/14/1981	Maricopa County FCD
5685	Columbia Hill	Precipitation	7/1/1981	Maricopa County FCD
5700	Horsethief Basin	Weather Station	11/24/1986	Maricopa County FCD
5715	Crown King	Precipitation	10/18/1982	Maricopa County FCD
5730	Sunset Point	Precipitation	7/1/1981	Maricopa County FCD
5745	Horseshoe Ranch	Precipitation	5/1/1981	Maricopa County FCD
5760	Horner Mtn. Ranch	Precipitation	4/1/1981	Maricopa County FCD
5775	Arizona Hunt Club	Precipitation	4/1/1981	Maricopa County FCD
5790	I-17 @ 169	Precipitation	11/11/1987	Maricopa County FCD
5805	Dewey	Precipitation	11/1/1981	Maricopa County FCD

FCD = Flood Control District
NA = Data not currently available to ADWR

Table 5.1-4 Reservoirs and Stockponds in the Agua Fria Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
None	Lake Pleasant (New Waddell Dam)[2]	Bureau of Reclamation	1,108,600	C,H,R,S	Federal

Source: US Army Corps of Engineers 2005, US Bureau of Reclamation 2007 and others

B: Other Large Reservoirs (50 acre surface area or greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
None identified by ADWR at this time					

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total Number: 2
Total maximum storage : 63

D. Other Small Reservoirs (between 5 and 50 acres surface area)[2]

Total Number: 2
Total surface area: 13

E. Stockponds (up to 15 acre-feet capacity)

Total number: 527 (from water right filings)

Notes:
[1]C=Flood Control; H=hydroelectric; R=recreation; S=water supply
[2]Dam is located in the Phoenix AMA but lake storage is in the Agua Fria Basin

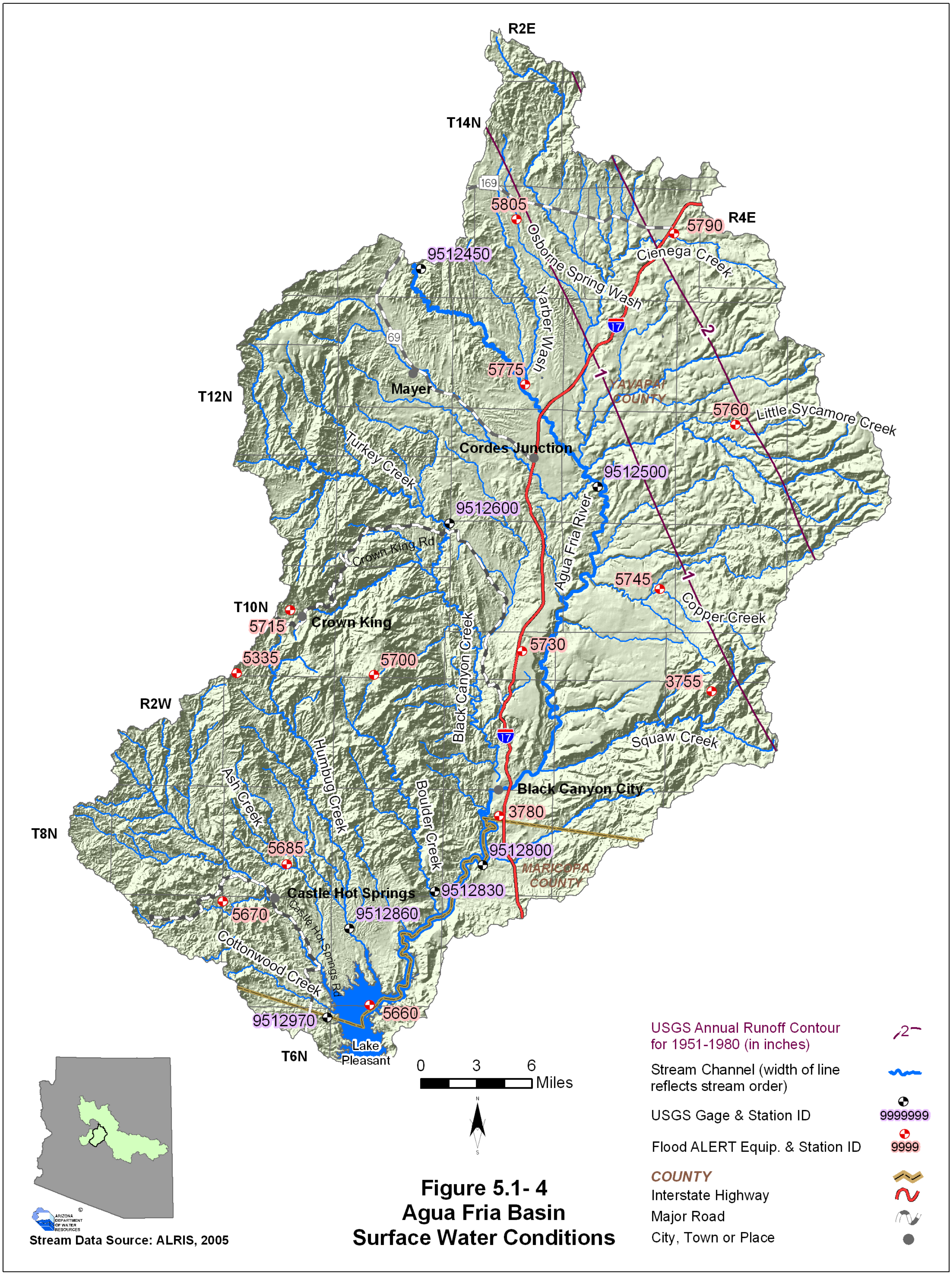


Figure 5.1- 4
Agua Fria Basin
Surface Water Conditions

5.1.5 Perennial/Intermittent Streams and Major Springs in the Agua Fria Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 5.1-5. The locations of major springs and perennial and intermittent streams are shown on Figure 5.1-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- Perennial streams in this basin include the Agua Fria River, Ash Creek, Sycamore Creek, Indian Creek, Silver Creek, a small reach of Humbug Creek, Yellow Jacket Creek and Grapevine Creek. Most perennial streams are in the northern portion of the basin.
- A number of intermittent streams are located throughout the basin.
- All perennial streams also have intermittent reaches.
- There are five major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions. All of the measurements were taken during or prior to 1982.
- All but one major spring is found in the central eastern portion of the basin. The greatest discharge rate was measured near Castle Hot Springs (Castle, 340 gpm) in the southern part of the basin.
- All but one of the major springs has a measured discharge rate of less than 100 gpm.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 5.1-5B. There are 14 minor springs identified in this basin.
- The total number of springs, regardless of discharge, identified by the USGS varies from 294 to 297, depending on the database reference.

Table 5.1-5 Springs in the Agua Fria Basin

A. Major Springs (10 gpm or greater):

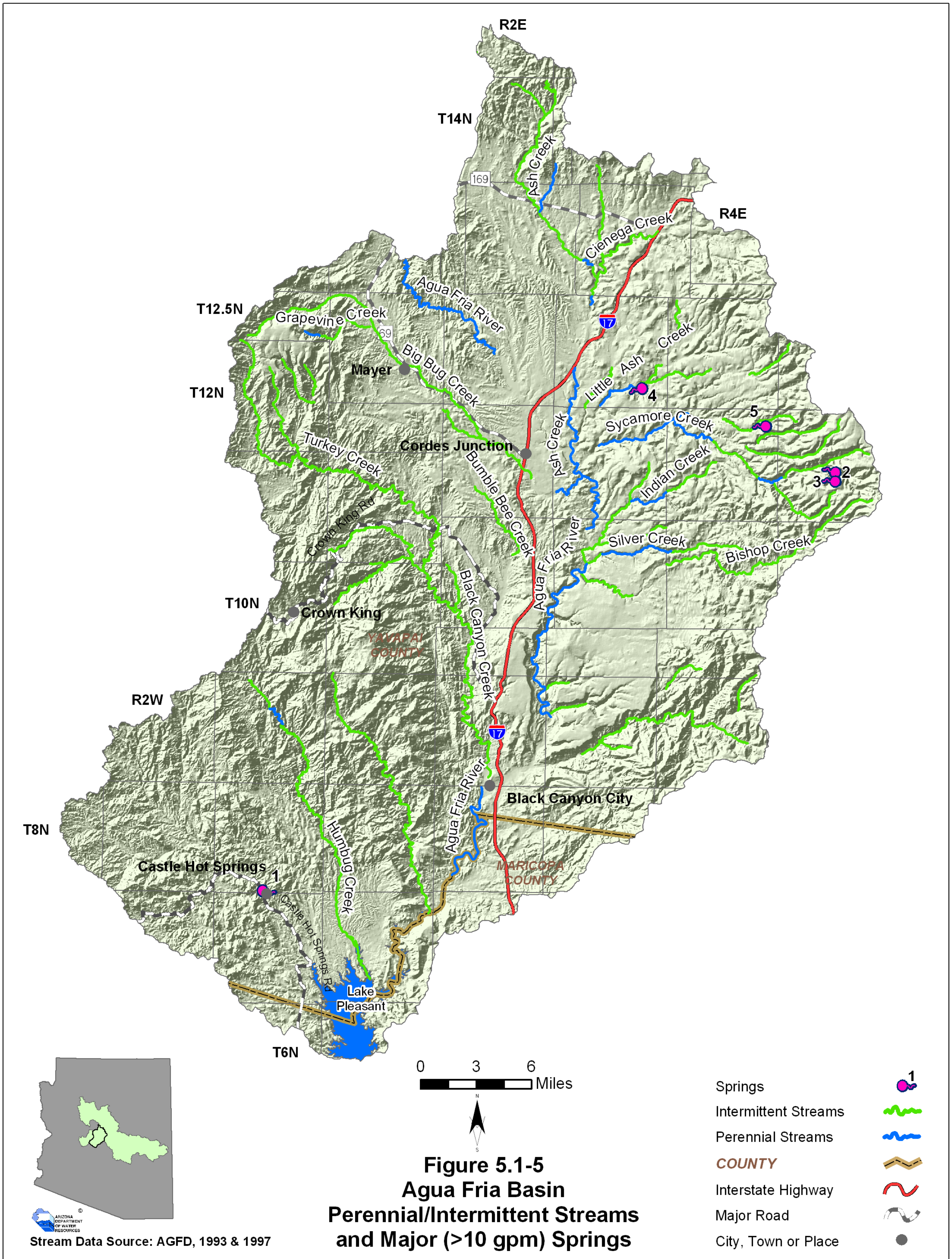
Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Castle	335908	1122134	340	During or prior to 1982
2	Nelson Place	341913	1114946	96	6/5/1981
3	Bee House	341846	1114945	50	12/13/1980
4	Brown	342302	1120049	40	8/31/1978
5	Willow	342119	1115343	14	10/23/1980

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Coyote	341800	1120248	6	9/16/1993
Larry Canyon[2]	340821	1120331	6	Not available
Unnamed	342905	1126121	5	10/20/1978
Sombero Canyon	341753	1115945	5	9/9/1993
Sheep	341800	1120220	3	9/1993
Alkali	335933	1122212	3	6/22/1979
Charlie's	342002	1120230	3	9/28/1993
Government[2]	342742	1120146	2	9/5/1978
Silver Creek	341515	1120146	2	8/1993
Badger	341356	1120633	2	4/9/1998
Unnamed	335558	1122126	1	8/9/1979
Unnamed	342857	1121704	1	10/20/1978
Unnamed	335559	1122124	1	8/9/1979
Little	342108	1120524	1	9/1985
Bear Creek	340627	1120727	1	During or prior to 2004

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and NHD, 2006): 294 to 297

Notes:
[1]Most recent measurement identified by ADWR
[2]Spring is not displayed on current USGS topo maps



Stream Data Source: AGFD, 1993 & 1997

Figure 5.1-5
Agua Fria Basin
Perennial/Intermittent Streams and Major (>10 gpm) Springs

5.1.6 Groundwater Conditions of the Agua Fria Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 5.1-6. Figure 5.1-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 5.1-7 contains hydrographs for selected wells shown on Figure 5.1-6. Figure 5.1-8 shows well yields in four yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 5.1-6 and Figure 5.1-6.
- Major aquifers in the basin include basin fill and sedimentary rock (conglomerate).
- Flow direction is generally from the north to the south from the basin boundaries toward the center of the basin.

Well Yields

- Refer to Table 5.1-6 and Figure 5.1-8.
- As shown on Figure 5.1-8 well yields in this basin range from less than 100 gallons per minute (gpm) to 2,000 gpm at several locations.
- One source of well yield information, based on 49 reported wells, indicates that the median well yield in this basin is 300 gpm.
- Well yields vary throughout the basin, with a cluster of less than 100 gallons per minute yields in the vicinity of Mayer.

Natural Recharge

- Refer to Table 5.1-6.
- The estimate of natural recharge for this basin is 9,000 acre-feet per year.

Water in Storage

- Refer to Table 5.1-6.
- There are two storage estimates for this basin, ranging from 620,000 acre-feet to a depth of 1,200 feet, to a more recent estimate from a 1994 ADWR study of 3.5 million acre-feet to an unknown depth.
- The predevelopment storage estimate is three million acre-feet to a depth of 1,200 acre-feet.

Water Level

- Refer to Figure 5.1-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures seven index wells in this basin.
- In 1979, the year of the last water level sweep, 49 wells were measured.
- The deepest recorded water level in the basin is 462 feet near Interstate 17 north of Black Canyon City and the shallowest is 21 feet east of Mayer.
- There is one ADWR automated groundwater level monitoring device located near.
- Hydrographs corresponding to selected wells shown on Figure 5.1-6 but covering a longer time period are shown in Figure 5.1-7.

Table 5.1-6 Groundwater Data for the Agua Fria Basin

Basin Area, in square miles:	1,263	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Basin Fill	
	Sedimentary Rock (Conglomerate)	
Well Yields, in gal/min:	Range 210-625 (2 wells measured)	Measured by ADWR and/or USGS
	Range 5-1,500 Median 300 (49 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 30-300	ADWR (1990)
	Range 0-500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	9,000	Freethey and Anderson (1986)
Estimated Water in Currently in Storage, in acre-feet:	620,000 - 3,500,000 (1990 to 1,200 ft, 1994 depth N/A)	ADWR (1990 and 1994)
	3,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	N/A	Arizona Water Commission (1975)
Current Number of Index Wells:	7	
Date of Last Water-level Sweep:	1979 (49 wells measured)	

[1] Predevelopment Estimate
N/A not available

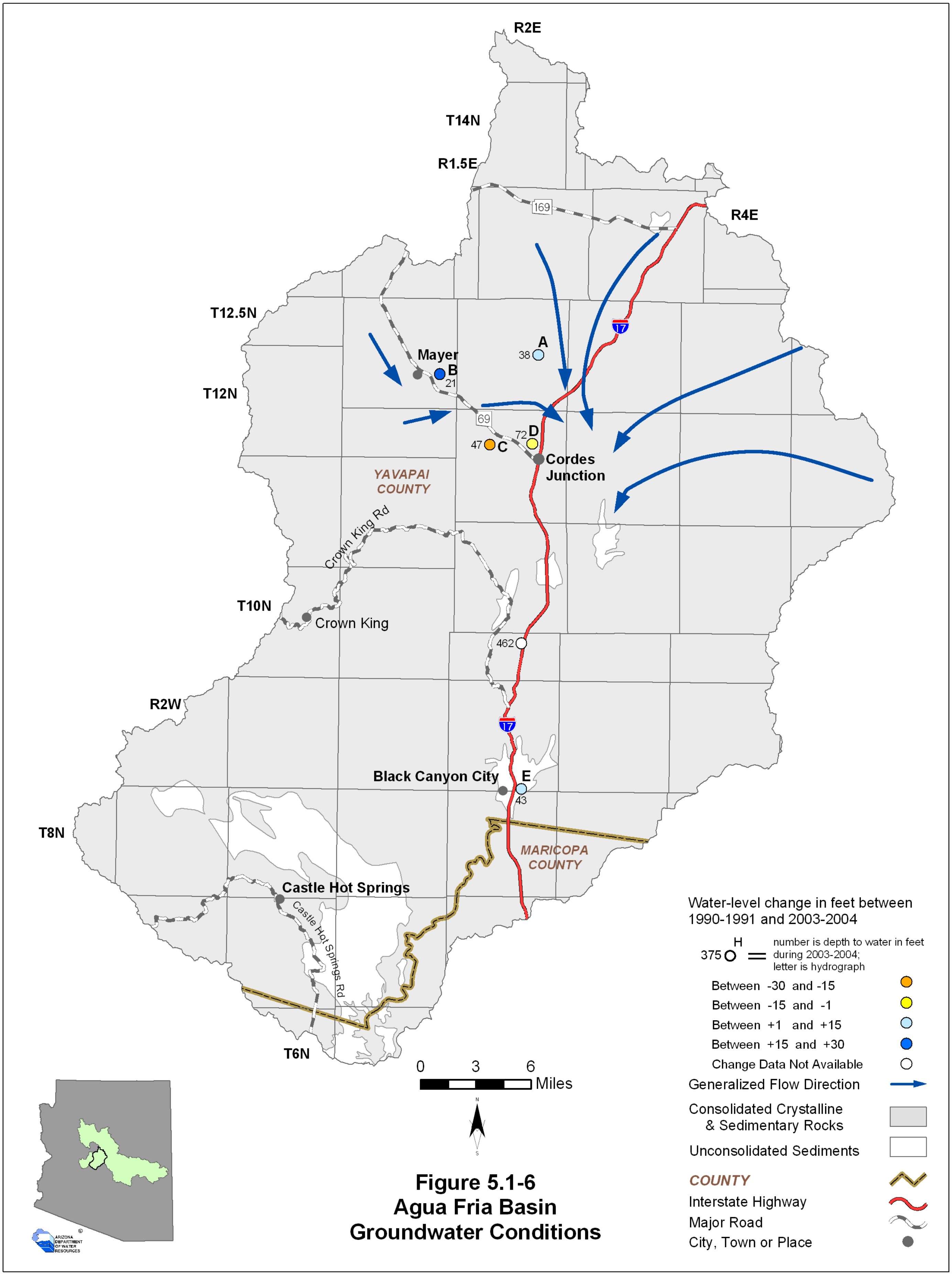
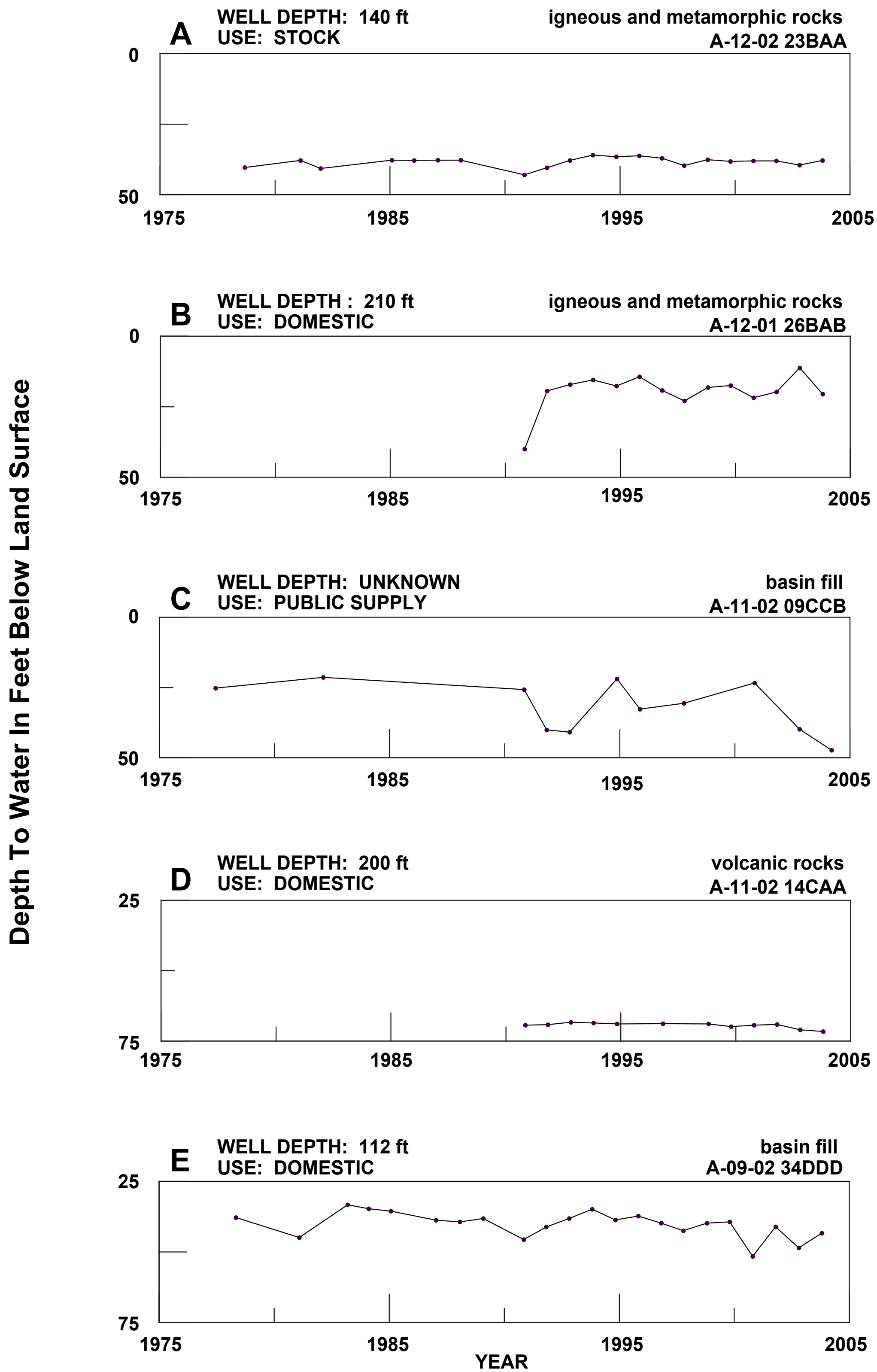


Figure 5.1-6
Agua Fria Basin
Groundwater Conditions

Figure 5.1-7
Agua Fria Basin
Hydrographs Showing Depth to Water in Selected Wells



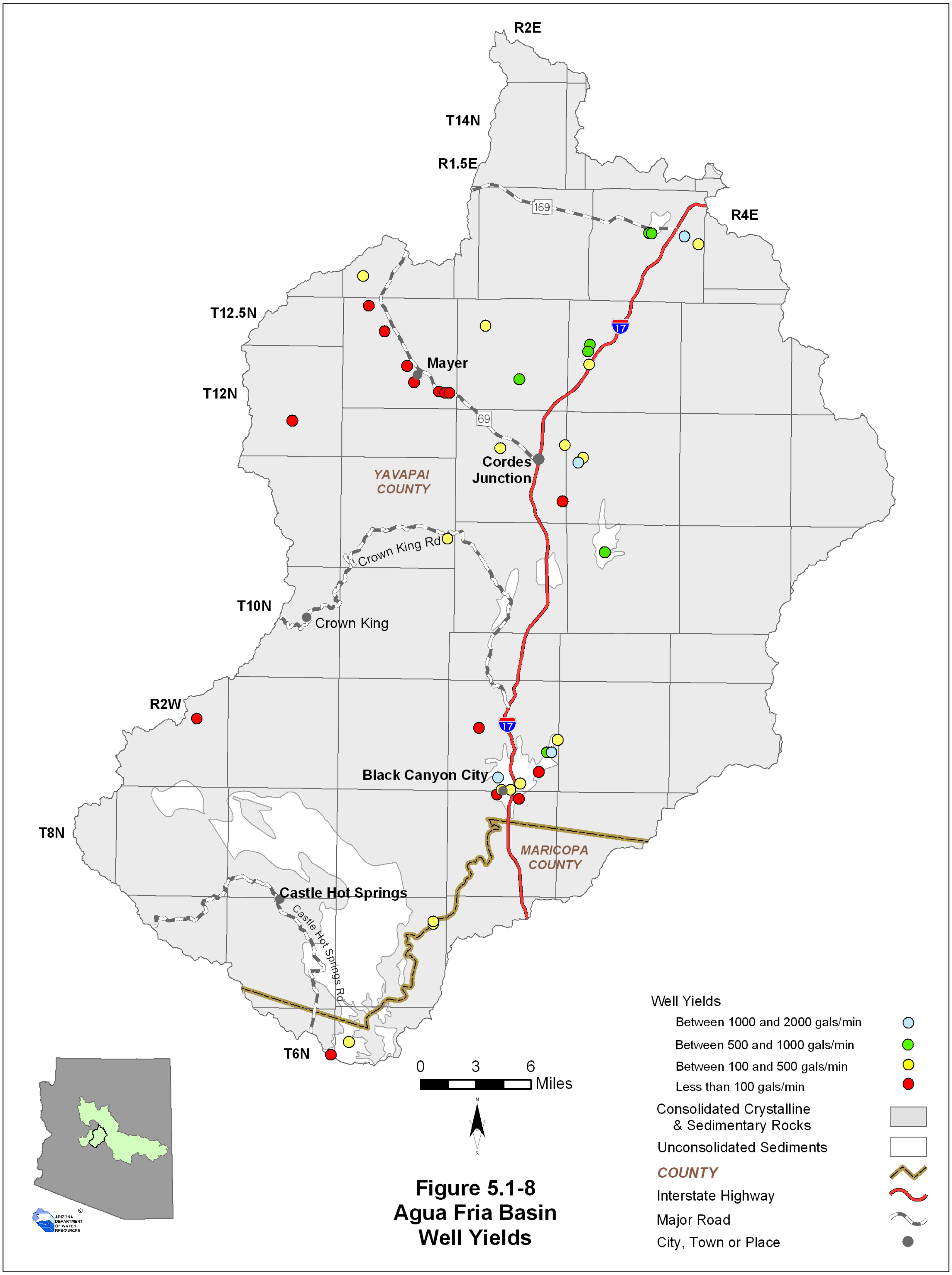


Figure 5.1-8
Agua Fria Basin
Well Yields

5.1.7 Water Quality of the Agua Fria Basin

Wells, springs and mine sites with parameter concentrations that have equaled or exceeded drinking water standard(s), including location and parameter(s) are shown in Table Table 5.1-7A. Impaired lakes and streams with site type, name, length of impaired reach, area of impaired lake, designated use standard and parameter(s) exceeded is shown in Table 5.1-7B. Figure 5.1-9 shows the location of water quality occurrences keyed to Table 5.1.7. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mines

- Refer to Table 5.1-7A.
- Forty-nine well and spring sites have parameter concentrations that have equaled or exceeded drinking water standards
- The drinking water standard most frequently equaled or exceeded in the sites measured was arsenic.
- Other standards equaled or exceeded include cadmium, fluoride and radionuclides.

Lakes and Streams

- Refer to Table 5.1-7B.
- Water quality standards were exceeded in a 21 mile reach of Turkey Creek from an unnamed tributary to Poland Creek.
- The standards exceeded were cadmium, copper, lead and zinc.
- Turkey Creek is not part of the ADEQ Total Maximum Daily Load program at this time.

Table 5.1-7 Water Quality Exceedences in the Agua Fria Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
		Township	Range	Section	
1	Spring	14 North	2 East	23	As
2	Spring	14 North	2 East	32	As
3	Spring	13 North	1 East	28	As
4	Well	13 North	2 East	12	As
5	Well	13 North	2 East	14	As
6	Spring	13 North	2 East	24	As
7	Well	13 North	2 East	33	As
8	Well	13 North	3 East	9	As
9	Well	13 North	3 East	14	As
10	Well	12 North	1 East	9	As
11	Well	12 North	1 East	26	As
12	Well	12 North	1 East	29	As
13	Well	12 North	1 East	36	As
14	Spring	12 North	2 East	17	As
15	Spring	12 North	3 East	35	As
16	Well	11 North	2 East	31	As
17	Well	9.5 North	2 East	26	As
18	Well	9 North	2 East	21	As
19	Well	9 North	2 East	27	F
20	Well	9 North	2 East	27	F
21	Well	9 North	2 East	27	As
22	Well	9 North	2 East	28	F
23	Well	9 North	2 East	28	F
24	Well	9 North	2 East	28	F
25	Well	9 North	2 East	28	As, F
26	Well	9 North	2 East	33	As
27	Well	9 North	2 East	34	As
28	Well	9 North	2 East	35	As
29	Well	9 North	2 East	35	As
30	Well	9 North	2 East	35	As
31	Well	9 North	2 East	35	As
32	Well	8 North	2 East	2	Rad
33	Well	8 North	2 East	4	As
34	Well	10 North	1 West	14	As
35	Well	10 North	1 West	15	Cd
36	Well	10 North	1 West	15	Cd
37	Well	10 North	1 West	15	Cd
38	Well	9 North	2 West	25	As
39	Well	8 North	1 West	4	As
40	Spring	8 North	1 West	14	As
41	Spring	8 North	1 West	25	As
42	Spring	8 North	1 West	33	As, F
43	Spring	8 North	1 West	33	F
44	Well	8 North	1 West	33	As, F
45	Spring	8 North	2 West	27	As
46	Well	8 North	3 West	13	As, Rad
47	Well	7 North	1 West	4	F
48	Spring	7 North	1 West	22	F
49	Spring	7 North	1 West	22	F

Table 5.1-7 Water Quality Exceedences in the Agua Fria Basin (cont'd)[1]

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard[3]	Parameter(s) Exceeding Use Standard[2]
a	Stream	Turkey Creek - unnamed tributary to Poland Creek	21	NA	A&W	Cd, Cu, Pb, Zn

Notes:

[1] Water quality samples collected between 1978 and 2003.
[2]As = Arsenic
Cd = Cadmium
Cu = Copper
F= Fluoride
Pb = Lead
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium
Zn = Zinc
[3]A&W = Aquatic and Wildlife
FBC = Full Body Contact
NA = Not available

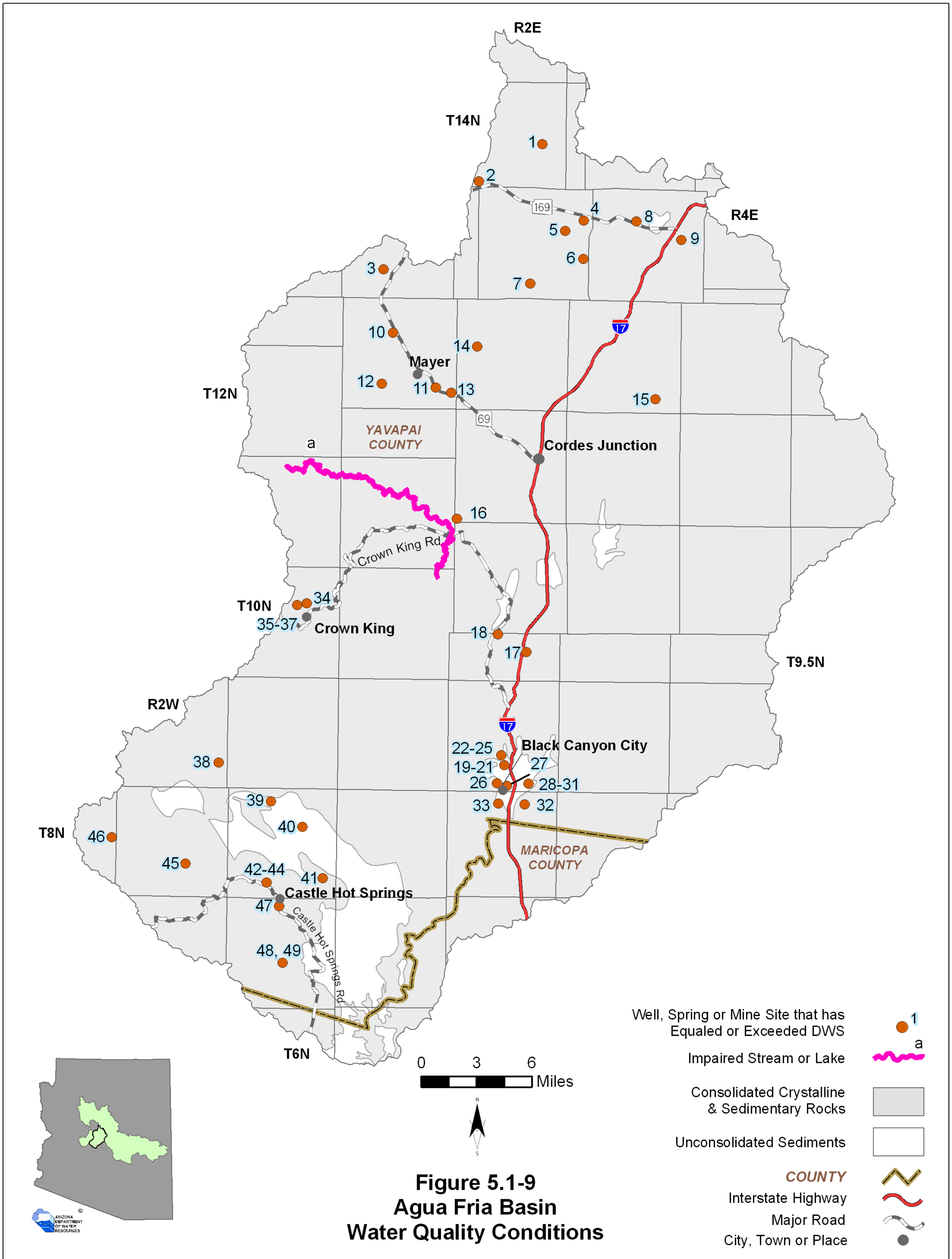


Figure 5.1-9
Agua Fria Basin
Water Quality Conditions

5.1.8 Cultural Water Demands in the Agua Fria Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 5.1-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 5.1-9. Figure 5.1-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 5.0.7.

Cultural Water Demands

- Refer to Table 5.1-8 and Figure 5.1-10.
- Population in this basin increased from 2,839 people in 1980 to 9,025 in 2003. Projections suggest a slower growth rate through 2050 to 20,220.
- Groundwater use has increased since 1971, with an average of 2,000 acre-feet per year from 1971-1975 and an average of 3,400 acre-feet pumped per year from 2001-2003. The highest average annual groundwater use, 5,000 acre-feet per year, occurred during 1981-1985.
- There are no reported surface water diversions in this basin.
- Municipal groundwater demand increased from an average of 1,100 acre-feet per year in 1991-1995 to an average of 1,800 acre-feet per year in 2001-2003.
- Agricultural demand has increased slightly from an average of 1,300 acre-feet per year in 1991-1995 to an average of 1,600 acre-feet per year in 2001-2003.
- No industrial groundwater demand was reported for this basin.
- Most municipal and industrial demand is found in the vicinity of Black Canyon City, Cordes Junction and Mayer.
- There are numerous small agricultural demand areas north and east of Cordes Junction.
- The basin contains two small mines or quarries, one northwest of Mayer and the other northeast of Castle Hot Springs.
- As of 2003 there were 1,688 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 159 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 5.1-9.
- This basin contains three wastewater treatment facilities.
- Information on population served, effluent generation and disposal was available for two facilities. These facilities serve almost 300 people and generate 22 acre-feet of effluent per year.

Table 5.1-8. Cultural Water Demands in the Agua Fria Basin[1]

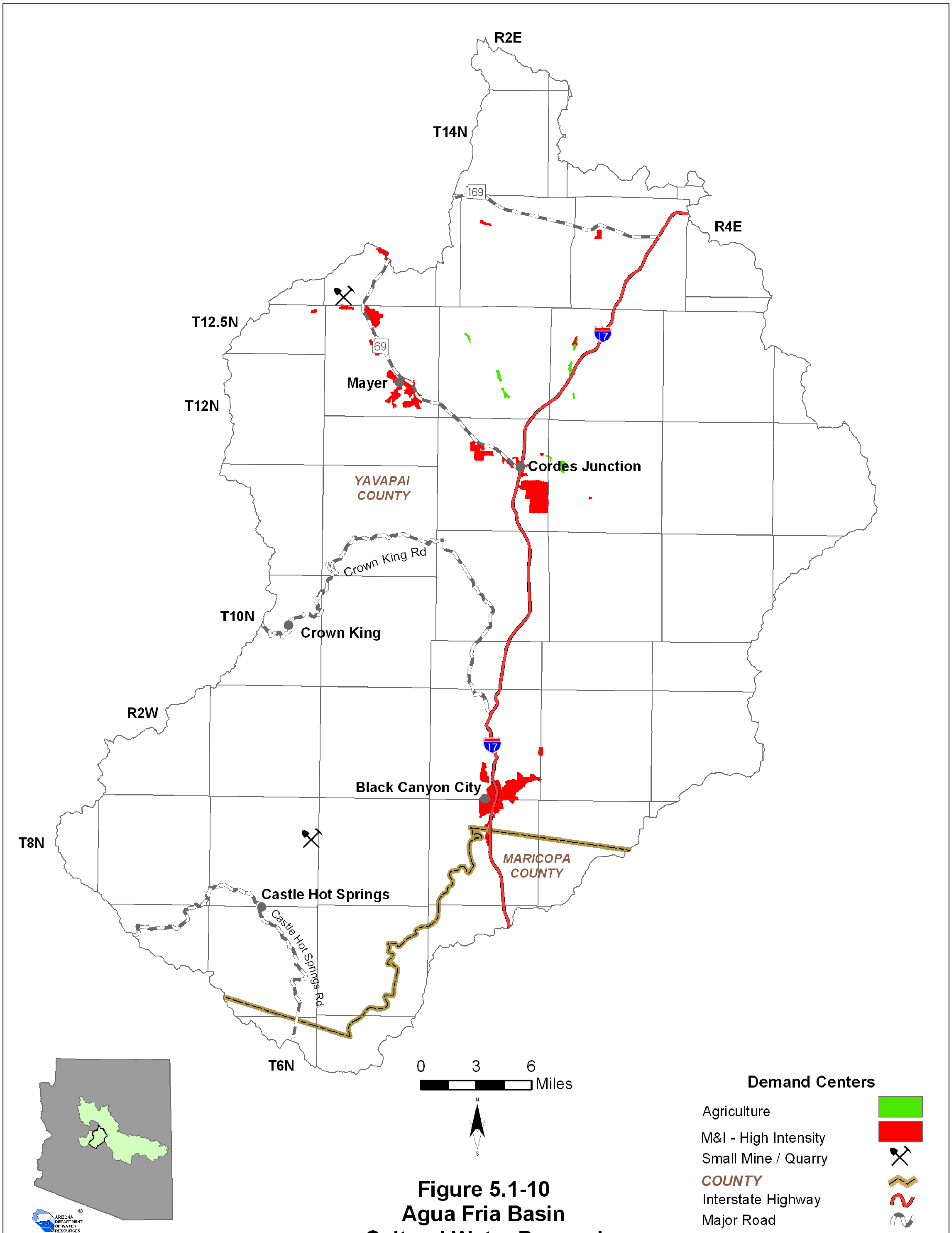
Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						
				Well Pumpage			Surface-Water Diversions			Data Source
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial	Irrigation	Municipal	Industrial	Irrigation	
1971										
1972										
1973				2,000			NR			
1974										
1975		859[2]	127[2]							
1976										
1977										
1978				3,000			NR			
1979										
1980	2,839									ADWR (1994)
1981	3,086									
1982	3,334									
1983	3,581	151	5	5,000			NR			
1984	3,829									
1985	4,076									
1986	4,323									
1987	4,571									
1988	4,818	138	11	4,000			NR			
1989	5,066									
1990	5,313									
1991	5,603									
1992	5,892									
1993	6,182	142	3	1,100	NR	1,300	NR			
1994	6,472									
1995	6,762									
1996	7,051									
1997	7,341									USGS (2005)
1998	7,631	205	4	1,500	NR	1,300	NR			
1999	7,920									
2000	8,210									
2001	8,482									
2002	8,754	94	5	1,800	NR	1,600	NR			
2003	9,025									
2010	10,928									
2020	13,389									
2030	15,287									
2040	17,213									
2050	20,220									
ADDITIONAL WELLS:[3]		**99**	**4**							
TOTAL WELLS:		**1,688**	**159**							

Notes:
NR - Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes all wells through 1980.
[3] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 5.1-9 Effluent Generation in the Agua Fria Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet/year)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Wildlife Area	Golf Course	Discharge to Another Facility	Infiltration Basin			
Arcosanti WWTF	Private	Arcosanti	273	21	NA							NA	610	1996
Crown King Work Center	Prescott NF	Site Facilities	NA											
Kings Ranch Unit II	Private	Black Canyon City	19	>1	Agua Fria							NA	NA	2003
Totals			292	22										

NA: Data not currently available to ADWR
WWTF: Wastewater Treatment Facility



Primary Data Source: USGS National Gap Analysis Program, 2004

Figure 5.1-10
Agua Fria Basin
Cultural Water Damand

5.1.9 Water Adequacy Determinations in the Agua Fria Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 5.1-10. Figure 5.1-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

Water Adequacy Reports

- See Table 5.1-10
- Fifteen water adequacy determinations have been made in this basin through May, 2005.
- Six determinations of inadequacy have been made; two near Cordes Junction and four along State Highway 69.
- All six determinations of inadequacy were because the applicant chose not to submit the necessary information, and/or the available hydrologic data was insufficient to make a determination. One inadequate determination also stated the existing supply was unreliable or physically unavailable or groundwater exceeds the depth-to-water criteria.
- All lots receiving an adequacy determination are in Yavapai County. Of the 1,177 lots in fourteen subdivisions for which lot information is available, 973 lots or 83% were determined to be adequate.

Table 5.1-10. Adequacy Determinations in the Agua Fria Basin[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Bensch Ranch Estates	Yavapai	11 North	2 East	6	411	22-400479	Adequate		02/26/01	Bradshaw Mountain View Water Company
2	Black Canyon Estates	Yavapai	8 North	2 East	3, 4	NA		Adequate		01/26/76	Trail's End Water Service
3	Black Canyon Estates # 2	Yavapai	8 North	2 East	3, 4, 9	142		Adequate		08/20/84	Trail's End Water Service
4	Bradshaw Overlook	Yavapai	11 North	2 East	5, 8	23		Adequate		01/22/90	Bradshaw Mountain View Water Company
5	Cordes Lakes	Yavapai	11 North	2 East	23, 24, 25, 26	101		Inadequate	A1	05/16/86	Cordes Lakes Water Company
6	Cordes Lakes # 8	Yavapai	11 North	2 East	24	7		Inadequate	A1	06/19/86	Cordes Lakes Water Company
7	Kings Ranch Units	Yavapai	8 North	2 East	4, 9	142		Adequate		01/26/76	Trail's End Water Service
8	Mayer Estates	Yavapai	12 North	1 East	27	163		Adequate		01/07/76	Mayer Water Company
9	Oak Hills	Yavapai	12 North	1 East	35	18		Adequate		07/14/94	Mayer Domestic Water Imp Distrct
10	Quail Hollow # 1	Yavapai	12 North	1 East	22	50		Adequate		04/19/90	Mayer Water Company
11	Rancho Vista Estates LLC	Yavapai	12 North	1 East	3, 4	58		Inadequate	A1, A2	02/22/95	Dry Lot Subdivision
12	Spring Valley # 3	Yavapai	11 North	2 East	8	18		Inadequate	A1	02/20/81	Bradshaw Mountain View Water Company
13	Spring Valley # 4	Yavapai	11 North	2 East	8	5		Inadequate	A1	09/16/85	Bradshaw Mountain View Water Company
14	Sunrise Estates	Yavapai	12 North	1 East	22	15	22-400244	Inadequate	A1	02/11/00	Mayer Domestic Water Improvement District
15	Westridge	Yavapai	8 North	2 East	4	24		Adequate		09/17/87	Black Canyon City Water Association

Notes:

[1] Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
2) Insufficient Supply (existing water supply unreliable or physically unavailable;for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)

B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records

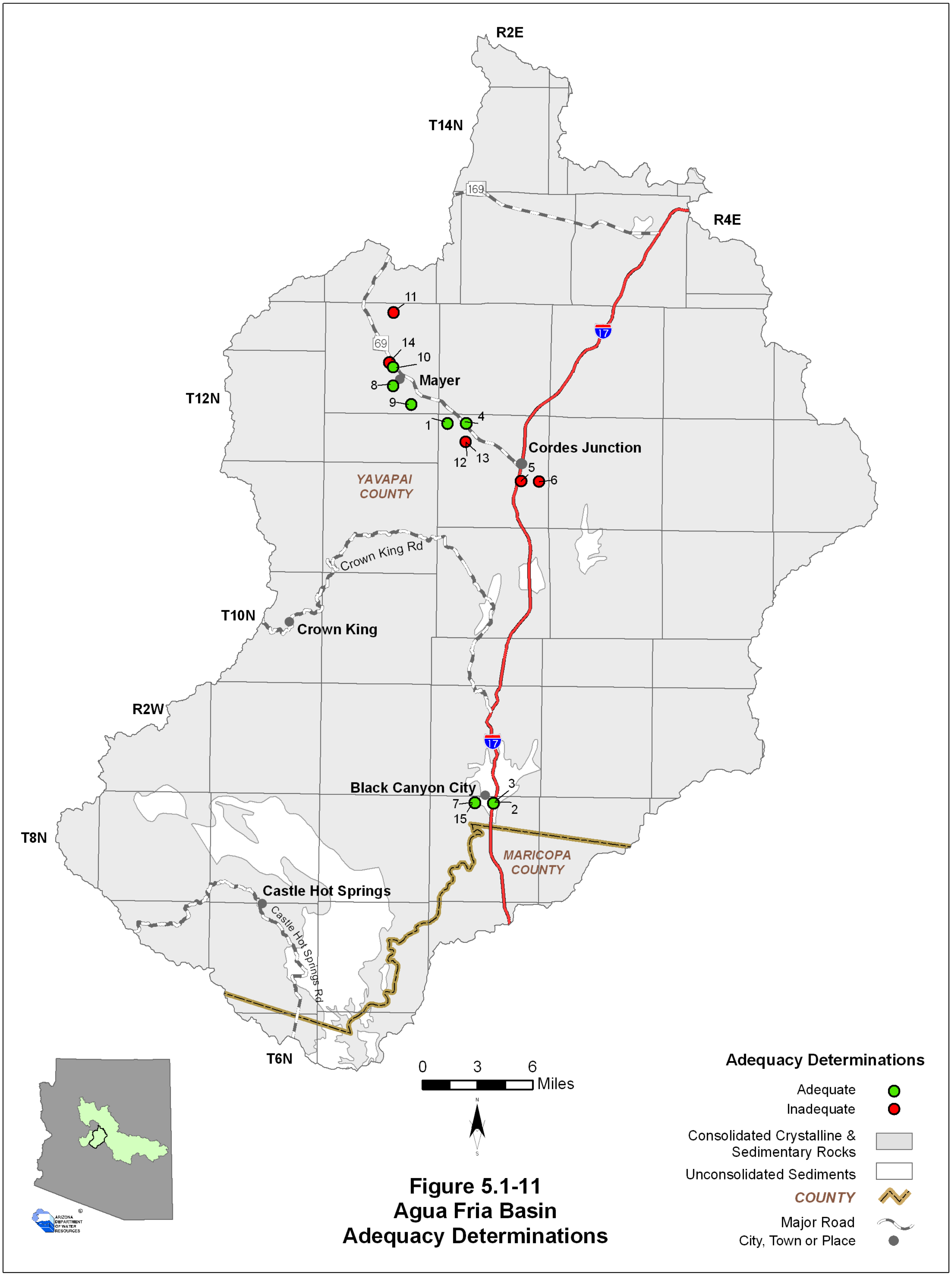


Figure 5.1-11
Agua Fria Basin
Adequacy Determinations

Agua Fria Basin
References and Supplemental Reading

References

A

Anderson, T.W., and Freethey, G.W., 1995, Simulation of groundwater flow in alluvial basins in south central Arizona and parts of adjacent states: USGS Professional Paper 1406-D.*

Arizona Corporation Commission (ACC), 2005, Annual reports, Private Sewer companies, 1990 to 2005: ACC Utilities Division.

______, 2005, Annual reports, Small water providers, 1990 to 2005: ACC Utilities Division.

Arizona Crop and Livestock Reporting Service, 1973, 1972 Arizona Agricultural Statistics: Bulletin S-8.

Arizona Department of Economic Security (DES), 2005, Workforce Informer: Data file, accessed August 2005, http://www.workforce.az.gov.*

Arizona Department of Environmental Quality (ADEQ), 2005, Active dairy farms & feedlots: Data file, received October 2005.

______, 2005, ADEQSWI: Data file, received September 2005.

______, 2005, ADEQWATP: Data file, received May 2005.*

______, 2005, ADEQWWTP: Data file, received August 2005.

______, 2005, Azurite: Data file, received September 2005.

______, 2005, Effluent dependent waters: GIS cover, received December 2005.

______, 2005, Impaired lakes and reaches: GIS cover, received January 2006.*

______, 2005, Surface water sources used by water providers: Data file, received June 2005.

______, 2005, WWTP and permit files: Miscellaneous working files, received July 2005.

______, 2004, Water providers with arsenic concentrations in wells over 10ppb: Data file, received August 2004.

______, 2004, Water quality exceedences by watershed: Data file, received June 2004.

______, 2004, Water quality exceedences for drinking water providers in Arizona: Data file, received September 2004.*

Arizona Department of Mines and Mineral Resources (ADMMR), 2005, Active mines in Arizona: Database, accessed at http:// www.admmr.state.az.us.*

Arizona Department of Water Resources (ADWR), 2006, Assured and adequate water supply applications: Project files, ADWR Hydrology Division.*

______, 2005, Agricultural Surface Water Use Estimates: Unpublished analysis, ADWR Office of Resource Assessment Planning.*

______, 2005, Automated recorder sites: Data files, ADWR Basic Data Unit.*

______, 2005, 2004 rural water provider questionnaire: Data files, ADWR Office of Resource Assessment Planning.*

______, 2005, Assured and adequate water supply determinations: Database, ADWR Office of Assured and Adequate Water Supply.*

______, 2005, Flood warning gages: Database, ADWR Office of Water Engineering.*

______, 2005, Inspected dams: Database, ADWR Office of Dam Safety.*

______, 2005, Non-jurisdictional dams: Database, ADWR Office of Dam Safety.

_____, 2005, Groundwater Site Inventory (GWSI): Database, ADWR Hydrology Division.*
_____, 2005, Registry of surface water rights: ADWR Office of Water Management.*
_____, 2005, Water Protection Fund: Database, ADWR Office of Drought, Conservation and Riparian Planning.
_____, 2005, Water use by golf courses in rural Arizona: Unpublished analysis, ADWR Office of Regional Strategic Planning.
_____, 2005, Wells55: Database.*
_____, 2002, Groundwater quality exceedences in rural Arizona from 1975 to 2001: Data file, ADWR Office of Regional Strategic Planning.*
_____, 1994, Arizona Water Resources Assessment, Vol. I, Inventory and Analysis.*
_____, 1994, Arizona Water Resources Assessment, Vol. II, Hydrologic Summary.*
_____, 1990, Draft outline of basin profiles for the state water assessment: ADWR Statewide Planning Division, Memorandum to L. Linser, D.W., January, 16, 1990.*
Arizona Game and Fish Department (AGF), 2005, Arizona Waterways: Data file, received April 2005.*
_____, 1997 & 1993, Statewide riparian inventory and mapping project: GIS cover.*
_____, 1982, Arizona Lakes Classification Study.
Arizona Land Resource Information System (ALRIS), 2005, Springs: GIS cover, accessed January 2006 at http://www.land.state.az.us/alris/index.html.*
_______, 2005, Streams: GIS cover, accessed 2005 at http://www.land.state.az.us/alris/index.html.*
_______, 2005, Water features: GIS cover, accessed July 2005 at http://www.land.state.az.us/alris/index.html.*
_______, 2004, Land ownership: GIS cover, accessed in 2004 at http://www.land.state.az.us/alris/index.html.*
Arizona Meteorological Network (AZMET), 2005, Arizona climate stations: Pan evaporation data, accessed December 2005 at http://www.ag.arizona.edu/azmet/locate.html.*
Arizona Water Commission, 1975, Summary, Phase I, Arizona State Water Plan, Inventory of resource and uses.

B

Bureau of Geology and Mineral Resources, 1982, Geothermal Resources of Arizona: University of Arizona map.*

D

Diroll, M., and Marsh, D., 2006, Status of water quality in Arizona-2004 integrated 305(b) assessment and 303(d) listing report: ADEQ report.*

E

Environmental Protection Agency (EPA), 2005, Surf Your Watershed: Facility reports, accessed April 2005 at http://oaspub.epa.gov/enviro/ef_home2.water.
_____, 2005, 2000 and 1996, Clean Watershed Needs Survey: datasets, accessed March 2005 at http://www.epa.gov/owm/mtb/cwns/index.htm.*

F

Fisk, G.G., Duet, D.W., Evans, C.E., Angernoth, N.K., and Longsworth, S.A., 2004, Water Resources Data, Arizona Water Year 2003: USGS Water-Data Report AZ-03-1.*

Fleming, J.B., 2004, Hydrologic characteristics of the Agua Fria National Monument, Central Arizona, determined from the reconnaissance study: USGS Scientific Investigations Report 2004-5163.*

Freethey, G.W. and Anderson, T.W. 1986, Predevelopment hydrologic conditions in the alluvial basins of Arizona and adjacent parts of California and New Mexico: USGS Hydrologic Investigations Atlas-HA664.*

G

Gebler, , J.B., 2000, Organochloride compounds in streambed sediment and in biological tissue from streams and their relationship to land use, Central Arizona: USGS Water Resources Investigation Report 00-4041.*

K

Konieczki, A.D. and Wilson, R.P., 1992, Annual summary of ground-water conditions in Arizona, spring 1986 to spring 1987: USGS Open File Report 92-54.*

M

McCormack, H.F., Fisk, G.G., Duet, N.R., Evans, D.W., Roberts, W.P., and Castillo, N.K., 2002, Water resources data Arizona, water year 2002: USGS Water Data Report AZ-02-1.*

N

Natural Resources Conservation Service (NRCS), 2005, SNOTEL (Snowpack Telemetry) stations: Data file, accessed December 2005 at http://www3.wcc.nrcs.usda.gov/nwcc/sntlsites.jsp?state=AZ.

______, 2005, Snow Course stations: Data file, accessed December 2005 at http://www.wcc.nrcs.usda.gov/nwcc/snow-course-sites.jsp?state=AZ

O

Oregon State University, Spatial Climate Analysis Service (SCAS), 2006, Average annual precipitation in Arizona for 1961-1990: PRISM GIS cover, accessed in 2006 at www.ocs.orst.edu/prism.*

P

Pope, G.L., Rigas, P.D., and Smith, C.F., 1998, Statistical summaries of streamflow data and characteristics of drainage basins for selected streamflow-gaging stations in Arizona through water year 1996: USGS Water Resources Investigations Report 98-4225.*

T

Tadayon, S., 2004, Water withdrawals for irrigation, municipal, mining, thermoelectric-power, and drainage uses in Arizona outside of the active management areas, 1991-2000: USGS Scientific Investigations Report 2004-5293, 27 pp.*

U

US Army Corps of Engineers, 2004 and 2005, National Inventory of Dams: Arizona Dataset, accessed November 2004 to April 2005 at http://crunch.tec.army.mil/nid/webpages/nid.cfm.*

US Bureau of Reclamation, 2007, Dams, Project and Power Plants: New Waddell Dam, at http://www.usbr.gov/dataweb/dams/az82929.htm*

US Geological Survey (USGS), 2006, Average annual runoff in the United States, 1951-1980: Data file, accessed March 2006 at http://aa179.cr.usgs.gov/metadata/wrdmeta/runoff.htm.*

_____, 2006, Springs and spring discharges: Dataset, received November 2004 and January 2006 from USGS office in Tucson, AZ. *

_____, 2006, National Hydrography Dataset: Arizona dataset, accessed at http://nhd.usgs.gov/.*

_____, 2005, National Water Information System (NWIS): Arizona dataset, accessed December 2005 at http://waterdata.usgs.gov/nwis.*

_____, 2004, Southwest Regional Gap analysis study- land cover descriptions: Electronic file, accessed January 2005 at http://earth.gis.usu.edu/swgap.*

_____, 1981, Geographic digital data for 1:500,000 scale maps: USGS National Mapping Program Data Users Guide.*

V

Valencia, R.A., Wennerlund, J.A., Winstead, R.A., Woods, S., Riley, L., Swanson, E., and Olson, S., 1993, Arizona riparian inventory and mapping project: Arizona Game and Fish Department.*

W

Wahl, C.R., Boe, S.R., Wennerlund, R.A., Winstead, R.A., Allison, L.J., Kubly, D.M., 1997, Remote sensing mapping of Arizona intermittent stream riparian areas: Arizona Game and Fish Technical Report 112.*

Water Infrastructure Finance Authority of Arizona (WIFA), 2005, Clean Watershed Needs Survey-2004: Unpublished data sheets, received July 2005.

Western Regional Climate Center (WRCC), 2005, Pan evaporation stations: Data file accessed December 2005 at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~GetCity~USA.*

_____, 2005, Precipitation and temperature stations: Data file, accessed December 2005 at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~GetCity~USA.*

Wilson, R.P., 1992, Summary of groundwater conditions in Arizona 1985 to 1986: USGS Water Resources Investigation Report, 90-4179.*

* All references marked with an asterisk contain information that was directly used in the basin summaries, tables or maps.

Supplemental Reading

Anning, D.W., 1998, Sources of nitrogen and phosphorus in drainage basins of central Arizona: in Water at the Confluence of Science, Law, and Public Policy: Proceedings from the 11th annual Arizona Hydrological Society Symposium, September 1998, Tucson, Arizona, p. 8.

Anning, D.W., 1999, Concentrations and stream loads of nitrogen and phosphorus in surface water resources of central Arizona: in Water Issues and Partnerships for Rural Arizona: Proceedings of the 12th annual Arizona Hydrological Society, September 1999, Pinetop, Arizona.

Anning, D.W., 2003, Assessment of selected inorganic constituents in streams in the central basins study area, Arizona and northern New Mexico, through 1998: USGS Water Resource Investigations Report 03-4063.

Anning, D. W., 2004, Effects of Natural and Human Factors on Stream Water Quality in Central Arizona: USGS Water Resource Supplement Jan.-Feb.

Baker, M.B., 1999, History of watershed research in the central Arizona highlands: US Forest Service Technical Report, GTR-29.

Barnett, Lloyd, Hawkins, R. and Guertin, D., 2002, Reconnaissance Watershed and Hydrologic Analysis on the Upper Agua Fria Watershed, Univeristy of Arizona, Tucson, Arizona.

Cordy, G.E., Gellenbeck, D.J., Gebler, J.B., Anning, D.W., Coes, A.L., Edmonds, R.J. Rees, J.A., and Sanger, H.W., 2000, Water quality in the central Arizona basins, Arizona, 1995-1998: USGS Circular 1213.

Dava and Associates, Inc., 2003, Yavapai County General Plan: Water Resources Element.

Gellenbeck, D.J., and Anning, D.W., 2002, Occurrence and distribution of pesticides and volatile organic compounds in groundwater and surface water in central Arizona basins, 1996-1998, and their relation to land use: USGS Water Resources Investigations Report 01-4144, 107 p.

Levick, L, Guertin, D.P. and Uhlman, K, 2006, NEMO Watershed Based Plan Upper Agua Fria Watershed, University of Arizona at www.arizonaNEMO.org

Melis, T.S., 1990, Evaluation of Flood Hydrology on Twelve Drainage Basins in the Central Highlands Region of Arizona: An Integrated Approach: Northern Arizona University, M.S. thesis, 135 p.

Scott, P.S., 1994, Basic geologic and hydrologic information, Bradshaw Mountains, Yavapai County Arizona, AZGS Open-File Report 94-2, 69 p.

Shafroth, P.B., Stromberg, J.C., Patten, D.T., Springer, A.E., Wright, J.M., 1996, Riparian habitat enhancement and groundwater recharge; a feasibility study on the Agua Fria River, Maricopa County, Arizona: in Wanted: Water for Rural Arizona. Arizona: Proceedings of the 9th annual Arizona Hydrological Society Symposium, Prescott, AZ, September 1996, p. 23.

Springer, A.E., Wright, J.M., Shafroth, P.B., Stromberg, J.C., Patten, D.T., 1999, Coupling ground-water and riparian vegetation models to simulate riparian vegetation changes due to a reservoir release: Water Resources Research, v. 35, p. 3621-3630.

Index to Section 5.0

Section 5.2
Salt River Basin

5.2.1 Geography of the Salt River Basin

The Salt River Basin occupies the eastern part of the planning area and is the second largest basin at 5,232 square miles. Geographic features and principal communities are shown on Figure 5.2-1. The basin is characterized by mid- to high-elevation mountain ranges, plateaus and canyons. Vegetation types include: Sonoran desertscrub; semidesert, great plains, and subalpine grasslands; chaparral; evergreen woodland; and subalpine, woodland and montane conifer forests. Riparian vegetation includes mesquite, mixed broadleaf and tamarisk along the Salt River and mixed broadleaf along the Black River.

- Principal geographic features shown on Figure 5.2-1 are:
    - Principal basin communities of Miami, Globe and Whiteriver
    - Other basin communities of Tortilla Flat, Roosevelt, Young, McNary, Cibecue, Carrizo, Hon-dah, Fort Apache and Hannagan Meadow
    - Salt River running east to west through the southern part of the basin from the confluence of the White and Black Rivers
    - White River and its tributaries in the northeastern portion of the basin
    - Black River running from the eastern basin boundary to the Salt River, which also demarcates part of Graham, Apache, Navajo and Greenlee county boundaries
    - Other major tributaries to the Salt River including Cherry Creek, Canyon Creek, Cibecue Creek, Carrizo Creek and Cedar Creek
    - Theodore Roosevelt Lake in the western portion of the basin
    - Apache Lake, Canyon Lake and Saguaro Lake in the vicinity of Tortilla Flat
    - Hawley Lake, Sunrise Lake, Crescent Lake and Big Lake in the high-elevation northeastern portion of the basin
    - Salt River Canyon (not on map) along the Salt River and numerous side canyons such as Sycamore Canyon and Sawmill Canyon
    - Superstition and Pinal Mountains near the southwestern basin boundary
    - Mogollon Rim along the northern basin boundary
    - Natanes Plateau along the southern basin boundary in Gila and Graham counties
    - Bonito Prairie between the White and Black Rivers south of Fort Apache
    - White Mountains in Apache County which contain the highest peak in the basin Mt. Baldy at 11,403 feet
- Not well shown on Figure 5.2-1 are Four Peaks along the Maricopa and Gila County line in the Mazatzal Mountains and the Sierra Ancha Mountains south of Young

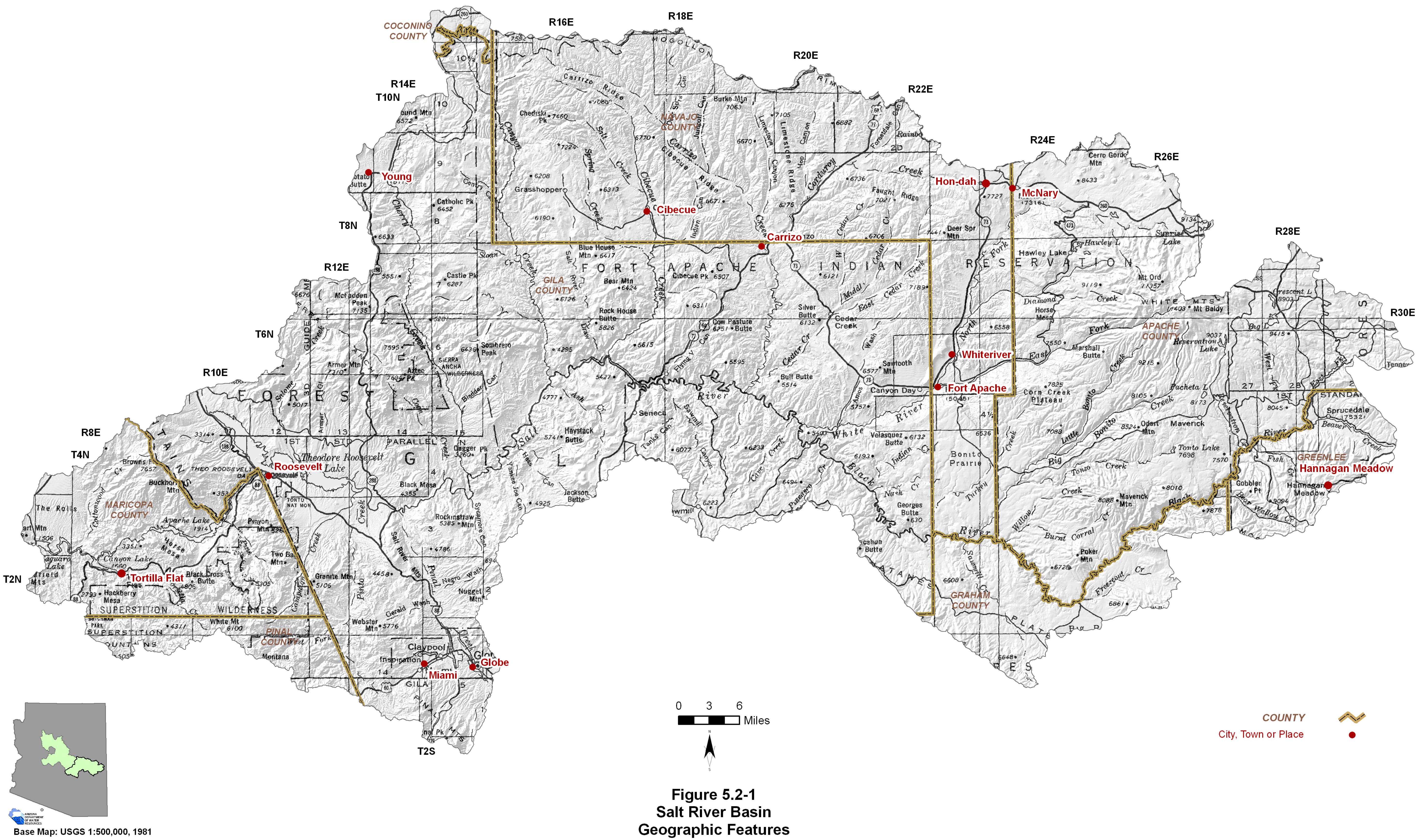


Figure 5.2-1
Salt River Basin
Geographic Features

5.2.2 Land Ownership in the Salt River Basin

Land ownership, including the percentage of ownership by category, for the Salt River Basin is shown in Figure 5.2-2. Principal features of land ownership in this basin are the large contiguous parcels of forest service and tribal lands. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

Indian Reservation

- 59.4% of the land is under tribal ownership.
- The basin includes two reservations, the Fort Apache Reservation in the north-central portion north of the Black River and the San Carlos Apache Reservation in the south-central portion of the basin.
- All tribal lands are contiguous.
- This basin contains the largest percentage of tribal lands in the planning area.
- Land uses include domestic, commercial, recreation, timber and ranching.

National Forest and Wilderness

- 38.6% of the land is federally owned and managed as National Forest and Wilderness.
- Forest lands in the basin are part of the Tonto and Apache-Sitgreaves National Forests.
- The basin contains approximately 236,000 acres in five wilderness areas, four in the Tonto National Forest and one in the Apache-Sitgreaves National Forest. Wilderness areas in the Tonto include the 18,515-acre Salome Wilderness, 21,007-acre Sierra Ancha Wilderness, a significant portion of the 160,135-acre Superstition Wilderness and the 32,088-acre Salt River Wilderness. A portion of the 11,336-acre Bear Wallow Wilderness in the Alpine Ranger District of the Apache-Sitgreaves National Forest is also located in the basin.
- There are numerous small private in-holdings in both forests.
- Land uses include recreation, grazing and timber production.

Private

- 1.5% of the land is private.
- The majority of the private land in the basin is in the vicinity of Miami/Globe and around Young. There are also numerous small private land in-holdings in the Tonto and Apache-Sitgreaves National Forests.
- Land uses include domestic, commercial, mining and ranching.

U.S. Bureau of Land Management (BLM)

- 0.2% of the land is federally owned and managed by the Safford Field Office Bureau of Land Management.
- All BLM lands are in the vicinity of Miami and Globe.
- Primary land uses are mining and grazing.

State Trust Land

- 0.1% of the land in this basin is held in trust for the public schools under the State Trust Land system.

- All state land is in the vicinity of Miami and Globe.
- Primary land use is grazing.

National Parks, Monuments and Recreation Areas

- 0.1% of the land is federally owned and managed by the National Park Service as the Tonto National Monument, located in the southwestern portion of the basin near Roosevelt.
- Primary land use is cultural preservation and recreation.

Other (Game and Fish, County and Bureau of Reclamation Lands)

- 0.1% of the land is owned and managed by the Arizona Game and Fish Department.
- All “other” land is located north of the Greenlee and Apache County line.
- Primary land use is unknown.

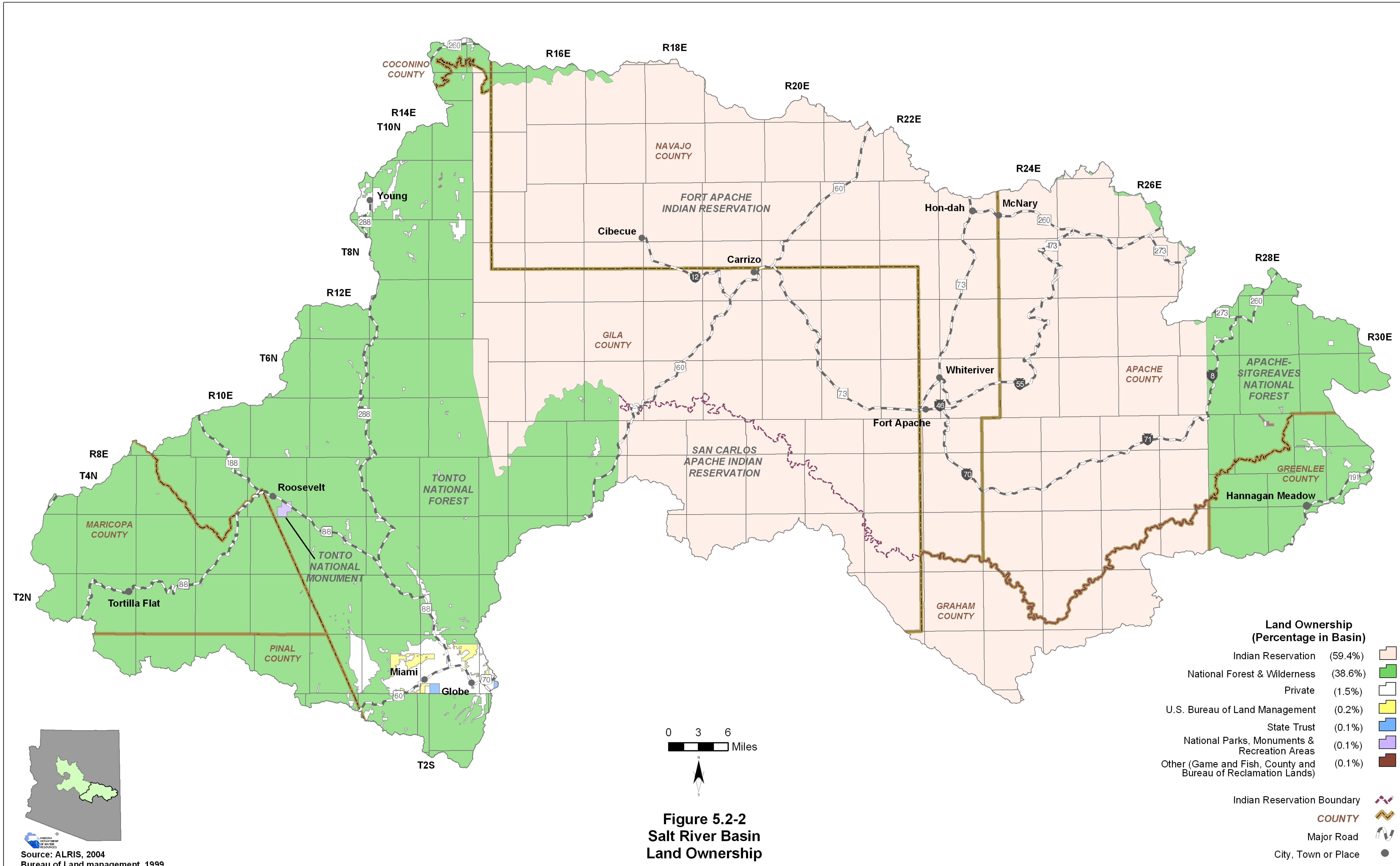


Figure 5.2-2
Salt River Basin
Land Ownership

5.2.3 Climate of the Salt River Basin

Climate data from NOAA/NWS Co-op Network, Evaporation Pan and SNOTEL/Snowcourse stations are complied in Table 5.2-1 and the locations are shown on Figure 5.2-3. Figure 5.2-3 also shows precipitation contour data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Salt River Basin does not contain AZMET stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 5.2-1A
- Elevations at the 13 NOAA/NWS Co-op network stations range from 1,710 feet at Mormon Flat to 8,180 feet at Hawley Lake.
- Minimum average temperature ranges from 24.3°F at Hawley Lake to 52.6°F at Mormon Flat.
- Maximum average temperature ranges from 90.3°F at Mormon Flat to 59.2°F at Hawley Lake.
- Station precipitation ranges from an average annual precipitation of 13.78 inches at Globe to 39.62 inches at Hawley Lake.
- Most stations report the highest seasonal rainfall in the summer (June-September) and all stations report the lowest seasonal rainfall in the spring (March-May).

Evaporation Pan

- Refer to Table 5.2-1B
- There are three evaporation pan sites in this basin, Hawley Lake, Roosevelt 1WNW and Whiteriver.
- The highest average annual pan evaporation rate is 96.71 inches at Roosevelt 1 WNW, elevation 2,200 feet, and the lowest is 33.17 inches at Hawley Lake, elevation 8,180 feet.

SNOTEL/Snowcourse

- Refer to table 5.2-1D
- There are 11 snow measurement sites in the basin. Five stations have been discontinued.
- The site elevation ranges from 6,900 feet at Workman Creek and Workman Creek SNOTEL to 9,200 feet at Maverick Fork SNOTEL.
- Seven sites record highest snowpack in March, three in February and one site, Workman Creek, has equally high snowpack in February and March.
- Highest average snowpack is 11.4 inches at Hannagan Meadows SNOTEL. Snowpack is measured in inches of snow water content. Ten inches of fresh snow can contain as little as 0.10 inches of water or up to 4 inches depending on a number of factors. The majority of U.S. snows fall with a water-to-snow ratio of between 0.04 and 0.10. (NSIDC, 2006)

SCAS Precipitation Data

- See Figure 5.2-3
- Additional precipitation data shows rainfall as high as 36 inches in several places in the basin and as low as 10 inches west of Tortilla Flat.
- In general, precipitation increases as altitude increases in this basin. The range of 24 inches between areas of highest and lowest precipitation is common for the planning area.

Table 5.2-1 Climate Data for the Salt River Basin

A. NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Black River Pumps	6,040	1971-2000	71.8/Jul	35.1/Jan	4.97	2.00	8.27	4.57	19.81
Cibecue	5,050	1927-1979[1]	73.7/Jul	37.1/Jan	5.57	2.00	5.34	6.08	18.98
Globe	3,550	1894-1975[1]	82.7/Jul	43.6/Jan	2.86	1.17	4.78	4.97	13.78
Globe 2	3,650	1971-2000	81.4/Jul	43.4/Dec	5.28	1.17	6.03	4.52	17.00
Hawley Lake	8,180	1967-1988[1]	59.2/Jul	24.3/Jan	12.49	4.96	12.95	9.22	39.62
Maverick	7,810	1948-1967	60.1/Jul	26.2/Jan	7.07	2.56	12.02	6.21	27.86
Miami	3,560	1971-2000	83.4/Jul	45.5/Jan	6.38	1.36	6.45	5.30	19.49
Mormon Flat	1,710	1971-2000	90.3/Jul	52.6/Dec	5.15	1.02	4.39	4.01	14.57
Pleasant Valley R.S.	5,050	1971-2000	72.5/Jul	38.2/Jan	7.08	1.96	7.85	5.66	22.55
Roosevelt 1WNW	2,210	1971-2000	88.1/Jul	48.4/Jan	6.51	1.20	4.37	4.81	16.89
Sierra Ancha	5,100	1913-1979[1]	77.1/Jul	41.6/Jan	9.45	2.58	7.39	8.67	28.09
Whiteriver 1 SW	5,120	1971-2000	72.4/Jul	39.9/Jan	5.55	2.02	7.81	4.76	20.14
Young	5,050	1903-1964	75.3/Jul, Aug	36.9/Jan	6.00	2.17	8.26	4.59	21.02

Source: WRCC, 2003.
Notes:
[1]Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
Hawley Lake	8,180	1967 - 1988	33.17
Roosevelt 1 WNW	2,200	1905 - 2002	96.71
Whiteriver	5,280	1900 - 2002	77.65

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (N*umber of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

Table 5.2-1 Climate Data for the Salt River Basin (cont'd)

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan.	Feb.	March	April	May	June
Beaverhead SNOTEL	7,990	1995 - current	1.6 *(9)*	2.3 *(9)*	2.9 *(9)*	.7 *(9)*	0 *(9)*	0 *(9)*
Buck Sping	7,400	1989 - current	1.1*(6)*	1*(6)*	1.7*(6)*	0.2*(6)*	0*(0)*	0*(0)*
Buck Spring SNOTEL	7,400	1985 - 1997 (discontinued)	2.6*(12)*	4.5*(12)*	4.0*(12)*	0.8*(12)*	0.1*(12)*	0*(12)*
Hannagan Meadows SNOTEL	9,020	1964 - current	5.3*(29)*	8.7*(41)*	11.4*(41)*	10.4*(41)*	1.9*(24)*	0*(22)*
Maverick Fork	9,150	1975 - 2003 (discontinued)	4.3*(26)*	6.9*(48)*	9.0*(49)*	8.2*(47)*	5.1*(1)*	0*(0)*
Maverick Fork SNOTEL	9,200	1950 - current	4.3*(31)*	7.4*(53)*	9.8*(54)*	8.3*(52)*	0.5*(18)*	0*(17)*
McNary	7,200	1939 - 1989 (discontinued)	1.9*(13)*	2.8*(47)*	2.5*(47)*	0.8*(46)*	0*(1)*	0*(0)*
Milk Ranch	7,000	1941 - 1989 (discontinued)	0.9*(9)*	1.9*(46)*	1*(45)*	0.4*(42)*	0*(0)*	0*(0)*
Wildcat SNOTEL	7,850	1985 - current	1.6*(20)*	2.9*(20)*	3.7*(20)*	1.3*(20)*	0*(20)*	0*(20)*
Workman Creek	6,900	1952 - 1993 (discontinued)	2.7*(12)*	4.7*(42)*	4.7*(42)*	2.8*(40)*	0*(0)*	0*(0)*
Workman Creek SNOTEL	6,900	1961 - current	2.3*(23)*	5.2*(44)*	5.5*(44)*	3.0*(44)*	0*(21)*	0*(22)*

Source: NRCS, 2005

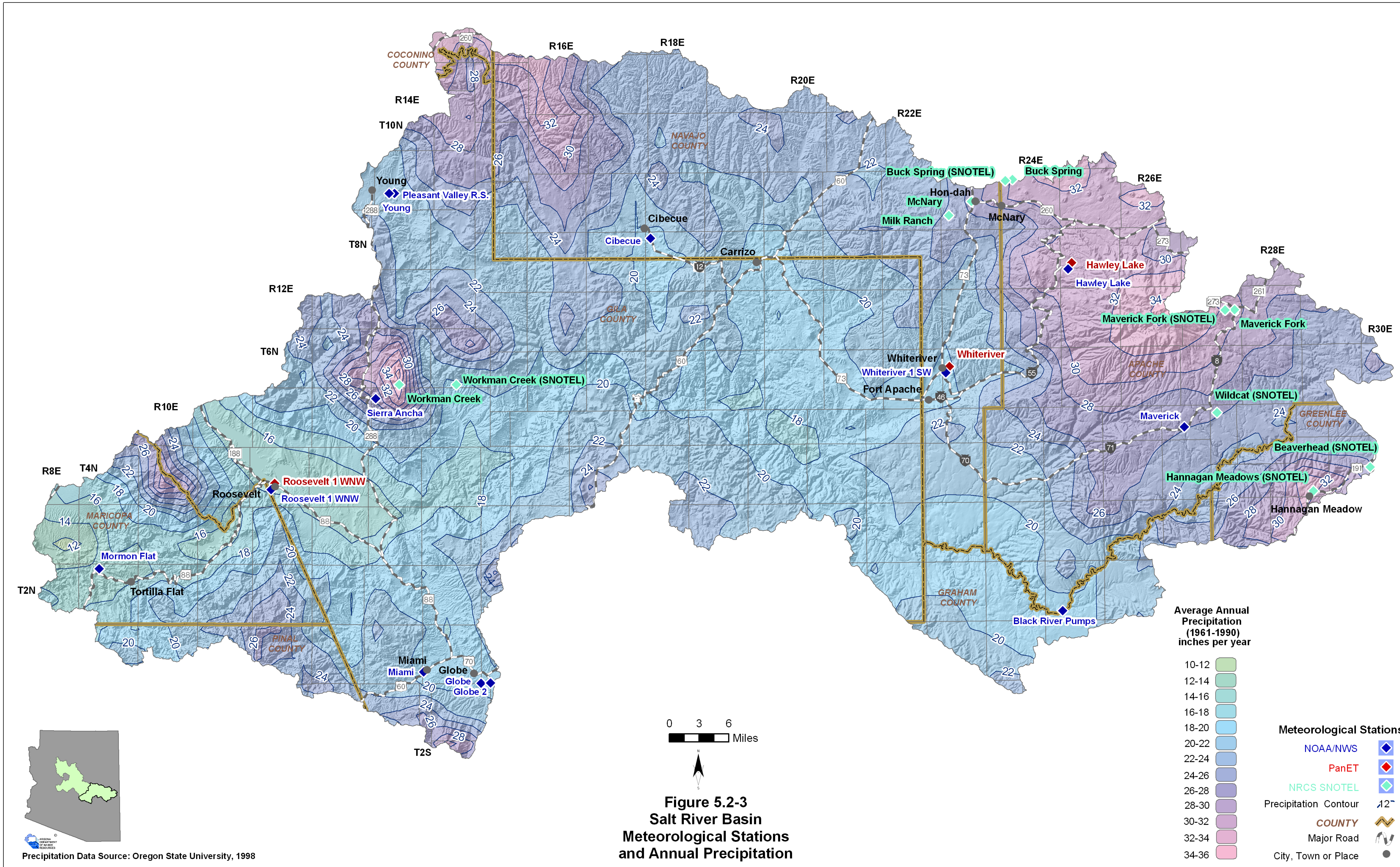


Figure 5.2-3
Salt River Basin
Meteorological Stations
and Annual Precipitation

5.2.4 Surface Water Conditions in the Salt River Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 5.2-2. Flood ALERT equipment in the basin is shown in Table 5.2-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 5.2-4. The location of streamflow gages identified by USGS number, flood ALERT equipment, USGS runoff contours and large reservoirs are shown on Figure 5.2-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 5.2-2.
- Data from 33 stations located at 20 watercourses are shown in the table and on Figure 5.2-4. Nineteen of the 33 stations have been discontinued and eight of the 14 remaining stations are real-time stations.
- The average seasonal flow at 17 stations is highest in the winter (January-March) when between 38% and 73% of the average annual flow occurs. These stations are located primarily lower in the watershed or along tributaries. At 14 stations, located primarily along the major tributaries to the Salt River and higher in the watershed in the eastern part of the basin, the average seasonal flow is highest in the spring (April-June) due to snowmelt when between 34% and 68% of the average annual flow occurs.
- The average seasonal flow is lowest at most stations in the summer (July-September). These stations receive between 3% and 13% of their average annual seasonal flow at this time and are located in both the upper and lower portions of the watershed.
- The largest annual flow recorded in the basin is 3.2 maf in 1905 at the Salt River at Roosevelt gage with a contributing drainage area of 5,824 square miles.
- Nine streams in this basin have a mean and median annual flow of over 10,000 acre-feet. Three of those nine streams, Black River, White River and Salt River, have a mean annual flow of over 100,000 acre-feet.

Flood ALERT Equipment

- Refer to Table 5.2-3.
- As of October 2005 there were five stations in the basin, three in Gila County, one in Maricopa County and one in Navajo County.
- Of the five stations two are precipitation only stations, two are precipitation/stage stations and one is a weather station.

Reservoirs and Stockponds

- Refer to Table 5.2-4.
- The basin contains 13 large reservoirs. The largest is Roosevelt with a maximum capacity of 1,653,043 acre-feet.
- The most common use of the large reservoirs is recreation. The reservoirs on the Salt River supply hydroelectric power, irrigation and water supply for users in the Phoenix metropolitan area.

- Surface water is stored or could be stored in 62 small reservoirs in the basin.
- Total maximum storage for the 26 small reservoirs with greater than 15 acre-feet and less than 500 acre-feet capacity is 3,239 acre-feet. The total surface area for the remaining 36 small reservoirs is 410 acres.
- There are 807 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 5.2-4.
- Average annual runoff is highest, 10 inches per year, in the White Mountains in the eastern portion of the basin and decreases to one inch per year in the southwestern portion of the basin.

Table 5.2-2 Streamflow Data for Salt River Basin

Station Number	USGS Station Name	Contributing Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Annual Flow Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9489070	North Fork of East Fork Black River near Alpine	38	9,060	6/1965-9/1978 (discontinued)	18	68	6	7	1,767 (1967)	5,933	9,121	33,593 (1973)	12
9489082	North Fork of Thomas creek near Alpine	1	NA	10/1985-9/2001 (discontinued)	25	58	8	8	23 (1989)	62	85	180 (1991)	6
9489100	Black River near Maverick	315	8,700	10/1962-9/1982 (discontinued)	28	49	10	13	27,591 (1977)	86,899	102,892	225,938 (1973)	19
9489200	Pacheta Creek at Maverick	15	8,810	10/1957-9/1980 (discontinued)	22	63	7	8	789 (1961)	4,851	6,443	17,593 (1973)	22
9489500	Black River below Pumping Plant near Point of Pines	560	8,000	6/1953-current (real-time)	37	42	9	13	28,459 (2002)	127,452	151,168	434,496 (1993)	49
9489700	Big Bonito Creek near Fort Apache	119	7,920	10/1957-9/1981 (discontinued)	29	49	11	12	13,828 (1961)	41,267	49,530	102,805 (1979)	23
9490800	North Fork White River near Greer	40	NA	6/1965 - 9/1978 (discontinued)	14	52	20	15	9704 (1971)	15,569	17,842	40,915 (1973)	13
9490000	Turkey Creek near Fort Apache	13	NA	6/1955-9/1960 (discontinued)	68	18	6	8	442 (1957)	514	1,017	2,599 (1958)	4
9492000	North Fork white River at White River	357	NA	10/1916 - 6/1922 (discontinued)	21	43	26	10	76,906 (1918)	109,638	118.159	167,933 (1919)	3
9490500	Black River near Fort Apache	1,232	7,200	11/1912-current	42	35	9	15	45,188 (2002)	233,904	280,932	818,301 (1993)	45
9491000	North Fork White River near McNary	66	9,320	6/1945-9/1985 (discontinued)	15	57	16	13	12,673 (1951)	32,442	34,855	73,140 (1983)	31
9492400	East Fork White River near Fort Apache	39	8,580	8/1957-current	18	53	16	13	6,930 (2002)	24,984	25,517	54,457 (1993)	45
9492500	Rock Creek near Fort Apache	20	NA	6/1955-9/1960 (discontinued)	50	34	9	8	217 (1958)	1,770	1,613	2,693 (1957)	4
9493500	White River at Fort Apache	499	NA	10/1912-6/1922 (discontinued)	28	44	22	7	110,217 (1918)	196,247	214,840	356,649 (1916)	4
9494000	White River near Fort Apache	632	7,400	10/1917-current	28	48	12	12	27,446 (2002)	149,177	144,517	345,424 (1993)	45
9494300	Carrizo Creek above Corduroy Creek near Show Low	225	NA	10/1953-6/1967 (discontinued)	47	12	8	32	1,926 (1961)	6,501	8,683	28,886 (1965)	13
9494500	Corduroy Creek above Forestdale Creek near Show Low	57	NA	9/1952-6/1961 (discontinued)	64	4	5	27	333 (1955)	2,404	2,867	6,306 (1960)	8
9495500	Forestdale Creek near Show Low	33	NA	9/1952-6/1961 (discontinued)	28	34	27	11	87 (1956)	1,314	2,190	7,023 (1960)	8

Table 5.2-2 Streamflow Data for Salt River Basin (cont'd)

Station Number	USGS Station Name	Contributing Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Annual Flow Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9496000	Corduroy Creek near mouth near Show Low	203	6,370	9/1951-current	54	17	7	21	1,600 (1970)	11,149	16,380	63,927 (1973)	23
9496500	Carrizo Creek near Show Low	439	6,320	6/1951-current	28	49	10	13	3,758 (1956)	22,232	35,030	124,556 (1993)	41
9496600	Cibecue 1 Tributary Carrizo Creek near Show Low	0.1	5,390	6/1958-9/1971 (discontinued)	0	0	80	20	1 (1960)	6	8	22 (1964)	12
9496700	Cibecue 2 Tributary Carrizo Creek near Show Low	0.1	5,240	6/1958-9/1971 (discontinued)	4	0	71	25	2 (1960-1961,1968)	4	6	17 (1963)	12
9497500	Salt River near Chrysotile	2,849	6,730	9/1924-current (real-time)	38	36	12	14	128,176 (2002)	393,581	474,817	1,459,907 (1993)	78
9497800	Cibecue Creek near Chysotile	295	5,700	5/1959-current	45	17	18	21	10,066 (1961)	23,535	32,597	128,176 (1993)	43
9497850	Canyon Creek near Globe	316	NA	10/1975 - 9/1981 (discontinued)	66	15	4	15	13,759 (1981)	99,282	81,149	147,149 (1979)	5
9497900	Cherry Creek near Young	62	6,030	8/1963-9/1977 (discontinued)	49	13	8	29	1,289 (1964)	5,495	7,817	20,706 (1965)	13
9497980	Cherry Creek near Globe	200	5,600	5/1965-current (real-time)	57	11	9	23	2,600 (2002)	15,026	24,302	84,003 (1993)	36
9498400	Pinal Creek at Inspiration Dam near Globe	162	NA	7/1980-current (real-time)	49	16	16	19	2,868 (1999)	6,087	8,980	61,481 (1993)	22
9498500	Salt River near Roosevelt	4,306	6,190	1/1913-current (real-time)	41	31	13	15	152,798 (2002)	518,499	644,942	2,422,315 (1916)	89
9500500	Salt River at Roosevelt	5,824	NA	1/1904-12/1907 (discontinued)	45	29	9	17	254,840 (1904)	1,321,983	1,531,574	3,227,492 (1905)	4
9498501	Pinto Creek below Haunted Canyon near Miami	37	NA	10/1995-current (real-time)	70	12	3	14	130 (2002)	1,709	1,600	3,722 (1998)	7
9498502	Pinto Creek near Miami	102	NA	9/1994-current (real-time)	68	15	8	9	449 (1996)	4,168	5,757	19,480 (1995)	8
9498503	South Fork Parker Creek near Roosevelt	1	NA	11/1985-current (real-time)	73	15	3	10	3 (2002)	192	266	1,036 (1995)	14

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Notes:
Statistics based on Calendar Year
Annual Flow statistics based on monthly values
Summation of Average Annual Flows may not equal 100 due to rounding.
Period of record may not equal Year of Record used for annual Flow/Year statistics due to only using years with a 12 month record

Table 5.2-3 Flood ALERT Equipment in the Salt River Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
81	Roosevelt Fire Station	Precipitation	10/2/04	Gila County FCD
910	Beer Tree Crossing Pinal Creek	Precipitation/Stage	NA	Gila County FCD
920	Guzman Crossing Pinal Creek	Precipitation/Stage	NA	Gila County FCD
1712	Pinetop County Club	Precipitation	NA	Navajo County FCD
6780	Saguaro Lake	Weather Station	1/24/00	Maricopa County FCD

FCD = Flood Control District
NA = Not available

Table 5.2-4 Reservoirs and Stockponds in the Salt River Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
1	Roosevelt	Bureau of Reclamation	1,653,043	H,I,R,S	Federal
2	Apache (Horse Mesa Dam)	Bureau of Reclamation	245,048	H,I,R,S	Federal
3	Saguaro (Stewart Mountain Dam)	Bureau of Reclamation	68,800	H,I,S	Federal
4	Canyon (Mormon Flat Dam)	Bureau of Reclamation	57,900	H,I,R,S	Federal
5	Sunrise	White Mountain Apache Tribe	15,000[2]	R	Tribal
6	Big	AZ Game & Fish	10,100	R	State
7	Reservation	San Carlos Apache Tribe	6,000[2]	R	Tribal
8	Crescent	AZ Game & Fish	5,800	F,R	State
9	Horseshoe Cienega	White Mountain Apache Tribe	1,170	R	Tribal
10	Cyclone	White Mountain Apache Tribe	775	R	Tribal
11	Hawley (Davis Dam)	White Mountain Apache Tribe	650	F,R	Tribal

Source: US Army Corps of Engineers 2005 and others

B: Other Large Reservoirs (50 acre surface area or greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
12	Nash Creek	White Apache Tribe	69	R	Tribal

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 26
Total maximum storage: 3,239 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[3]

Total number: 36
Total surface area: 410 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 807 (from water right filings)

Notes:
[1]F=fish & wildlife pond; H=hydroelectric; I=irrigation; R=recreation; S=water supply
[2]Normal capacity < 500acre-feet

Figure 5.2-4
Salt River Basin
Surface Water Conditions

5.2.5 Perennial/Intermittent Streams and Major Springs in the Salt River Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 5.2-5. The locations of major springs and perennial and intermittent streams are shown on Figure 5.2-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- There are numerous perennial streams located throughout the basin, particularly in the high elevation eastern portion, and include the Salt River, Black River, White River, East Fork White River, North Fork White River, Carrizo Creek, Cibecue Creek, Canyon Creek and Cherry Creek.
- Most of the intermittent streams are found in the western portion of the basin.
- There are 26 major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions. Many of the measurements were taken during or prior to 1952.
- Springs are found throughout the basin with the largest concentration of springs in the vicinity of McNary. The greatest discharge rate was measured on the White River, south of Hon-dah (Alchesay, 8,980 gpm).
- Fourteen of the major springs have a measured discharge rate of 100 gpm or greater and four springs have discharge rates of 1,000 gpm or greater.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 5.2-5B. There is one minor spring identified in this basin.
- The total number of springs, regardless of discharge, identified by the USGS varies from 624 to 822, depending on the database reference.

Table 5.2-5 Springs in the Salt River Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Alchesay	335641	1095523	8,980	During or prior to 1952
2	Canyon[2]	334040	1111242	2,224	During or prior to 2001
3	Mann[2]	340340	1094810	1,980	10/24/1979
4	Gosseberry Creek	340654	1094117	1,000	5/22/1952
5	Warm	334403	1101256	874	During or prior to 1982
6	Unnamed	341740	1104858	480	11/5/2002
7	Unnamed	341738	1104853	410	11/5/2002
8	Unnamed	341738	1104853	310	11/5/2002
9	Blue Lake	340402	1094805	260	5/19/1952
10	Gomez[2, 3]	340338	1095156	200	6/18/1946
11	Boy	340420	1094703	200	5/20/1952
12	Ess	334049	1093308	200	6/18/1952
13	Big	340539	1095932	150	6/20/1952
14	Upper Bull Cienega	340348	1095315	100[4]	6/20/1952
15	Government[2]	340410	1095210	75	6/18/1946
16	Maurel[2, 3]	332422	1104425	50	4/11/1946
17	Unnamed[2, 3]	334942	1095100	40	2/19/1952
18	Haystack # 1[2]	340450	1095037	40[4]	6/18/1946
19	Unnamed[3]	334430	1101316	30[5]	During or prior to 1992
20	Earl Spring # 3[2]	340424	1095123	20[4]	6/18/1946
21	Unnamed[3]	340441	1094840	20[4]	6/20/1946
22	Haystack # 2[2]	340450	1095052	20	6/18/1946
23	Columbine	335631	1095510	Greater than 10	6/5/2005
24	White	341109	1103055	Greater than 10	6/6/2005
25	Williams (Fish Hatchery)	340341	1094832	Greater than 10	6/5/2005
26	Unnamed[3]	334414	1101339	10[5]	During or prior to 1982

B. Minor Springs (1 to 10 gpm):

Name[1]	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Bull Cienega	340348	1095314	2	6/20/1952

C. Total number of springs, regardless of discharge, identified by USGS
(see ALRIS, 2005 and NHD, 2006): 624 to 822

Notes:
[1]Most recent measurement identified by ADWR
[2]Spring is not displayed on current USGS topo maps
[3]Location approximated by ADWR
[4]Estimated discharge
[5]Average discharge

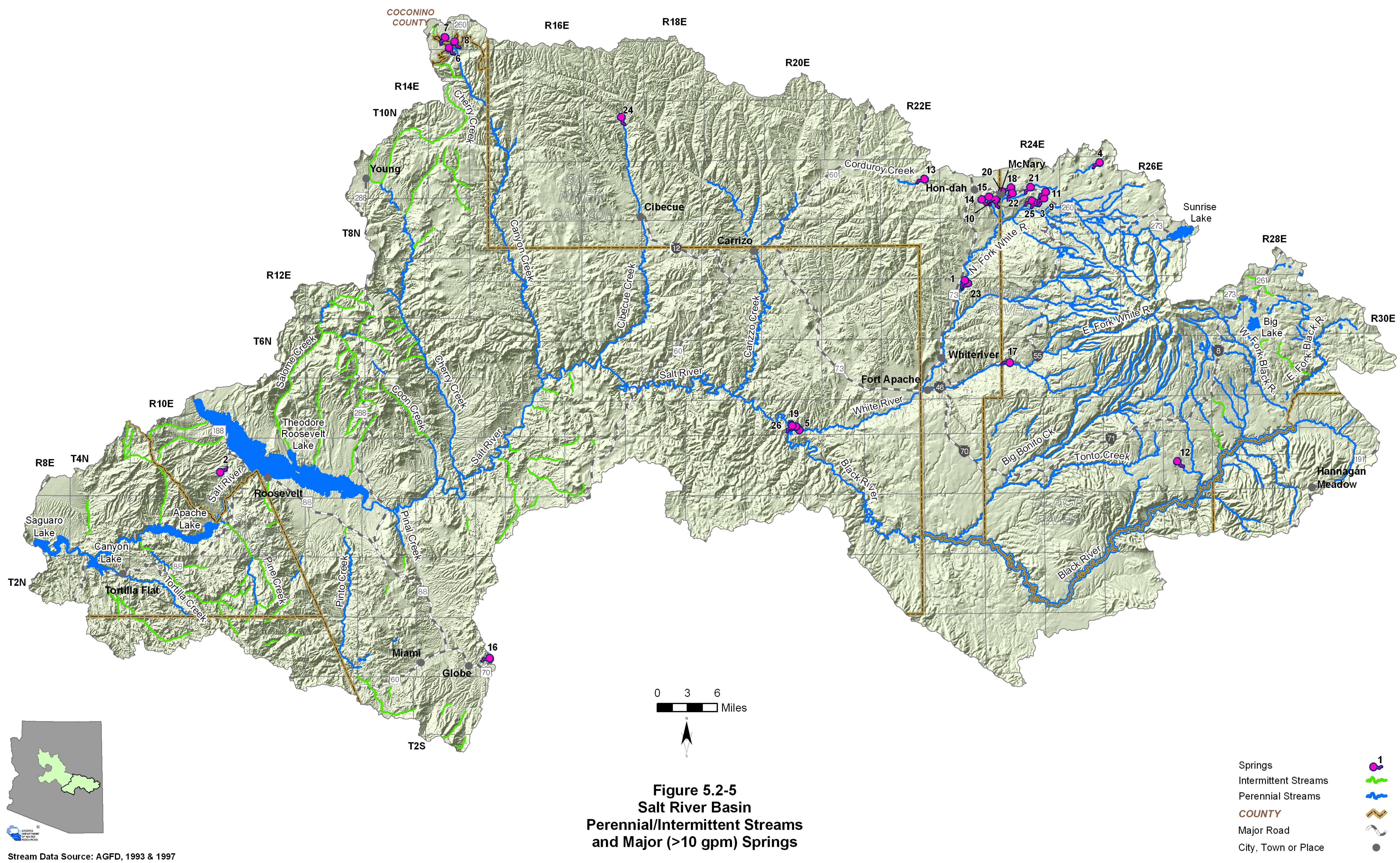


Figure 5.2-5
Salt River Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

5.2.6 Groundwater Conditions of the Salt River Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 5.2-6. Figure 5.2-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 5.2-7 contains hydrographs for selected wells shown on Figure 5.2-6. Figure 5.2-8 shows well yields in five yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 5.2-6 and Figure 5.2-6.
- Major aquifers in the basin include recent stream alluvium, volcanic rock (Pinetop-Lakeside Aquifer) and sedimentary rock (Gila Conglomerate, and C and R Aquifers).
- Most of the basin geology consists of consolidated crystalline and sedimentary rock.
- The basin contains four sub-basins: Black River, White River, Salt River Canyon and Salt River Lakes.
- Flow directions are generally not available due to the consolidated nature of the basin geology. Groundwater flow in the C-aquifer in the northwestern portion of the basin is from north to south.

Well Yields

- Refer to Table 5.2-6 and Figure 5.2-8.
- As shown on Figure 5.2-8, well yields in this basin range from less than 100 gallons per minute (gpm) to greater than 2,000 gpm.
- One source of well yield information, based on 140 reported wells, indicates that the median well yield in this basin is 170 gpm.
- Well yields vary throughout the basin, with the lowest and the highest well yields found in the Globe-Miami area in unconsolidated sediments.

Natural Recharge

- Refer to Table 5.2-6.
- The estimate of natural recharge for this basin is 178,000 acre-feet per year.

Water in Storage

- Refer to Table 5.2-6.
- There is one estimate of water in storage for this basin. This estimate, from a 1992 ADWR study, indicates the basin has more than 8,700,000 acre-feet in storage to a depth of 1,200 feet.

Water Level

- Refer to Figure 5.2-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures one index well in this basin, located near Young.
- There are no recorded well sweeps in this basin.
- All water level information is from the western portion of the basin. The deepest recorded

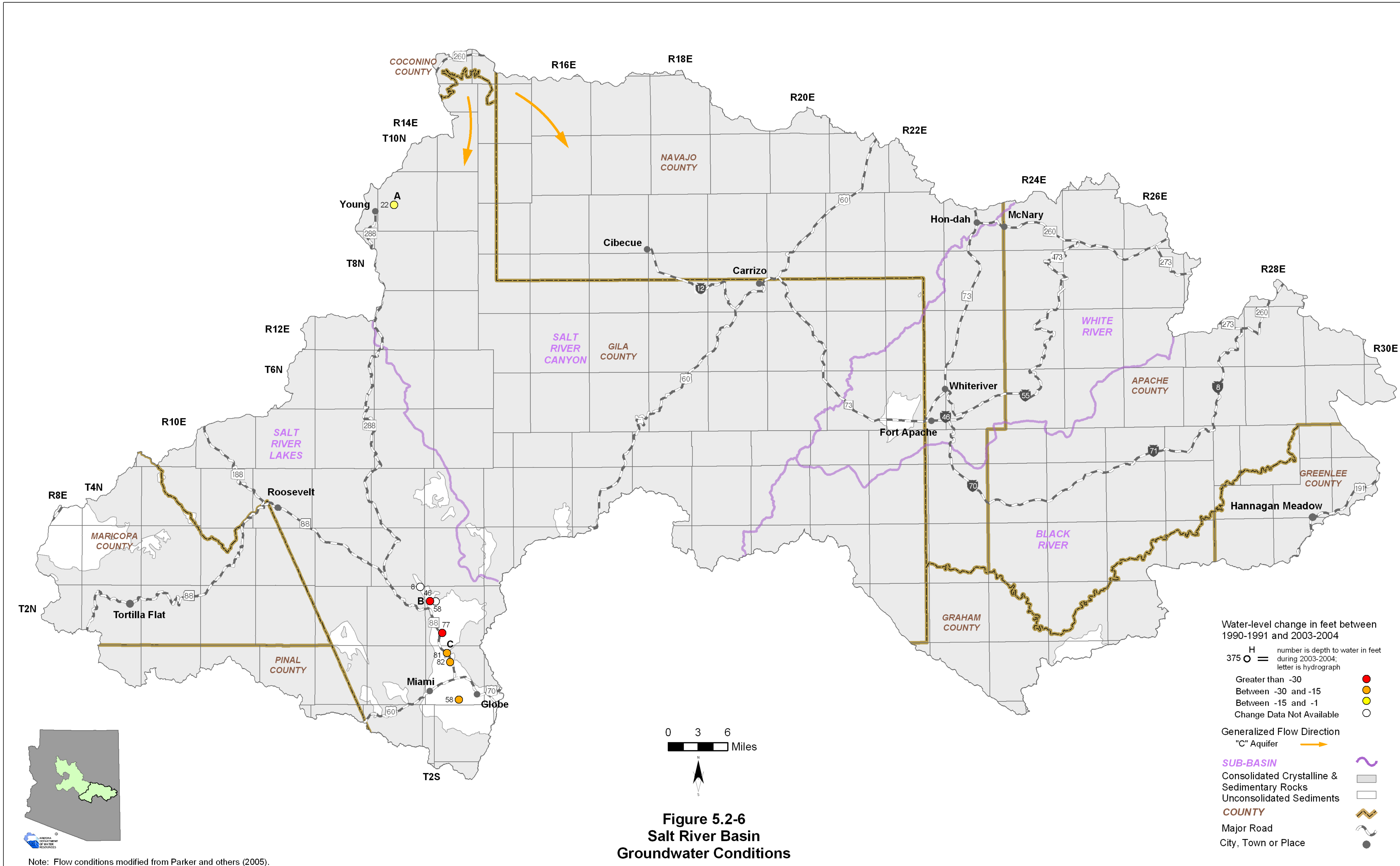
water level is 82 feet and the shallowest is eight feet, both located north of Miami-Globe.

- Hydrographs corresponding to selected wells shown on Figure 5.2-6 but covering a longer time period are shown in Figure 5.2-7.

Table 5.2-6 Groundwater Data for the Salt River Basin

Basin Area, in square miles:	5,232	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Recent Stream Alluvium	
	Volcanic Rock (Pinetop-Lakeside Aquifer)	
	Sedimentary Rock (Gila Conglomerate)	
	Sedimentary Rock (C and R Aquifers)	
Well Yields, in gal/min:	60 (1 well measured)	Measured by ADWR and/or USGS
	Range 2-2,000 Median 170 (140 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 10-300	ADWR (1990 and 1994)
	Range 0-500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	178,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	N/A	ADWR (1994)
	>8,700,000 (to 1,200 ft)	ADWR (1992)
	N/A	Freethey and Anderson (1986)
	N/A	Arizona Water Commission (1975)
Current Number of Index Wells:	1	
Date of Last Water-level Sweep:	N/A	

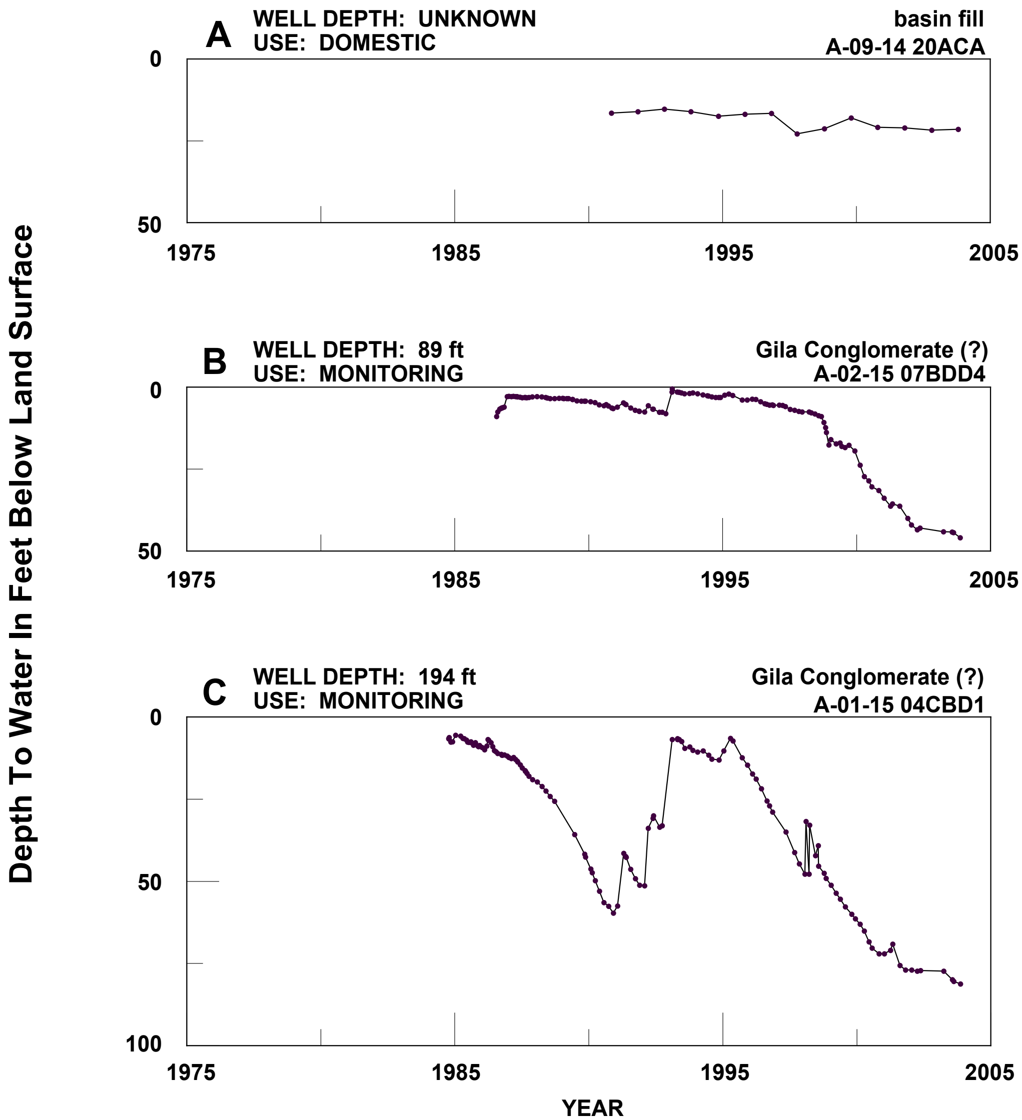
NA - Not available



Note: Flow conditions modified from Parker and others (2005).

Figure 5.2-6
Salt River Basin
Groundwater Conditions

Figure 5.2-7
Salt River Basin
Hydrographs Showing Depth to Water in Selected Wells



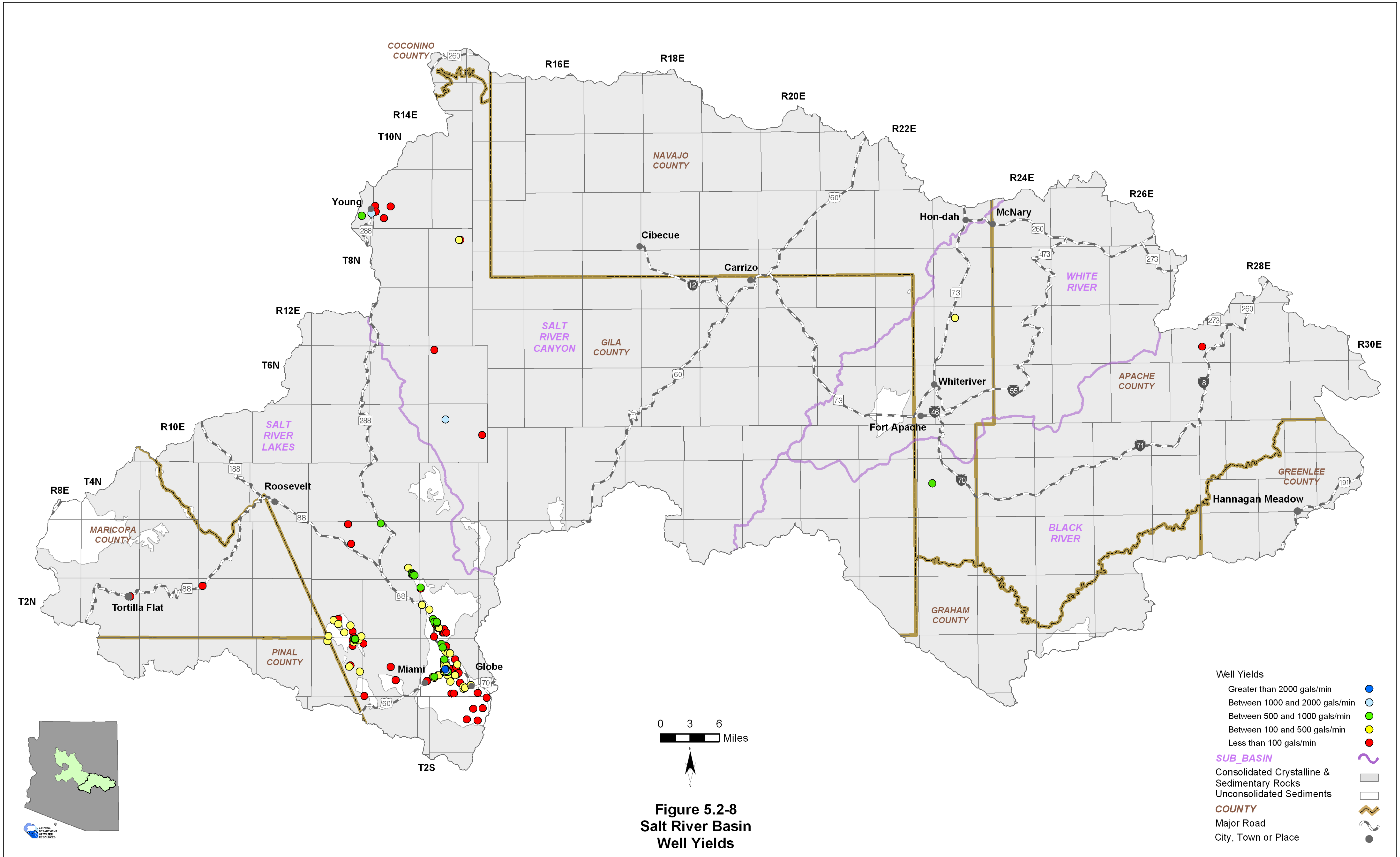


Figure 5.2-8
Salt River Basin
Well Yields

5.2.7 Water Quality of the Salt River Basin

Wells, springs and mine sites with parameter concentrations that have equaled or exceeded drinking water standard(s), including location and parameter(s) are shown in Table Table 5.2-7A. Impaired lakes and streams with site type, name, length of impaired reach, area of impaired lake, designated use standard and parameter(s) exceeded is shown in Table Table 5.2-7B. Figure 5.2-9 shows the location of water quality occurrences keyed to Table 5.2-7. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mines

- Refer to Table 5.2-7A.
- Seventy sites have parameter concentrations that have equaled or exceeded drinking water standards All but one occurrence is in the southwest portion of the basin.
- Of the ten standards equalled or exceeded in this basin, the most commonly equalled or exceeded was cadmium.
- Multiple standards including fluoride, beryllium, copper, lead, cadmium, chromium and total dissolved solids were equalled or exceeded at sites in the vicinity of Miami-Globe.
- Other standards equalled or exceeded in this basin include nitrate/nitrite, arsenic and radionuclides.

Lakes and Streams

- Refer to Table 5.2-7B.
- Water quality standards in this basin were exceeded for two lakes and four stream reaches on two streams.
- The most commonly exceeded standard was copper. Other standards exceeded include dissolved oxygen, high pH and selenium.
- A total of 37 miles in three reaches of Pinto Creek are impaired.
- The three impaired reaches of Pinto Creek are part of the ADEQ water quality improvement effort called the Total Maximum Daily Load (TMDL) program. Phase I of the TMDL reports have been approved and specific site standards are being developed.
- Canyon Lake, Crescent Lake and the Gibson Mine tributary are not a part of the TMDL program at this time.

Table 5.2-7 Water Quality Exceedences in the Salt River Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
		Township	Range	Section	
1	Well	4 North	29 East	34	NO3
2	Well	3 North	12 East	14	Rad
3	Well	3 North	13 East	2	As
4	Well	3 North	13 East	9	As
5	Well	3 North	13 East	10	As
6	Well	3 North	13 East	15	As
7	Well	3 North	13 East	15	As
8	Well	3 North	14 East	26	Pb, TDS
9	Well	3 North	14 East	26	Pb, TDS
10	Well	2 North	9 East	11	As, F
11	Well	2 North	11 East	6	Rad
12	Spring	2 North	13 East	16	Rad
13	Well	2 North	14 East	1	F
14	Well	2 North	15 East	6	F
15	Well	2 North	15 East	6	F
16	Well	2 North	15 East	6	F
17	Well	2 North	15 East	6	F
18	Well	2 North	15 East	6	F
19	Well	2 North	15 East	7	Be, Cd, Cu, F, Pb
20	Well	2 North	15 East	7	Be, Cd, Cu, Pb
21	Well	2 North	15 East	7	Be, Cd, Cu, F, Pb
22	Well	2 North	15 East	7	Be, Cd, Cu, F
23	Well	2 North	15 East	7	Cd
24	Well	2 North	15 East	7	Be, Cd, Cr, Pb, TDS
25	Well	2 North	15 East	7	Pb
26	Well	2 North	15 East	7	Be, Cd, Cr, Pb, TDS
27	Well	2 North	15 East	7	Pb
28	Well	2 North	15 East	7	Cd, Pb, TDS
29	Well	2 North	15 East	7	Cd, Pb, TDS
30	Well	2 North	15 East	7	Cd
31	Well	2 North	15 East	18	Be, Cd, Cu, F, Pb, TDS
32	Well	2 North	15 East	18	Be, Cd, Cu, F, Pb, TDS
33	Well	2 North	15 East	18	Be, Cd, F, Pb
34	Well	2 North	15 East	29	TDS
35	Well	2 North	15 East	29	Be, Cd, Cu, F, Pb, TDS
36	Well	2 North	15 East	29	Be, Cd, Cu, F, Pb, TDS
37	Well	2 North	15 East	29	Be, Cd, Cu, F, Pb, TDS
38	Well	2 North	15 East	29	Cd
39	Well	2 North	15 East	32	As
40	Well	1 North	14 East	27	As
41	Well	1 North	15 East	4	Be, Cd, Cr, F, Pb, TDS
42	Well	1 North	15 East	4	Be, Cd, Cu, Cr, F, Pb, TDS
43	Well	1 North	15 East	4	Be, Cd, Cu, Cr, F, Pb, TDS
44	Well	1 North	15 East	4	Be, Cd, Cu, F, Pb
45	Well	1 North	15 East	4	Pb
46	Well	1 North	15 East	9	Be, Cd, Cu, Cr, F, Pb, TDS
47	Well	1 North	15 East	9	Be, Cd, Cu, Cr, F, Pb, TDS
48	Well	1 North	15 East	9	Be, Cd, Cu, Cr, F, Pb, TDS
49	Well	1 North	15 East	9	Be, Cd, Cu, F, Pb, TDS
50	Well	1 North	15 East	9	Pb
51	Well	1 North	15 East	9	Be, Cd, Cu, F, Pb
52	Well	1 North	15 East	9	Cu
53	Well	1 North	15 East	9	Cu
54	Well	1 North	15 East	9	Be, Cd, Cu, Cr, F, Pb, TDS
55	Well	1 North	15 East	9	Be, Cd, Cu, F, TDS
56	Well	1 North	15 East	9	Be, Cd, Cu, F, TDS
57	Well	1 North	15 East	9	Be, Cd, Cu, F, TDS

Table 5.2-7 Water Quality Exceedences in the Salt River Basin (cont'd)[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
		Township	Range	Section	
58	Well	1 North	15 East	9	Be, Cd, Cu, Pb
59	Well	1 North	15 East	9	Be, Cd, Cu, TDS
60	Well	1 North	15 East	23	Cd
61	Well	1 North	15 East	23	Cd
62	Well	1 North	15 East	23	Cd
63	Well	1 North	15 East	23	Cd
64	Well	1 North	15 East	23	Cd
65	Well	1 North	15 East	34	Cd
66	Well	1 North	15 East	34	Cd, Pb
67	Well	1 North	15 East	35	Cd
68	Well	1 South	13 East	12	NO3
69	Well	1 South	14 East	2	F
70	Well	1 South	15 East	12	NO3

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard[3]	Parameter(s) Exceeding Use Standard[2]
a	Lake	Canyon Lake	NA	450	A&W	DO
b	Lake	Crescent Lake	NA	150	A&W, FBC, AgL, AgI	high pH
c	Stream	Gibson Mine tributary (headwaters to Pinto Creek)	1	NA	A&W	Cu
d	Stream	Pinto Creek (headwaters to tributary latitude 331927, longitude 1105456)	3	NA	A&W	Cu
e	Stream	Pinto Creek (Ripper Spring Canyon to Roosevelt Lake)	18	NA	A&W	Cu, Se
f	Stream	Pinto Creek tributary (latitude 331927, longitude 1105456 to Ripper Spring)	16	NA	A&W	Cu

Notes:

[1] Water quality samples collected between 1984 and 2002.

[2] As = Arsenic
Be = Beryllium
Cd = Cadmium
Cr = Chromium
Cu = Copper
DO = Dissolved oxygen
F= Fluoride
Pb = Lead
NO3 = Nitrate/Nitrite
Organics = One or more of several volatile and semi-volatile organic compounds and pesticides
pH = Measurement of acidity or alkalinity
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium
Se = Selenium
TDS = Total Dissolved Solids

[3] A&W = Aquatic and Wildlife
FBC = Full Body Contact
AgL - Agricltural - livestock watering
AgI = Agricultural - irrigation

NA = Not Available

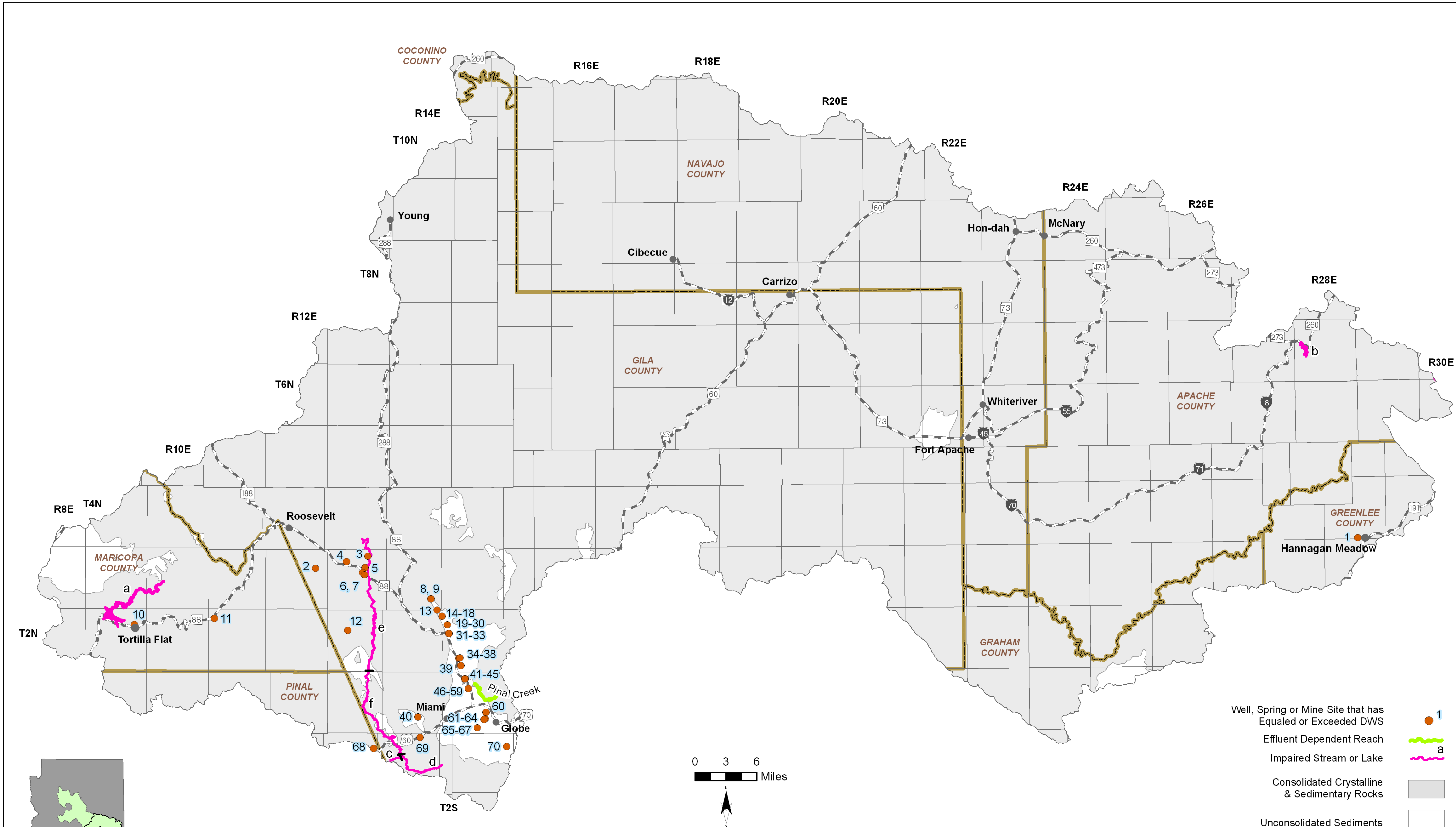


Figure 5.2-9
Salt River Basin
Water Quality Conditions

5.2.8 Cultural Water Demands in the Salt River Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 5.2-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 5.2-9. Figure 5.2-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 5.0.7.

Cultural Water Demands

- Refer to Table 5.2-8 and Figure 5.2-10.
- Population in this basin has increased from 27,318 in 1980 to 32,144 in 2003 and is projected to reach 40,000 by 2050.
- Total groundwater use has decreased in this basin since 1971, from an average of 20,000 acre-feet per year from 1971-1975 to an average of 11,300 acre-feet per year in 2001-2003.
- From 1991-2003 municipal groundwater use averaged 4,000 acre-feet per year.
- Groundwater use for industrial purposes has decreased from 10,500 acre-feet per year on average in 1991-1995 to 8,000 acre-feet per year in 2001-2003.
- Groundwater use for irrigation occurs on non-reservation lands and has remained constant at less than 1,000 acre-feet per year on average from 1991-2003.
- Information on surface water diversions is not available from 1971-1990. Surface water diversions for both municipal and irrigation uses is assumed to have remained constant from 1991-2003. Municipal use averages less than 300 acre-feet per year and irrigation use averages 6,400 acre-feet per year.
- Surface water diversions for industrial use have decreased from an average of 6,300 acre-feet per year from 1991-1995 to 4,800 acre-feet per year during 2001-2003.
- Municipal and industrial demand is found in the Globe – Miami area, around Young and near Fort Apache and Whiteriver on the Fort Apache Indian Reservation.
- There are three large copper mines, Pinto Valley, Carlotta and Miami Mine, and two small mines or quarries located in the vicinity of Miami. Not all mines are currently in production.
- As of 2003 there were 1,491 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 216 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 5.2-9.
- There are twelve wastewater treatment facilities in this basin.
- Information on population served was available for seven facilities and information on effluent generation was available for six facilities. These facilities serve over 20,000 people and generate over 2,600 acre-feet of effluent per year.

- Of the seven facilities with information on the effluent disposal method: two discharge to evaporation ponds; two discharge for irrigation; one reuses effluent for irrigation, a wildlife area and a golf course; one facility discharges to the Globe WWTF and two discharge into a watercourse.

Table 5.2-8 Cultural Water Demands in the Salt River Basin[1]

<table>
<tr><th rowspan="3">Year</th><th rowspan="3">Recent (Census) and Projected (DES) Population</th><th colspan="2" rowspan="2">Number of Registered Water Supply Wells Drilled</th><th colspan="6">Average Annual Demand (in acre-feet)</th><th rowspan="3">Data Source</th></tr>
<tr><th colspan="3">Well Pumpage</th><th colspan="3">Surface-Water Diversions</th></tr>
<tr><th>Q ≤ 35 gpm</th><th>Q > 35 gpm</th><th>Municipal</th><th>Industrial</th><th>Irrigation</th><th>Municipal</th><th>Industrial</th><th>Irrigation</th></tr>
<tr><td>1971</td><td></td><td rowspan="10">989[2]</td><td rowspan="10">158[2]</td><td colspan="3" rowspan="5">20,000</td><td colspan="3" rowspan="5">NR</td><td rowspan="20">ADWR (1994)</td></tr>
<tr><td>1972</td><td></td></tr>
<tr><td>1973</td><td></td></tr>
<tr><td>1974</td><td></td></tr>
<tr><td>1975</td><td></td></tr>
<tr><td>1976</td><td></td><td colspan="3" rowspan="5">20,000</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>1977</td><td></td></tr>
<tr><td>1978</td><td></td></tr>
<tr><td>1979</td><td></td></tr>
<tr><td>1980</td><td>27,318</td></tr>
<tr><td>1981</td><td>27,453</td><td rowspan="5">25</td><td rowspan="5">11</td><td colspan="3" rowspan="5">20,000</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>1982</td><td>27,589</td></tr>
<tr><td>1983</td><td>27,724</td></tr>
<tr><td>1984</td><td>27,859</td></tr>
<tr><td>1985</td><td>27,995</td></tr>
<tr><td>1986</td><td>28,130</td><td rowspan="5">69</td><td rowspan="5">22</td><td colspan="3" rowspan="5">22,000</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>1987</td><td>28,265</td></tr>
<tr><td>1988</td><td>28,401</td></tr>
<tr><td>1989</td><td>28,536</td></tr>
<tr><td>1990</td><td>28,671</td></tr>
<tr><td>1991</td><td>28,942</td><td rowspan="5">140</td><td rowspan="5">8</td><td rowspan="5">3,900</td><td rowspan="5">10,570</td><td rowspan="5"><1,000</td><td rowspan="5"><300</td><td rowspan="5">6,300</td><td rowspan="5">6,400</td><td rowspan="13">USGS (2005)
ADWR (2005)
ADWR (1992)
Truini (2005)</td></tr>
<tr><td>1992</td><td>29,213</td></tr>
<tr><td>1993</td><td>29,484</td></tr>
<tr><td>1994</td><td>29,755</td></tr>
<tr><td>1995</td><td>30,026</td></tr>
<tr><td>1996</td><td>30,297</td><td rowspan="5">182</td><td rowspan="5">12</td><td rowspan="5">4,100</td><td rowspan="5">7,570</td><td rowspan="5"><1,000</td><td rowspan="5"><300</td><td rowspan="5">6,600</td><td rowspan="5">6,400</td></tr>
<tr><td>1997</td><td>30,568</td></tr>
<tr><td>1998</td><td>30,839</td></tr>
<tr><td>1999</td><td>31,110</td></tr>
<tr><td>2000</td><td>31,381</td></tr>
<tr><td>2001</td><td>31,635</td><td rowspan="3">38</td><td rowspan="3">3</td><td rowspan="3">4,000</td><td rowspan="3">8,070</td><td rowspan="3"><1,000</td><td rowspan="3"><300</td><td rowspan="3">4,800</td><td rowspan="3">6,400</td></tr>
<tr><td>2002</td><td>31,889</td></tr>
<tr><td>2003</td><td>32,144</td></tr>
<tr><td>2010</td><td>33,923</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2020</td><td>36,006</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2030</td><td>37,774</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2040</td><td>39,175</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2050</td><td>40,609</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">ADDITIONAL WELLS:[3]</td><td>45</td><td>2</td><td colspan="7"></td></tr>
<tr><td colspan="2">WELL TOTALS:</td><td>1,491</td><td>216</td><td colspan="7"></td></tr>
</table>

Notes:
NR - Not reported
1 Does not include evaporation losses from stockponds and reservoirs.
2 Includes all wells through 1980.
3 Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 5.2-9 Effluent Generation in the Salt River Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet/year)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Wildlife Area	Golf Course	Discharge to Another Facility	Infiltration Basin			
Arizona DOC/Globe	Department of Corrections	Prison	NA											
Cobra Valley Plaza	Cobra Valley SD	Claypool	100	11	Miami Wash							Secondary	NA	2000
Globe Central Heights Collection Systems	Globe	Globe	1,990	NA						Globe WWTF		NA		2001
Globe Holgate STP	Globe	Globe	190	22	NA							Secondary	NA	2000
Globe WWTF	Globe	Globe	190	784	Unnamed wash to Pinal Creek		X					Secondary	NA	2001
Hon-Dah WWTP	White Mountain Apache Tribe	Resort	NA											
Houston Creek Landing	Private	Star Valley	NA											
Miami WWTF	Miami	Miami	5,238	488			X					Secondary	762	2000
Pinal Creek	Globe	Globe	NA				Reuse					NA		2004
Roosevelt WWTP	Tonto National Forest	Recreation Area	NA											
White Mountain Apache	White Mountain Apache Tribe	Reservation	2,000	224		X						Secondary	1,250	2000
White River	White Mountain Apache Tribe	White River	10,700	1,120		X						Secondary	2000	2000
Total			20,408	2,649										

NA: Data not currently available to ADWR
WWTF: Waste Water Treatment Facility
WWTP: Waste Water Treatment Plant
STP:Sewage Treatment Plant
SD: Sanitation District

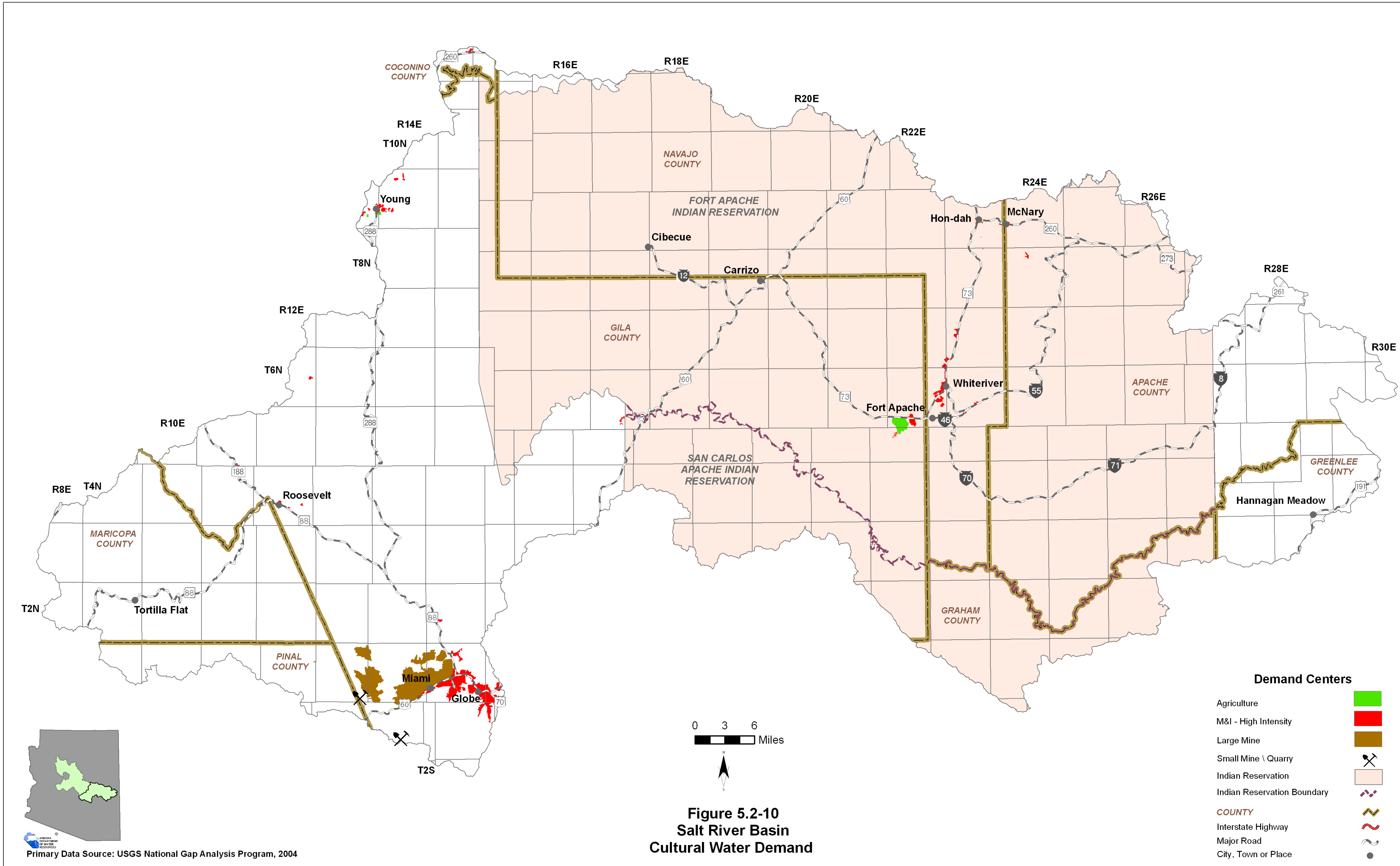


Figure 5.2-10
Salt River Basin
Cultural Water Demand

5.2.9 Water Adequacy Determinations in the Salt River Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 5.2-10. Figure 5.2-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

Water Adequacy Reports

- See Table 5.2-10
- A total of seventeen water adequacy determinations have been made in this basin through May, 2005.
- Fifteen subdivisions received inadequate determinations.
- The most common reason for an inadequacy determination is because the applicant did not submit the necessary information and/or the available hydrologic data was insufficient to make a determination.
- Other reasons for an inadequacy determination were because the existing water supply was unreliable or unavailable or the groundwater exceeded the depth-to-water criteria.
- The number of lots receiving a water adequacy determination, by county, are:

County	Number of Subdivision Lots	Number of Lots Determined to be Adequate	Percent Adequate
Apache County	0	0	NA
Coconino County	0	0	NA
Gila County	909	47	5%
Greenlee County	0	0	NA
Graham County	0	0	NA
Navajo County	59	59	100%
Maricopa County	0	0	NA

Table 5.2-10. Adequacy Determinations in the Salt River Basin[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Cherry Creek Estates Amended	Gila	9.0	14.0	4	55		Inadequate	A1	04/18/88	Dry Lot Subdivision
2	Copper Canyon Ranches #1	Gila	1.0	15.0	2, 3, 10	53		Inadequate	A1	10/16/90	Dry Lot Subdivision
3	Country Club Annex	Gila	1.0	15.0	22	46		Inadequate	A1	07/30/85	Arizona Water Company
4	Country Club Annex Unit 1	Gila	1.0	15.0	22	34	22-300428	Inadequate	A1	03/27/98	Arizona Water Company
5	Dream Catcher Ranch	Gila	6.0	13.0	24, 25	63	22-300058	Inadequate	A2	10/20/95	Dry Lot Subdivision
6	Kristy Terrace	Gila	1.0	15.0	22	10		Inadequate	A1, A2	06/10/76	Arizona Water Company
7	Kristy Terrace # 2	Gila	1.0	15.0	22	7		Inadequate	A1	04/20/84	Arizona Water Company
8	Miami Gardens	Gila	1.0	15.0	21, 27	40		Inadequate	A2	07/07/75	Arizona Water Company
9	Morning Shadow Estates	Gila	1.0	15.0	22	50		Inadequate	A2	02/23/77	Arizona Water Company
10	Mountain Gate Unit One	Navajo	9.0	22.0	16	59	22-400802	Adequate		10/09/02	Arizona Water Company - Lakeside
11	Pinto Creek Valley	Gila	3.0	13.0	11	NA		Inadequate	A1	05/22/92	Roosevelt Lake Resort Water Company
12	Pioneer Hills	Gila	1.0	15.0	15, 22	170		Inadequate	A1, A2	09/03/74	Arizona Water Company
13	Quail Run Mobile Home Subdivision	Gila	3.0	13.0	15	74	22-300053	Inadequate	A1	10/11/95	Quail Run Homeowners' Association
14	Quail Run Subdivision	Gila	3.0	13.0	15	74	22-300174	Inadequate	A1	07/17/96	Quail Run Homeowners' Association
15	Roosevelt Lake RV Resort	Gila	3.0	13.0	15	167		Inadequate	A1	03/11/93	Utility Management Services and Operations,
16	Sierra Grande	Gila	1.0	15.0	14	19		Inadequate	A2	02/07/75	Arizona Water Company
17	Tierra Madre	Gila	9.0	13.0 14.0	24 19	47		Adequate		02/23/77	Dry Lot Subdivision

Notes:
[1]Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.
[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.
[3] A. Physical/Continuous
1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
2) Insufficient Supply (existing water supply unreliable or physically unavaible;for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)
B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records
NA = Not Available

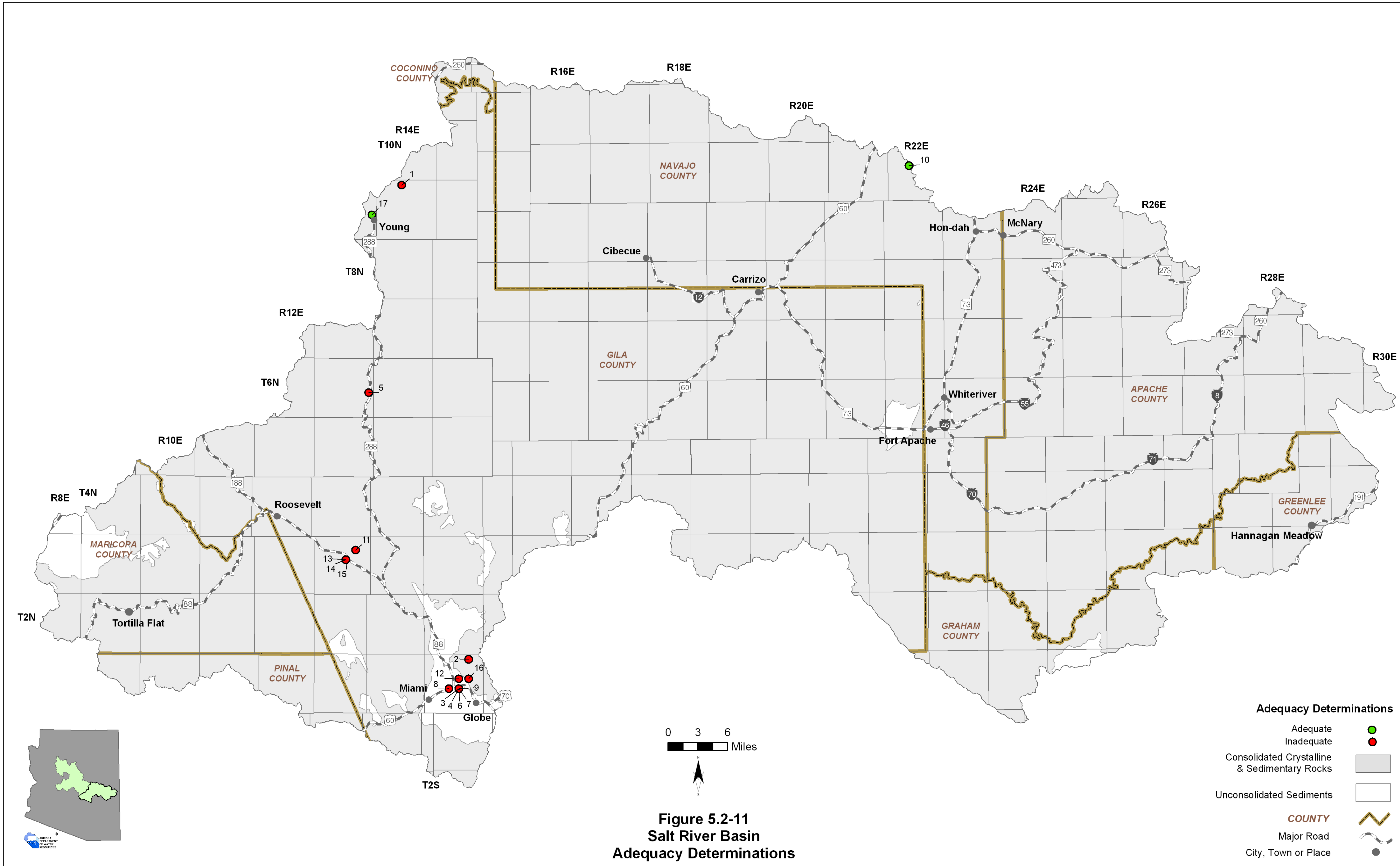


Figure 5.2-11
Salt River Basin
Adequacy Determinations

Salt River Basin
References and Supplemental Reading

References

A

Anderson, T.W., and Freethey, G.W., 1995, Simulation of groundwater flow in alluvial basins in south central Arizona and parts of adjacent states: USGS Professional Paper 1406-D.*

Anning, D., 2003, Assessment of selected inorganic constituents in streams in the Central Arizona basin study area, Arizona and Northern Mexico, through 1998: USGS Water Resources Investigations Report 03-4063.*

Arizona Corporation Commission (ACC), 2005, Annual reports, Private Sewer companies, 1990 to 2005: ACC Utilities Division.

______, 2005, Annual reports, Small water providers, 1990 to 2005: ACC Utilities Division.*

Arizona Crop and Livestock Reporting Service, 1973, 1972 Arizona Agricultural Statistics: Bulletin S-8.

Arizona Department of Economic Security (DES), 2005, Workforce Informer: Data file, accessed August 2005, http://www.workforce.az.gov.*

Arizona Department of Environmental Quality (ADEQ), 2005, Active dairy farms & feedlots: Data file, received October 2005.

_____, 2005, ADEQSWI: Data file, received September 2005.*

_____, 2005, ADEQWATP: Data file, received May 2005.*

_____, 2005, ADEQWWTP: Data file, received August 2005.*

_____, 2005, Azurite: Data file, received September 2005.

_____, 2005, Effluent dependent waters: GIS cover, received December 2005.

_____, 2005, Impaired lakes and reaches: GIS cover, received January 2006.*

_____, 2005, Surface water sources used by water providers: Data file, received June 2005.*

_____, 2005, WWTP and permit files: Miscellaneous working files, received July 2005.

_____, 2004, Water providers with arsenic concentrations in wells over 10ppb: Data file, received August 2004.*

_____, 2004, Water quality exceedences by watershed: Data file, received June 2004.*

_____, 2004, Water quality exceedences for drinking water providers in Arizona: Data file, received September 2004.*

Arizona Department of Mines and Mineral Resources (ADMMR), 2005, Active mines in Arizona: Database, accessed at http:// www.admmr.state.az.us.*

Arizona Department of Water Resources (ADWR), 2006, Assured and adequate water supply applications: Project files, ADWR Hydrology Division.*

______, 2006, Statement of claimants filed by the Indian tribes or the United States on their behalf in the Gila and Little Colorado River adjudications: Data files, ADWR Office of Planning and Adjudications Support.*

______, 2005, Agricultural Surface Water Use Estimates: Unpublished analysis, ADWR Office of Resource Assessment Planning.*

______, 2005, Automated recorder sites: Data files, ADWR Basic Data Unit.*

______, 2005, 2004 rural water provider questionnaire: Data files, ADWR Office of Resource

Assessment Planning.*
______, 2005, Assured and adequate water supply determinations: Database, ADWR Office of Assured and Adequate Water Supply.*
______, 2005, Flood warning gages: Database, ADWR Office of Water Engineering.*
______, 2005, Inspected dams: Database, ADWR Office of Dam Safety.*
______, 2005, Non-jurisdictional dams: Database, ADWR Office of Dam Safety.
______, 2005, Groundwater Site Inventory (GWSI): Database, ADWR Hydrology Division.
______, 2005, Registry of surface water rights: ADWR Office of Water Management.*
______, 2005, Water Protection Fund: Database, ADWR Office of Drought, Conservation and Riparian Planning.
______, 2005, Water use by golf courses in rural Arizona: Unpublished analysis, ADWR Office of Regional Strategic Planning.*
______, 2005, Wells55: Database.*
______, 2002, Groundwater quality exceedences in rural Arizona from 1975 to 2001: Data file, ADWR Office of Regional Strategic Planning.*
______, 1994, Arizona Water Resources Assessment, Vol. I, Inventory and Analysis.*
______, 1994, Arizona Water Resources Assessment, Vol. II, Hydrologic Summary.*
______, 1992, Hydrographic Survey Report for the Upper Salt River Watershed: Volume 1 General Assessment.*
______, 1990, Draft outline of basin profiles for the state water assessment: ADWR Statewide Planning Division, Memorandum to L. Linser, January, 16, 1990.*
Arizona Game and Fish Department (AGF), 2005, Arizona Waterways: Data file, received April 2005.*
______, 1997 & 1993, Statewide riparian inventory and mapping project: GIS cover.*
______, 1982, Arizona Lakes Classification Study.*
Arizona Land Resource Information System (ALRIS), 2005, Springs: GIS cover, accessed January 2006 at http://www.land.state.az.us/alris/index.html.*
_______, 2005, Streams: GIS cover, accessed 2005 at http://www.land.state.az.us/alris/index.html.*
______, 2005, Water features: GIS cover, accessed July 2005 at http://www.land.state.az.us/alris/index.html.*
______, 2004, Land ownership: GIS cover, accessed in 2004 at http://www.land.state.az.us/alris/index.html.*
Arizona Meteorological Network (AZMET), 2005, Arizona climate stations: Pan evaporation data, accessed December 2005 at http://www.ag.arizona.edu/azmet/locate.html.
Arizona Water Commission, 1975, Summary, Phase I, Arizona State Water Plan, Inventory of resource and uses.

B

Bureau of Geology and Mineral Resources, 1982, Geothermal Resources of Arizona: University of Arizona map.*

D

Diroll, M., and Marsh, D., 2006, Status of water quality in Arizona-2004 integrated 305(b) assessment and 303(d) listing report: ADEQ report.*

E

Environmental Protection Agency (EPA), 2005, Surf Your Watershed: Facility reports, accessed April 2005 at http://oaspub.epa.gov/enviro/ef_home2.water.*

______, 2005, 2000 and 1996, Clean Watershed Needs Survey: datasets, accessed March 2005 at http://www.epa.gov/owm/mtb/cwns/index.htm.*

______, 2002, Total Maximum Daily Load for Copper in Pinto Creek, Arizona, USEPA Region 9.

F

Fisk, G.G., Duet, D.W., Evans, C.E., Angernoth, N.K., and Longsworth, S.A., 2004, Water Resources Data, Arizona Water Year 2003: USGS Water-Data Report AZ-03-1.*

Freethey, G.W. and Anderson, T.W. 1986, Predevelopment hydrologic conditions in the alluvial basins of Arizona and adjacent parts of California and New Mexico: USGS Hydrologic Investigations Atlas-HA664.*

G

Gellenbeck, D.J. and Hunter, Y., 1994, Hydrologic data from the study of acid contamination in the Miami Wash- the Pinal Creek area, Arizona, water years 1992-1993: USGS Open file 94 – 508.*

K

Konieczki, A.D. and Wilson, R.P., 1992, Annual summary of ground-water conditions in Arizona, spring 1986 to spring 1987: USGS Open File Report 92-54.*

L

Larcher, L. 2005, White Mountain Apache tribe hydrologist: personal communication.*

M

McCormack, H.F., Fisk, G.G., Duet, N.R., Evans, D.W., Roberts, W.P., and Castillo, N.K., 2002, Water resources data Arizona, water year 2002: USGS Water Data Report AZ-02-1.*

N

Natural Resources Conservation Service (NRCS), 2005, SNOTEL (Snowpack Telemetry) stations: Data file, accessed December 2005 at http://www3.wcc.nrcs.usda.gov/nwcc/sntlsites.jsp?state=AZ.*

______, 2005, Snow Course stations: Data file, accessed December 2005 at http://www.wcc.nrcs.usda.gov/nwcc/snow-course-sites.jsp?state=AZ.*

O

Oregon State University, Spatial Climate Analysis Service (SCAS), 2006, Average annual precipitation in Arizona for 1961-1990: PRISM GIS cover, accessed in 2006 at www.ocs.orst.edu/prism.*

P

Parker, J., Steinkampf, W. and Flynn, M., 2005, Hydrogeology of the Mogollon Highlands, central Arizona: USGS Scientific Investigations Report 2004-5294.*

Pope, G.L., Rigas, P.D., and Smith, C.F., 1998, Statistical summaries of streamflow data and characteristics of drainage basins for selected streamflow-gaging stations in Arizona through water year 1996: USGS Water Resources Investigations Report 98-4225.*

T

Tadayon, S., 2004, Water withdrawals for irrigation, municipal, mining, thermoelectric-power, and drainage uses in Arizona outside of the active management areas, 1991-2000: USGS Scientific Investigations Report 2004-5293, 27 pp.*

Truini, M.*

U

US Army Corps of Engineers, 2004 and 2005, National Inventory of Dams: Arizona Dataset, accessed November 2004 to April 2005 at http://crunch.tec.army.mil/nid/webpages/nid.cfm.*

US Geological Survey (USGS), 2006, Average annual runoff in the United States, 1951-1980: Data file, accessed March 2006 at http://aa179.cr.usgs.gov/metadata/wrdmeta/runoff.htm.*

______, 2006, Springs and spring discharges: Dataset, received November 2004 and January 2006 from USGS office in Tucson, AZ.*

______, 2006, National Hydrography Dataset: Arizona dataset, accessed at http://nhd.usgs.gov/.*

______, 2005, National Water Information System (NWIS): Arizona dataset, accessed December 2005 at http://waterdata.usgs.gov/nwis.*

______, 2004, Southwest Regional Gap analysis study- land cover descriptions: Electronic file, accessed January 2005 at http://earth.gis.usu.edu/swgap.*

______, 1981, Geographic digital data for 1:500,000 scale maps: USGS National Mapping Program Data Users Guide.*

V

Valencia, R.A., Wennerlund, J.A., Winstead, R.A., Woods, S., Riley, L., Swanson, E., and Olson, S., 1993, Arizona riparian inventory and mapping project: Arizona Game and Fish Department.*

W

Wahl, C.R., Boe, S.R., Wennerlund, R.A., Winstead, R.A., Allison, L.J., Kubly, D.M., 1997, Remote sensing mapping of Arizona intermittent stream riparian areas: Arizona Game and Fish Technical Report 112.*

Water Infrastructure Finance Authority of Arizona (WIFA), 2005, Clean Watershed Needs Survey-2004: Unpublished data sheets, received July 2005.

Western Regional Climate Center (WRCC), 2005, Pan evaporation stations: Data file accessed December 2005 at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~GetCity~USA.*

______, 2005, Precipitation and temperature stations: Data file, accessed December 2005

at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~GetCity~USA.*
Wilson, R.P., 1992, Summary of groundwater conditions in Arizona 1985 to 1986: USGS Water Resources Investigation Report, 90-4179.*

*All references marked with an asterisk contain information that was directly used in the basin summaries, tables or maps.

Supplemental Reading

Angeroth, C.E., 2002, Characterization of hydraulic conductivity of the alluvium and basin fill, Pinal Creek basin near Globe, Arizona: USGS Water Resources Investigations Report 02-420515 p.

Angeroth, C.E., Fuller, C.C., Glynn, P.D., and Harvey, J.W., 1999, Surface and groundwater investigations in Pinal Creek basin near Globe, Arizona: in Water Issues and Partnerships for Rural Arizona: Proceedings of the 12th annual Arizona Hydrological Society Symposium, September 1999, Pinetop, Arizona.

Andersen, Mark, 2005, Assessment of water availability in the Lower Colorado River basin: in Conservation and Innovation in Water Management: Proceedings of the 18th annual Arizona Hydrological Society Symposium, Flagstaff, Arizona, September, 2005.

Anning, D.W., 1999, Concentrations and stream loads of nitrogen and phosphorus in surface water resources of central Arizona: in Water Issues and Partnerships for Rural Arizona: Proceedings of the 12th annual Arizona Hydrological Society Symposium, September 1999, Pinetop, Arizona.

Anning, D. W., 2004, Effects of natural and human factors on stream water quality in central Arizona: USGS Water Resource Supplement Jan.-Feb.

Arizona Department of Water Resources, 1996, Review of springs on the Fort Apache Indian Reservation.

Arizona Water Company, 2007, System Water Plan: Miami Water System, Submitted to the Arizona Department of Water Resources.

Baker, M.B., 1999, History of watershed research in the central Arizona highlands: US Forest Service Technical Report, GTR-29.

Baldys, S., and Bayles, J.A., 1990, Flow characteristics of streams that drain the Ft. Apache and San Carlos Indian Reservations, east central Arizona: USGS Water Resources Investigation Report 90-4053.

Baldys, S., and Hjalmarson, H.W., 1994, Effects of controlled burning of chaparral on streamflow and sediment characteristics, East Fork Sycamore Creek, Central Arizona: USGS Water Resources Investigations Report 93-4102,33p.

Best, J.E., 2002, Geochemical characterization of trace metal substitution in manganese precipitates from Pinal Creek, Arizona: Arizona State University, M.S. thesis, 126 p.

Bibhuti, P., Rucker, M., and Bansberg, R., 2003, Evaluation of sustainable groundwater resources in a fractured hard rock aquifer: in Sustainability Issues of Arizona's Regional Watersheds: Proceedings of the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona,. *Study done* n*ear Payson*

Brown, J.G., 1996, Hydrology and geochemistry of aquifer and stream contamination related to acidic water in Pinal Creek basin near Globe Arizona: USGS Water Supply Paper 2466, 103 p.

Brown, J.G., Brew, R., and Harvey, J.W., 1997, Research on acidic metal contaminants in Pinal Creek Basin near Globe, Arizona: USGS Fact Sheet FS-005-97.

Brown, J.G., Fuller, C.C., and Harvey, J.W., 2001, Controls on metals attenuation in streamflow and shallow groundwater in Pinal Creek basin near Globe, Arizona: in Proceedings of the 14th annual Arizona Hydrological Society Symposium, September 2001, Tucson, Arizona, p.122.

Brown, J.G., Glynn, P.D., and Bassett, R.L., 1999, Geochemistry and reactive transport of metal contaminants in ground water, Pinal Creek basin, Arizona: USGS Water-Resources Investigations 99-4018A, p. 141-153.

Carpenter, T.L., 2001, The origin of isotopically anomalous waters of the Mogollon Rim region of Arizona: Arizona State University, M.S. thesis, 107 p.

City of Globe, 2006, Drought Preparedness and Water Conservation Plans, Submitted to the Arizona Department of Water Resources.

Condon, A.K., 2003, Investigation of zinc uptake processes by manganese-oxide-coated sediments from a mining-contaminated stream, Pinal Creek, Arizona: University of Arizona, M.S. thesis.

Cordy, G.E., Gellenbeck, D.J., Gebler, J.B., Anning, D.W., Coes, A.L., Edmonds, R.J. Rees, J.A., and Sanger, H.W., 2000, Water quality in the central Arizona basins, Arizona, 1995-1998: USGS Circular 1213.

Cordy, G.E., and Bouwer, H., 1999, Where do the salts go? The potential effects and management of salt accumulation in south-central Arizona: USGS Fact Sheet 170-98, 4 p.

Cordy, G.E., Rees, J.A., Edmonds, R.J., Gebler, J.B., Wirt, L., Gellenbeck, D.J., and Anning, D.W., 1998, Water quality assessment of the central Arizona basins, Arizona and northern Mexico - An environmental setting and overview of water quality: USGS Water Resources Investigations Report 98-4097, 72 p.

Davey, J. V., 1985, The mixing of waters of the Salt and Verde rivers: University of Arizona M.S. thesis.

Eychaner, J.H., 1991, Inorganic contaminants in acidic water near Globe, Arizona: in Desert Water Quality and Quantity - Issues into the 21st Century: in Proceedings from the 3nd annual Arizona Hydrological Symposium, September 1990, Casa Grande, Arizona, p.242-252.

Eychaner, J.H., 1991, Solute transport in perennial streamflow at Pinal Creek, Arizona: USGS Water Resources Investigations Report 91-4034.

Flinchbaugh, H., 1996, Biotic and abiotic processes contributing to the removal of Mn(II), Co(II) and Cd(II) from Pinal Creek, Globe, Arizona: University of Arizona, M.S. thesis.

Fuller, C.C., and Harvey, J.W., 1999, The effect of trace-metal reactive uptake in the Hyporheic zone on reach-scale metal transport in Pinal Creek, Arizona: in the USGS Toxic Substance Hydrology Program: Proceedings of the technical meeting in March 1999, Charleston, SC: USGS Water-Resources Investigations, p.163-172.

Fuller, C.C., and Harvey, J.W., 2000, Reactive uptake of trace metals in the hyporheic zone of a mining-contaminated stream, Pinal Creek, Arizona: Environmental Science and Technology, vol. 34, no. 7, p. 1150-1155.

Gebler, J. B., 1998, Water quality of selected effluent dependent stream reaches in southern Arizona as indicated by concentrations of periphytic chlorophyll *a* and aquatic invertebrate communities: USGS Water Resources Investigations Report 98-4199, 12 p.

Gebler, J.B., 2000, Organochlorine compounds in streambed sediment and in biological tissue from streams and their relations to land use, Central Arizona: USGS Water Investigations Report 00-4041.

Geiger, K.M., 1990, Characterization and distribution of transition metals in manganese oxides from a mining-contaminated stream, Pinal Creek, Arizona: Arizona State University, M. S. thesis, 128 p.

Gellenbeck, D.J., and Anning, D.W., 2002, Occurrence and distribution of pesticides and volatile organic compounds in groundwater and surface water in Central Arizona basins, 1996-1998, and their relation to land use: USGS Water Resources Investigations Report 01-4144, 107 p.

Haag, D.M., Whitmore, P.C., Plato, P.R., Travers, B.C., Hulst, M.A., Culbertson, C. and Legg, C.J., 1999, The hydro-geologic conceptual model for the Payson water quality assurance revolving fund site - Payson, Arizona: in Water Issues and Partnerships for Rural Arizona: Proceedings of the 12th annual Arizona Hydrological Society Symposium, September 1999, Pinetop, Arizona.

Ham, L.K., 1995, Historical overview and limnological reconnaissance of Theodore Roosevelt Lake, Arizona: USGS Water Resources Investigations Report 95-4053, 36 p.

Hart, R.J., Ward, J.J., Bills, D.J., and Flynn M.E., 2002, Generalized hydrology and groundwater budget for the C aquifer, Little Colorado River basin, and parts of Verde and Salt River basin, Arizona and New Mexico: USGS Water Resources Investigations Report 02-4026, 47 p.

Harvey, J.W., Conklin, M.H., Koelsch, R.S., 2003, Predicting changes in hydrologic retention in an evolving semi-arid alluvial stream: in Modeling Hyporheic Zone Processes, Runkel, R.L., McKnight, D.M., Rajaram, H., eds., Advances in Water Resources, 26, 9, p. 939-950.

Harvey, J.W. and Fuller, C.C., 1996, Association of selected metals with colloidal and suspended particulate material in shallow ground water and surface water at Pinal Creek, Arizona: in the USGS Toxic Substances Hydrology Program: Proceedings of the technical meeting in September 1993, Colorado Springs, Colorado: USGS Water-Resources Investigations Report 94-4015, p. 1073-1080.

Harvey, J.W., Fuller, C.C., and Wagner, B.J., 1996, Interactions between shallow ground water and surface water that affect metal transport in Pinal Creek, Arizona, in Morganwolp, D.W., and Aronson, D.A., eds., U.S. Geological Survey Toxic Substances Hydrology Program—Proceedings of the Technical Meeting, Colorado Springs, Colorado, September 20-24, 1993L U.S. Geological Survey Water-Resources Investigations Report 94-4015, p. 1065-1072.

Hirschboeck, K.K., 2004, Using tree rings to determine the long-term record of synchronous extreme stream flow episodes in the Salt-Verde and Upper Colorado River basins: in The Value of Water: Proceedings from the 17th annual Arizona Hydrological Society symposium, September 2004, Tucson Arizona.

Hulseapple, S.M., 1995, A field study of re-aeration and solute transport at Pinal Creek, Globe, Arizona, August 1995, University of Arizona, M.S. thesis.

Ingram, R.S., 2003, Groundwater pumping and injection well recharge system for

Arizona Department of Highway road construction purposes on the Tonto National Forest: in Sustainability Issues of Arizona's Regional Watersheds: Proceedings of the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona.

Jones, C., 2003, Public policy, cows, riparian areas, drought, sustainability and the Tonto National Forest: in Sustainability Issues and Arizona's Regional Watersheds: Proceedings of the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona.

Kay, J.T., 2000, The reactive uptake and release of Mn(II), Co(II), Ni(II), and Zn(II) by sediments from a mining-contaminated stream, Pinal Creek, Arizona: University of Arizona, M.S. thesis.

Keadle, D.A., Brown, C.A., Eichberg, S., Musielak, W.D., Whitmer, T., Rall, K.L., 1999, Verde River watershed study: in Water Issues and Partnerships for Rural Arizona: Proceedings of the 12th annual Arizona Hydrological Society Symposium, September 1999, White Mountains Arizona.

Koelsch, R.S., 2000, Effect of floods and recovering aquatic vegetation on surface and subsurface storage processes at Pinal Creek, Globe, Arizona: University of Arizona, M.S. thesis.

Konieczki, A.D., and Angeroth, C.E., 1997, Hydrologic data from the study of acid contamination in the Miami Wash-Pinal Creek area, Arizona: USGS Open – File Report 97-247, 94 p.

Lacher, L.J., 2002, Drought conditions preceding the Rodeo-Chediski fire in the White Mountains of Arizona: in Water Transfers: Past, Present and Future: Proceedings of the15th annual Arizona Hydrological Society Symposium, September 2002, Flagstaff, Arizona.

Long, J.W., 1999, Riparian restoration projects on the White Mountain Apache Reservation: in Water Issues and Partnerships for Rural Arizona: Proceedings of the 12th annual Arizona Hydrological Society Symposium, September 1999, Pinetop, Arizona.

Lovely, C., 2003, Hydrologic impacts of the Rodeo-Chedeski fire: in Sustainability Issues of Arizona's Regional Watersheds: Proceedings of the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona.

Marble, J.C., 1998, Biotic Contribution of Mn(II) removal at Pinal Creek, Globe, Arizona: University of Arizona, M.S. thesis.

Marble, J.C., Corley, T.L., Conklin, M.H., 1999, Representative plant and algal uptake of metals near Globe, Arizona: in the USGS Toxic Substances Hydrology Program: Proceedings of the technical meeting in March 1999, Charleston, SC: USGS Water Resources Investigation Report, p. 239-245.

Marble, J.C., Corley, T.L., Conklin, M.H., Fuller, C.C., 1999, Environmental factors affecting oxidation of manganese in Pinal Creek, Arizona: in the USGS Toxic Substances Hydrology Program: Proceedings of the technical meeting in March 1999, Charleston, SC: USGS Water Resources Investigations Report, p. 173-183.

Melis, T.S., 1990, Evaluation of Flood Hydrology on Twelve Drainage Basins in the Central Highlands Region of Arizona: An Integrated Approach: Northern Arizona University, M.S. thesis, 135 p.

Neaville, C.C., and Brown J.G., 1994, Hydrogeology and hydrologic system of Pinal Creek basin, Gila County, Arizona: USGS Water Resources Investigations Report, 93-4212, 33 p.

Oureshi, M.T.A., 1995, Sources of arsenic in the Verde River and the Salt River watersheds, Arizona: Arizona State University, M.S. thesis, 116 p.

Parker, E.A., 1998, A Photochemical study of manganese oxides from Pinal Creek, Globe, Arizona: University of Arizona, M.S. thesis.

Plato, P.R., Haag, R.G., Travers, B.C., Whitmore, P.C., Legg, C.J., and Culbertson, A.C., 1998, Development of a groundwater flow model for water treatment system design for the town of Payson WRQF site: in Water at the Confluence of Science, Law and Public Policy: Proceedings of the 11th annual Arizona Hydrological Society Symposium, September 1998, Tucson, Arizona, p. 40-41.

Plato, P.R., Nesky, M., Travers, R.G., Haag, D.M., and Downs, L.A., 1999, Town of Payson water quality assurance revolving fund site groundwater treatment facility, Payson, Arizona: in Water Issues and Partnerships for Rural Arizona: Proceedings of the 12th annual Arizona Hydrological Society Symposium, September 1999, Pinetop, Arizona.

Pool, D.R., and Eychaner, J.H., 1991, Temporal microgravity measurements of aquifer storage change and specific yield along Pinal Creek, central Arizona: in Abstracts and Programs: Geological Society of America Annual Meeting, October 1991, San Diego California, p.A124.

Pool, D.R., and Leenhouts, J.M., 2002, A multi-parameter approach for measuring flood induced aquifer and bank storage changes along the San Pedro River, Arizona: in Supplement to Eos Transactions: American Geophysical Union 2002 Fall Meeting, December 2002, San Francisco California, vol.83, no.47, Abstract H61B-0779.

Reese, R.S., Bassett, R.L., 1990, Characterization of organic contamination of ground water in a mining area, Globe, Arizona: in Ground Water Geochemistry, Kansas City, MO, United States, Feb. 20-21, 1990: Ground Water Management, 1, p. 221-236.

Robbins, E., 2003, The role of water speedwell in the distribution and rates of metal removal from Pinal Creek, near Globe, Arizona: University of Arizona, M.S. thesis.

Robbins, E.I., Corley, T.L., Conklin, M.H., 1999, Manganese removal by epilithic microbial consortium at Pinal Creek near Globe, Arizona: in Morganwalp, D.W., and Buxton, H.T., eds., U.S. Geological Survey Toxic Substances Hydrology Program; proceedings of the technical meeting, Charleston, SC, United States, March 8-12, 1999: USGS Water-Resources Investigations, p.247-258.

Robertson, F.N., 1991, Geochemistry of groundwater in alluvial basins of Arizona and adjacent parts of Nevada, New Mexico and California: USGS Professional Paper 1406-C, 87 p.

Wagner, B.J., Harvey, J.W., 1993, Solute-transport parameter estimation for an injection experiment at Pinal Creek, Arizona: in the USGS Toxic Substances Hydrology Program: Proceedings of the technical meeting in September 1993, Colorado Springs, CO, USGS Water Resources Investigation Report, p. 1081-1087.

Wallin, R.W., 1991, Ground water transport of polycyclic aromatic hydrocarbons in association with humic substances in the Pinal Creek basin, Globe, Arizona: University of Arizona, M.S. thesis.

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Section 5.3
Tonto Creek Basin

5.3.1 Geography of the Tonto Creek Basin

The Tonto Creek Basin, located in the east central part of the planning area is 955 square miles in area. Geographic features and principal communities are shown on Figure 5.3-1. The basin is characterized by mid-elevation mountain ranges. Vegetation types include Sonoran desertscrub, semidesert grassland, chaparral, woodland and montane conifer forests. Riparian vegetation is found along streams including mixed broadleaf, tamarisk and mesquite along Tonto Creek.

- Principal geographic features shown on Figure 5.3-1 are:
    - Basin communities of Punkin Center, Rye, Star Valley and Kohls Ranch
    - Tonto Creek running north to south through the center of the basin from Kohls Ranch and exiting the basin about eight miles south of Punkin Center
    - The lowest point in the basin is about 5,000 feet along Tonto Creek where it exits the basin
    - Rye Creek flowing through Rye in the western portion of the basin
    - Spring Creek and Hayler Creek flowing from the eastern basin boundary to Tonto Creek
    - The Tonto Basin located in the south central part of the basin along Tonto Creek
- Not well shown on Figure 5.3-1 are
    - The Mogollon Rim along the northern basin boundary
    - The Sierra Ancha Mountains along the eastern boundary
    - The Mazatzal Mountains along the western boundary, which contain the highest point in the basin, Mazatzal Peak at 7,888 feet

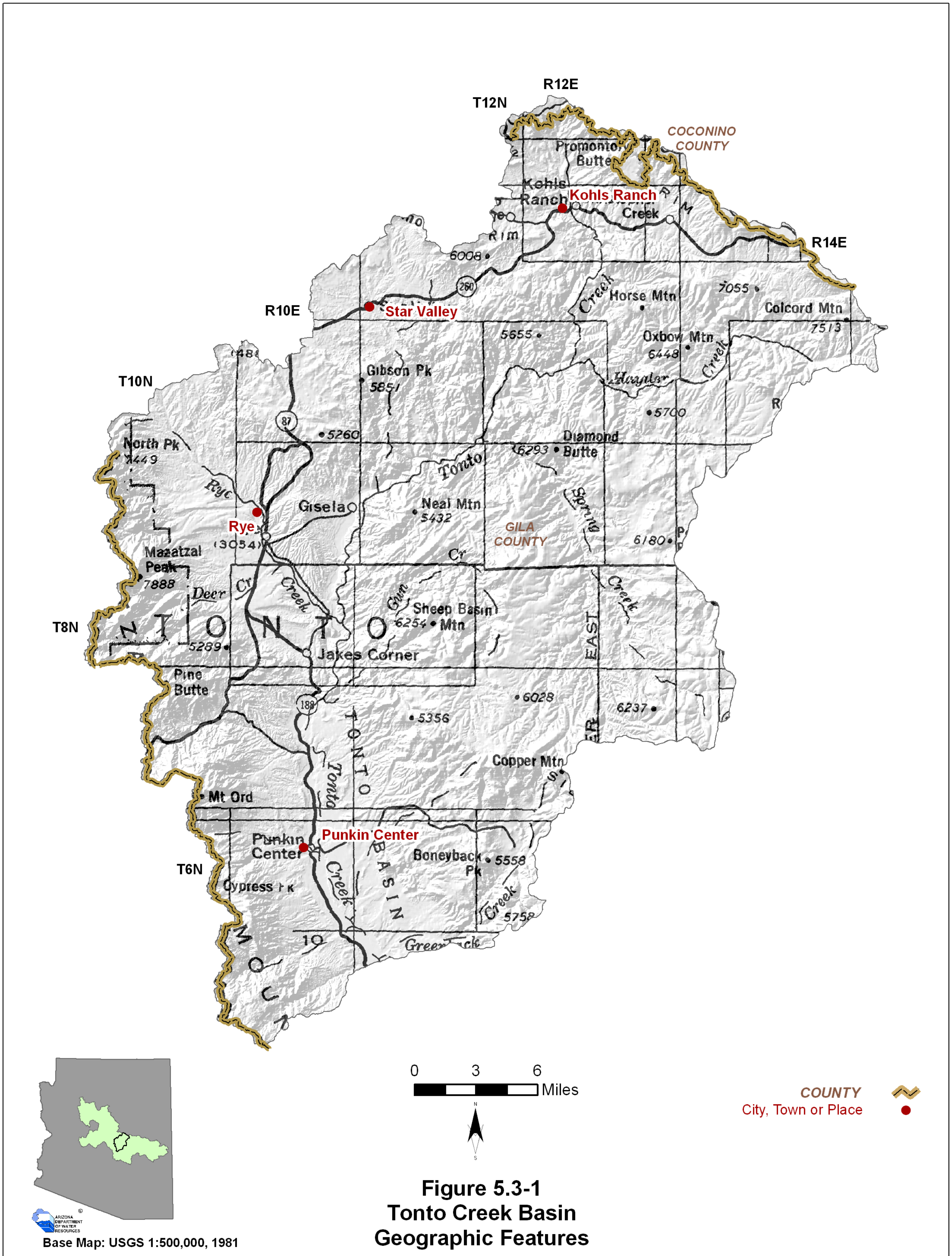


Figure 5.3-1
Tonto Creek Basin
Geographic Features

5.3.2 Land Ownership in the Tonto Creek Basin

Land ownership, including the percentage of ownership by category, for the Tonto Creek Basin is shown in Figure 5.3-2. The principal feature of land ownership in this basin is the large amount of forest service land. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

National Forest and Wilderness

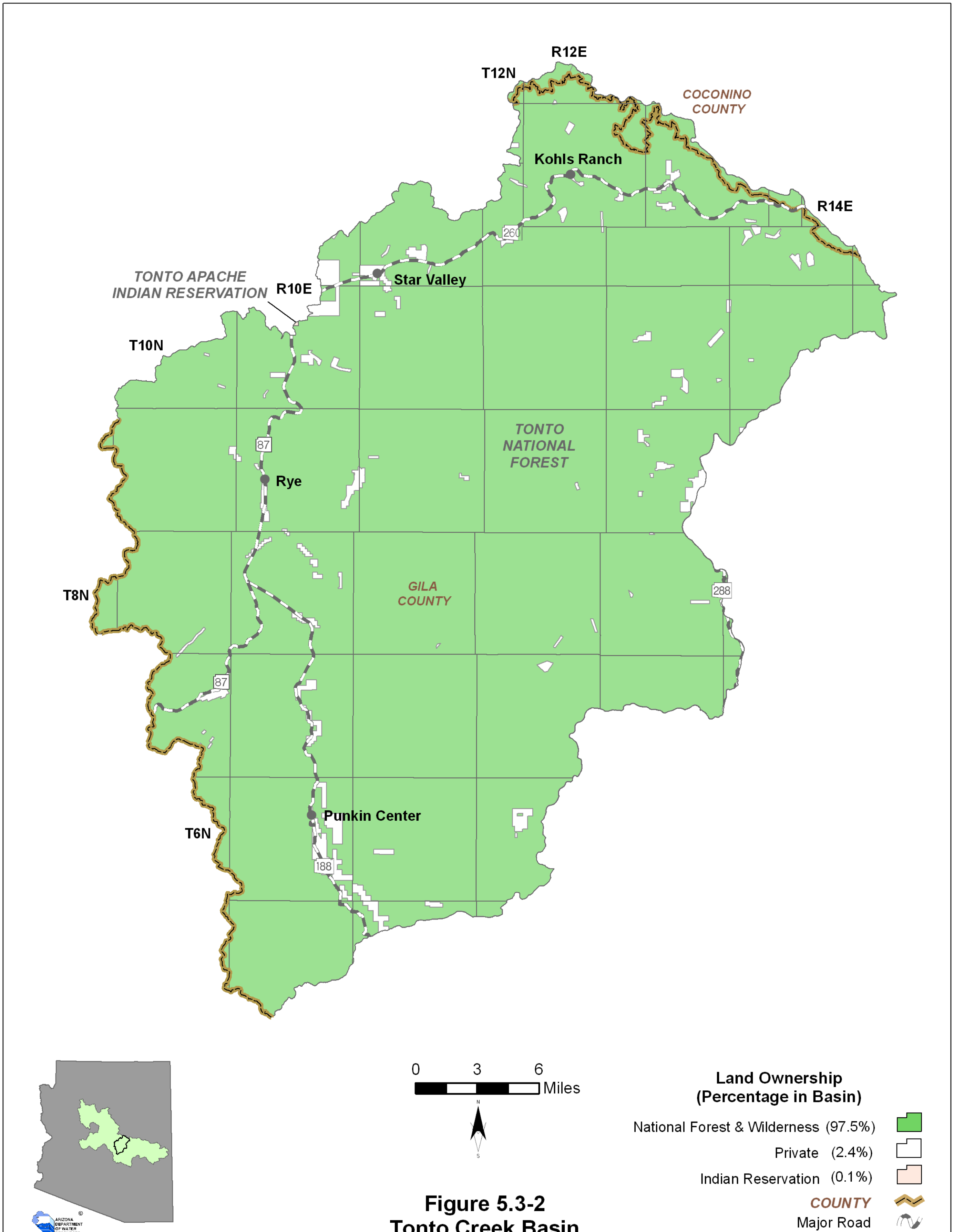
- 97.5% of the land is federally owned and managed as National Forest and Wilderness, the largest percentage of any basin in the planning area.
- Forest lands in the basin are part of the Tonto National Forest.
- The basin contains two wilderness areas, a portion of the 250,053-acre Mazatzal Wilderness and the entire 37,399-acre Hellsgate Wilderness.
- There are numerous small private in-holdings.
- Land uses include recreation, grazing and timber production.

Private

- 2.4% of the land is private.
- Small in-holdings of private land are scattered throughout the basin with a number of larger parcels in the vicinity of Punkin Center and Star Valley.
- Land uses include domestic, commercial and ranching.

Indian Reservation

- 0.1% of the land is under ownership of the Tonto Apache tribe.
- The small portion of tribal land in this basin is located in T10N, R10E.
- Land use includes domestic and ranching.



Source: ALRIS, 2004
Bureau of Land Management, 1999

Figure 5.3-2
Tonto Creek Basin
Land Ownership

5.3.3 Climate of the Tonto Creek Basin

Climate data from NOAA/NWS Co-op Network and SNOTEL/Snowcourse stations are complied in Table 5.3-1 and the locations are shown on Figure 5.3-3. Figure 5.3-3 also shows precipitation contour data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Tonto Creek Basin does not contain Evaporation Pan or AZMET stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 5.3-1A
- Elevation at the three NOAA/NWS Co-op network stations is similar, ranging from 2,360 feet at Punkin Center to 2,900 feet at Gisela.
- Minimum average temperature ranges from 40.8°F at Gisela to 45.3°F at Punkin Center.
- Maximum average temperatures are also similar and range from 86.8°F at Reno R.S. to 81.9°F at Gisela.
- Station precipitation ranges from 18.23 inches at Punkin Center to 19.77 at Reno R.S.
- The Reno R.S. station reports highest average seasonal rainfall in the fall (October-December) and the other two stations report highest seasonal annual rainfall in the winter (January – March). All three stations report the lowest seasonal rainfall in the spring (April-June).

SNOTEL/Snowcourse

- Refer to table 5.3-1D
- There are two stations in this basin, Promontory Butte and Promontory Pillow (SNOTEL). The Promontory Butte station was discontinued in 1989.
- Both stations are at an elevation of 7,930 feet and record highest average snowpack in April.
- The highest average snowpack at Promontory Butte is 15.1 inches and at Promontory Pillow (SNOTEL) is 14.1 inches. Snowpack is measured in inches of snow water content. Ten inches of fresh snow can contain as little as 0.10 inches of water or up to 4 inches depending on a number of factors. The majority of U.S. snows fall with a water-to-snow ratio of between 0.04 and 0.10. (NSIDC, 2006)

SCAS Precipitation Data

- See Figure 5.3-3
- Additional precipitation data shows rainfall as high as 38 inches on the northern basin boundary at the Mogollon Rim and as low as 14 inches on the southern basin boundary south of Punkin Center.
- In general, precipitation increases as altitude increases in this basin. The range of 24 inches between areas of highest and lowest precipitation is common for the planning area.

Table 5.3-1 Climate Data for the Tonto Creek Basin

A. NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Gisela	2,900	1895-2004[1]	81.9/Jul	40.8/Dec	6.53	1.39	6.10	4.89	18.91
Reno R.S.	2,420	1915-1973[1]	86.8/Jul	45.1/Jan	3.51	1.05	6.58	8.61	19.77
Punkin Center	2,360	1971-2000	85.9/Jul	45.3/Dec	6.92	1.23	4.83	5.24	18.23

Source: WRCC, 2003.

Notes:
[1]Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*Number of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan.	Feb.	March	April	May	June
Promontory Butte	7,930	1973 - 1989 (discontinued)	4.2*(10)*	8.4*(13)*	13.7*(16)*	15.1*(15)*	11.3*(1)*	0*(0)*
Promontory SNOTEL	7,930	1973 - current	3.9*(25)*	8.1*(28)*	13.7*(31)*	14.1*(30)*	2.3*(22)*	0*(21)*

Source: NRCS, 2005

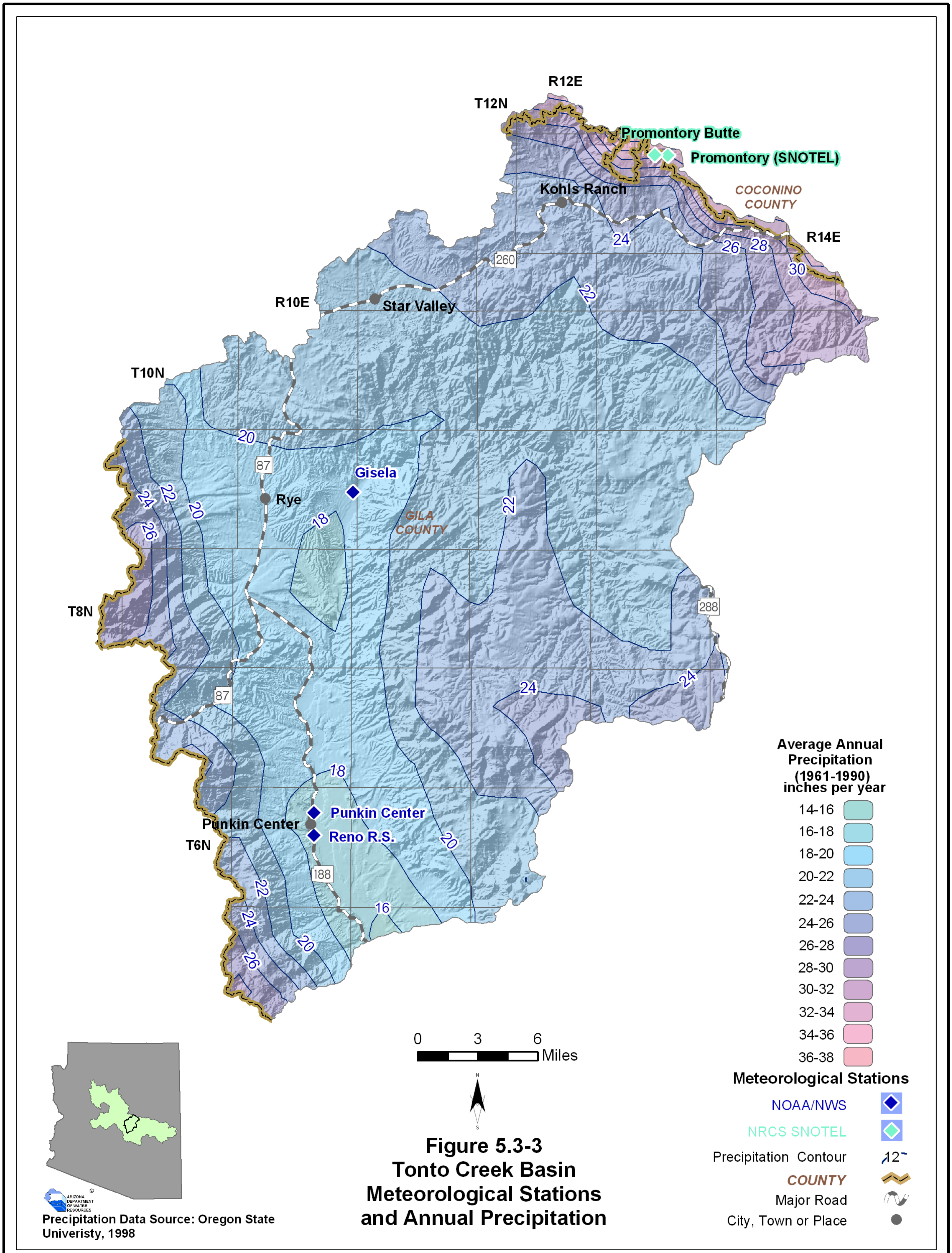


Figure 5.3-3
Tonto Creek Basin
Meteorological Stations
and Annual Precipitation

5.3.4 Surface Water Conditions in the Tonto Creek Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 5.3-2. Flood ALERT equipment in the basin is shown in Table 5.3-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 5.3-4. The location of streamflow gages identified by USGS number, flood ALERT equipment and USGS runoff contours are shown on Figure 5.3-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 5.3-2.
- Data from four stations located on Tonto Creek and Rye Creek are shown in the table and on Figure 5.3-4. Three of the four stations have been discontinued. The fourth station, Tonto Creek above Gun Creek near Roosevelt, is a real-time station.
- The average seasonal flow at all stations is highest in the winter (January-March) when between 43% and 65% of the average annual flow occurs. The average seasonal flow is lowest at all stations in the summer (July-September) when between 7% and 10% of the average annual flow occurs.
- Maximum annual flows range from 469,256 acre-feet (1978, Tonto Creek above Gun Creek near Roosevelt) to 64,289 acre-feet (1978, Rye Creek near Gisela). Minimum annual flows range from 1,245 acre-feet (1971, Rye Creek near Gisela) to 32,796 acre-feet (1974, Tonto Creek near Gisela).
- Both gaged streams in this basin have a mean annual flow of over 10,000 acre-feet. Tonto Creek has a recorded mean annual flow of over 100,000 acre-feet.

Flood ALERT Equipment

- Refer to Table 5.3-3.
- As of October 2005, there were nine stations in the basin. All stations are in Gila County, however, one station is operated by the Maricopa County Flood Control District. The remaining stations are operated by the Gila County Flood Control District.
- Of the nine stations, six are precipitation only stations, two are precipitation/stage stations and one is a repeater/precipitation station.

Reservoirs and Stockponds

- Refer to Table 5.3-4.
- The basin does not contain any large reservoirs.
- Surface water is stored or could be stored in one small reservoir in the basin. This reservoir has a maximum storage of 20 acre-feet.
- There are 389 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 5.3-4.
- Average annual runoff is two inches per year in the southern tip of the basin and increases to five inches per year in the northern portion of the basin.

Table 5.3-2 Streamflow Data for the Tonto Creek Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow (in acre-feet/year)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9498800	Tonto Creek near Gisela	430	5,810	12/1964-9/1975 (discontinued)	43	15	8	33	32,796 (1974)	68,705	93,147	236,741 (1965)	10
9498870	Rye Creek near Gisela	122	4,390	12/1965-9/1985 (discontinued)	65	10	7	18	1,245 (1971)	9,267	19,030	64,289 (1978)	19
9499000	Tonto Creek above Gun Creek near Roosevelt	675	5,020	12/1940-current (real-time)	61	12	8	19	2,853 (2002)	66,297	113,232	469,256 (1978)	62
9499500	Tonto Creek near Roosevelt	841	NA	10/1913-12/1940 (discontinued)	59	17	10	15	17,452 (1934)	89,796	104,292	225,214 (1916)	27

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Notes:
Statistics based on Calendar Year
Annual Flow statistics based on monthly values
Summation of Average Annual Flows may not equal 100 due to rounding.
Period of record may not equal Year of Record used for annual Flow/Year statistics due to only using years with a 12 month record
NA = Data not currently availble to ADWR

Table 5.3-3 Flood ALERT Equipment in the Tonto Creek Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
51	Upper Deer Creek	Precipitation	NA	Gila County FCD
54	Christopher Creek	Precipitation	5/1/2005	Gila County FCD
67	Rock Creek (Rye Tributary)	Precipitation	NA	Gila County FCD
80	Hardt Creek @ SR 87	Precipitation/Stage	NA	Gila County FCD
92	Little Pine Flat	Precipitation	8/29/2005	Gila County FCD
930	Deer Creek Shake Ridge (Bar T Bar North)	Precipitation	NA	Gila County FCD
931	Upper Rye Creek	Precipitation	NA	Gila County FCD
3900	Houston Creek	Precipitation/Stage	10/26/2005	Gila County FCD
5960	Mt. Ord Repeater	Repeater/Precipitation	10/28/1982	Maricopa County FCD

FCD = Flood Control District

NA = Data not currently available to ADWR

Table 5.3-4 Reservoirs and Stockponds in the Tonto Creek Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE	JURISDICTION
None identified by ADWR at this time					

B. Other Large Reservoirs (50 acre surface area or greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
None identified by ADWR at this time					

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 1
Total maximum storage: 20 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)

Total number: 0
Total surface area: 0 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 389 (from water right filings)

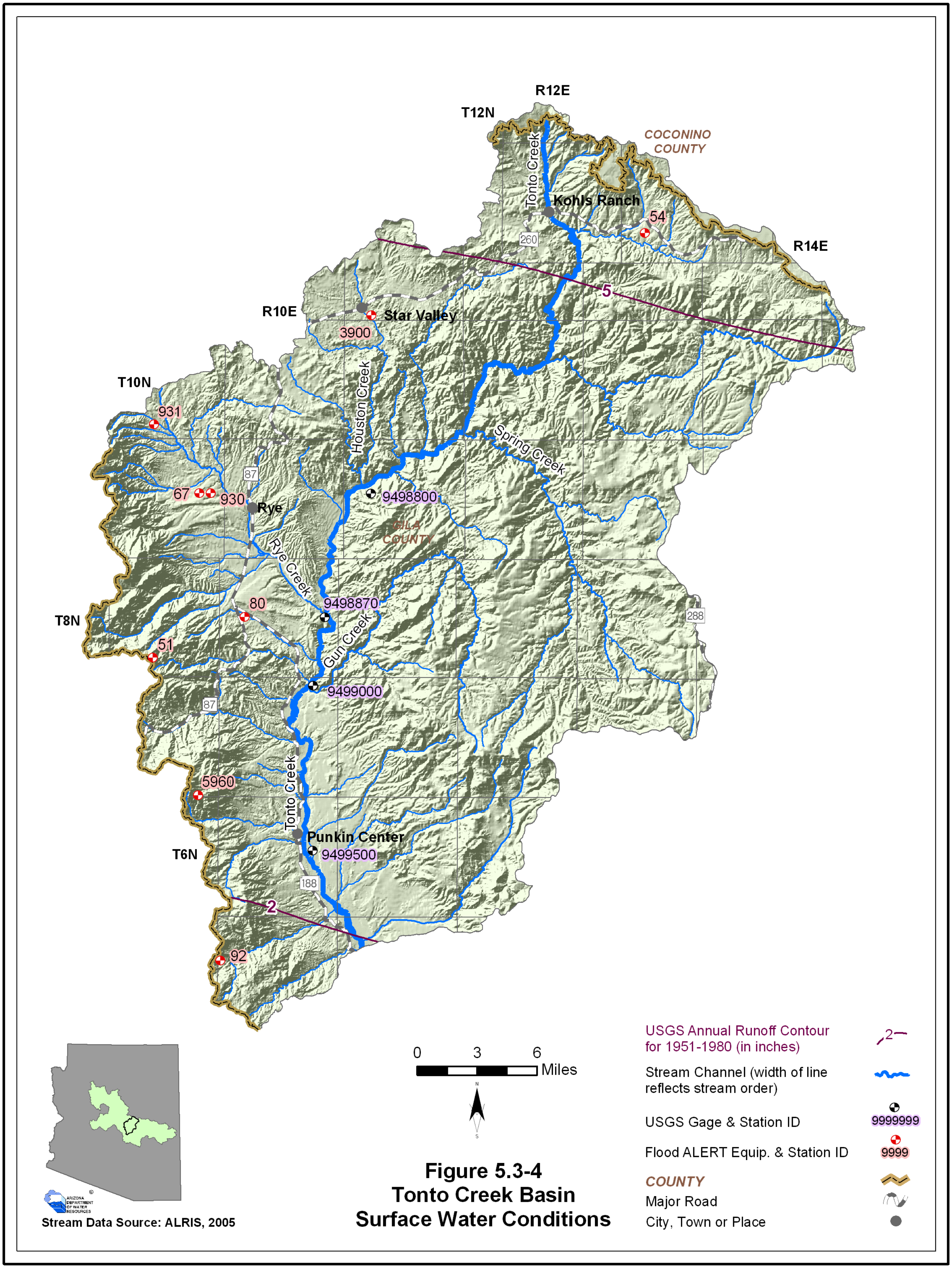


Figure 5.3-4
Tonto Creek Basin
Surface Water Conditions

5.3.5 Perennial/Intermittent Streams and Major Springs in the Tonto Creek Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 5.3-5. The locations of major springs and perennial and intermittent streams are shown on Figure 5.3-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- Perennial streams in this basin include Tonto Creek, Haigler Creek, Spring Creek, Dell Shay Creek, Houston Creek, Christopher Creek and Greenback Creek.
- There are numerous intermittent streams located throughout the basin.
- Tonto Creek is the longest continuously perennial stream in the basin. Most other perennial streams also contain intermittent reaches.
- There are 10 major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions. Only four of the ten springs have measured discharges in the past decade.
- All springs are found in the vicinity of Kohls Ranch in the northern portion of the basin below the Mogollon Rim. The greatest discharge rate was measured near the Gila and Coconino County boundary (Tonto, 1,291 gpm).
- Three of the major springs have measured discharge rates of 100 gpm or greater.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 5.3-5B. There are seven minor springs identified in this basin.
- The total number of springs, regardless of discharge, identified by the USGS varies from 169 to 175, depending on the database reference.

Table 5.3-5 Springs in the Tonto Creek Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Tonto	342312	1110541	1,291	During or prior to 2001
2	R-C	341827	1110311	800	5/14/1952
3	Horton	342217	1110333	392	10/2/2002
4	See	342108	1110039	84	During or prior to 2002
5	Nappa	342118	1110111	70	8/17/1966
6	Henturkey[2]	342037	1110541	60	10/17/1952
7	Wildcat/Arsenic	341726	1111031	59	10/20/1952
8	Indian Gardens	341926	1110610	26	During or prior to 2002
9	Winters # 3	342235	1110633	20	5/16/1952
10	Unnamed[2]	342043	1110054	15	8/17/1966

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Bootleg	341852	1110358	8	During or prior to 2001
Allenbaugh	341620	1105353	8[3]	4/19/2001
Turkey-south	341356	1111752	5[4]	5/14/1952
Blue-south	341007	1111943	4	5/14/1952
Bear Flat/ Columbine	341716	1110357	4	7/16/1975
Winters # 1	342233	1110634	1	5/16/1952
Winters # 2	342233	1110634	1	During or prior to 1952

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and NHD, 2006): 169 to 175

Notes:
[1]Most recent measurement identified by ADWR
[2]Spring is not displayed on current USGS topo maps
[3]Most recent measurement < 1gpm
[4]Average gpm

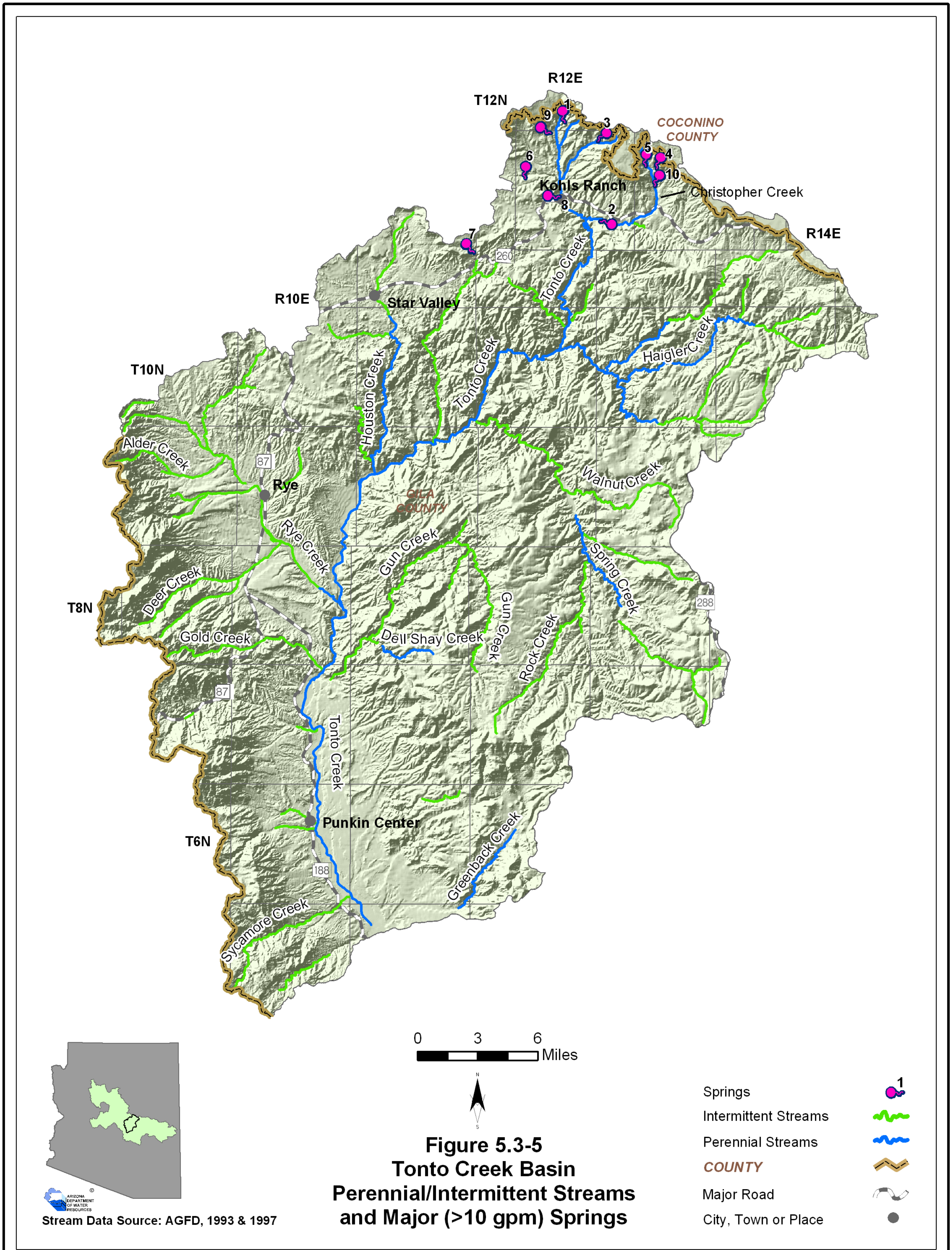


Figure 5.3-5
Tonto Creek Basin
Perennial/Intermittent Streams and Major (>10 gpm) Springs

5.3.6 Groundwater Conditions of the Tonto Creek Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 5.3-6. Figure 5.3-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 5.3-7 contains hydrographs for selected wells shown on Figure 5.3-6. Figure 5.3-8 shows well yields in five yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 5.3-6 and Figure 5.3-6.
- The major aquifers in the basin are basin fill and sedimentary rock (C and R aquifers).
- Most of the basin geology consists of consolidated crystalline and sedimentary rocks.
- Flow direction is generally from the north to the south.

Well Yields

- Refer to Table 5.3-6 and Figure 5.3-8.
- As shown on Figure 5.3-8, well yields in this basin range from less than 100 gallons per minute (gpm) to greater than 2,000 gpm.
- One source of well yield information, based on 51 reported wells, indicates that the median well yield in this basin is 120 gpm.
- The highest well yields in the basin are located along Highway 188 north of Punkin Center.

Natural Recharge

- Refer to Table 5.3-6.
- There are two estimates of natural recharge for this basin ranging from 17,000 acre-feet per year to 37,000 acre-feet per year.

Water in Storage

- Refer to Table 5.3-6.
- There are three estimates of water in storage for this basin ranging from two million acre-feet to 9.4 million acre-feet. The most recent estimate, from a 1994 ADWR study, is three million acre-feet in storage to a depth of 1,200 feet.
- The predevelopment storage estimate is two million acre-feet to a depth of 1,200 feet.

Water Level

- Refer to Figure 5.3-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures 11 index wells in this basin.
- In 1975, the year of the last water level sweep, 42 wells were measured.
- There is one ADWR automated water-level recording device in this basin located near Star Valley.

- The deepest recorded water level in the basin is 106 feet east of Kohls Ranch and the shallowest is 14 feet near Punkin Center.

- Hydrographs corresponding to selected wells shown on Figure 5.3-6 but covering a longer time period are shown in Figure 5.3-7.

Table 5.3-6 Groundwater Data for the Tonto Creek Basin

Basin Area, in square miles:	955	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Basin Fill	
	Sedimentary Rock (C and R Aquifers)	
Well Yields, in gal/min:	N/A	Measured by ADWR and/or USGS
	Range 5-2,200 Median 120 (51 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 10-50	ADWR (1990)
	Range 0-500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	17,000	ADWR (1994)
	37,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	3,000,000 (to 1,200 feet)	ADWR (1994)
	9,400,000 (to 1,200 feet)	ADWR (1992)
	2,000,000[1] (to 1,200 feet)	Freethey and Anderson (1986)
	N/A	Arizona Water Commission (1975)
Current Number of Index Wells:	11	
Date of Last Water-level Sweep:	1975 (42 wells measured)	

[1] Predevelopment Estimate
N/A = not available

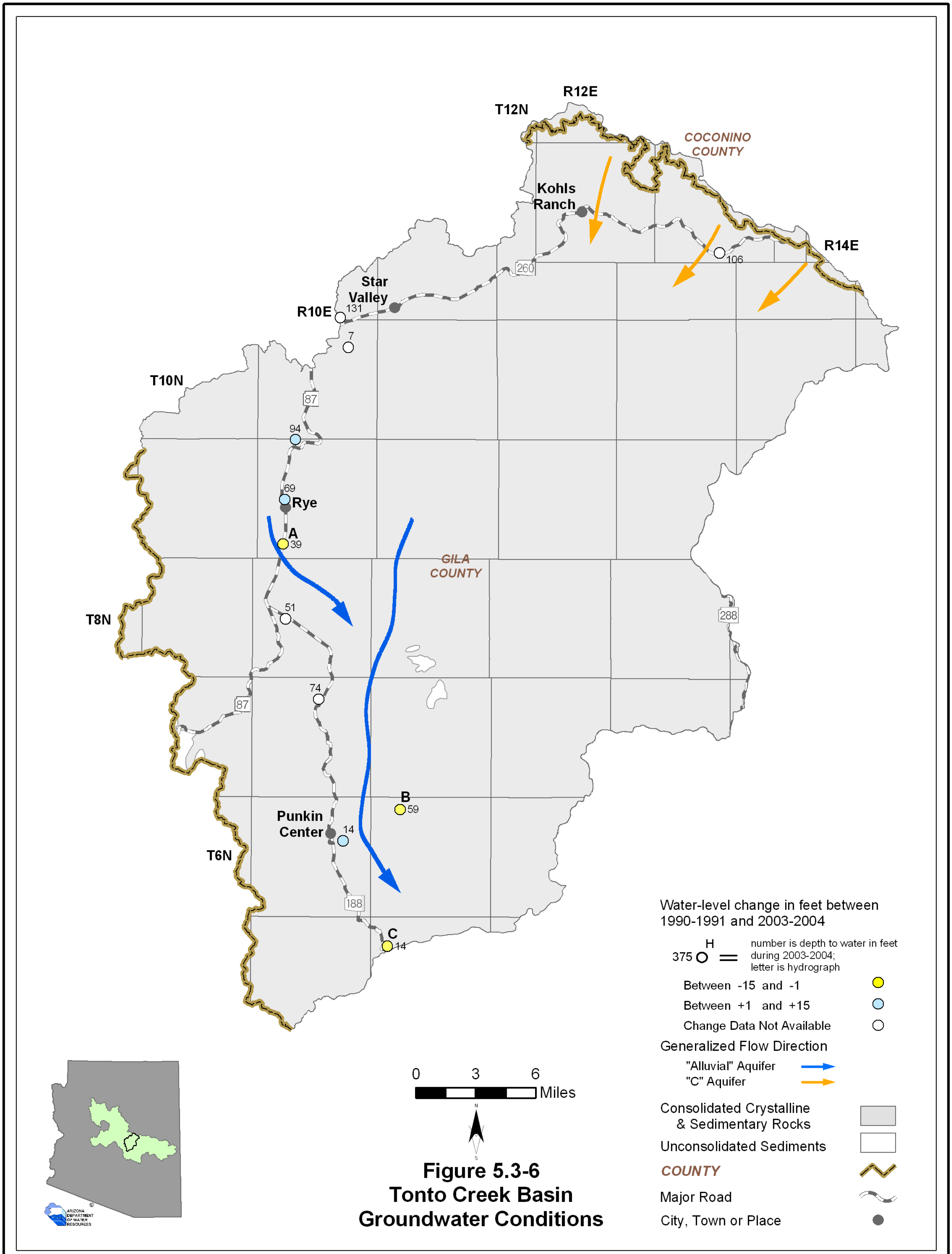
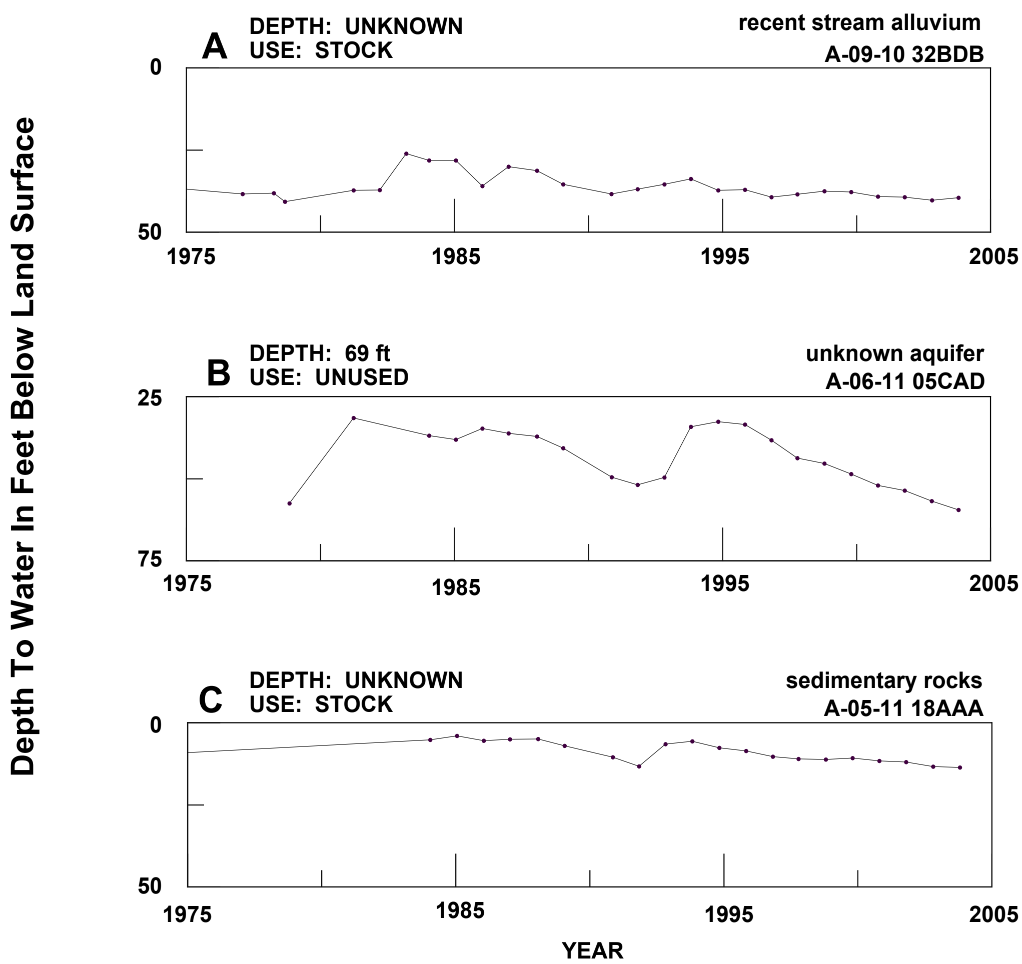


Figure 5.3-6
Tonto Creek Basin
Groundwater Conditions

Figure 5.3-7
Tonto Creek Basin
Hydrographs Showing Depth to Water in Selected Wells



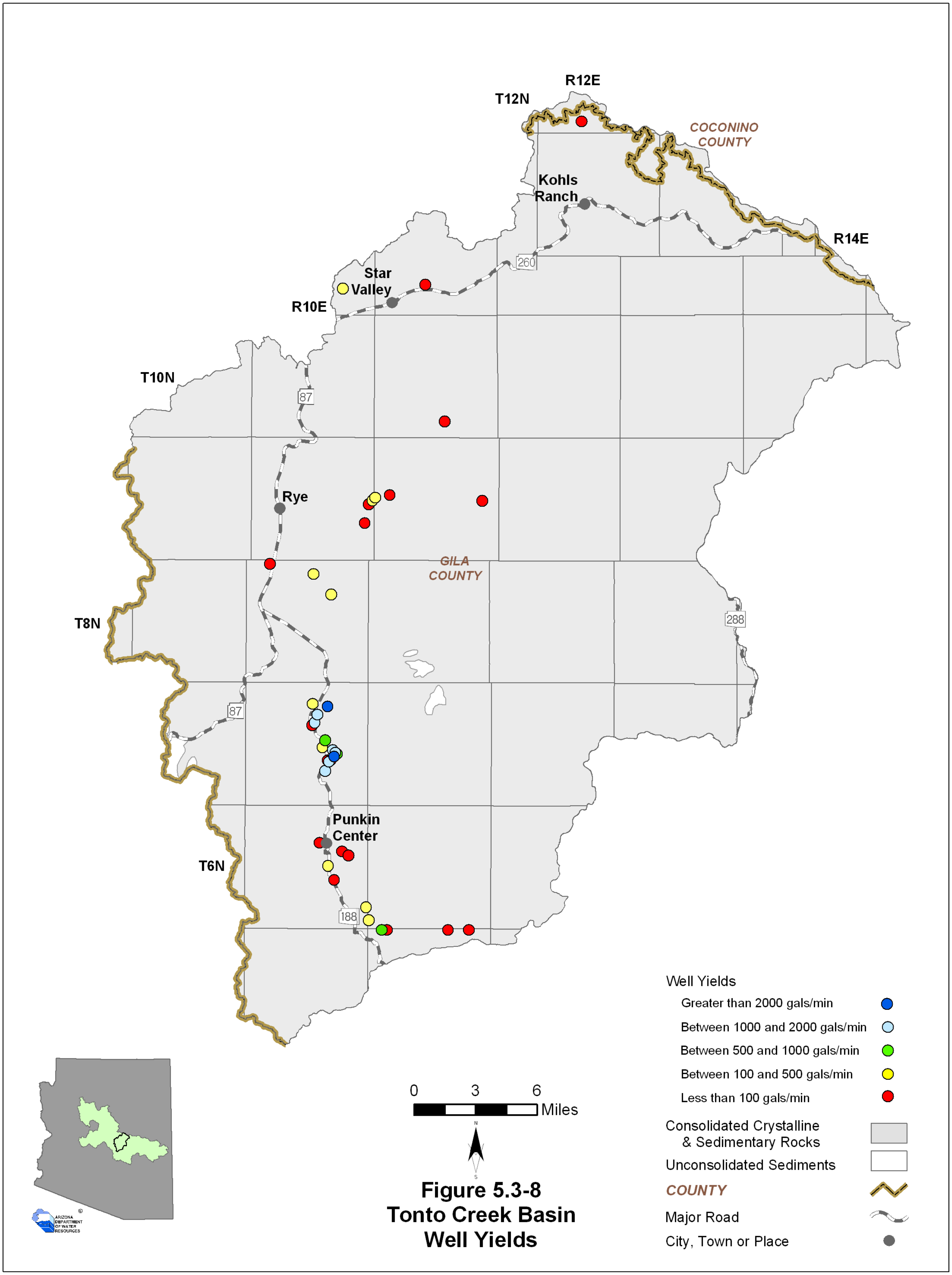


Figure 5.3-8
Tonto Creek Basin
Well Yields

5.3.7 Water Quality of the Tonto Creek Basin

Wells, springs and mine sites with parameter concentrations that have equaled or exceeded drinking water standard(s), including location and parameter(s) are shown in Table 5.3-7A. Impaired lakes and streams with site type, name, length of impaired reach, area of impaired lake, designated use standard and parameter(s) exceeded is shown in Table 5.3-7B. Figure 5.3-9 shows the location of water quality occurrences keyed to Table 5.3-7. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mines

- Refer to Table 5.3-7A.
- Nine sites have parameter concentrations that have equaled or exceeded drinking water standards
- Standards equalled or exceeded in this basin include arsenic, nitrate/nitrite, beryllium, radionuclides and organic compounds or pesticides.

Lakes and Streams

- Refer to Table 5.3-7B.
- Water quality standards were exceeded in three stream reaches on two streams.
- The standard exceeded in all reaches was E. coli. The two reaches on Tonto Creek also exceeded the standard for nitrates/nitrites.
- All three impaired reaches are part of the ADEQ water quality improvement effort called the Total Maximum Daily Load (TMDL) program. The final TMDL reports for the streams have been completed.

Table 5.3-7 Water Quality Exceedences in the Tonto Creek Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
		Township	Range	Section	
1	Well	11 North	12 East	34	Rad
2	Well	9 North	10 East	25	As
3	Well	9 North	11 East	18	Rad
4	Well	9 North	12 East	23	As, NO3
5	Well	8 North	10 East	13	NO3
6	Well	8 North	10 East	26	Be
7	Well	8 North	10 East	26	As
8	Well	8 North	10 East	27	As
9	Well	5 North	11 East	8	Organics

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard[3]	Parameter(s) Exceeding Use Standard[2]
a	Stream	Christopher Creek (headwaters to Tonto Creek)	8	NA	FBC	E. coli
b	Stream	Tonto Creek (headwaters to unnamed tributary latitude 341810, longitude 1110414)	8	NA	A&W, FBC	E. coli, NO3
c	Stream	Tonto Creek (unnamed tributary latitude 341810, longitude 1110414 to Haigler Creek)	9	NA	A&W, FBC	E. coli, NO3

[1] Water quality samples taken from 1979 to 2002
[2]As = Arsenic
Be = Beryllium
NO3 = Nitrate/Nitrite
Organics = One or more of several volatile and semi-volatile organic compounds and pesticides
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium
[3] A&W = Aquatic and Wildlife
FBC = Full Body Contact
NA = Not Available

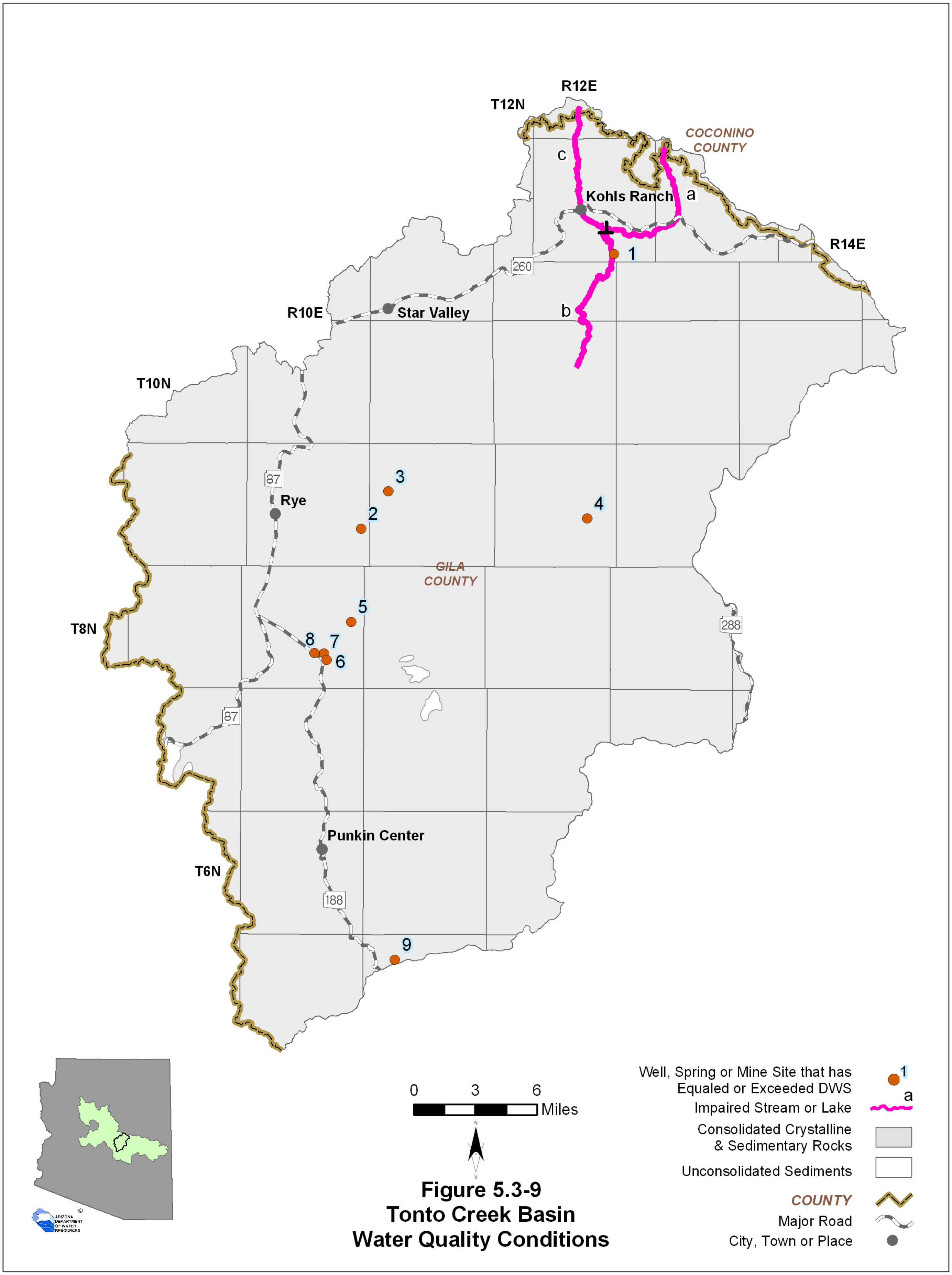


Figure 5.3-9
Tonto Creek Basin
Water Quality Conditions

5.3.8 Cultural Water Demands in the Tonto Creek Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 5.3-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 5.3-9. Figure 5.3-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 5.0.7.

Cultural Water Demands

- Refer to Table 5.3-8 and Figure 5.3-10.
- Population in this basin has increased from 1,934 in 1980 to 7,537 in 2000. Projections suggest the population will double by 2050 to 16,377.
- Groundwater use has fluctuated from a low of 2,000 acre-feet per year in the 1970s to an average of 4,000 acre-feet per year from 1986-1990. During 2001-2003 the average annual groundwater demand was 3,400 acre-feet per year.
- Municipal groundwater use has increased from an average of 1,600 acre-feet per year in 1991-1995 to 2,200 acre-feet per year in 2001-2003.
- There was no reported industrial groundwater use in 1991. In 2001-2003, industrial demand was 200 acre-feet per year on average.
- Groundwater demand for irrigation was less than 1,000 acre-feet per year on average from 1991-2003.
- Information on surface water diversions is not available from 1971-1990. From 1991-2003, 1,000 acre-feet per year on average was used for irrigation.
- Municipal and industrial demand is principally found in the vicinity of Payson and Star Valley with smaller demand centers scattered along State Highways 188 and 260 as well as east of Rye.
- A small amount of agriculture is located east of Rye and in T9N, R10E.
- There is one small mine or quarry in this basin along Highway 87 south of Payson.
- As of 2003 there were 1,916 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 93 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 5.3-9.
- There is one wastewater treatment facility in this basin. It is a private facility serving the Hunter Creek development near Kohl's Ranch.

Table 5.3-8 Cultural Water Demands in the Tonto Creek Basin[1]

Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						Data Source
				Well Pumpage			Surface-Water Diversions			
		Q $\leq$ 35 gpm	Q > 35 gpm	Municipal	Industrial	Irrigation	Municipal	Industrial	Irrigation	
1971										
1972										
1973				2,000			NR			
1974										
1975										
1976		822[2]	75[2]							
1977										
1978				2,000			NR			
1979										
1980	1,934									ADWR (1994)
1981	2,202									
1982	2,470									
1983	2,738	259	11	3,000			NR			
1984	3,006									
1985	3,275									
1986	3,543									
1987	3,811									
1988	4,079	280	3	4,000			NR			
1989	4,347									
1990	4,615									
1991	4,907									
1992	5,200									
1993	5,492	187	2	1,600	NR	<1000	NR	NR	1,000	
1994	5,784									
1995	6,076									
1996	6,368									
1997	6,660									
1998	6,953	289	1	1,900	200	<1000	NR	NR	1,000	USGS (2005) ADWR (2005) ADWR (1992)
1999	7,245									
2000	7,537									
2001	7,753									
2002	7,968	79	1	2,200	200	<1000	NR	NR	1,000	
2003	8,184									
2010	9,693									
2020	11,844									
2030	13,810									
2040	15,136									
2050	16,377									
ADDITIONAL WELLS: [3]										
WELL TOTALS:		**1,916**	**93**							

Notes:
NR - Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes all wells through 1980.
[3] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 5.3-9 Effluent Generation in the Tonto Creek Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course	Wildlife Area	Discharge to another Facility	Infiltration Basin			
Hunter Creek WWTP	Private	Hunter Creek	NA											

NA: Data not currently available to ADWR
WWTP: Waste Water Treatment Plant

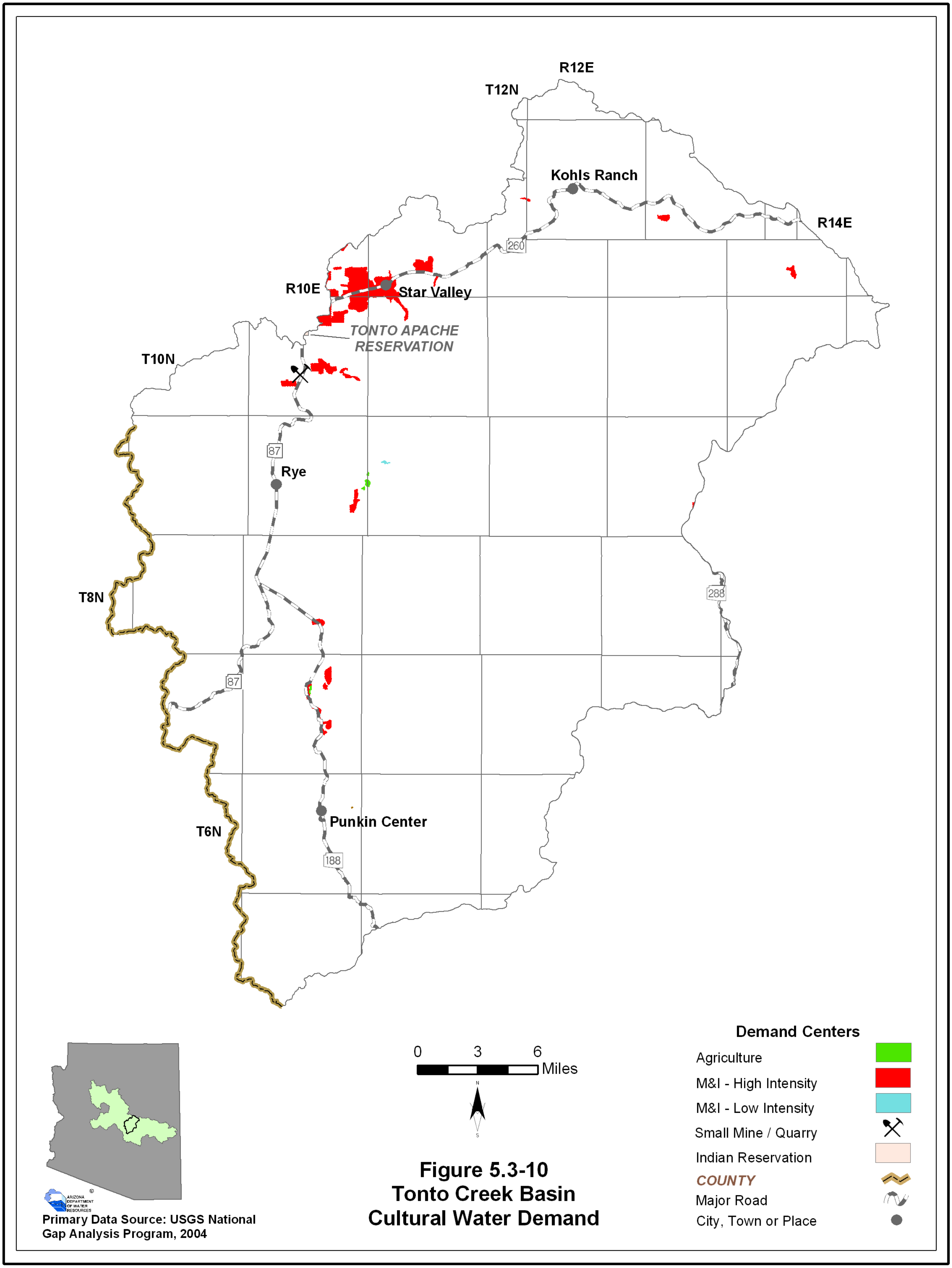


Figure 5.3-10
Tonto Creek Basin
Cultural Water Demand

5.3.9 Water Adequacy Determinations in the Tonto Creek Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 5.3-10. Figure 5.3-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

Water Adequacy Reports

- A total of 54 water adequacy determinations have been made in this basin through May, 2005.
- The most common reason for an inadequate determination was because the applicant did not submit the necessary information and/or available hydrologic data were insufficient to make a determination.
- Other reasons for an inadequacy determination included: the existing supply was unreliable or physically unavailable or groundwater exceeds the depth-to-water criteria; the applicant failed to demonstrate a legal right to use the water or failed to demonstrate their legal authority to serve the subdivision; and water quality. For one subdivision the reason for the inadequacy determination is unknown because the records could not be located.
- All water adequacy determinations are in Gila County. Of the 3,676 lots in 51 subdivisions for which lot information was available, 352 lots or less than 10% were determined to be adequate.

Table 5.3-10. Adequacy Determinations in the Tonto Creek Basin[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Alpine Heights	Gila	11 North	10	26, 27, 34, 35	257		Inadequate	A1 ,A2	07/11/78	United Utilities Company
2	Boulder Creek	Gila	10 North	10	11	20	22-401552	Inadequate	A1	11/18/04	Town of Payson
3	Chaparral Lakes	Gila	11 North	10	35	88	22-400536	Inadequate	A1	06/29/01	Town of Payson
4	Chaparral Pines # 1	Gila	11 North	10	25, 35, 36	475	22-300080	Inadequate	A1, A2	12/18/95	Town of Payson
5	Chaparral Pines # 2	Gila	11 North	10	25, 35, 36	281	22-300281	Inadequate	A1	04/03/97	Town of Payson
6	Chaparral Ranch	Gila	11 North	10	25, 36	14		Inadequate	A2, C	02/23/95	Town of Payson
7	Collins Ranch	Gila	11.5 North	11.5	32	36		Inadequate	A1	01/15/80	Dry Lot Subdivision
8	Deer Creek Village	Gila	8 North	10	5	154		Inadequate	A1 ,A2	04/09/82	
9	Elk Ridge	Gila	10 North	10	10	108	22-300056	Inadequate	A2, C	10/05/95	Town of Payson
10	Evergreen Meadows	Gila	10 North	11	5, 8	63		Inadequate	B	08/11/75	Dry Lot Subdivision
11	Foothills East	Gila	11 North	10	35	6	22-300599	Inadequate	A1	10/19/98	Town of Payson
12	Gisela Heights	Gila	9 North	10	24, 25	47		Adequate		03/30/77	Gisela Water Company
13	Golden Frontier # 1	Gila	10 North	10	10	112		Inadequate	A1, A2	01/17/80	United Utilities Company
14	Golden Frontier # 2	Gila	10 North	10	10	87		Inadequate	A1, A2	08/15/84	Town of Payson
15	Gordon Canyon Creek	Gila	10.5 North	14	20	7		Inadequate	A1, A2	08/10/76	Dry Lot Subdivision
			11 North	13	36	7					
16	Granite Dells Estates	Gila	10 North	10	2, 11	19		Inadequate	A1, A2	01/19/77	Dry Lot Subdivision
17	Greenback Vista Estates	Gila	6 North	10	14	35	22-300392	Adequate		02/03/98	United Utilities Company
18	Haigler Creek Haciendas	Gila	10 North	13	13	NA		Inadequate	A1, B	04/11/83	Dry Lot Subdivision
19	Highlands at the Rim	Gila	10 North	10	2	130	22-400671	Inadequate	A1	02/12/02	Town of Payson
20	Houston Creek Landing	Gila	11 North	11	32	91	22-400372	Inadequate	A1	08/25/00	Brooke Utilities
21	Hunter Creek Ranch	Gila	11 North	13	29, 30, 31, 32	118		Adequate		02/27/90	Hunter Creek Ranch Homeowners Association
22	Juniper Ridge	Gila	11 North	10	26	6	22-400015	Inadequate	A1	02/09/99	Town of Payson
23	Knolls # 1	Gila	11 North	11	31	34		Inadequate	A1, A2	08/24/93	United Utilities, Inc.
24	Knolls # 2	Gila	11 North	11	31	22		Inadequate	A1, A2	03/28/94	United Utilities, Inc.
25	Knolls # 3	Gila	11 North	11	31	27	22-300048	Inadequate	A2	09/19/95	United Utilities, Inc.
26	Kohl's Ranch	Gila	11 North	12	21	123	22-300010	Inadequate	A1, A2	05/16/95	Kohl's Ranch Water Company
27	Kohl's Tonto Creek Ranch	Gila	11 North	12	21	20		Adequate		07/08/77	Kohl's Ranch Water Company
28	Oak Ridge Hills	Gila	11 North	10	26	9	22-300168	Inadequate	A2	07/01/96	Town of Payson
29	Pine Gate	Gila	11 North	10	36	11	22-300435	Inadequate	A1	04/21/98	Town of Payson
30	Pine Island at Chaparral Pines	Gila	11 North	10	36	43	22-300081	Inadequate	A1, A2	12/14/96	Town of Payson

Table 5.3-10. Adequacy Determinations in the Tonto Creek Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
31	Pine Ridge	Gila	11 North	11	32	36	22-300600	Inadequate	A1	02/02/99	Brooke Utilities
32	Pinon Ridge #1	Gila	10 North	10	10	41	22-300286	Inadequate	A1	05/14/97	Town of Payson
33	Pinon Ridge Unit Two	Gila	10 North	10	10	39	22-300433	Inadequate	A1	03/20/98	Town of Payson
34	Ponderosa Springs (Colcord Sps)	Gila	10.5 North	14	26, 27, 34, 35	28		Adequate		01/02/80	Dry Lot Subdivision
35	Preserve, on Haigler Creek	Gila	10 North	13	13	29		Inadequate	A1	01/13/86	Dry Lot Subdivision
36	Punkin Center Village	Gila	6 North	10	13, 14	NA		Inadequate	A1	10/15/84	Sheer Speed Water Company
37	Quail Valley	Gila	11 North	11	34	160		Inadequate	A1, A2	04/30/82	United Utilities Company
38	Quail Valley # 2	Gila	11 North	11	32	9		Inadequate	A1, A2	03/17/87	United Utilities Company
39	Ridge at Hunter Creek	Gila	11 North	13	29	19	22-300505	Adequate		08/10/98	Hunter Creek Ranch Homeowners Association
40	Rim Club Cabins, Unit One	Gila	10 North	10	1	9	22-401384	Inadequate	D	09/02/04	Town of Payson
41	Rim Golf Club	Gila	11 North	10	36, 1	317	22-300426	Inadequate	A1	04/21/98	Town of Payson
42	Rim View Heights Estates	Gila	10 North	10	10, 11	101		Inadequate	A1, A2	03/21/88	Town of Payson
43	Settle in at Pine Meadows	Gila	11 North	12	32, 33	210	22-400482	Inadequate	A1	04/06/01	Pine Meadows Domestic Water System
44	Siena Creek	Gila	11 North	10	36	25	22-400859	Inadequate	A1	12/23/02	Town of Payson
45	Star Valley Vista	Gila	11 North	11	31, 32	12		Inadequate	A1, A2	03/18/87	United Utilities Company
46	Tonto Creek Shores	Gila	9 North	10	25	8	22-300532	Inadequate	A1	09/09/98	United Utilities, Inc.
47	Tonto Creek Shores B	Gila	9 North	10	25	13	22-400392	Inadequate	A1	09/18/00	NA
48	Tonto Rim Ranch	Gila	11 North	12	4, 9	12	22-300557	Inadequate	A1	11/13/98	Tonto Creek Utility Co.
49	Tonto Village # 3	Gila & Maricopa	11 North	11.5	5, 8	NA		Adequate		07/17/78	Tonto Village Water Company
50	Walnut Springs	Gila	6 North	10	26	85		Adequate		01/06/98	United Utilities, Inc.
51	Whisper Ridge	Gila	10 North	10	2	20	22-400774	Inadequate	A1	08/08/02	Town of Payson
52	Wildflower Ridge	Gila	11 North	10	35	50	22-401559	Inadequate	A1	11/17/04	Town of Payson
53	Woods of Payson	Gila	11 North	10	26	8	22-300372	Inadequate	A1	10/08/97	Town of Payson
54	Zane Grey Ranch	Gila	12 North	12	32	5		Inadequate	A1	08/05/93	Zane Grey Ranch Homeowners

Notes:

[1] Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
2) Insufficient Supply (existing water supply unreliable or physically unavaible;for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)
B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records
NA = Not Available

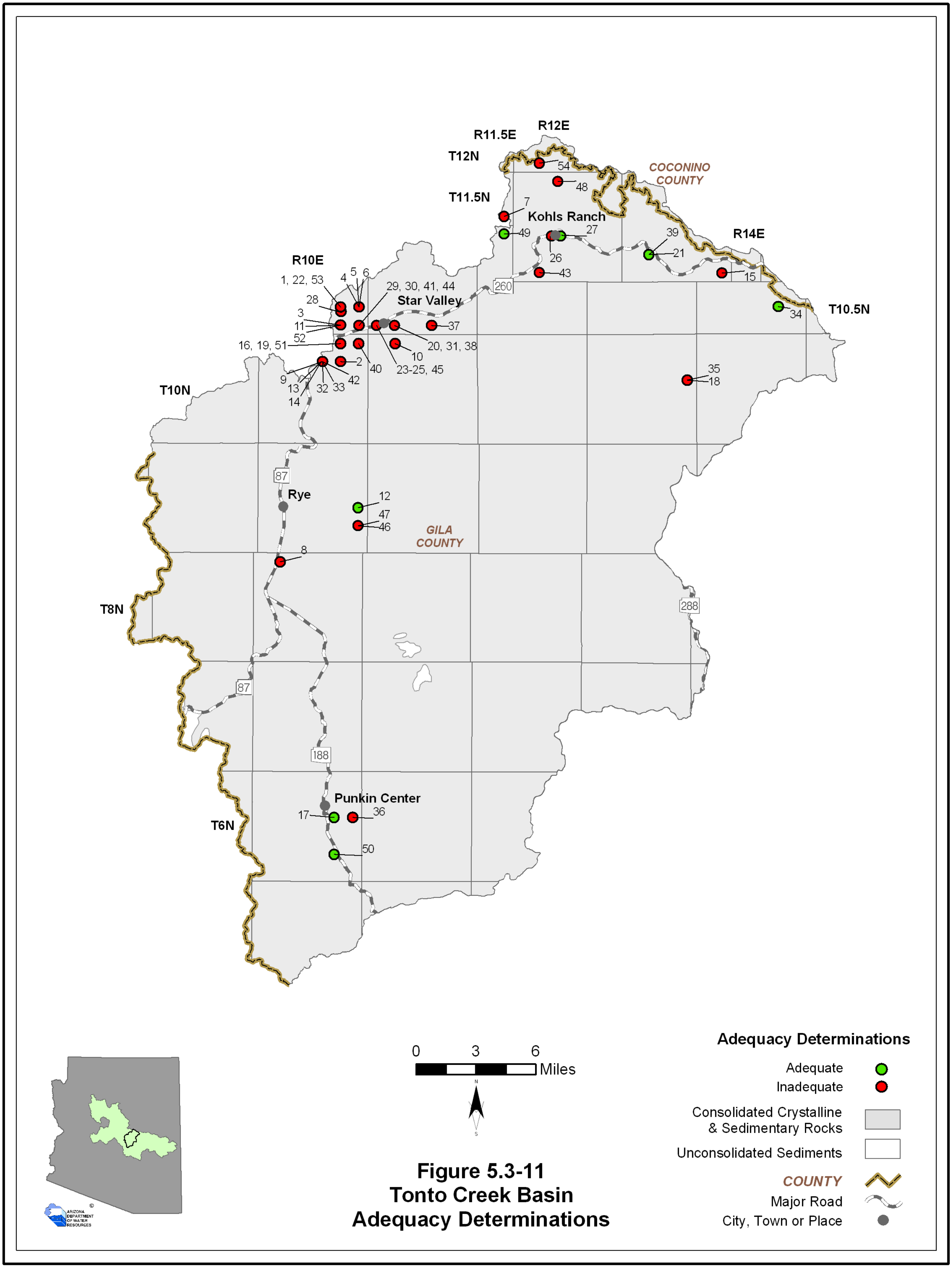


Figure 5.3-11
Tonto Creek Basin
Adequacy Determinations

Tonto Creek Basin
References and Supplemental Reading

References

A

Anderson, T.W., and Freethey, G.W., 1995, Simulation of groundwater flow in alluvial basins in south central Arizona and parts of adjacent states: USGS Professional Paper 1406-D.*

Arizona Corporation Commission (ACC), 2005, Annual reports, Private Sewer companies, 1990 to 2005: ACC Utilities Division.

____, 2005, Annual reports, Small water providers, 1990 to 2005: ACC Utilities Division.

Arizona Crop and Livestock Reporting Service, 1973, 1972 Arizona Agricultural Statistics: Bulletin S-8.

Arizona Department of Economic Security (DES), 2005, Workforce Informer: Data file, accessed August 2005, http://www.workforce.az.gov.*

Arizona Department of Environmental Quality (ADEQ), 2005, Active dairy farms & feedlots: Data file, received October 2005.

______, 2005, ADEQSWI: Data file, received September 2005.

______, 2005, ADEQWATP: Data file, received May 2005.

______, 2005, ADEQWWTP: Data file, received August 2005.*

______, 2005, Azurite: Data file, received September 2005.

______, 2005, Effluent dependent waters: GIS cover, received December 2005.

______, 2005, Impaired lakes and reaches: GIS cover, received January 2006.*

______, 2005, Surface water sources used by water providers: Data file, received June 2005.

______, 2005, WWTP and permit files: Miscellaneous working files, received July 2005.*

______, 2004, Total Maximum Daily Load for Tonto Creek and Christopher Creek.

______, 2004, Water providers with arsenic concentrations in wells over 10ppb: Data file, received August 2004.

______, 2004, Water quality exceedences by watershed: Data file, received June 2004.*

______, 2004, Water quality exceedences for drinking water providers in Arizona: Data file, received September 2004.*

Arizona Department of Mines and Mineral Resources (ADMMR), 2005, Active mines in Arizona: Database, accessed at http:// www.admmr.state.az.us.

Arizona Department of Water Resources (ADWR), 2006, Assured and adequate water supply applications: Project files, ADWR Hydrology Division.*

______, 2006, Statement of claimants filed by the Indian tribes or the United States on their behalf in the Gila and Little Colorado River adjudications: Data files, ADWR Office of Planning and Adjudications Support.

______, 2005, Agricultural Surface Water Use Estimates: Unpublished analysis, ADWR Office of Resource Assessment Planning.*

______, 2005, Automated recorder sites: Data files, ADWR Basic Data Unit.*

______, 2005, 2004 rural water provider questionnaire: Data files, ADWR Office of Resource Assessment Planning.*

______, 2005, Assured and adequate water supply determinations: Database, ADWR Office of Assured and Adequate Water Supply.*
______, 2005, Flood warning gages: Database, ADWR Office of Water Engineering.*
______, 2005, Inspected dams: Database, ADWR Office of Dam Safety.
______, 2005, Non-jurisdictional dams: Database, ADWR Office of Dam Safety.
______, 2005, Groundwater Site Inventory (GWSI): Database, ADWR Hydrology Division.*
______, 2005, Registry of surface water rights: ADWR Office of Water Management.*
______, 2005, Water Protection Fund: Database, ADWR Office of Drought, Conservation and Riparian Planning.
______, 2005, Water use by golf courses in rural Arizona: Unpublished analysis, ADWR Office of Regional Strategic Planning.
______, 2005, Wells55: Database.*
______, 2002, Groundwater quality exceedances in rural Arizona from 1975 to 2001: Data file, ADWR Office of Regional Strategic Planning.*
______, 1994, Arizona Water Resources Assessment, Vol. I, Inventory and Analysis.*
______, 1994, Arizona Water Resources Assessment, Vol. II, Hydrologic Summary.*
______, 1992, Hydrographic Survey Report for the Upper Salt River Watershed: Volume 1 General Assessment.*
______, 1990, Draft outline of basin profiles for the state water assessment: ADWR Statewide Planning Division, Memorandum to L. Linser from Sundie, D.W., January, 16, 1990.*
Arizona Game and Fish Department (AGF), 2005, Arizona Waterways: Data file, received April 2005.*
______, 1997 & 1993, Statewide riparian inventory and mapping project: GIS cover.*
______, 1982, Arizona Lakes Classification Study.
Arizona Land Resource Information System (ALRIS), 2005, Springs: GIS cover, accessed January 2006 at http://www.land.state.az.us/alris/index.html.*
_______, 2005, Streams: GIS cover, accessed 2005 at http://www.land.state.az.us/alris/index.html.*
______, 2005, Water features: GIS cover, accessed July 2005 at http://www.land.state.az.us/alris/index.html.*
______, 2004, Land ownership: GIS cover, accessed in 2004 at http://www.land.state.az.us/alris/index.html.*
Arizona Meteorological Network (AZMET), 2005, Arizona climate stations: Pan evaporation data, accessed December 2005 at http://www.ag.arizona.edu/azmet/locate.html.
Arizona Water Commission, 1975, Summary, Phase I, Arizona State Water Plan, Inventory of resource and uses.

D

Diroll, M., and Marsh, D., 2006, Status of water quality in Arizona-2004 integrated 305(b) assessment and 303(d) listing report: ADEQ report.*
Diroll, M., and Marsh, D., 2003, Status of Water Quality in Arizona – 2004: ADEQ draft report.

E

Environmental Protection Agency (EPA), 2005, Surf Your Watershed: Facility reports, accessed

April 2005 at http://oaspub.epa.gov/enviro/ef_home2.water.*

______, 2005, 2000 and 1996, Clean Watershed Needs Survey: datasets, accessed March 2005 at http://www.epa.gov/owm/mtb/cwns/index.htm.*

F

Fisk, G.G., Duet, D.W., Evans, C.E., Angernoth, N.K., and Longsworth, S.A., 2004, Water Resources Data, Arizona Water Year 2003: USGS Water-Data Report AZ-03-1.*

Freethey, G.W. and Anderson, T.W. 1986, Predevelopment hydrologic conditions in the alluvial basins of Arizona and adjacent parts of California and New Mexico: USGS Hydrologic Investigations Atlas-HA664.*

H

Hart, R.J., Ward, J.J., Bills, D.J., and Flynn, M.E., 2003, Generalized hydrology and groundwater budget for the C aquifer, Little Colorado River basin and parts of the Verde and Salt River systems, Arizona and New Mexico: USGS Water Resources Investigations Report 02-4026.*

K

Konieczki, A.D. and Wilson, R.P., 1992, Annual summary of ground-water conditions in Arizona, spring 1986 to spring 1987: USGS Open File Report 92-54.*

M

McCormack, H.F., Fisk, G.G., Duet, N.R., Evans, D.W., Roberts, W.P., and Castillo, N.K., 2002, Water resources data Arizona, water year 2002: USGS Water Data Report AZ-02-1.*

N

Natural Resources Conservation Service (NRCS), 2005, SNOTEL (Snowpack Telemetry) stations: Data file, accessed December 2005 at http://www3.wcc.nrcs.usda.gov/nwcc/sntlsites.jsp?state=AZ.*

______, 2005, Snow Course stations: Data file, accessed December 2005 at http://www.wcc.nrcs.usda.gov/nwcc/snow-course-sites.jsp?state=AZ.*

National Snow and Ice Data Center (NSIDC), 2007, Cryoshpere Glossary at http://nsidc.org/cgi-bin/words/glossary.pl*

O

Oregon State University, Spatial Climate Analysis Service (SCAS), 2006, Average annual precipitation in Arizona for 1961-1990: PRISM GIS cover, accessed in 2006 at www.ocs.orst.edu/prism.*

P

Parker, J., Steinkampf, W. and Flynn, M., 2005, Hydrogeology of the Mogollon Highlands, central Arizona: USGS Scientific Investigations Report 2004-5294.*

Pope, G.L., Rigas, P.D., and Smith, C.F., 1998, Statistical summaries of streamflow data and characteristics of drainage basins for selected streamflow-gaging stations in Arizona through water year 1996: USGS Water Resources Investigations Report 98-4225.*

T

Tadayon, S., 2004, Water withdrawals for irrigation, municipal, mining, thermoelectric-power, and drainage uses in Arizona outside of the active management areas, 1991-2000: USGS Scientific Investigations Report 2004-5293, 27 pp.*

U

US Army Corps of Engineers, 2004 and 2005, National Inventory of Dams: Arizona Dataset, accessed November 2004 to April 2005 at http://crunch.tec.army.mil/nid/webpages/nid.cfm

US Geological Survey (USGS), 2006, Average annual runoff in the United States, 1951-1980: Data file, accessed March 2006 at http://aa179.cr.usgs.gov/metadata/wrdmeta/runoff.htm.*

______, 2006, Springs and spring discharges: Dataset, received November 2004 and January 2006 from USGS office in Tucson, AZ.*

______, 2006, National Hydrography Dataset: Arizona dataset, accessed at http://nhd.usgs.gov/.*

______, 2005, National Water Information System (NWIS): Arizona dataset, accessed December 2005 at http://waterdata.usgs.gov/nwis.*

______, 2004, Southwest Regional Gap analysis study- land cover descriptions: Electronic file, accessed January 2005 at http://earth.gis.usu.edu/swgap.*

______, 1981, Geographic digital data for 1:500,000 scale maps: USGS National Mapping Program Data Users Guide.*

V

Valencia, R.A., Wennerlund, J.A., Winstead, R.A., Woods, S., Riley, L., Swanson, E., and Olson, S., 1993, Arizona riparian inventory and mapping project: Arizona Game and Fish Department.

W

Wahl, C.R., Boe, S.R., Wennerlund, R.A., Winstead, R.A., Allison, L.J., Kubly, D.M., 1997, Remote sensing mapping of Arizona intermittent stream riparian areas: Arizona Game and Fish Technical Report 112.

Water Infrastructure Finance Authority of Arizona (WIFA), 2005, Clean Watershed Needs Survey-2004: Unpublished data sheets, received July 2005.

Western Regional Climate Center (WRCC), 2005, Pan evaporation stations: Data file accessed December 2005 at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~GetCity~USA.

_______, 2005, Precipitation and temperature stations: Data file, accessed December 2005 at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~GetCity~USA.*

Wilson, R.P., 1992, Summary of groundwater conditions in Arizona 1985 to 1986: USGS Water Resources Investigation Report, 90-4179.*

*All references marked with an asterisk contain information that was directly used in the basin summaries, tables or maps.

Supplemental Reading

Andersen, Mark, 2005, Assessment of water availability in the Lower Colorado River basin: in Conservation and Innovation in Water Management: Proceedings of the 18th annual Arizona Hydrological Society Symposium, Flagstaff, Arizona, September, 2005.

Anning, D. W., 2004, Effects of Natural and Human Factors on Stream Water Quality in Central Arizona: USGS Water Resource Supplement Jan.-Feb.

Anning, D.W., 1999, Concentrations and stream loads of nitrogen and phosphorus in surface water resources of central Arizona: in Water Issues and Partnerships for Rural Arizona: Proceedings from the 12th annual Arizona Hydrological Society Symposium, September 1999, Pinetop, Arizona.

Baker, M.B., 1999, History of watershed research in the central Arizona highlands: US Forest Service Technical Report, GTR-29.

Carpenter, T.L., 2001, The origin of isotopically anomalous waters of the Mogollon Rim region of Arizona: Arizona State University, M.S. thesis, 107 p.

Cordy, G.E., Gellenbeck, D.J., Gebler, J.B., Anning, D.W., Coes, A.L., Edmonds, R.J. Rees, J.A., and Sanger, H.W., 2000, Water quality in the central Arizona basins, Arizona, 1995-1998: USGS Circular 1213.

Gæaorama, Inc., 2006, Draft Geology and Structureal Controls of Groundwater, Mogollon Rim Water resources Management Study, prepared for the Bureau of Reclamation.

Jones, C., 2003, Public policy, cows, riparian areas, drought, sustainability and the Tonto National Forest: in Sustainability Issues and Arizona's Regional Watersheds: Proceedings from the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona.

Melis, T.S., 1990, Evaluation of flood hydrology on twelve drainage basins in the Central Highlands Region of Arizona: An integrated approach: Northern Arizona University, M.S. thesis, 135 p.

Nemecek, E.A., 2003, Sustainability of Arizona's few remaining perennial streams: in Sustainability Issues of Arizona's Regional Watersheds: Proceedings from the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona.

Parker, J.T.C., Steinkamph, W.C. and Flynn, M.E., 2005, Hydrogeology of the Mogollon Highlands, Central Arizona: U.S. Geological Survey Scientific Investigations Report 2004-5294, 87 p.

Woodhouse, B.G., Parker, J.T.C., Bills, D.J., and Flynn, M.E., 2000, USGS investigation of rural Arizona watersheds: Coconino Plateau, Upper and Middle Verde River, and Fossil Creek- East Verde River -Tonto Creek: in Environmental Technologies for the 21st Century: Proceedings from the 13th annual Arizona Hydrological Society Symposium, September 2000, Phoenix, Arizona, p.97.

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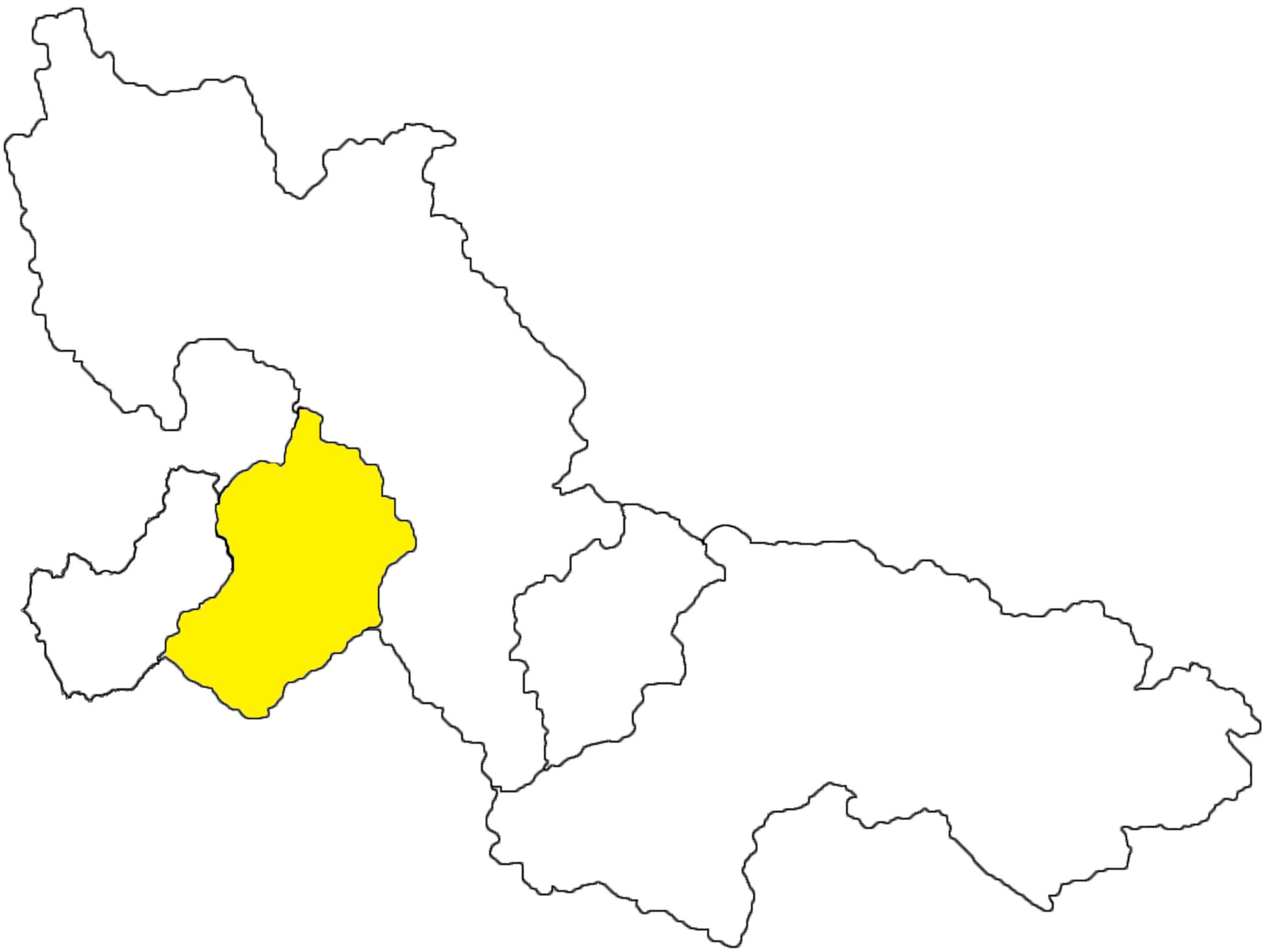
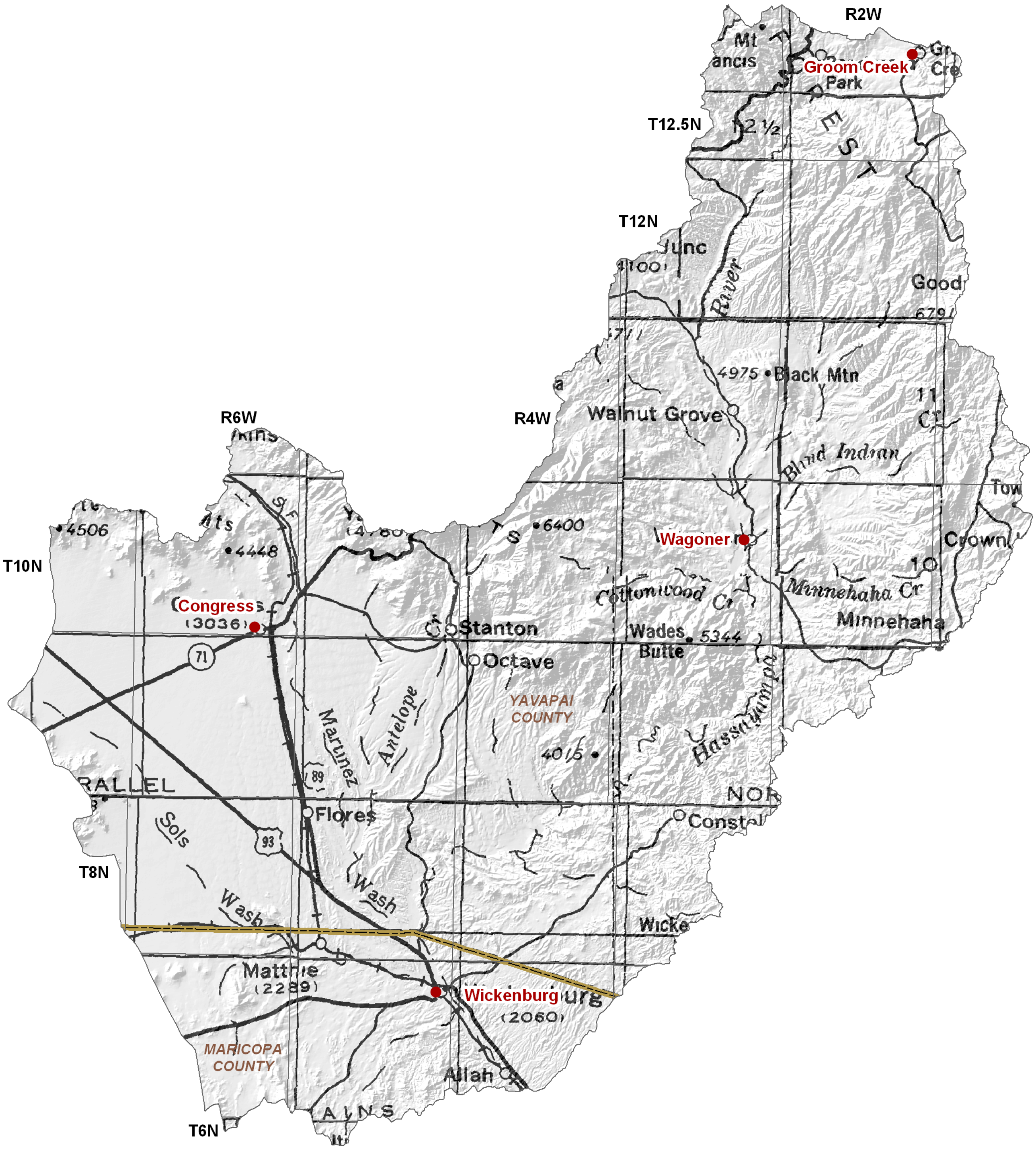
Section 5.4
Upper Hassayampa Basin



5.4.1 Geography of the Upper Hassayampa Basin

The Upper Hassayampa Basin, located in the eastern part of the planning area is the smallest basin in the planning area at 787 square miles. Geographic features and principal communities are shown on Figure 5.4-1. The basin is characterized by mid-elevation mountains and valleys. Vegetation types include Sonoran desertscrub, semidesert grassland and chaparral. Riparian vegetation including mesquite and cottonwood/willow is found along the perennial portions of the Hassayampa River.

- Principal geographic features shown on Figure 5.4-1 are:
  - Principal basin communities of Wickenburg and Congress, and small communities of Wagoner and Groom Creek
  - Hassayampa River running north to south through the center of the basin and Wickenburg
  - Martinez Wash and Antelope Creek in the center of the basin
  - The highest point in the basin is about 7,000 feet in the Bradshaw Mountains east Wagoner
- Not well shown on Figure 5.4-1 are the Weaver Mountains near Groom Creek, the Bradshaw Mountains along the eastern basin boundary and the Date Creek Mountains north of Congress.



Base Map: USGS 1:500,000, 1981

Figure 5.4-1
Upper Hassayampa Basin
Geographic Features

5.4.2 Land Ownership in the Upper Hassayampa Basin

Land ownership, including the percentage of ownership by category, for the Verde River Basin is shown in Figure 5.4-2. The principal feature of land ownership in this basin is the relatively large portion of state trust land. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

State Trust Land

- 38.3% of the land in this basin is held in trust for the public schools and three other beneficiaries under the State Trust Land system.
- State land is located throughout most of the basin. In the western portion of the basin state land is contiguous and in the remainder of the basin it is interspersed with private and Bureau of Land Management (BLM) lands.
- Primary land use is grazing.

National Forest and Wilderness

- 24.7% of the land is federally owned and managed as National Forest and Wilderness.
- Forest lands in the basin are part of the Prescott National Forest.
- The basin contains one National Forest wilderness area, the 25,536-acre Castle Creek Wilderness.
- All forest lands are in the northern portion of the basin and contain numerous private in-holdings.
- Land uses include recreation, grazing and timber production.

U.S. Bureau of Land Management (BLM)

- 20.7% of the land is federally owned and managed by the Hassayampa Field office of the Bureau of Land Management.
- All BLM lands are located in the center of the basin.
- The basin includes the 11,840-acre Hassayampa River Canyon Wilderness Area.
- Land uses include recreation and grazing.

Private

- 16.2% of the land is private.
- Private land is located throughout the basin interspersed with state, BLM and National Forest lands. Larger portions of private land are located in the vicinity of Wickenburg and along Wagoner Road.
- Land uses include domestic, commercial and ranching.

Other (Game and Fish, County and Bureau of Reclamation Lands)

- 0.1% of the land is owned and managed by the City of Wickenburg as local parks.
- Primary land use is recreation.

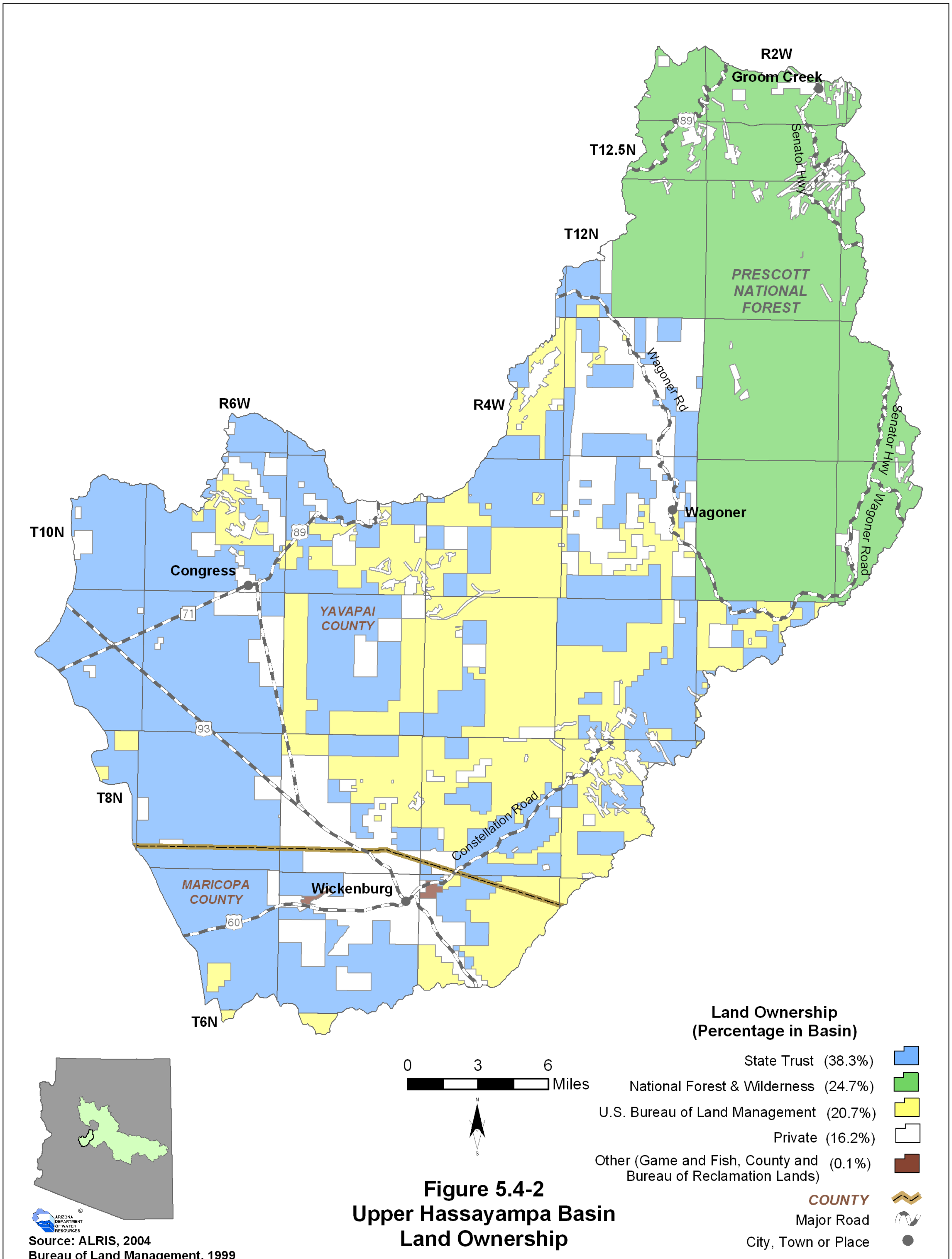


Figure 5.4-2
Upper Hassayampa Basin
Land Ownership

5.4.3 Climate of the Upper Hassayampa Basin

Climate data from NOAA/NWS Co-op stations are complied in Table 5.4-1 and the locations are shown on Figure 5.4-3. Figure 5.4-3 also shows precipitation contour data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Upper Hassayampa Basin does not contain Evaporation Pan, AZMET or SNOTEL/Snowcourse stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 5.4-1A
- Elevation at the three NOAA/NWS Co-op network climate stations range from 2,050 feet at Wickenburg to 6,110 feet at Groom Creek.
- Minimum average temperature ranges from 34.2°F at Groom Creek to 49.4°F at Wickenburg.
- Maximum average temperature ranges from 87.2°F at Wickenburg to 68.9°F at Groom Creek.
- Station precipitation varies with an average annual rainfall of 12.25 inches at Wickenburg, 15.35 inches at Stanton and 22.08 inches at Groom Creek.
- The Groom Creek and Stanton stations report highest average seasonal rainfall in the summer (July-September). The Wickenburg station reports slightly higher average seasonal rainfall in the winter (January-March) than in the summer. All three stations report the lowest average seasonal rainfall in the spring (April-June).

SCAS Precipitation Data

- See Figure 5.4-3
- Additional precipitation data shows rainfall as high as 32 inches on the east central basin boundary and as low as 10 inches in the southern portion of the basin around Wickenburg.
- In general, precipitation increases as altitude increases in this basin. The range of 22 inches between areas of highest and lowest precipitation is common for the planning area.

Table 5.4-1 Climate Data for the Upper Hassayampa Basin

A.NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Groom Creek	6,110	1948-1976[1]	68.9/Jul	34.2/Jan	5.15	3.12	8.79	5.02	22.08
Wickenburg	2,050	1971-2000	87.2/Jul	49.4/Dec	4.48	0.86	4.36	2.55	12.25
Stanton	3,480	1948-1969	83.5/Jul	48.0/Jan	4.27	1.35	6.09	3.65	15.35

Source: WRCC, 2003

Notes:
[1]Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*Number of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan.	Feb.	March	April	May	June
None								

Source: NRCS, 2005

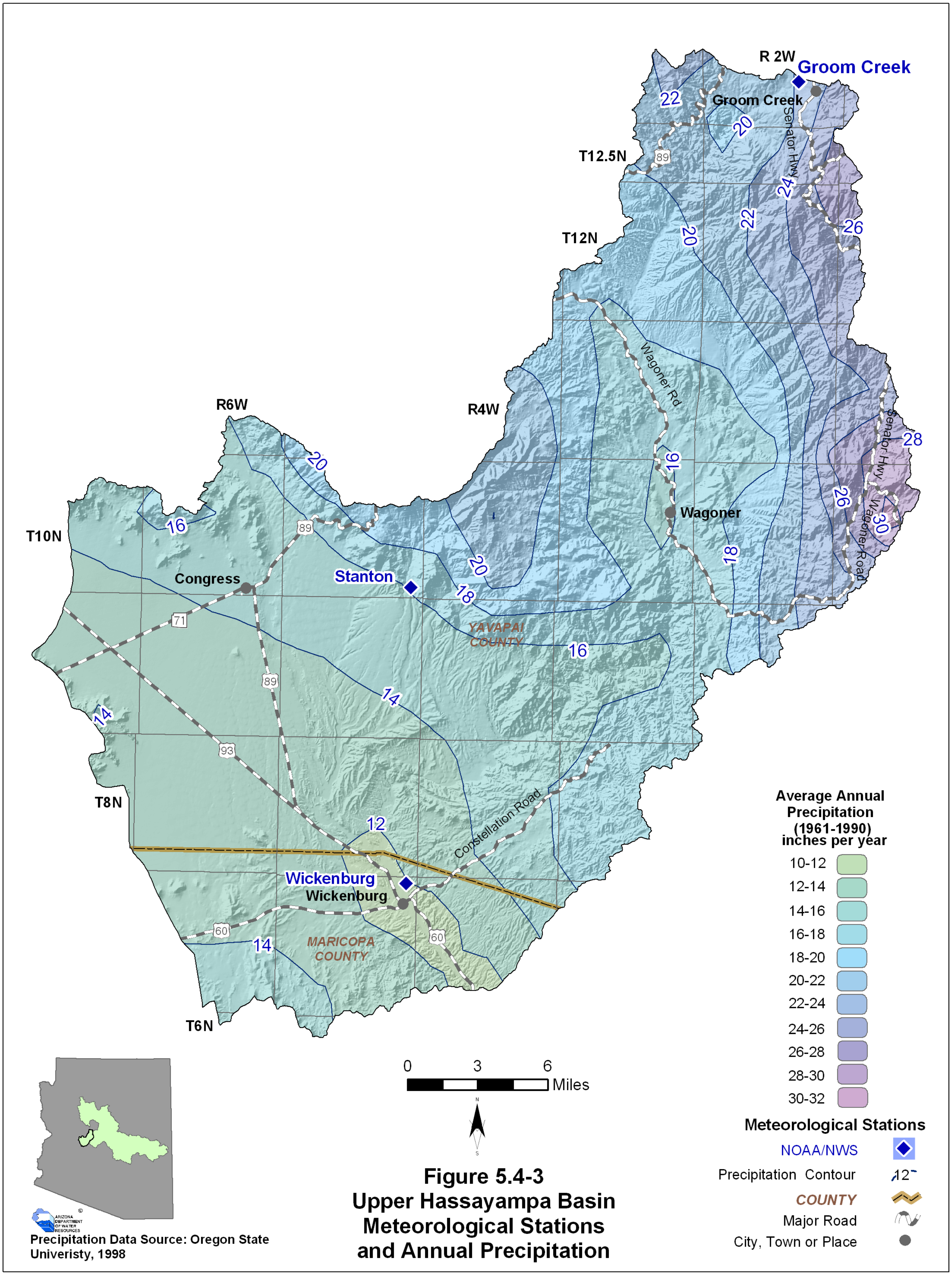


Figure 5.4-3
Upper Hassayampa Basin
Meteorological Stations
and Annual Precipitation

5.4.4 Surface Water Conditions in the Upper Hassayampa Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 5.4-2. Flood ALERT equipment in the basin is shown in Table 5.4-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 5.4-4. The location of streamflow gages identified by USGS number, flood ALERT equipment and USGS runoff contours are shown on Figure 5.3-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 5.4-2.
- Data from three stations located at the Hassayampa River are shown in the table and on Figure 5.4-4. All of the stations have been discontinued.
- The average seasonal flow at two stations, Hassayampa River at Walnut Grove near Wagoner and Hassayampa River at Box Damsite near Wickenburg, was highest in the winter (January-March) when between 55% and 59% respectively, of the average annual flow occurs. The third site, Hassayampa River near Wagoner received highest average seasonal flows in both the winter (January-March) and spring (April-June) when 41% of the average annual flow occurs. The average seasonal flow is lowest at all stations in the fall (October-December) when between 8% and 11% of the average annual flow occurs.
- The highest annual flow recorded in the basin is 123,076 acre-feet in 1980 at the Hassayampa River at Box Damsite near Wickenburg station, however, the median annual flow at this gage is 7,457 acre-feet. Minimum annual flows range from 731 acre-feet (1981, Hassayampa River at Walnut Grove near Wagoner) to 1,499 acre-feet (1940, Hassayampa River near Wagoner).

Flood ALERT Equipment

- Refer to Table 5.4-3.
- As of October 2005 there were 34 stations in the basin. Stations are located in Maricopa and Yavapai counties, however, all but one station is operated by the Maricopa County Flood Control District.
- Most stations are located in the vicinity of Wickenburg or in the western half of the basin.
- Of the 34 stations 15 are precipitation only stations, 15 are precipitation/stage stations, two are repeater/precipitation stations, one is a repeater/weather station and one is a weather station.

Reservoirs and Stockponds

- Refer to Table 5.4-4.
- The basin does not contain any large reservoirs.
- Surface water is stored or could be stored in seven small reservoirs. These reservoirs have a maximum storage capacity of 1,684 acre-feet.
- There are 266 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 5.4-4.
- Average annual runoff is 0.5 inches per year in most of the basin with one inch of runoff in a small area along the west central basin boundary.

Table 5.4-2 Streamflow Data for the Upper Hassayampa Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow (in acre-feet/year)				Years of Annual Flow Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9514500	Hassayampa River near Wagoner	79	NA	1/1940-9/1946 (discontinued)	41	41	9	8	1,499 (1940)	3,015	6,552	23,022 (1941)	6
9515000	Hassayampa River at Walnut Grove near Wagoner	107	NA	11/1912-10/1983 (discontinued)	55	23	14	9	731 (1981)	2,907	3,989	9,412 (1982)	4
9515500	Hassayampa River at Box Damsite near Wickenburg	417	4,750	1/1938-9/1982 (discontinued)	59	15	14	11	883 (1962)	7,457	17,585	123,076 (1980)	35

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Notes:
Statistics based on Calendar Year
Annual Flow statistics based on monthly values
Summation of Average Annual Flows may not equal 100 due to rounding.
Period of record may not equal Year of Record used for annual Flow/Year statistics due to only using years with a 12 month record
NA = Not available

Table 5.4-3 Flood ALERT Equipment in the Upper Hassayampa Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
320	Saw Mountain	Precipitation	11/8/90	Yavapai County FCD
358	Mt. Union Repeater	Repeater/Weather Station	4/28/92	Maricopa County FCD
5225	Hassayampa River @ US 60	Precipitation/Stage	3/14/94	Maricopa County FCD
5230	Sunset FRS	Precipitation/Stage	5/11/89	Maricopa County FCD
5245	Sunnycove FRS	Precipitation/Stage	7/1/86	Maricopa County FCD
5260	Vulture Mine Road	Precipitation	10/14/81	Maricopa County FCD
5275	Sols Wash @ SR 71	Precipitation/Stage	9/24/81	Maricopa County FCD
5290	Yarnell Hill	Repeater/Precipitation	7/13/81	Maricopa County FCD
5305	Hassayampa River @ Box Canyon	Precipitation/Stage	11/17/83	Maricopa County FCD
5320	O'Brien Gulch	Precipitation	9/1/81	Maricopa County FCD
5340	Towers Mountain Repeater	Repeater/Precipitation	5/1/92	Maricopa County FCD
5350	Hassayampa River @ Wagoner Rd.	Precipitation/Stage	12/19/83	Maricopa County FCD
7000	Stanton	Precipitation	6/16/94	Maricopa County FCD
7005	Mid-Martinez Creek	Precipitation	4/27/95	Maricopa County FCD
7010	Martinez Creek	Precipitation/Stage	11/23/94	Maricopa County FCD
7020	Congress	Precipitation	6/16/94	Maricopa County FCD
7025	Sols Tributary @ US 93	Precipitation/Stage	5/2/05	Maricopa County FCD
7030	Sols Tank	Precipitation	7/25/95	Maricopa County FCD
7035	Black Hill	Precipitation	6/15/95	Maricopa County FCD
7040	Sols Wash near Matthie	Precipitation/Stage	8/4/95	Maricopa County FCD

Table 5.4-3 Flood ALERT Equipment in the Upper Hassayampa Basin (cont'd)

Station ID	Station Name	Station Type	Install Date	Responsibility
7050	Black Mountain	Precipitation	7/6/94	Maricopa County FCD
7060	Hartman Wash	Precipitation/Stage	7/6/94	Maricopa County FCD
7070	Flying E Tank	Precipitation	5/9/95	Maricopa County FCD
7080	Flying E Wash	Precipitation/Stage	7/12/94	Maricopa County FCD
7090	Casandro Wash	Precipitation/Stage	7/12/94	Maricopa County FCD
7100	Constellation Road	Precipitation	8/3/94	Maricopa County FCD
7110	Powder House Wash	Precipitation/Stage	5/18/95	Maricopa County FCD
7120	Wickenburg Airport	Weather Station	8/3/94	Maricopa County FCD
7130	Casandro Dam	Precipitation/Stage	3/26/91	Maricopa County FCD
7135	Centennial Divide	Precipitation	8/21/01	Maricopa County FCD
7155	Burton Tank	Precipitation	3/19/02	Maricopa County FCD
7160	Bucks Well	Precipitation	12/11/02	Maricopa County FCD
7165	Antelope Creek	Precipitation/Stage	7/9/03	Maricopa County FCD
7170	Upper Martinez Creek	Precipitation	2/26/02	Maricopa County FCD

FCD = Flood Control District
FRS = Flood Retarding Structure

Table 5.4-4 Reservoirs and Stockponds in the Upper Hassayampa Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE	JURISDICTION
None identified by ADWR at this time					

B. Other Large Reservoirs (50 acre surface area or greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
None identified by ADWR at this time					

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 7
Total maximum storage: 1,684 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)

Total number: 0
Total surface area: 0 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 266 (from water right filings)

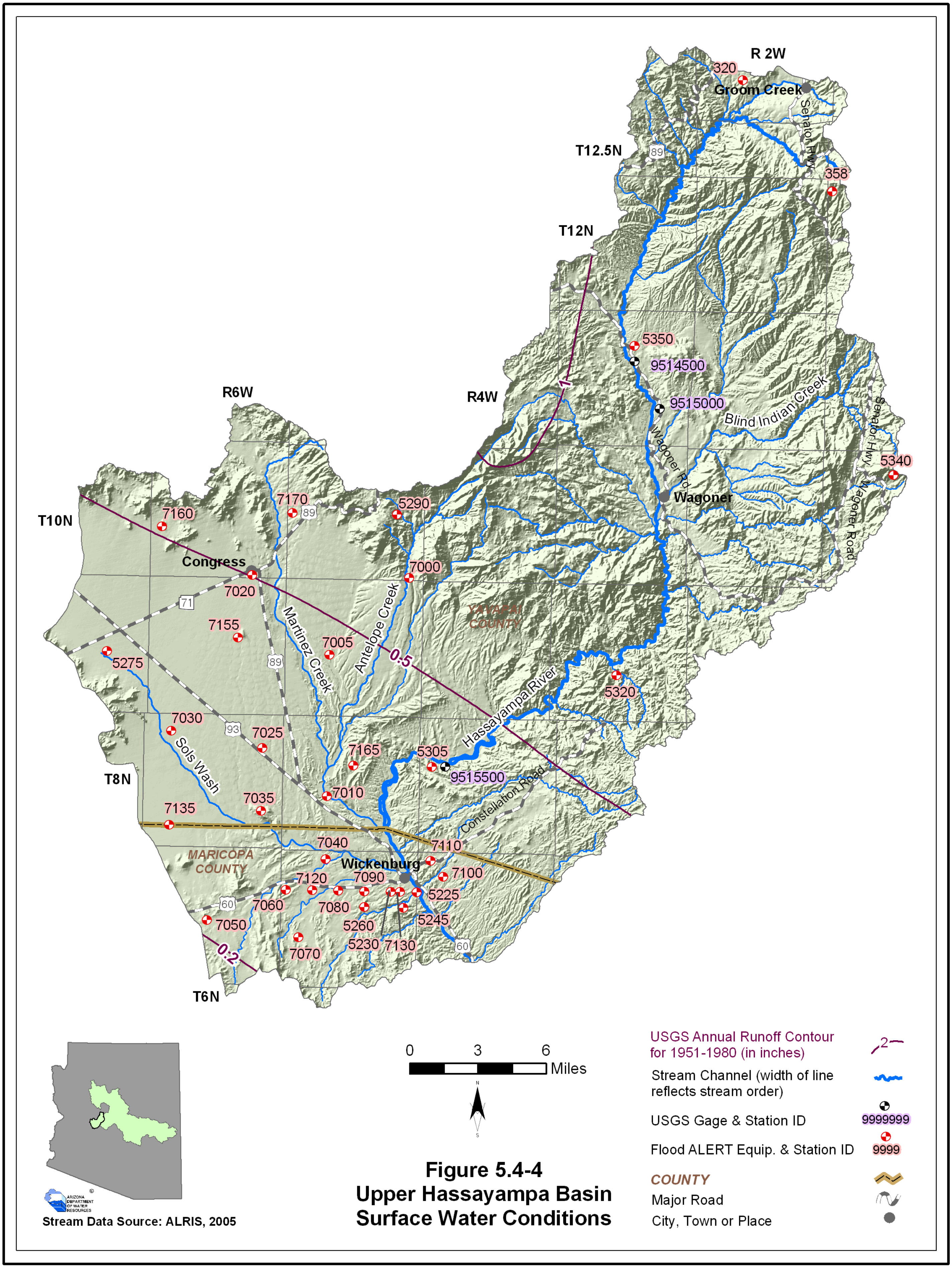


Figure 5.4-4
Upper Hassayampa Basin
Surface Water Conditions

5.4.5 Perennial/Intermittent Streams and Major Springs in the Upper Hassayampa Basin

There are no data on major or minor springs in this basin (Table 5.4-5). The locations of perennial and intermittent streams are shown on Figure 5.4-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- Perennial streams in this basin include portions of the Hassayampa River, Ash Creek, Weaver Creek, Minnehaha Creek and Antelope Creek.
- Intermittent streams are located predominantly in the northern portion of the basin.
- All perennial streams are intermittent for most of their length.
- The total number of springs with discharges of less than one gpm identified by the USGS ranges from 164 to 166, depending on the database reference.

Table 5.4-5 Springs in the Upper Hassayampa Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)	Date Discharge Measured
		Latitude	Longitude		
None identified by ADWR at this time					

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)	Date Discharge Measured
	Latitude	Longitude		
None identified by ADWR at this time				

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and NHD, 2006): 164 to 166

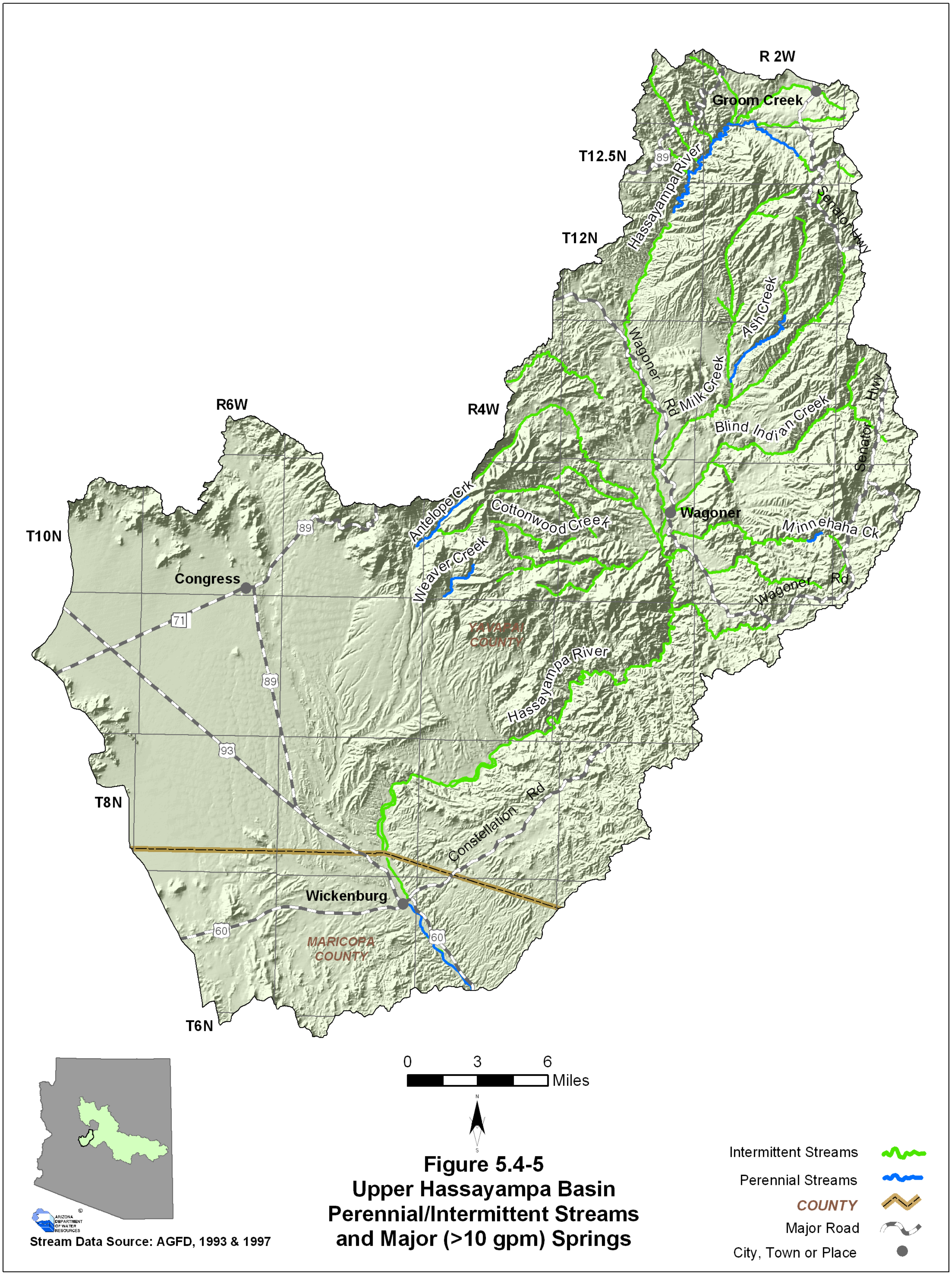


Figure 5.4-5
Upper Hassayampa Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

5.4.6 Groundwater Conditions of the Upper Hassayampa Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 5.4-6. Figure 5.4-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 5.4-7 contains hydrographs for selected wells shown on Figure 5.4-6. Figure 5.4-8 shows well yields in four yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 5.4-6 and Figure 5.4-6.
- The major aquifer in the basin is basin fill.
- Flow direction is generally from the north to the south.

Well Yields

- Refer to Table 5.4-6 and Figure 5.4-8.
- As shown on Figure 5.4-8 well yields in this basin range from less than 100 gallons per minute (gpm) to 2,000 gpm.
- One source of well yield information, based on 61 reported wells, indicates that the median well yield in this basin is 125 gpm.
- Most well yields in the basin are less than 500 gallons per minute. The highest well yields are in the vicinity of Wickenburg.

Natural Recharge

- Refer to Table 5.4-6.
- The estimate of natural recharge for this basin is 8,000 acre-feet per year.

Water in Storage

- Refer to Table 5.4-6.
- There are two estimates of water in storage for this basin ranging from 1 million acre-feet to 1.1 million acre-feet. The most recent estimate, from a 1994 ADWR study, indicates the basin has 1.1 million acre-feet to a depth of 1,200 feet.
- The predevelopment storage estimate is one million acre-feet to a depth of 1,200 acre-feet.

Water Level

- Refer to Figure 5.4-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures six index wells in this basin.
- In 1978, the year of the last water level sweep, 135 wells were measured.
- There is one ADWR automated groundwater level monitoring device located near Congress.
- The deepest recorded water level in the basin is 817 feet west of Congress and the shallowest is 20 feet in the vicinity of Wickenburg.
- Hydrographs corresponding to selected wells shown on Figure 5.4-6 but covering a longer time period are shown in Figure 5.4-7.

Table 5.4-6 Groundwater Data for the Upper Hassayampa Basin

Basin Area, in square miles:	787	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Basin Fill	
Well Yields, in gal/min:	Range 1-1,324 Median 125 (61 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 100-500	ADWR (1990)
	Range 0-500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	8,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	1,100,000 (to 1,200 feet)	ADWR (1994)
	1,000,000[1] (to 1,200 feet)	Freethey and Anderson (1986)
	N/A	Arizona Water Commission (1975)
Current Number of Index Wells:	6	
Date of Last Water-level Sweep:	1978 (135 wells measured)	

[1] Predevelopment Estimate

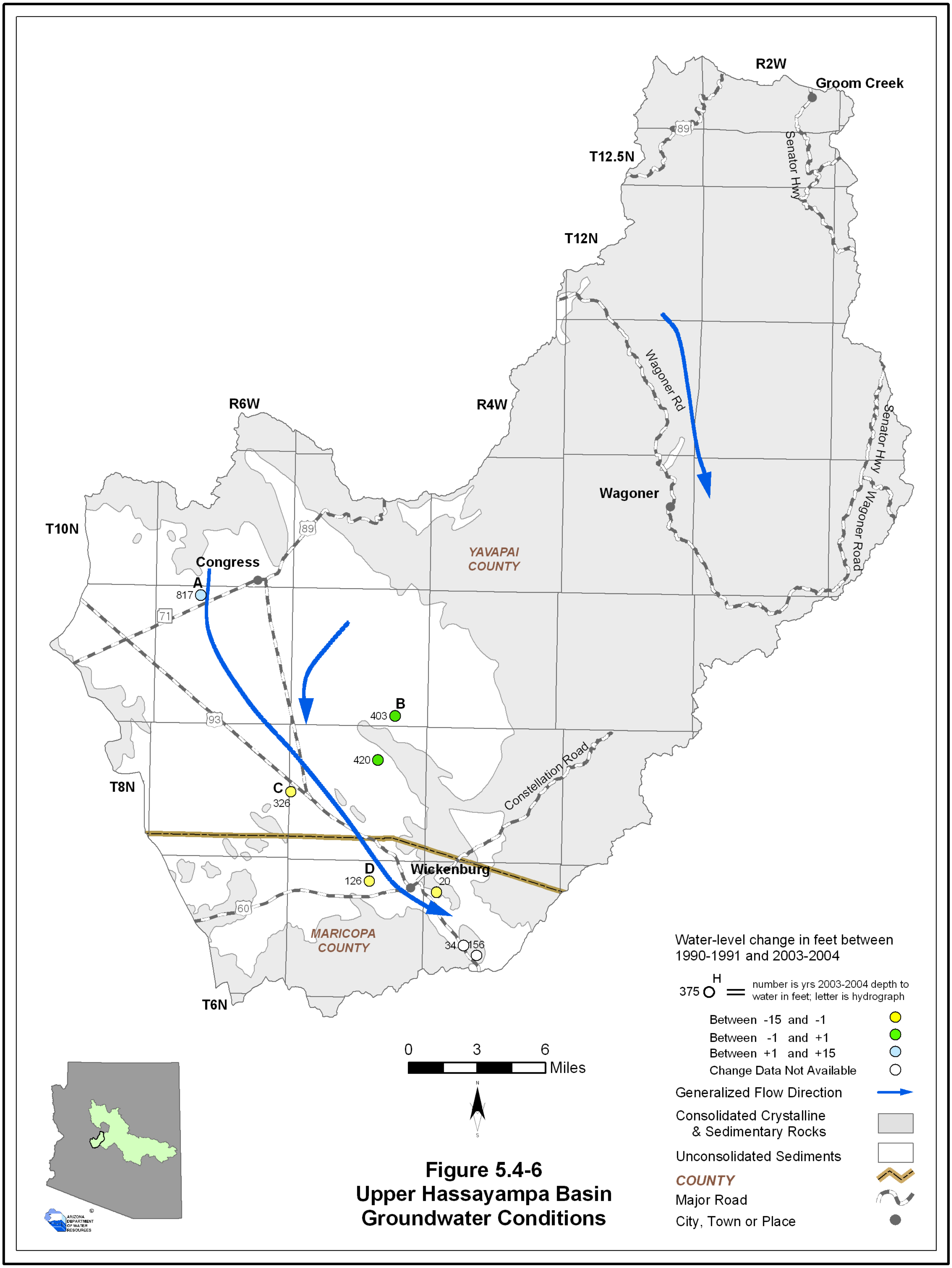
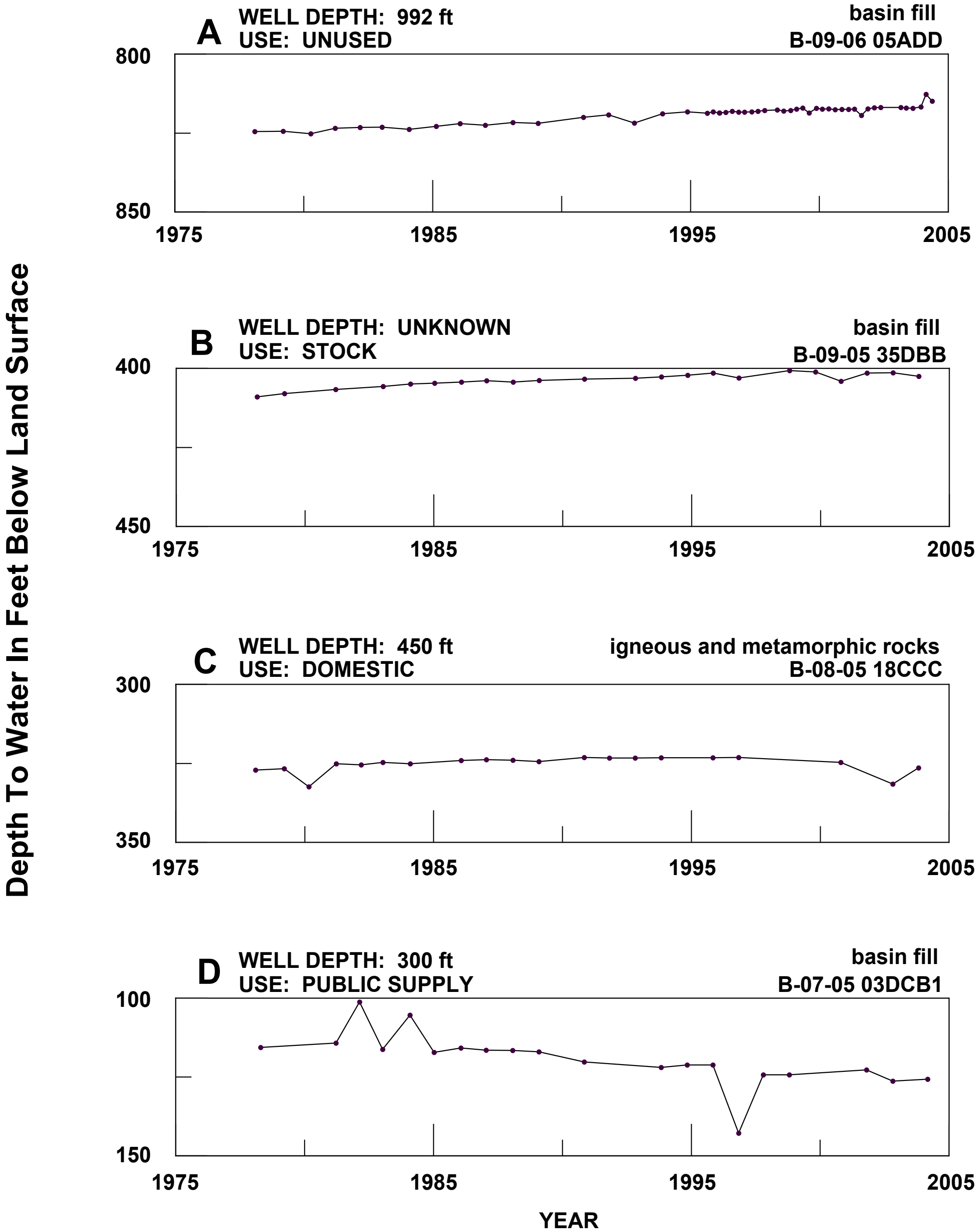


Figure 5.4-6
Upper Hassayampa Basin
Groundwater Conditions

Figure 5.4-7
Upper Hassayampa Basin
Hydrographs Showing Depth to Water in Selected Wells



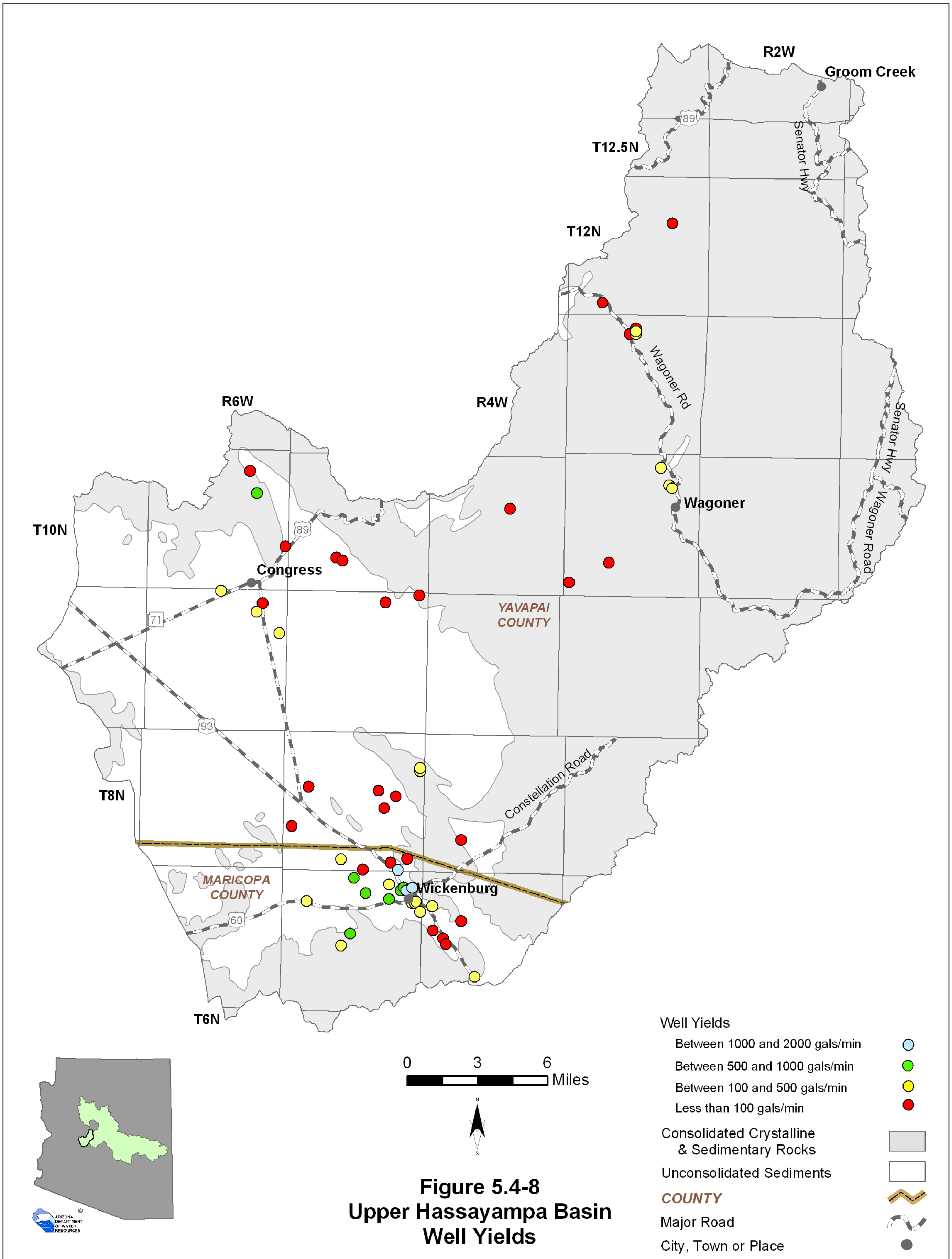


Figure 5.4-8
Upper Hassayampa Basin
Well Yields

5.4.7 Water Quality of the Upper Hassayampa Basin

Wells, springs and mine sites with parameter concentrations that have equaled or exceeded drinking water standard(s), including location and parameter(s) are shown in Table 5.4-7A. Impaired lakes and streams with site type, name, length of impaired reach, area of impaired lake, designated use standard and parameter(s) exceeded is shown in Table 5.4-7B. Figure 5.4-9 shows the location of water quality occurrences keyed to Table 5.4-7. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mines

- Refer to Table 5.4-7A.
- Forty-five sites have parameter concentrations that have equaled or exceeded drinking water standards. The majority of the sites are in the vicinity of Wickenburg.
- The most commonly equalled or exceeded standard was arsenic.
- Other standards equalled or exceeded include cadmium, lead, radionuclides, barium, beryllium, copper, and mercury.
- Many sites have equalled or exceeded multiple standards.

Lakes and Streams

- Refer to Table 5.4-7B.
- Water quality standards were exceeded in four stream reaches on three streams in the basin.
- All reaches exceeded standards for copper and zinc. Other standards exceeded include cadmium and pH.
- The French Gulch impaired reach is part of the ADEQ water quality improvement effort called the Total Maximum Daily Load (TMDL) program. The final report has been completed for this reach.
- Impaired reaches on Cash Mine Creek and the Hassayampa River are not part of the TMDL program at this time.

Table 5.4-7 Water Quality Exceedences in the Upper Hassayampa Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
		Township	Range	Section	
1	Well	13 North	2 West	26	Cd
2	Well	13 North	2 West	26	Pb
3	Well	12.5 North	3 West	35	Rad
4	Well	11 North	4 West	12	Cd
5	Spring	10 North	1 West	21	As
6	Well	10 North	3 West	14	NO3
7	Well	10 North	5 West	28	NO3, Rad
8	Well	10 North	6 West	25	NO3
9	Well	10 North	7 West	23	Rad
10	Well	9 North	5 West	1	As
11	Well	8 North	3 West	30	Rad
12	Well	8 North	4 West	27	NO3
13	Well	8 North	4 West	27	As
14	Well	8 North	5 West	16	NO3
15	Well	8 North	5 West	17	NO3
16	Well	7 North	4 West	18	NO3
17	Well	7 North	4 West	18	NO3
18	Well	7 North	5 West	1	As, Ba, Be, Cd, Cu, Pb
19	Well	7 North	5 West	1	As, Ba, Be, Cu, Pb
20	Well	7 North	5 West	1	As, Ba, Be, Pb
21	Well	7 North	5 West	1	As, Ba, Be, Pb, Hg
22	Well	7 North	5 West	1	As, Ba, Be, Cd, Pb
23	Well	7 North	5 West	1	As, Ba, Be, Cu
24	Well	7 North	5 West	1	As, Be, Pb
25	Well	7 North	5 West	1	As, Ba, Be, Pb
26	Well	7 North	5 West	1	As, Ba, Be, Cu, Pb
27	Well	7 North	5 West	1	As, Pb
28	Well	7 North	5 West	1	As, Pb
29	Well	7 North	5 West	1	Ba, Be
30	Well	7 North	5 West	1	As, Pb
31	Well	7 North	5 West	1	As, Pb
32	Well	7 North	5 West	1	As, Ba, Be, Cu, Pb
33	Well	7 North	5 West	1	As, Pb
34	Well	7 North	5 West	1	As, Ba, Be, Cd, Cu, Pb
35	Well	7 North	5 West	1	As, Ba, Be, Cu, Pb
36	Well	7 North	5 West	1	As, Ba, Be, Pb
37	Well	7 North	5 West	1	As, Ba, Pb
38	Well	7 North	5 West	1	Pb
39	Well	7 North	5 West	1	As, Ba, Be, Pb
40	Well	7 North	5 West	1	As, Cd, Pb, Hg
41	Well	7 North	5 West	2	As, Pb
42	Well	7 North	5 West	2	Pb
43	Well	7 North	5 West	12	As, Ba, Be, Pb
44	Well	7 North	5 West	12	As, Ba, Be, Pb
45	Well	7 North	5 West	12	As, Ba, Be, Pb

Table 5.4-7 Water Quality Exceedences in the Upper Hassayampa Basin (cont'd)[1]

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard[3]	Parameter(s) Exceeding Use Standard[2]
a	Stream	Cash Mine Creek (headwaters to Hassayampa River)	1	NA	A&W, FBC	Cu, Zn
b	Stream	Cash Mine Creek (unnamed tributary of headwaters to Cash Mine Creek	1	NA	A&W	Cd, Cu, Zn
c	Stream	French Gulch (headwaters to Hassayampa River)	10	NA	A&W	Cd, Cu, Zn
d	Stream	Hassayampa River (headwaters to Copper Creek)	11	NA	A&W, FC, FBC, AgL, AgI	Cd, Cu, pH, Zn

Notes:

[1] Water quality samples collected between 1993 and 2003.

[2] As = Arsenic
BA = Barium
Be = Beryllium
Cd = Cadmium
Cu = Copper
Pb = Lead
Hg = Mercury
NO3 = Nitrate/Nitrite
Organics = One or more of several volatile and semi-volatile organic compounds and pesticides
pH = Measurement of acidity or alkalinity
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium
Zn = Zinc

[3] A&W = Aquatic and Wildlife
FBC = Full Body Contact
FC = Fish Consumption
AgL = Agricultural - livestock watering
AgI = Agricultural - irrigation
NA = Not available

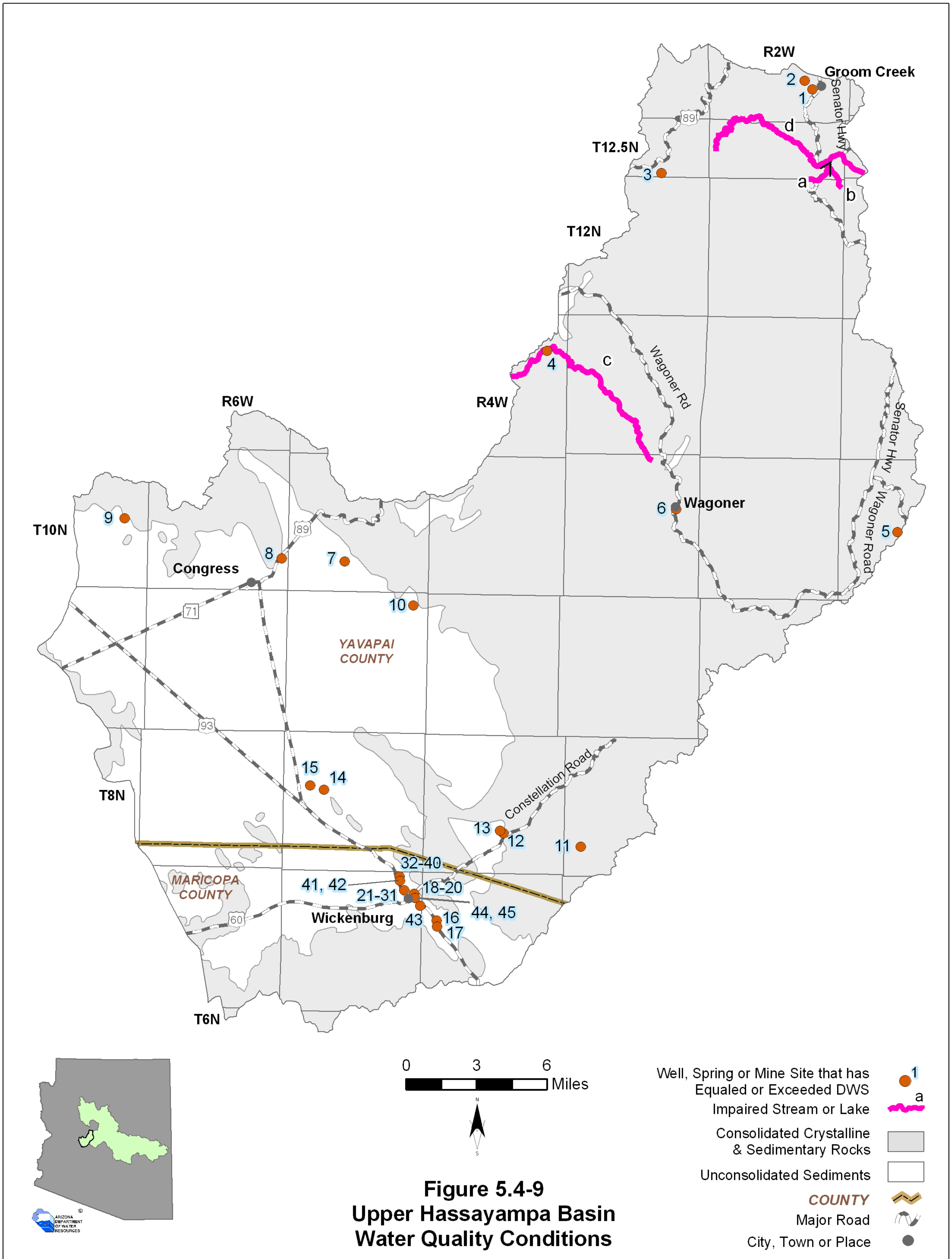


Figure 5.4-9
Upper Hassayampa Basin
Water Quality Conditions

5.4.8 Cultural Water Demands in the Upper Hassayampa Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 5.4-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 5.4-9. Figure 5.4-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 5.0.7.

Cultural Water Demands

- Refer to Table 5.4-8 and Figure 5.4-10.
- Population in this basin has almost doubled since 1980, from 6,050 in 1980 to 11,673 in 2003. Projections suggest the population will almost double by 2050 to about 22,100.
- Total groundwater use has increased in this basin since 1971, with an average of 3,000 acre-feet per year pumped during1971-1975 to an average of about 4,600 acre-feet per year in 2001-2003.
- Municipal groundwater use has increased slightly from an average of 2,200 acre-feet per year in 1991-1995 to 2,800 acre-feet per year in 2001-2003.
- Industrial use of groundwater has remained a constant 800 acre-feet per year on average from 1991-2003, primarily due to dairy use.
- Groundwater use for irrigation located north of Wagoner was less than 1,000 acre-feet per year on average between 1991-2003.
- There are no recorded surface water diversions in this basin.
- Municipal and industrial demand is found in the vicinity of Wickenburg, north of Congress and near Groom Creek.
- The basin contains a large currently inactive copper mine, the Zonia Property, and three small mines or quarries near Wagoner Road. Two small mines or quarries are located north of Congress.
- As of 2003 there were 1,887 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 131 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 5.4-9.
- There are two treatment facilities in this basin serving 5,824 people and generate 573 acre-feet of effluent per year.
- Information on disposal method is only available for the Wickenburg facility. Effluent at this facility is discharged to irrigated fields and to unlined impoundments that recharge the aquifer.

Table 5.4-8 Cultural Water Demands in the Upper Hassayampa Basin[1]

Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						
				Well Pumpage			Surface-Water Diversions			Data Source
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial	Irrigation	Municipal	Industrial	Irrigation	
1971										
1972										
1973				3,000			NR			
1974										
1975										
1976		887[2]	105[2]							
1977										
1978				3,000			NR			
1979										
1980	6,050									ADWR (1994)
1981	6,251									
1982	6,452									
1983	6,653	206	12	3,000			NR			
1984	6,855									
1985	7,056									
1986	7,257									
1987	7,458									
1988	7,659	213	9	3,000			NR			
1989	7,860									
1990	8,062									
1991	8,303									
1992	8,545									
1993	8,787	178	1	2,200	800	<1,000	NR			
1994	9,029									
1995	9,270									
1996	9,512									
1997	9,754									USGS (2005) ADWR (2005)
1998	9,996	241	2	2,600	800	<1,000	NR			
1999	10,237									
2000	10,479									
2001	10,878									
2002	11,277	79	2	2,800	800	<1,000	NR			
2003	11,677									
2010	14,471									
2020	16,092									
2030	17,895									
2040	19,800									
2050	22,128									
ADDITIONAL WELLS:[3]		**83**								
WELL TOTALS:		**1,887**	**131**							

Notes:
NR - Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes all wells through 1980.
[3] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 5.4-9 Effluent Generation in the Upper Hassayampa Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method							Current Treatment Level	Population not served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/ Turf Irrigation	Wildlife Area	Discharged to Another Facility	Infiltration Basin			
Escapees at North Ranch	Private	Congress	324	13	NA									2001
Wickenburg WWTP	Wickenburg	Wickenburg	5,500	560			X				X	Adv. Trt. I & Nutrient Removal	3,837	2004
Totals			5,824	573										

NA: Data not currently available to ADWR
WWTP: Waste Water Treatment Plant

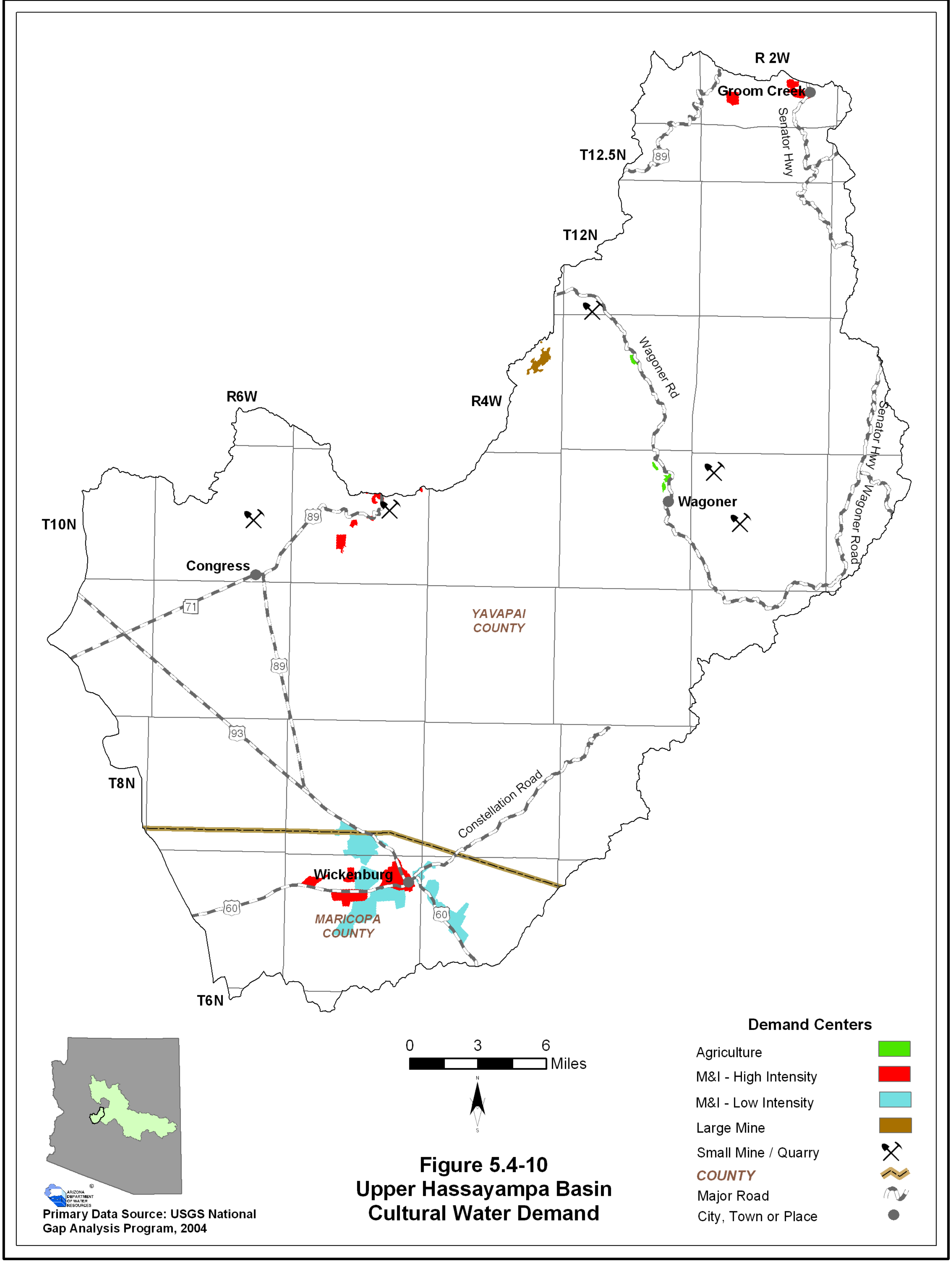


Figure 5.4-10
Upper Hassayampa Basin
Cultural Water Demand

5.4.9 Water Adequacy Determinations in the Upper Hassayampa Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 5.4-10. Figure 5.4-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

Water Adequacy Reports

- See Table 5.4-10
- A total of 26 water adequacy determinations have been made in this basin through May, 2005.
- Nine determinations of inadequacy have been made.
- All nine determinations of inadequacy were because the applicant did not submit the necessary information and/or the available hydrologic data was insufficient to make a determination.
- Two subdivisions receiving inadequate determinations also had existing supplies that were unreliable or physically unavailable or the groundwater exceeded the depth-to-water criteria.
- All lots receiving an adequacy determination are in Yavapai County. Of the 1,564 lots in 25 subdivisions for which lot information is available, 1,225 lots or 78% were determined to be adequate.

Table 5.4-10 Adequacy Determinations in the Upper Hassayampa Basin[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Berry's-Groom Creek	Yavapai	13 North	2 West	26	1		Adequate		08/06/75	Spring
2	Bird's Eye View	Yavapai	8 North	5 West	27	11	22-300086	Adequate		05/01/96	Dry Lot Subdivision
3	Black Mountain Ranches	Maricopa	7 North	5 West	7	40	22-400862	Inadequate	A1	12/24/02	Dry Lot Subdivision
4	Brough Subdivision # 1	Yavapai	10 North	6 West	35	24		Inadequate	A1	05/07/79	Congress Water Company
5	Chaparral Estates # 1	Yavapai	10 North	6 West	35	86		Inadequate	A1	05/07/79	Congress Water Company
6	Congress Village	Yavapai	9 North	6 West	3	36		Adequate		08/28/90	Congress Water Company
7	Congress Village # 2	Yavapai	9 North	6 West	3	36	22-300110	Adequate		03/07/96	Congress Water Company
8	Escapees at North Ranch	Yavapai	9 North	6 West	24	436	22-400004	Adequate		02/10/99	Rainbow Parks
9	Gold Dollar Estates	Yavapai	10 North	6 West	26, 27	21		Adequate		10/18/82	Congress Water Company
10	Groom Creek Pines Plat B	Yavapai	13 North	2 West	26	5		Inadequate	A1	06/01/87	Groom Creek Water Users Association
11	Hacienda Heights	Yavapai	10 North	6 West	35	24		Inadequate	A1	05/07/79	Congress Water Company
12	High Desert One and Two	Yavapai	9 North	6 West	12, 13, 24	51	22-400656	Adequate		09/24/02	Congress Domestic Water Improvement
13	High Desert One, Unit One and Two	Yavapai	9 North	6 West	12, 13	50	22-400434	Adequate		12/14/00	Dry Lot Subdivision
14	Loma Estates	Yavapai	13 North	2 West	26	47		Adequate		12/04/73	Loma Estate Water Company
15	Millsite Village	Yavapai	12.5 North	2 West	36	35		Inadequate	A1	06/24/86	Millsite Water Users, Inc.
16	Mira Monte Vistas	Yavapai	9 North	6 West	2	57		Adequate		10/29/90	Congress Water Company
17	Quail Village Unit 1	Yavapai	9 North	6 West	3	25	22-300516	Adequate		09/10/99	Congress Water Company
18	Ranchos de los Caballeros # 2	Maricopa	7 North	5 West	21	15		Inadequate	A1, A2	10/20/94	Caballeros Water Company
19	Ranchos de Los Caballeros # 3	Maricopa	7 North	5 West	15, 16, 21	100		Inadequate	A1, A2	02/01/83	Caballeros Water Company
20	S J Claims	Yavapai	12.5 North	2 West	36	10	22-300404	Inadequate	A1	01/20/98	Homeowners Association Wells
21	Smoke Tree Ranch # 1	Yavapai	11 North	3 West	26	61		Adequate		03/06/89	Dry Lot Subdivision
22	Vista Royale	Yavapai	8 North	6 West	13	138	22-300141	Adequate		06/03/96	Dry Lot Subdivision
23	Vista Royale Phase 1-B	Yavapai	8 North	6 West	13	23	22-300499	Adequate		09/09/98	Dry Lot Subdivision
24	Vista Royale Phase II	Yavapai	8 North	6 West	13	61	22-400378	Adequate		09/12/00	Dry Lot Subdivision
25	Weaver Mountain Estates	Yavapai	10 North	6 West	35	171	22-400493	Adequate		07/31/01	Congress Water Company
26	Wickenburg Inn	Yavapai	8 North	5 West	8, 17, 7, 16, 18, 19, 20, 21	NA		Adequate		07/01/86	Yavapai Hills Water Company

Notes:
[1]Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.
[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.
[3] A. Physical/Continuous
1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
2) Insufficient Supply (existing water supply unreliable or physically unavaible;for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)
B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records

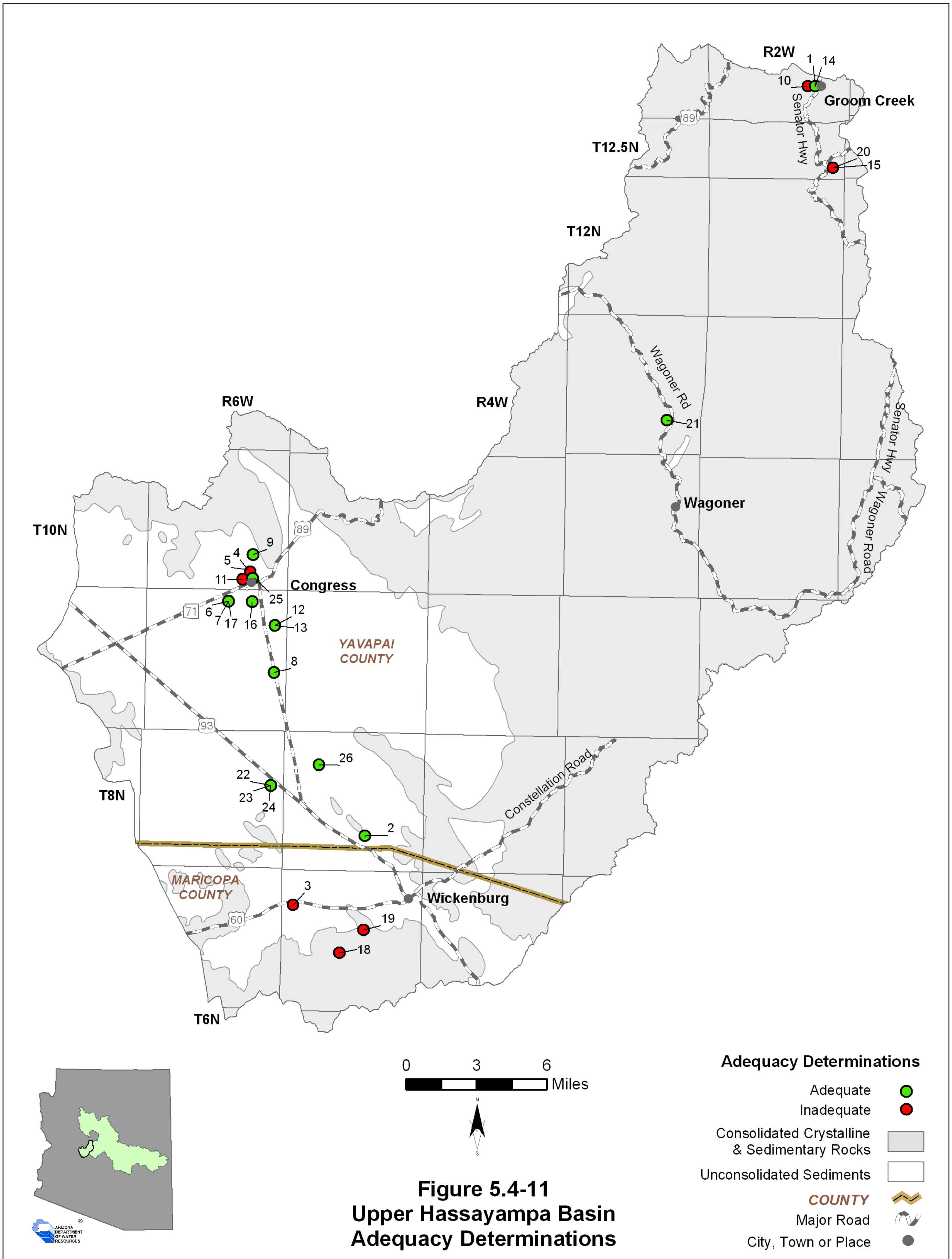


Figure 5.4-11
Upper Hassayampa Basin
Adequacy Determinations

Upper Hassayampa Basin
References and Supplemental Reading

References

A

Anderson, T.W., and Freethey, G.W., 1995, Simulation of groundwater flow in alluvial basins in south central Arizona and parts of adjacent states: USGS Professional Paper 1406-D.*

Arizona Corporation Commission (ACC), 2005, Annual reports, Private Sewer companies, 1990 to 2005: ACC Utilities Division.

_____, 2005, Annual reports, Small water providers, 1990 to 2005: ACC Utilities Division.

Arizona Crop and Livestock Reporting Service, 1973, 1972 Arizona Agricultural Statistics: Bulletin S-8.

Arizona Department of Economic Security (DES), 2005, Workforce Informer: Data file, accessed August 2005, http://www.workforce.az.gov.*

Arizona Department of Environmental Quality, 2005, Active dairy farms & feedlots: Data file, received October 2005.

_____, 2005, ADEQSWI: Data file, received September 2005.

_____, 2005, ADEQWATP: Data file, received May 2005.

_____, 2005, ADEQWWTP: Data file, received August 2005.

_____, 2005, Azurite: Data file, received September 2005.

_____, 2005, Effluent dependent waters: GIS cover, received December 2005.

_____, 2005, French Gulch: TMDLS for Cadmium, Copper and Zinc, Headwaters to Hassayampa River.

_____, 2005, Impaired lakes and reaches: GIS cover, received January 2006.*

_____, 2005, Surface water sources used by water providers: Data file, received June 2005.

_____, 2005, WWTP and permit files: Miscellaneous working files, received July 2005.

_____, 2004, Water providers with arsenic concentrations in wells over 10ppb: Data file, received August 2004.

_____, 2004, Water quality exceedences by watershed: Data file, received June 2004.*

_____, 2004, Water quality exceedences for drinking water providers in Arizona: Data file, received September 2004.

Arizona Department of Mines and Mineral Resources (ADMMR), 2005, Active mines in Arizona: Database, accessed at http:// www.admmr.state.az.us.*

Arizona Department of Water Resources (ADWR), 2006, Assured and adequate water supply applications: Project files, ADWR Hydrology Division.*

_____, 2005, Agricultural Surface Water Use Estimates: Unpublished analysis, ADWR Office of Resource Assessment Planning.*

_____, 2005, Automated recorder sites: Data files, ADWR Basic Data Unit.*

_____, 2005, 2004 Rural water provider questionnaire: Data files, ADWR Office of Resource Assessment Planning.*

_____, 2005, Assured and adequate water supply determinations: Database, ADWR Office of Assured and Adequate Water Supply.*

_____, 2005, Flood warning gages: Database, ADWR Office of Water Engineering.*

______, 2005, Inspected dams: Database, ADWR Office of Dam Safety.
______, 2005, Non-jurisdictional dams: Database, ADWR Office of Dam Safety.
______, 2005, Groundwater Site Inventory (GWSI): Database, ADWR Hydrology Division.*
______, 2005, Registry of surface water rights: ADWR Office of Water Management.*
______, 2005, Water Protection Fund: Database, ADWR Office of Drought, Conservation and Riparian Planning.
______, 2005, Water use by golf courses in rural Arizona: Unpublished analysis, ADWR Office of Regional Strategic Planning.
______, 2005, Wells55: Database.*
______, 2002, Groundwater quality exceedances in rural Arizona from 1975 to 2001: Data file, ADWR Office of Regional Strategic Planning.*
______, 1994, Arizona Water Resources Assessment, Vol. I, Inventory and Analysis.*
______, 1994, Arizona Water Resources Assessment, Vol. II, Hydrologic Summary.*
______, 1990, Draft outline of basin profiles for the state water assessment: ADWR Statewide Planning Division, Memorandum to L. Linser, January, 16, 1990.*
Arizona Game and Fish Department (AGF), 2005, Arizona Waterways: Data file, received April 2005.
______, 1997 & 1993, Statewide riparian inventory and mapping project: GIS cover.*
______, 1982, Arizona Lakes Classification Study.
Arizona Land Resource Information System (ALRIS), 2005, Springs: GIS cover, accessed January 2006 at http://www.land.state.az.us/alris/index.html.*
______, 2005, Streams: GIS cover, accessed 2005 at http://www.land.state.az.us/alris/index.html.*
______, 2005, Water features: GIS cover, accessed July 2005 at http://www.land.state.az.us/alris/index.html.*
______, 2004, Land ownership: GIS cover, accessed in 2004 at http://www.land.state.az.us/alris/index.html.*
Arizona Meteorological Network (AZMET), 2005, Arizona climate stations: Pan evaporation data, accessed December 2005 at http://www.ag.arizona.edu/azmet/locate.html.
Arizona Water Commission, 1975, Summary, Phase I, Arizona State Water Plan, Inventory of resource and uses.

D

Diroll, M., and Marsh, D., 2006, Status of water quality in Arizona-2004 integrated 305(b) assessment and 303(d) listing report: ADEQ report.*
Diroll, M., and Marsh, D., 2003, Status of Water Quality in Arizona – 2004: ADEQ draft report.

E

Environmental Protection Agency (EPA), 2005, Surf Your Watershed: Facility reports, accessed April 2005 at http://oaspub.epa.gov/enviro/ef_home2.water.*
______, 2005, 2000 and 1996, Clean Watershed Needs Survey: datasets, accessed March 2005 at http://www.epa.gov/owm/mtb/cwns/index.htm.*

F

Fisk, G.G., Duet, D.W., Evans, C.E., Angernoth, N.K., and Longsworth, S.A., 2004, Water Resources Data, Arizona Water Year 2003: USGS Water-Data Report AZ-03-1.*

Freethey, G.W. and Anderson, T.W. 1986, Predevelopment hydrologic conditions in the alluvial basins of Arizona and adjacent parts of California and New Mexico: USGS Hydrologic Investigations Atlas-HA664.*

K

Konieczki, A.D. and Wilson, R.P., 1992, Annual summary of ground-water conditions in Arizona, spring 1986 to spring 1987: USGS Open File Report 92-54.*

M

McCormack, H.F., Fisk, G.G., Duet, N.R., Evans, D.W., Roberts, W.P., and Castillo, N.K., 2002, Water resources data Arizona, water year 2002: USGS Water Data Report AZ-02-1.*

N

Natural Resources Conservation Service (NRCS), 2005, SNOTEL (Snowpack Telemetry) stations: Data file, accessed December 2005 at http://www3.wcc.nrcs.usda.gov/nwcc/sntlsites.jsp?state=AZ.

______, 2005, Snow Course stations: Data file, accessed December 2005 at http://www.wcc.nrcs.usda.gov/nwcc/snow-course-sites.jsp?state=AZ

O

Oregon State University, Spatial Climate Analysis Service (SCAS), 2006, Average annual precipitation in Arizona for 1961-1990: PRISM GIS cover, accessed in 2006 at www.ocs.orst.edu/prism.*

P

Pope, G.L., Rigas, P.D., and Smith, C.F., 1998, Statistical summaries of streamflow data and characteristics of drainage basins for selected streamflow-gaging stations in Arizona through water year 1996: USGS Water Resources Investigations Report 98-4225.*

T

Tadayon, S., 2004, Water withdrawals for irrigation, municipal, mining, thermoelectric-power, and drainage uses in Arizona outside of the active management areas, 1991-2000: USGS Scientific Investigations Report 2004-5293, 27 pp.*

U

US Army Corps of Engineers, 2004 and 2005, National Inventory of Dams: Arizona Dataset, accessed November 2004 to April 2005 at http://crunch.tec.army.mil/nid/webpages/nid.cfm

US Geological Survey (USGS), 2006, Average annual runoff in the United States, 1951-1980: Data file, accessed March 2006 at http://aa179.cr.usgs.gov/metadata/wrdmeta/runoff.htm.*

______, 2006, Springs and spring discharges: Dataset, received November 2004 and January 2006 from USGS office in Tucson, AZ.*

_____, 2006, National Hydrography Dataset: Arizona dataset, accessed at http://nhd.usgs.gov/.*
_____, 2005, National Water Information System (NWIS): Arizona dataset, accessed December 2005 at http://waterdata.usgs.gov/nwis.*
_____, 2004, Southwest Regional Gap analysis study- land cover descriptions: Electronic file, accessed January 2005 at http://earth.gis.usu.edu/swgap*.
_____, 1981, Geographic digital data for 1:500,000 scale maps: USGS National Mapping Program Data Users Guide.*

V

Valencia, R.A., Wennerlund, J.A., Winstead, R.A., Woods, S., Riley, L., Swanson, E., and Olson, S., 1993, Arizona riparian inventory and mapping project: Arizona Game and Fish Department.*

W

Wahl, C.R., Boe, S.R., Wennerlund, R.A., Winstead, R.A., Allison, L.J., Kubly, D.M., 1997, Remote sensing mapping of Arizona intermittent stream riparian areas: Arizona Game and Fish Technical Report 112.*
Water Infrastructure Finance Authority of Arizona (WIFA), 2005, Clean Watershed Needs Survey-2004: Unpublished data sheets, received July 2005.
Western Regional Climate Center (WRCC), 2005, Pan evaporation stations: Data file accessed December 2005 at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~GetCity~USA.
_____, 2005, Precipitation and temperature stations: Data file, accessed December 2005 at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~GetCity~USA.*
Wilson, R.P., 1992, Summary of groundwater conditions in Arizona 1985 to 1986: USGS Water Resources Investigation Report, 90-4179.*

*All references marked with an asterisk contain information that was directly used in the basin summaries, tables or maps.

Supplemental Reading

Andersen, Mark, 2005, Assessment of water availability in the Lower Colorado River basin: in Conservation and Innovation in Water Management: Proceedings of the 18th annual Arizona Hydrological Society Symposium, Flagstaff, Arizona, September, 2005.

Anning, D. W., 2004, Effects of natural and human factors on stream water quality in central Arizona: USGS Water Resource Supplement Jan.-Feb.

Anning, D.W., 2003, Assessment of selected inorganic constituents in streams in the central basins study area, Arizona and northern New Mexico, through 1998: USGS Water Resource Investigations Report 03-4063.

Anning, D.W., 1999, Concentrations and stream loads of nitrogen and phosphorus in surface water resources of central Arizona: in Water Issues and Partnerships for Rural Arizona: Proceedings from the 12th annual Arizona Hydrological Society Symposium, September 1999, Pinetop, Arizona

Anning, D., 1998, Sources of nitrogen and phosphorus in drainage basins of central Arizona: in Water at the Confluence of Science, Law, and Public Policy: Proceedings from the 11th annual Arizona Hydrological Society Symposium, September 1998, Tucson, Arizona, p. 8

Baker, M.B., 1999, History of watershed research in the central Arizona highlands: US Forest Service Technical Report, GTR-29

Cordy, G.E., Gellenbeck, D.J., Gebler, J.B., Anning, D.W., Coes, A.L., Edmonds, R.J. Rees, J.A., and Sanger, H.W., 2000, Water quality in the central Arizona basins, Arizona, 1995-1998: USGS Circular 1213

Dava and Associates, Inc., 2003, Yavapai County General Plan: Water Resources Element.

Gebler, J.B., 2000, Organochlorine compounds in streambed sediment and in biological tissue from streams and their relations to land use, Central Arizona: USGS Water Investigations Report 00-4041

Gellenbeck, D.J., and Anning, D.W., 2002, Occurrence and distribution of pesticides and volatile organic compounds in groundwater and surface water in Central Arizona basins, 1996-1998, and their relation to land use: USGS Water Resources Investigations Report 01-4144, 107 p

Melis, T.S., 1990, Evaluation of Flood Hydrology on Twelve Drainage Basins in the Central Highlands Region of Arizona: An Integrated Approach: Northern Arizona University, M.S. thesis, 135 p

Town of Wickenburg, 2006, Drought Preparedness Plan, Submitted to the Arizona Department of Water Resources.

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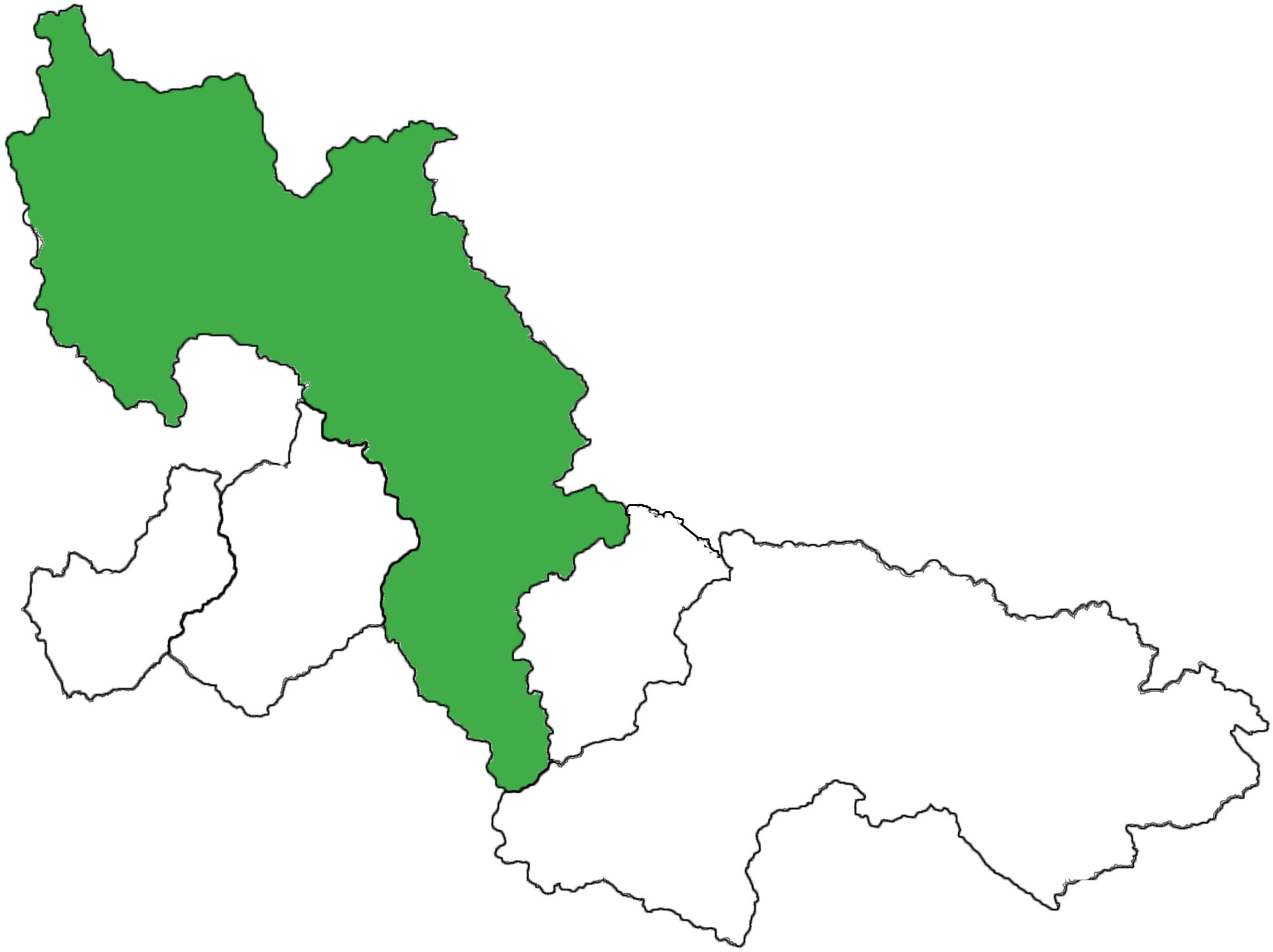
Section 5.5
Verde River Basin



5.5.1 Geography of the Verde River Basin

The Verde River Basin, located in the northern and central part of the planning area is the largest basin in the planning area at 5,661 square miles. Geographic features and principal communities are shown on Figure 5.5-1. The basin is characterized by mid-elevation mountain ranges and valleys with high elevation areas along its north central boundary. Vegetation types include Sonoran desertscrub, semidesert grassland, chaparral, woodland and montane conifer forests. Riparian vegetation is found along streams including mixed broadleaf and mesquite along the Verde River and mixed broadleaf along other streams such as West Clear Creek, Wet Beaver Creek and Oak Creek.

- Principal geographic features shown on Figure 5.5-1 are:
    - Principal basin communities of Cottonwood, Camp Verde, Clarkdale, Payson and Sedona
    - Other communities of Ash Fork, Bellemont, Jerome, Lake Montezuma, Munds Park, Paulden, Pine, Seligman, Strawberry and Sunflower
    - Verde River beginning from south of Paulden and running southeast through the basin and the communities of Clarkdale, Cottonwood and Camp Verde
    - Notable tributaries to the Verde River include Sycamore Creek, which joins the Verde River north of Clarkdale; Oak Creek, which joins the Verde River south of Cottonwood; Wet Beaver Creek and West Clear Creek, which join the Verde River near Camp Verde; and Fossil Creek and East Verde River, which join the Verde River west of Strawberry and Pine
    - Big Chino Wash in the northwestern portion of the basin entering the basin at the northernmost basin boundary and exiting south of Paulden
    - Horseshoe Reservoir on the Verde River northwest of Sunflower and Bartlett Reservoir on the Verde west of Sunflower
    - Stoneman Lake southeast of Munds Park near the Yavapai and Coconino County boundary
    - Chino Valley in the northwestern portion of the basin, extending from Seligman to Paulden
    - Verde Valley in the center of the basin around Clarkdale and Cottonwood
    - Bloody Basin in the southwestern portion of the basin west of Payson
    - Big Black Mesa southwest of Ash Fork
    - Garland Prairie south of Bellemont
    - Mogollon Rim east of Strawberry and Pine along the Gila County boundary
    - Juniper Mountains on the northwestern basin boundary
    - Mingus Mountain on the western basin boundary south of Jerome
- Not well shown on the Figure 5.5-1 are
    - The Mazatzal Mountains in the southern portion of the basin
    - Humphreys Peak, the highest point in the basin at 12,633 feet, on the north central basin boundary northeast of Bellemont
    - The Black Hills, west of Camp Verde along the basin boundary

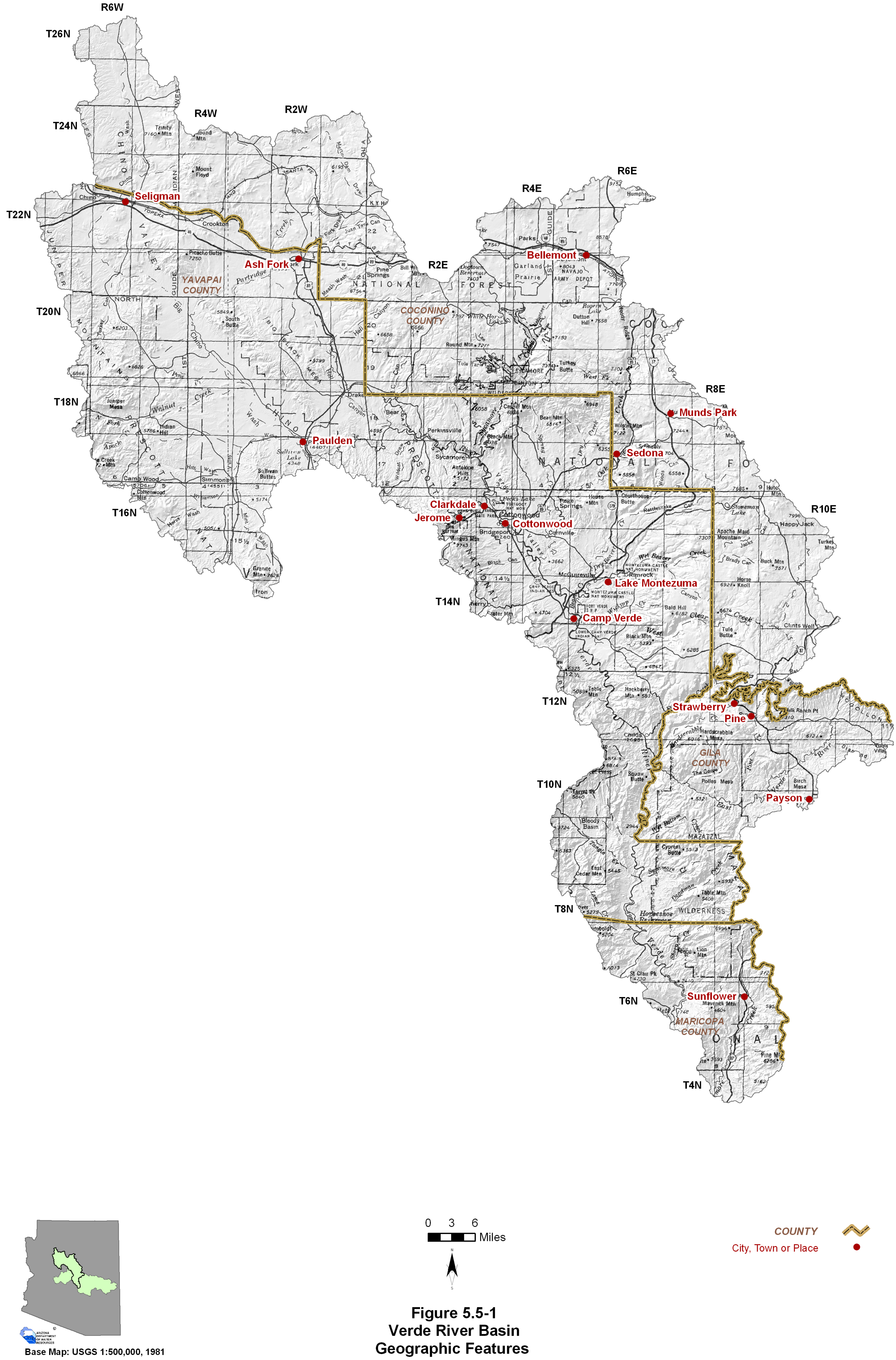


Figure 5.5-1
Verde River Basin
Geographic Features

5.5.2 Land Ownership in the Verde River Basin

Land ownership, including the percentage of ownership by category, for the Verde River Basin is shown in Figure 5.5-2. Principal features of land ownership in this basin are the large contiguous parcels of forest service lands and the relatively large portion of private land. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

National Forest and Wilderness

- 71.3% of the land is federally owned and managed as National Forest and Wilderness.
- Forest lands in the basin are part of the Prescott, Kaibab, Coconino and Tonto National Forests.
- The basin contains approximately 434,000 acres in eleven wilderness areas. The 57,916-acre Sycamore Canyon Wilderness is located in the Prescott, Kaibab and Coconino National Forests. Coconino National Forest wilderness areas include: the 48,263-acre Red Rock Secret Mountain Wilderness, 18,069-acre Munds Mountain Wilderness, 6,178-acre Wet Beaver Creek Wilderness, 15,267-acre West Clear Creek Wilderness and the 10,400-acre Fossil Creek Wilderness. Prescott National Forest wilderness areas include: 7,708-acre Juniper Mesa Wilderness, 5,553-acre Woodchute Wilderness, 9,747-acre Granite Mountain Wilderness and most of the 5,488-acre Apache Creek Wilderness. Most of the 250,053-acre Mazatzal Wilderness in the Tonto National Forest is located in the southern part of the basin.
- There are numerous small private in-holdings in all forests.
- National forest land is located throughout the basin.
- Land uses include recreation, grazing and timber production.

Private

- 20.2% of the land is private.
- The majority of the private land in the basin is in a checkerboard pattern in the northwestern portion of the basin. There are also parcels of private land in the vicinity of Cottonwood, Camp Verde and Sedona.
- Land uses include domestic, commercial, mining, farming and ranching.

State Trust Land

- 7.4% of the land in this basin is held in trust for the public schools and many other beneficiaries under the State Trust Land system.
- The majority of state land is located in a checkerboard pattern in the northwestern portion of the basin interspersed with private lands. State lands are also located in the vicinity of Clarkdale and south of the Navajo Army Depot.
- Primary land use is grazing.

U.S. Military

- 0.7% of the land is federally owned and operated by the U.S. Military as the Navajo Army Depot located in the vicinity of Bellemont in the northeastern portion of the basin.
- Land uses include National Guard training and army equipment storage.

Indian Reservation

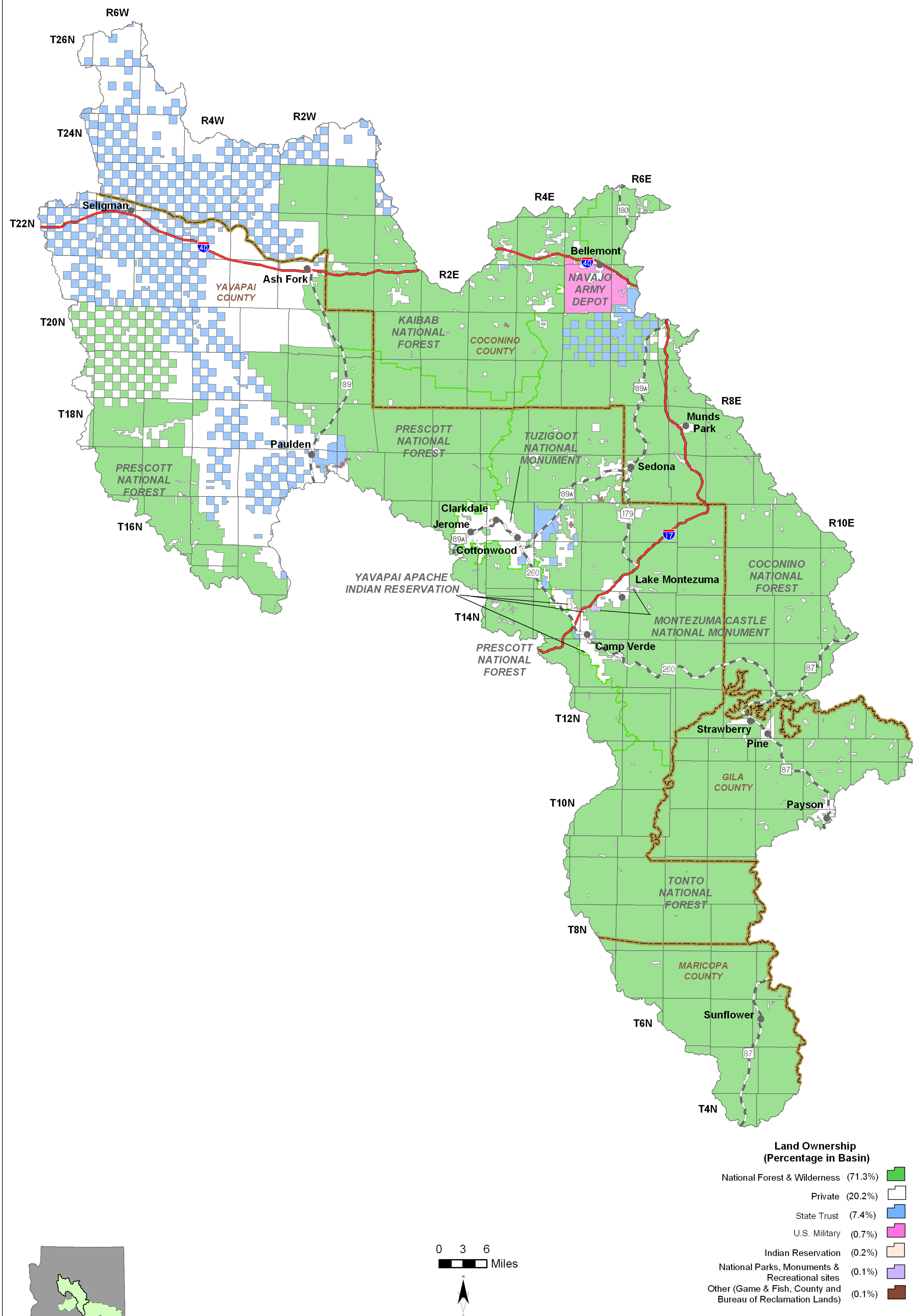
- 0.2% of the land is under ownership of the Yavapai Apache Tribe.
- Tribal lands are composed of five separate parcels located in the vicinity of Camp Verde.
- Land uses include domestic and commercial.

National Parks, Monuments and Recreation Areas

- 0.1% of the land is federally owned and managed by the National Park Service as the Montezuma Castle National Monument located near Interstate 17 in the center of the basin.
- Land uses include cultural preservation and recreation.

Other (Game and Fish, County and Bureau of Reclamation Lands)

- 0.1% of the land is owned and managed by the Arizona Game and Fish Department as the Upper Verde River Wildlife Area located in the vicinity of Paulden.
- Land uses include wildlife preservation and recreation.



Source: ALRIS , 2004

Figure 5.5-2
Verde River Basin
Land Ownership

5.5.3 Climate of the Verde River Basin

Climate data from NOAA/NWS Co-op Network, AZMET and SNOTEL/Snowcourse stations are complied in Table 5.5-1 and the locations are shown on Figure 5.5-3. Figure 5.5-3 also shows precipitation contour data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Verde River Basin does not contain Evaporation Pan stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 5.5-1A
- Elevation at the 18 NOAA/NWS Co-op network climate stations range from 2,650 feet at Childs to 7,480 feet at Happy Jack R.S.
- Minimum average temperature ranges from 27.5°F at Happy Jack R.S. to 45.6°F at Childs. Seventeen stations have minimum average temperatures between 35°F and 46°F.
- Maximum average temperature ranges from 84.5°F at Childs to 63.7°F at Happy Jack R.S. Fifteen stations have maximum average temperatures between 73°F and 85°F.
- Station precipitation ranges from an average annual precipitation of 10.55 inches at Cottonwood to 28.46 inches at Junipine.
- Most stations report the highest seasonal rainfall in the summer (July-September) and all stations report the lowest seasonal rainfall in the spring (April-June).

AZMET

- Refer to Table 5.5-1C
- There is one AZMET station in the basin at Payson.
- The station is at 4,849 feet and reported an average annual reference evapotranspiration of 59.48 inches based on one year of record.

SNOTEL/Snowcourse

- Refer to table 5.3-1D
- There are 14 snow measurement sites in the basin. Five stations have been discontinued.
- The site elevation ranges from 6,120 feet at Sugar Loaf Pillow SNOTEL to 7,720 feet at Williams Ski Run.
- Most sites record highest average snowpack in March. Several sites have high snowpacks in May, however, the average for these sites is based only on one year of data.
- Highest average snowpack is 12.8 inches at Baker Butte No. 2, located at 7,700 feet. Snowpack is measured in inches of snow water content. Ten inches of fresh snow can contain as little as 0.10 inches of water or up to 4 inches depending on a number of factors. The majority of U.S. snows fall with a water-to-snow ratio of between 0.04 and 0.10. (NSIDC, 2006)

SCAS Precipitation Data

- See Figure 5.5-3

- Additional precipitation data shows rainfall as high as 38 inches in the southern portion of the basin north of Pine. Rainfall is as low as 10 inches in the Big Chino Valley in the vicinity of Paulden.
- In general, precipitation increases as altitude increases in this basin. The range of 28 inches between highest and lowest precipitation is the largest range in the planning area.

Table 5.5-1 Climate Data for the Verde River Basin

A. NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Ashfork 6N	5,310	1902-1987[1]	74.0/Jul	36.1/Jan	1.91	1.42	5.37	3.98	12.69
Beaver Creek R.S.	3,820	1971-2000	80.8/Jul	43.1/Dec	5.25	1.63	5.75	4.08	16.71
Childs	2,650	1971-2000	84.5/Jul	45.6/Dec	6.67	1.56	6.40	4.90	19.53
Cottonwood	3,380	1949-1977[1]	82.2/Jul	43.1/Jan	2.15	1.25	3.76	3.40	10.55
Happy Jack R.S.	7,480	1971-2000	63.7/Jul	27.5/Jan	10.05	2.96	7.92	6.60	27.53
Jerome	4,950	1971-2000	78.7/Jul	41.4/Jan	6.11	2.23	7.26	4.15	19.75
Junipine	5,130	1948-1982[1]	74.4/Jul	39.0/Jan	10.69	3.25	6.92	7.60	28.46
Montezuma Castle N.M.	3,180	1971-2000	81.9/Jul	42.5/Dec	4.13	1.45	5.49	3.42	14.49
Natural Bridge	4,610	1893-1972	76.8/Jul	40.9/Jan	7.34	2.35	8.30	6.16	24.17
Oak Creek Canyon	5,080	1971-2000	73.4/Jul	39.2/Jan	11.14	2.99	7.48	6.84	28.45
Payson	4,910	1971-2000	75.4/Jul	39.9/Jan	7.35	2.18	7.20	5.34	22.01
Payson 12 NNE	5,510	1952-1976[1]	70.6/Jul	36.0/Jan	7.15	3.03	9.12	8.93	28.24
Payson R.S.	4,850	1893-1974[1]	73.1/Jul	36.3/Jan	4.01	1.88	5.70	7.57	19.14
Sedona R.S.	4,220	1971-2000	80.3/Jul	43.5/Jan	6.73	2.23	5.49	4.56	19.01
Seligman	5,250	1971-2000	73.5/Jul	37.1/Jan	3.67	1.41	5.13	2.61	12.82
Seligman 13 SSW	5,240	1962-1982[1]	73.8/Jul	35.1/Jan	3.89	1.21	4.94	3.02	13.06
Tuzigoot	3,470	1971-2000	83.1/Jul	44.8/Dec	3.51	1.19	5.29	2.75	12.74
Walnut Creek	5,090	1971-2000	72.1/Jul	36.0/Dec	5.16	1.45	5.73	3.45	15.79

Source: WRCC, 2003.

Notes:
[1]Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*number of years to calculate averages*)
Payson	4,849	2003 - current	59.48 (1)

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan.	Feb.	March	April	May	June
Baker Butte	7,300	1966 - 1999 (discontinued)	2.4*(32)*	5.2*(34)*	6.3*(34)*	4.5*(34)*	12.1*(1)*	0*(0)*
Baker Butte No. 2	7,700	1972 - current	4.0*(30)*	7.7*(33)*	11.6*(33)*	12.8*(33)*	12.1*(1)*	0*(0)*
Baker Butte SNOTEL	7,300	1966 - current	2.3*(36)*	4.7*(38)*	6.0*(38)*	4.1*(38)*	0.8*(22)*	0*(21)*
Chalender	7,100	1947 - current	1.3*(30)*	2.6*(58)*	*2.9(58)*	1.4*(58)*	0.2*(1)*	0*(0)*

Table 5.5-1 Climate Data for the Verde River Basin (cont'd)

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan.	Feb.	March	April	May	June
Fry SNOTEL	7,200	1983 - current	2.7*(21)*	4.6*(21)*	5.8*(21)*	2.1*(21)*	0*(21)*	0*(0)*
Gaddes Canyon	7,600	1954 - 1989 (discontinued)	2.6*(10)*	4.0*(36)*	5.4*(36)*	5.1*(35)*	0*(0)*	0*(0)*
Happy Jack	7,630	1951 - current	1.9*(32)*	3.3*(52)*	4.1*(53)*	2.4*(50)*	6.6*(1)*	0*(0)*
Happy Jack SNOTEL	7,630	2000 - current	1.5*(5)*	2.5*(5)*	*3.3(5)*	0.2*(5)*	0*(5)*	0*(5)*
Mingus Mountain	7,100	1947 - 1989 (discontinued)	0.9*(9)*	1.9*(46)*	1.0*(45)*	0.4*(42)*	0*(0)*	0*(0)*
Newman Park	6,750	1963 - current	1.2*(31)*	2.*(42)*	2.2*(42)*	0.8*(42)*	0.3*(1)*	0*(0)*
Sugar Loaf SNOTEL	6,120	1983-1999 (discontinued)	0.1*(16)*	0.3*(16)*	0.5*(15)*	0*(16)*	0*(17)*	0*(17)*
White Horse Lake Jct	7,180	1967 - 1999 (discontinued)	1.4*(25)*	3.1*(31)*	3.8*(33)*	2.1*(33)*	0.9*(33)*	0*(0)*
White Horse Lake SNOTEL	7,180	1967 - current	1.8*(31)*	3.6*(36)*	4.9*(38)*	2.6*(38)*	0.2*(25)*	0*(22)*
Williams Ski Run	7,720	1967 - current	2.9*(21)*	5.8*(38)*	8.3*(38)*	*8.7(37)*	0*(0)*	0*(0)*

Source: NRCS, 2005

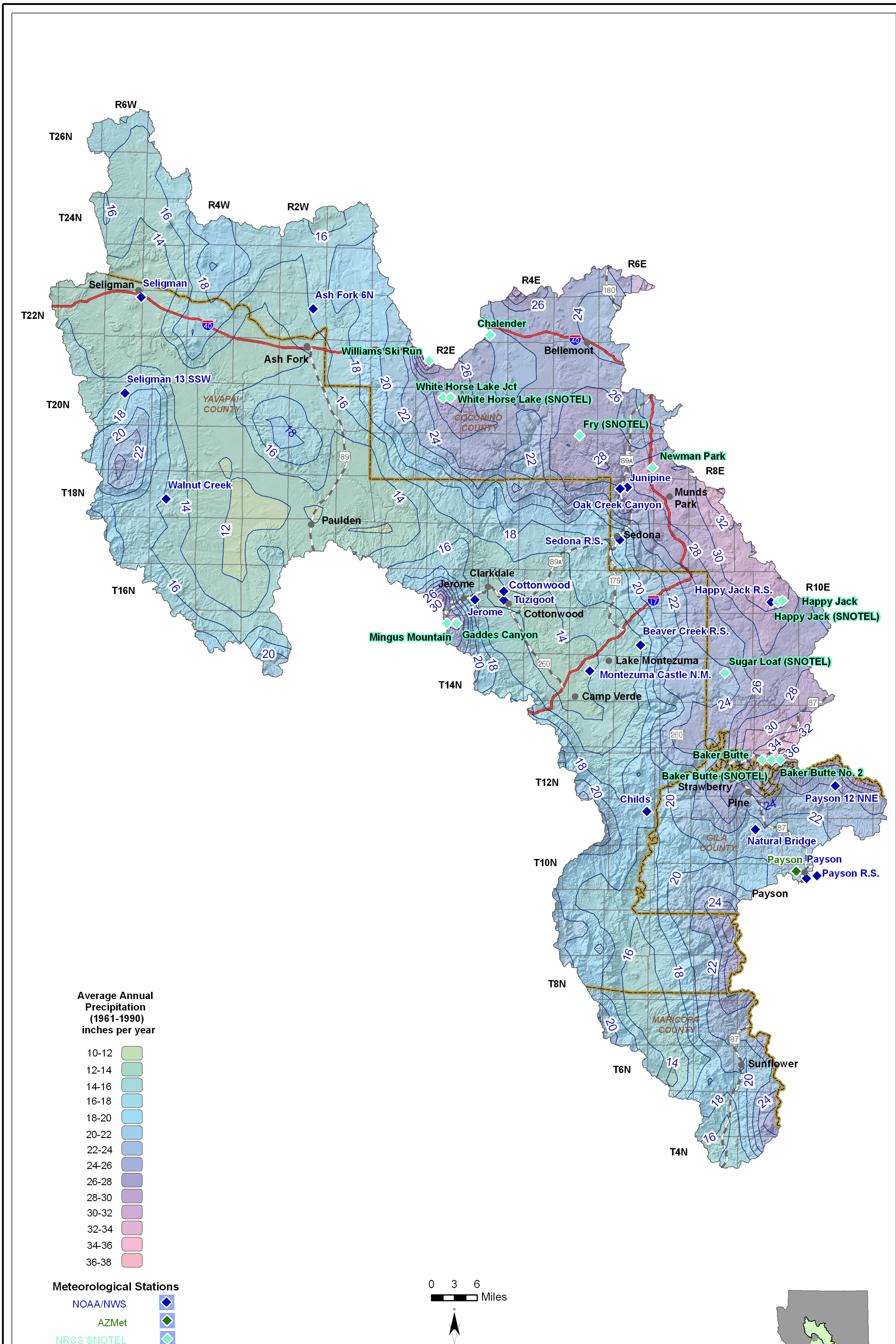


Figure 5.5-3
Verde River Basin
Meteorological Stations
and Annual Precipitation

5.5.4 Surface Water Conditions in the Verde River Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 5.5-2. Flood ALERT equipment in the basin is shown in Table 5.5-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 5.5-4. The location of streamflow gages identified by USGS number, flood ALERT equipment, USGS runoff contours and large reservoirs are shown on Figure 5.3-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 5.5-2.
- Data from 36 stations located at 22 watercourses are shown in the table and on Figure 5.5-4. Twenty-one of the 36 stations have been discontinued and 13 of the stations are real-time stations.
- The average seasonal flow at all stations but one is highest in the winter (January-March) when between 37% and 71% of the average annual flow occurs. The average seasonal flow is lowest at most stations in the summer (July-September) when between 1% and 24% of the average annual flow occurs.
- Maximum annual flows range from 1,583,014 acre-feet (1993, Verde River below Tangle Creek above Horseshoe Dam) to 376 acre-feet (1991, Rocky Gulch near Rimrock). Minimum annual flows range from seven acre-feet (1964, East Fork Sycamore Creek near Sunflower) to 258,525 acre-feet (1939, Verde River below East Verde River near Childs).
- Seventeen streams in this basin have a mean annual flow of over 10,000 acre-feet. One river, Verde River, has a mean annual flow of over 100,000 acre-feet.

Flood ALERT Equipment

- Refer to Table 5.5-3.
- As of October 2005 there were 41 stations in the basin. Stations are in Maricopa, Yavapai and Coconino Counties, however, all stations in Coconino County are operated by Yavapai County Flood Control District and one station in Yavapai County is operated by Maricopa County Flood Control District.
- Of the 41 stations, 25 are precipitation only stations, seven are precipitation/stage stations, four are weather stations, three are repeater/precipitation stations and two are repeater/weather stations.

Salt River Project (SRP) Low-Flow Gages

- Refer to Table 5.5-3a
- There are three SRP low-flow gages in this basin. These gages are a project of SRP, Prescott National Forest and Arizona Game and Fish designed to provide real-time information to the public about the Verde River streamflow.

Reservoirs and Stockponds

- Refer to Table 5.5-4.

- The basin contains 13 large reservoirs. The largest, Bartlett, has a maximum storage of 178,186 acre-feet.
- The most common use of the reservoirs is for fire protection, stock or farm pond. Other uses include recreation, irrigation, water supply, flood control and other. Bartlett and Horseshoe store water for use in the Phoenix metropolitan area.
- Surface water is stored or could be stored in 59 small reservoirs in the basin.
- Total maximum storage for the 27 small reservoirs with greater than 15 acre-feet and less than 500 acre-feet capacity is 3,592 acre-feet. The total surface area for the remaining 32 small reservoirs is 496 acres.
- There are 2,328 registered stockponds in this basin.

Runoff Contour
- Refer to Figure 5.5-4.
- Average annual runoff is 0.1 inches per year in the northwestern portion of the basin and 1 inch in the southwestern portion of the basin. Average annual runoff increases to five inches per year in the west central portion of the basin.

Table 5.5-2 Streamflow Data for Verde River Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow (in acre-feet/year)				Years of Annual Flow Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9403990	Dogtown Wash above Dogtown Reservoir near Williams	4.7	NA	2/1964-5/1965 (discontinued)	No statistics run; less than 3 years of data								1
9502800	Williamson Valley Wash near Paulden	255	5,120	3/1965-current (real-time)	64	7	10	19	770 (2002)	2,064	5,199	22,959 (1980)	20
9503700	Verde River near Paulden	2,507	5,410	7/1963-current (real-time)	46	16	16	19	16,511 (2002)	20,783	30,743	156,19 (1993)	39
9503720	Hell Canyon near Williams	15	7,110	8/1965-9/1972 (discontinued)	49	6	8	37	123 (1967)	1,444	2,316	5,017 (1966)	6
9503800	Volunteer Wash near Bellemont	131	7,620	8/1965-9/1972	59	7	1	33	61 (1967)	1,792	2,709	6,719 (1966)	6
9504000	Verde River near Clarkdale	3,124	5,490	6/1915-current (real-time)	50	16	14	20	54,529 (2002)	104,279	128,062	458,393 (1993)	40
9504420	Oak Creek near Sedona	233	NA	10/1981 -current (real-time)	54	18	10	17	22,587 (2002)	46,298	58,873	164,776 (1993)	21
9504430	Oak Creek at Sedona	233	NA	10/1981-9/1995 (discontinued)	58	16	9	18	24,108 (1989)	53,792	67,074	165,067 (1993)	13
9504500	Oak Creek near Cornville	355	6,200	7/1940-current (real-time)	50	20	9	21	21,357 (1956)	51,402	61,972	182,440 (1978)	56
9505000	Verde River at Camp Verde	3,849	NA	1/1913-3/1920 (discontinued)	55	20	12	14	149,139 (1913)	309,138	305,312	545,879 (1916)	7
9505200	Wet Beaver Creek near Rimrock	111	6,410	10/1961-current (real-time)	55	22	8	15	5,489 (1977)	18,176	23,659	64,667 (1993)	33
9505220	Rocky Gulch near Rimrock	1	7,190	10/1985-9/1992 (discontinued)	66	25	4	6	62 (1989)	210	215	376 (1991)	4
9505250	Red Tank Draw near Rimrock	48	5,910	4/1957 - 9/1978, (discontinued)	58	16	4	22	33 (1963)	3,183	4,666	22,304 (1965)	20
9505300	Rattlesnake Canyon near Rimrock	25	6,560	6/1957-9/1980, (discontinued)	59	22	2	17	101 (1963)	4,345	5,763	21,652 (1965)	22
9505350	Dry Beaver Creek near Rimrock	142	6,220	10/1960-current (real-time)	61	21	3	15	253 (1996)	21,978	31,271	105,727 (1978)	42
9505500	Beaver Creek at Camp Verde	433	NA	12/1912-3/1920 (discontinued)	64	21	6	9	26,715 (1913)	64,072	70,274	132,488 (1915)	6
9505550	Verde River below Camp Verde	4,288	5,544	11/1971-11/1981 (discontinued)	42	24	7	27	67,620 (1977)	192,578	267,706	603,073 (1978)	7
9505800	West Clear Creek near Camp Verde	241	6,680	12/1964- current (real-time)	54	20	8	18	11,152 (2002)	34,542	45,858	133,245 (1993)	38

Table 5.5-2 Streamflow Data for Verde River Basin (cont'd)

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow (in acre-feet/year)				Years of Annual Flow Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9506000	Verde River near Camp Verde	4,644	5,560	4/1934-current (real-time)	59	17	11	14	99,934 (2002)	222,679	299,621	990,650 (1993)	24
9507600	East Verde River near Pine	6	6,430	9/1961-9/1971 (discontinued)	26	32	24	19	521 (1963)	10,208	8,860	16,507 (1968)	9
9507700	Webber Creek above West Fork Webber Creek near Pine	5	6,980	7/1959-9/1974 (discontinued)	37	36	7	20	478 (1967)	1,814	1,876	4,547 (1965)	14
9507800	West Fork Webber Creek near Pine	4	NA	7/1959-9/1965 (discontinued)	51	36	4	9	181 (1963)	348	586	1,115 (1962)	5
9507900	Webber Creek below WF Webber Creek near Pine	10	NA	7/1959-9/1965 (discontinued)	46	40	6	9	557 (1963)	1,050	1,775	3,424 (1960)	5
9507950	East Verde River near Payson	272	NA	7/1961-9/1965 (discontinued)	50	33	16	2	4,684 (1964)	10,425	9,211	12,544 (1962)	3
9507980	East Verde River near Childs	331	5,140	9/1961-current (real-time)	59	16	10	15	1,499 (2002)	34,036	46,674	208,558 (1993)	38
9508000	Verde River below East Verde River near Childs	5,241	NA	6/1934 -current	67	13	9	11	258,525 (1939)	395,733	444,220	733,574 (1937)	6
9508300	Wet Bottom Creek near Childs	36	4,810	10/1967-current (real-time)	71	6	5	18	87 (2002)	8,471	10,182	37,864 (1978)	35
9508500	Verde River below Tangle Creek above Horseshoe Dam	5,493	5,470	8/1945-current (real-time)	51	17	11	20	131,073 (2002)	294,733	409,875	1,583,014 (1993)	57
9509000	Verde River at Bartlett Reservoir near Cave Creek	6,065	NA	10/1938-12/1945 (discontinued)	48	25	11	16	245,428 (1942)	381,536	434,387	1,036,012 (1941)	7
9510070	West Fork Sycamore Creek above McFar Canyon near Sunflower	5	5,430	10/1966-5/1986 (discontinued)	60	12	4	24	27 (1971)	623	816	2,121 (1983)	10
9510080	West Fork Sycamre Creek near Sunflower	10	5,260	10/1961-9/1974 (discontinued)	54	13	6	26	50 (1971)	923	1,573	4,503 (1973)	12
9510100	East Fork Sycamore Creek near Sunflower	4	5,760	10/1961-5/1986 (discontinued)	69	13	4	14	7 (1964)	308	678	2,302 (1980)	22
9510150	Sycamore Creek near Sunflower	52	4,260	10/1961-9/1976 (discontinued)	47	14	6	34	297 (1964)	2,881	5,476	18,244 (1965)	14
9510170	Camp Creek near Sunflower	3	NA	8/1963-9/1966 (discontinued)	No statistics run; less than 3 years of data								2
9510180	Rock Creek near Sunflower	15	3,680	3/1963-9/1972 (discontinued)	44	7	12	38	109 (1971)	999	1,227	4,474 (1965)	8
9510200	Sycamore Creek near Fort McDowell	164	3,820	12/1960-current (real-time)	70	11	3	17	41 (2002)	8,290	19,584	111,493 (1993)	42

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Notes:
Statistics based on Calendar Year
Annual Flow statistics based on monthly values
Summation of Average Annual Flows may not equal 100 due to rounding.
Period of record may not equal Year of Record used for annual Flow/Year statistics due to only using years with a 12 month record
NA = Not available

Table 5.5-3 Flood Alert Equipment in the Verde River Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
105	Metz Mountain	Precipitation	7/14/1994	Yavapai County FCD
110	Woody Mountain	Precipitation	7/12/1993	Yavapai County FCD
115	Kelly Pocket	Precipitation	7/13/1993	Yavapai County FCD
120	Red Hill	Precipitation	7/3/1993	Yavapai County FCD
125	Small Tank	Precipitation	7/2/1993	Yavapai County FCD
130	Coyote Park	Precipitation	7/11/1993	Yavapai County FCD
135	Bear Seep	Precipitation	7/14/1993	Yavapai County FCD
140	Munds Park	Precipitation/Stage	7/9/1993	Yavapai County FCD
145	Pumphouse Wash	Precipitation/Stage	11/12/1997	Yavapai County FCD
150	Sedona Airport	Weather Station	7/2/1993	Yavapai County FCD
155	West Fork Oak Creek	Precipitation/Stage	11/12/1997	Yavapai County FCD
160	Oak Creek @ Tlaquepaque	Precipitation/Stage	11/12/1997	Yavapai County FCD
165	ADOT Rim Camp	Precipitation	7/9/1993	Yavapai County FCD
175	Dry Creek Levee	Precipitation/Stage	8/28/2001	Yavapai County FCD
180	Merry-Go-Round	Precipitation	3/23/2005	Yavapai County FCD
185	Chick Road Detention Pond	Precipitation/Stage	12/15/2000	Yavapai County FCD
193	Mingus Mountain Repeater	Repeater/Weather Station	8/22/1997	Yavapai County FCD
240	Jacks Point	Precipitation	7/27/2004	Yavapai County FCD
250	Jacks Canyon	Precipitation	7/19/2004	Yavapai County FCD
260	House Mountain	Precipitation	7/14/2004	Yavapai County FCD
370	Summit Mountain	Precipitation	5/6/1997	Yavapai County FCD

Table 5.5-3 Flood Alert Equipment in the Verde River Basin (cont'd)

Station ID	Station Name	Station Type	Install Date	Responsibility
375	Happy Jack	Precipitation	5/6/1997	Yavapai County FCD
410	Walnut Creek @ Williamson Valley Rd	Precipitation/Stage	8/27/2001	Yavapai County FCD
415	Sycamore Point	Precipitation	8/28/2001	Yavapai County FCD
420	White Hills	Precipitation	7/15/2004	Yavapai County FCD
425	Yavapai County Verde Roads Yard	Precipitation	11/19/1997	Yavapai County FCD
430	Cottonwood Pubilc Works Yard	Weather Station	8/21/2001	Yavapai County FCD
460	Apache Maid	Precipitation	4/17/2000	Yavapai County FCD
465	Buck Mountain	Precipitation	7/13/2000	Yavapai County FCD
470	Lee Butte	Precipitation	12/4/2000	Yavapai County FCD
485	Cedar Flat	Precipitation	8/1/2001	Yavapai County FCD
490	Calloway Butte	Precipitation	4/28/2000	Yavapai County FCD
495	Baker Butte	Precipitation	8/29/2001	Yavapai County FCD
3800	Hyde Mountain Repeater	Repeater/Precipitation	4/13/2005	Yavapai County FCD
3805	Williamson Valley Fire Department	Precipitation	6/16/2005	Yavapai County FCD
3825	Big Chino Wash @ SR 89	Precipitation/Stage	4/1/2005	Yavapai County FCD
3850	Bill Williams Repeater	Repeater/Precipitation	9/20/2005	ADWR
4940	Humboldt Mountain Repeater	Repeater/Weather Station	7/14/1981	Maricopa County FCD
4950	Seven Springs	Precipitation	11/12/1981	Maricopa County FCD
5890	Horseshoe Lake	Weather Station	9/11/2000	Maricopa County FCD
5910	Bartlett Lake	Weather Station	8/31/2000	Maricopa County FCD

FCD = Flood Control District
ADWR = Arizona Department of Water Resources

Table 5.5-3 a. SRP Low Flow Gages in the Verde River Basin

Map Key	Station Name	GaugeType	Install Date	Upper Flow Limit (cfs)
a	Verde Headwaters	Critical Depth Flume	4/2004	100
b	Verde at Black Bridge	Radar based level sensor	9/2001	150
c	Verde Falls	Low Flow Gage	6/2001 (destroyed spring 2004 and reinstalled summer 2006)	150

Table 5.5-4 Reservoirs and Stockponds in the Verde Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
1	Barlett	Bureau of Reclamation	178,186	R,S	Federal
2	Horseshoe	Bureau of Reclamation	131,500	I,S	Federal
3	Hells Canyon Tank (Hell Canyon)	AZ Dept. of Transportation	1,545	P	State
4	Wineglass Ranch	AZ Land Dept	1,226	P	State
5	Railroad Embarkment	Atchison, Topeka, & Santa Fe RR	1,000	C	State
6	Padre Reservoir (Pan Dam)	Atchison, Topeka, & Santa Fe RR	760	O	State
7	Canyon Mouth	Atchison, Topeka, & Santa Fe RR	600	O	State

B. Other Large Reservoirs (50 acre surface area or greater)[2]

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE[1]	JURISDICTION
8	Rogers[3]	Coconino NF	1,134	P	Federal
9	Stoneman	Coconino NF	220	P	Federal
10	Unnamed[4]	Private	94	P	NA
11	Little Red Lake[4]	Private	85	P	NA
12	Horse[4]	Private	83	P	NA
13	Duck	Private	50	P	NA

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 27
Total maximum storage: 3,592 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[2]

Total number: 32
Total surface area: 496 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 2,328 (from water right flings)

Notes:
NA = Not applicable
[1]C=flood control; F=fish & wildlife pond; I=irrigation; O=other; P=fire protection, stock or farm pond R=recreation; S=water supply
[2]Capacity data not available to ADWR
[3]Intermittent Lake
[4]Dry Lake

0 3 6 Miles

Stream Data Source: ALRIS, 2005

Figure 5.5-4
Verde River Basin
Surface Water Conditions

USGS Annual Runoff Contour for 1951-1980 (in inches)
Stream Channel (width of line reflects stream order)
Large Reservoir
USGS Gage & Station ID 9999999
Flood ALERT Equip. & Station ID 9999
SRP Low Flow Gage
County
Interstate Highway
Major Road
City, Town or Place

5.5.5 Perennial/Intermittent Streams and Major Springs in the Verde River Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 5.5-5. The locations of major springs and perennial and intermittent streams are shown on Figure 5.5-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- Perennial streams are located throughout most of the basin and include the Verde River, Oak Creek, Fossil Creek, East Verde Creek, West Clear Creek, Wet Beaver Creek, Deadman Creek and Sycamore Creek. These streams are perennial for all or most of their length.
- Intermittent streams are found throughout the basin except for the northwestern portion of the basin.
- There are 101 major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time, the largest number reported in any groundwater basin in Arizona.
- Listed discharge rates may not be indicative of current conditions. Many of the measurements were taken during or prior to 1981.
- Most springs are located in the western portion of the basin with large concentrations of springs in the Lower Oak Creek Area, Upper Oak Creek Area and in the vicinity of Strawberry and Pine. The greatest discharge rate was measured at Fossil Creek Spring, 21,647 gpm.
- Forty of the major springs have a measured discharge rate of 100 gpm or greater and nine springs have discharge rates of 1,000 gpm or greater.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 5.2-5B. There are 79 minor springs in this basin.
- The total number of springs, regardless of discharge, identified by the USGS varies from 493 to 571, depending on the database reference.

Table 5.5-5 Springs in the Verde River Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Fossil Creek (multiple)	342523	1113423	21,647	During or prior to 2001
2	Big Chino	345107	1122546	8,941	During or prior to 1997
3	Bubbling Pond	344625	1115403	3,879	5/20/1968
4	Buckhorn	343340	1113108	1,000	5/28/1959
5	Unnamed	345327	1120815	2,917	7/4/1991
6	Page	344542	1115318	2,693	1/20/1975
7	Summers	345250	1120358	2,100	10/12/2003
8	Wet Beaver	344116	1113433	850-1,350[2]	10/28/1999
9	Parson	345410	1120349	1,600	11/27/1999
10	Webber Canyon	341923	1112003	996	During or prior to 2002
11	Montezuma Well	343856	1114503	916	During or prior to 1990
12	Cold	342058	1111547	830	11/11/1952
13	Unnamed	345838	1114507	749	During or prior to 1949
14	Haskell	344407	1120357	600	10/24/1958
15	Lower Newell[3]	344438	1115332	520	2/4/1959
16	Duff	345234	1121727	449	During or prior to 1997
17	Sullivan Lake	345148	1122636	448	During or prior to 1997
18	Grotto	341859	1112026	340	5/15/1952
19	Bonito[3]	342410	1111238	330	11/19/1999
20	Lolo-Mai	344631	1115403	300	7/10/1974
21	Sterling # 1	350130	1114420	300	10/12/2003
22	Tree Root	344627	1115405	264	7/9/1952
23	Dude	342925	1111351	250	11/18/1999
24	Blue	343125	1114959	230	6/11/1981
25	Upper Parsnip[3]	342616	1112543	230	11/9/1999
26	Unnamed[3]	341935	1114515	220	4/21/1976
27	Unnamed[3]	343135	1115015	220	11/6/1980
28	Spring Creek	344633	1115511	207	10/12/2003
29	Pieper Hatchery	342602	1111527	200	10/12/2003
30	Chase[3]	342557	1111740	200	11/11/1999
31	Unnamed[3]	343138	1115035	190	6/9/1981
32	Spider John	345300	1120422	15-85	10/27/1999
33	Thompson Pasture	345436	1114335	177	2/14/1952
34	Big	341854	1112037	175	5/15/1952
35	Turtle Pond	344627	1115404	160	12/10/1952
36	Indian Gardens	345439	1114336	115	2/14/1952

Table 5.4-5 Springs in the Verde River Basin (cont'd)

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
37	Sheepshead Canyon	344448	1115557	111	3/1/1974
38	Bear	343259	1112548	100	5/27/1959
39	Tonto Bridge	341918	1112716	100	10/12/2003
40	Burned house[3, 4]	342257	1111700	100	10/18/1952
41	Unnamed	343122	1114959	90	11/6/1980
42	Beaverhead	344251	1114701	85	6/4/1974
43	Unnamed	342221	1111709	75	10/18/1952
44	Unnamed	345316	1120734	75	6/8/1977
45	Walker Creek[3]	343847	1114111	75	7/10/1959
46	Banjo Bill	345739	1114509	75[2]	3/6/1974
47	Nad-1	351315	1115000	64	8/2/1978
48	Unnamed	351313	1114958	64	8/2/1978
49	Unnamed	351320	1115033	60	8/9/1949
50	Page area # 1	344634	1115405	60	7/10/1974
51	Ellison Headwater	342333	1110913	60	12/1/1999
52	Gravel Plant[3]	344605	1120235	60	10/29/1958
53	Landon	350726	1114238	60	8/29/1979
54	Walnut	344423	1120801	52	5/10/1978
55	Unnamed	345106	1129358	50	During or prior to 1965
56	Unnamed	345832	1114546	50	8/18/1949
57	Unnamed	351324	1115045	50	8/9/1949
58	Brown	342439	1114721	50	2/3/1959
59	Pine Flat	350040	1114411	50	10/4/2002
60	Sherwood	345908	1114450	50	1/20/2000
61	Unnamed	340735	1115116	45	5/12/1976
62	Big	350929	1120448	40	6/11/1997
63	Ellison	342330	110959	40	12/1/1999
64	Twin springs	344132	1120619	40	5/10/1978
65	Clear Creek # 1	343138	1113925	30	11/17/1999
66	Lelani	345905	1114443	30	During or prior to 1949
67	Geronimo	350440	1115649	10-30[2, 5]	During or prior to 2001
68	North Sycamore[3]	342521	1111908	30	1/12/1999
69	Sheep Bridge Hot (multiple)	340441	1114223	26	6/13/2002
70	Cave	345955	1114423	25	1/20/2000
71	Lolami	345937	1114437	25	8/17/1949
72	Woods	345211	1113723	25	12/13/1960
73	Hummingbird	345903	1114450	25	8/18/1949
74	Lo	350913	1115857	24	7/24/2002

Table 5.5-5 Springs in the Verde River Basin (cont'd)

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
75	Catfish	343112	1115003	22	6/11/1981
76	Sterling # 2	350130	1114423	21[5]	8/13/1949
77	Sterling # 3	350130	1114421	20	8/13/1949
78	Hutch # 1	341232	1115311	20	6/12/2002
79	Hutch # 2	341229	1115306	20	6/12/2002
80	LX	341005	1115005	20	6/13/2002
81	Stone Camp	340704	1115105	20	7/6/2002
82	Zig Zag # 1	341040	1114734	20	6/13/02
83	Mine	342903	1115107	20	1/27/1982
84	Poison	350802	1115828	20[5]	8/31/1949
85	Pivot Rock	342927	1112351	20[5]	12/2/1999
86	Parsnip	342600	1112553	20[5]	11/9/1999
87	Clear Creek # 3	343222	1113730	20	11/17/1999
88	Clear Creek # 2	343141	1113919	15	11/17/1989
89	Unnamed	345745	1114604	15	During or prior to 1951
90	Pyle Ranch	342215	1111009	15	12/1/1999
91	Soda	343845	1114429	15	2/6/1959
92	Unnamed[3]	343120	1115001	13	11/6/1980
93	Little	351812	1115724	12	6/6/1979
94	Verde Hot	342119	1114233	12	6/20/02
95	Unnamed	341126	1114730	10	7/7/1976
96	Bunker Hill	345900	1115524	10	9/20/1962
97	Frey Ranch	344635	1115413	10	7/10/1974
98	Lindberg/Fulton	350629	1114313	10	7/8/1952
99	Washington Park	342526	1111600	10	10/18/1952
100	Washington	342603	1111619	10[5]	4/29/1905
101	Gray	350736	1115743	10[5]	9/20/1962

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Babe's Hole	350421	1115623	8	8/10/2002
Bull Pen	343214	1114145	7	10/10/1959
Lower Lo	350906	1115854	6	10/24/2001
Cottontail	344337	1115538	5	6/9/1977

Table 5.5-5 Springs in the Verde River Basin (cont'd)

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Maxwell	351657	1114746	5	6/5/1978
Unnamed	345202	1122523	5	5/2/1977
Storm Seep	350107	1123053	5	4/19/2001
Hackberry # 2	342558	1114122	5	5/31/2002
Wet Prong	342431	1114350	5	6/21/2002
Big	343228	1113724	5	11/19/1999
Unnamed	352017	1114328	5	8/17/1978
Lockwood	350248	1115147	5[6]	9/20/1960
Irving High	342426	1113611	5[6]	11/15/1999
Irving Low	342417	1113640	5[6]	5/24/1978
Hance	343336	1114420	4	5/27/1981
Frizell Ranch (Hell's Canyon)	344443	1115511	4	2/6/1959
Picnic	340941	1114957	4	6/13/2002
Turkey	322436	1112307	4	7/27/2002
North Pasture	340750	1115127	3	6/14/2002
Red rock	342214	1112402	3	7/22/1946
Dripping(2)	342327	1112603	3	7/20/1946
Unnamed	351354	1115136	3	8/2/1978
Spitz	351537	1115823	3	6/1/1978
Oak	342102	1112822	3	08/1946
Sycamore #1B	342825	1114232	3	6/7/2002
Cottonwood	343102	1115215	3	12/13/1977
Lee	345605	1125506	2	4/20/2001
Russell	343709	1114536	2	10/12/2003
Quail	344015	1120258	2	7/11/2002
Phroney	342631	1114134	2	6/10/2000
Sycamore #1A	342830	1114230	2	6/7/2002
Sycamore # 2	342754	1114249	2	6/7/2002
Zig Zag # 2	341041	1114733	2	6/13/2002
Pine	345759	1125413	2	4/20/2001
Ash	340459	1115214	2	5/12/1976
Beaver Creek[3]	344044	1114108	2	4/20/1978
Buzzard	350026	1114943	2	9/20/1962
West Twin	351006	1121326	2	9/30/1976
Little Hutch # 1	341232	1115316	2	6/12/2002
Little Hutch # 2	341231	1115317	2	6/12/2002
Sheep	345458	1113214	2	6/24/2002
Ryal	343030	1115410	2	7/10/1959

Table 5.5-5 Springs in the Verde River Basin (cont'd)

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Powell	343454	1120445	2	4/20/1978
Goat Camp	343748	1120141	2	4/18/1978
Hogpen	344552	1120603	2	5/4/1978
Unnamed	345606	1124002	2	7/15/1969
Surprise	343614	1123242	2	4/19/2001
Log	343606	1120420	2	6/29/2002
Rosalida	351030	1120341	2	6/11/1997
Cherry 361b	343625	1120038	2	7/11/2002
Tappen	351057	1114655	2	9/6/1949
Black	350802	1114117	1	8/1/1949
Baker	350115	1141729	1	12/2/1999
Railroad	350807	1115734	1	11/2/2001
Pine	342242	1112323	1	8/11/2002
Pfau	343622	1120012	1	7/11/2002
Trail Jct.	335838	1114021	1	7/18/2002
Kelsey	350432	1115605	1	8/6/2002
Hackberry # 1	342603	1114117	1	10/12/2003
Fuller/Strawberry	342436	1112833	1	7/24/1946
Dripping(1)	342328	1112306	1	10/11/2002
Unnamed	343154	1115035	1	10/28/1981
North Mine	342916	1115113	1	1/27/1982
Fourty Four	342905	1112217	1	1/19/2000
Unnamed	343425	1114352	1	5/27/1981
Holly	344501	1115502	1	3/1/1974
Bell Rock	344752	1114552	1	4/25/1974
Dorsey	350316	1115640	1	8/11/1949
Grassy Meadow	350014	1114402	1	8/17/1949
Aspen	350738	1114707	1	6/22/1978
Buck	351120	1120240	1	During or prior to 11/2004
Garland	351116	1115949	1	During or prior to 11/2004
Huffer	342756	1112315	1	12/2/1999
Strawberry Hollow	342346	1112814	1	7/24/46
Chasm	342643	1114942	1	7/1/2002
Rock Top	345109	1113253	1	6/27/2002
Cottonwood[3, 4]	342248	1112840	1	7/24/1946
Unnamed[3, 4]	350633	1114929	1	During or prior to 1946
Fisher (tank)	351022	1114531	1	8/18/1949

Table 5.5-5 Springs in the Verde River Basin (cont'd)

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and NHD, 2006): 493 to 571

Notes:
[1]Most recent measurement identified by ADWR
[2]Discharge is expressed as a range
[3]Spring is not displayed on current USGS topo maps
[4]Location approximated by ADWR
[5]Most recent measurement < 10gpm
[6]Most recent measurement < 1gpm

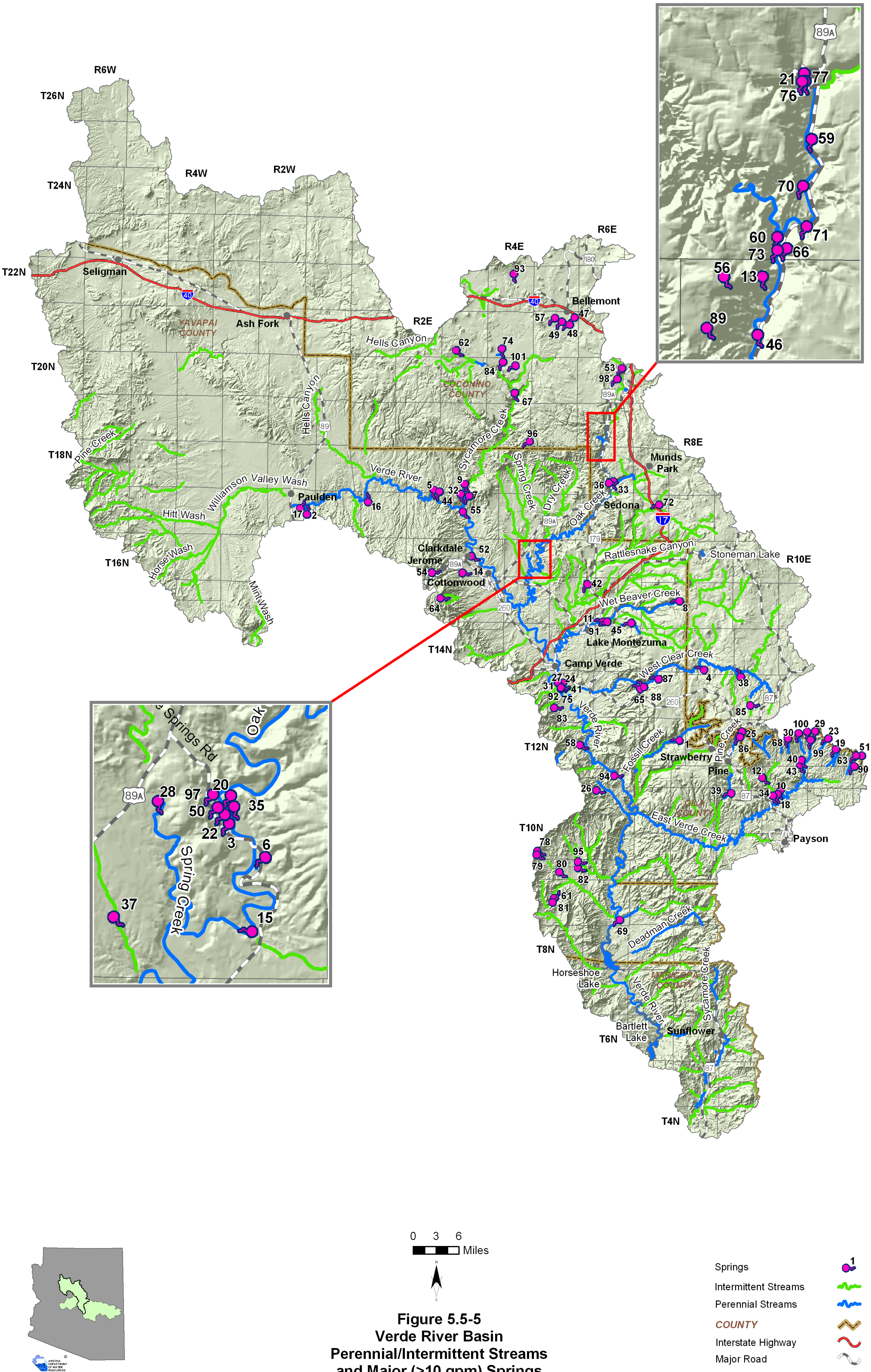


Figure 5.5-5
Verde River Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

Stream Data Source: AGFD, 1993 & 1997

5.5.6 Groundwater Conditions of the Verde River Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 5.5-6. Figure 5.5-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. In the Verde Valley and Big Chino sub-basins few wells were measured in 1990-1991. Figures 5.5-6A and 5.5-6B show water level changes in these sub-basins measured in other years. Figure 5.5-7 contains hydrographs for selected wells shown on Figure 5.5-6. Figure 5.5-8 shows well yields in five yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 5.5-6 and Figures 5.5-6 and 5.5-6 A and B.
- Major aquifers in the basin include the Verde formation, recent stream alluvium, basin fill carbonate aquifers and igneous and metamorphic rock.
- The basin contains three sub-basins, Big Chino, Verde Valley and Verde Canyon.
- Flow direction is generally from the north to the south following the Verde River.

Well Yields

- Refer to Table 5.5-6 and Figure 5.5-8.
- As shown on Figure 5.5-8, well yields in this basin range from less than 100 gallons per minute (gpm) to greater than 2,000 gpm.
- One source of well yield information, based on 262 reported wells, indicates that the median well yield in this basin is 260 gpm.
- Most well yields in the basin are less than 100 gallons per minute. The highest well yields are in the vicinity of Paulden in the Big Chino sub-basin.

Natural Recharge

- Refer to Table 5.5-6.
- There are two estimates of natural recharge for this basin ranging from 107,000 acre-feet per year to more than 138,000 acre-feet per year.
- Natural recharge in the Big Chino Sub-basin is from runoff along the mountain fronts and the major washes. Recharge in the Verde Valley Sub-basin is principally from infiltration of precipitation in the higher elevations and is estimated at 167,470 acre-feet per year (Blausch et al., 2006).

Water in Storage

- Refer to Table 5.5-6.
- There are three estimates of water in storage for this basin ranging from 13 million acre-feet to 28 million acre-feet. The most recent estimate, from a 1990 ADWR study, indicates the basin has 28 million acre-feet in storage to a depth of 1,200 feet.
- The predevelopment storage estimate is 13 million acre-feet to a depth of 1,200 acre-feet.

Water Level

- Refer to Figures 5.5-6 and 5.5-6 A and B. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures 106 index wells in this basin.
- In 2004, the year of the last water level sweep, 681 wells were measured.
- The deepest recorded water level in the basin is 1,375 feet in the vicinity of Strawberry. There are two wells in the basin where the depth to water is only one foot, located southwest of Paulden and south and east of Bellemont.
- There are three ADWR automated groundwater level monitoring devices in this basin located near Cottonwood, Payson and .
- Hydrographs corresponding to selected wells shown on Figures 5.5-6 and 5.5-6 A and B but covering a longer time period are shown in Figure 5.5-7.

Table 5.5-6 Groundwater Data for the Verde River Basin

Basin Area, in square miles:	5,661	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Recent Stream Alluvium	
	Basin Fill with Interbedded Volcanic Rock	
	Sedimentary Rock (Verde Formation)	
	Sedimentary Rock (C and R Aquifers)	
	Igneous and Metamorphic Rock	
Well Yields, in gal/min:	Range 10-2,908 Median 102 (55 wells measured)	Measured by ADWR and/or USGS
	Range 1-5,500 Median 260 (262 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	10-1000	ADWR (1994)
	Range 0-2,500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	167,470 (average for Verde Valley Sub-basin during 1990 - 2003)[1]	Blasch and others (2006)
	30,300 (average for Big Chino Sub-basin during 1990 - 2003)[2]	Blasch and others (2006)
	31,770 (Big Chino Sub-basin during 1996 and 1997)[3]	ADWR (2000)
	1,826 (Town of Payson only)	Southwest Groundwater Consultants (1998)
	>138,000	ADWR (1994)
	107,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	6,800,000 (portion of Upper Big Chino Sub-basin)	Southwest Groundwater Consultants (2005)
	10,000,000 (Big Chino Sub-basin to 1,200 feet)	McGavock (2003)
	9,230 (Pine/Strawberry area)[4]	ADWR (1996)
	28,000,000 (to 1,200 feet)	ADWR (1990)
	13,000,000 (to 1,200 feet)	Freethey and Anderson (1986)
	>22,000,000	Arizona Water Commission (1975)
Current Number of Index Wells:	106	
Date of Last Water-level Sweep:	2004 (681 wells measured)	

[1] Includes 19,300 AF of incidental and artificial recharge.
[2] Includes 4,300 AF of incidental and artificial recharge.
[3] Includes 8,010 AF of incidental recharge.
[4] This figure has been refuted as an overestimation by Morrison Maierle (2003).

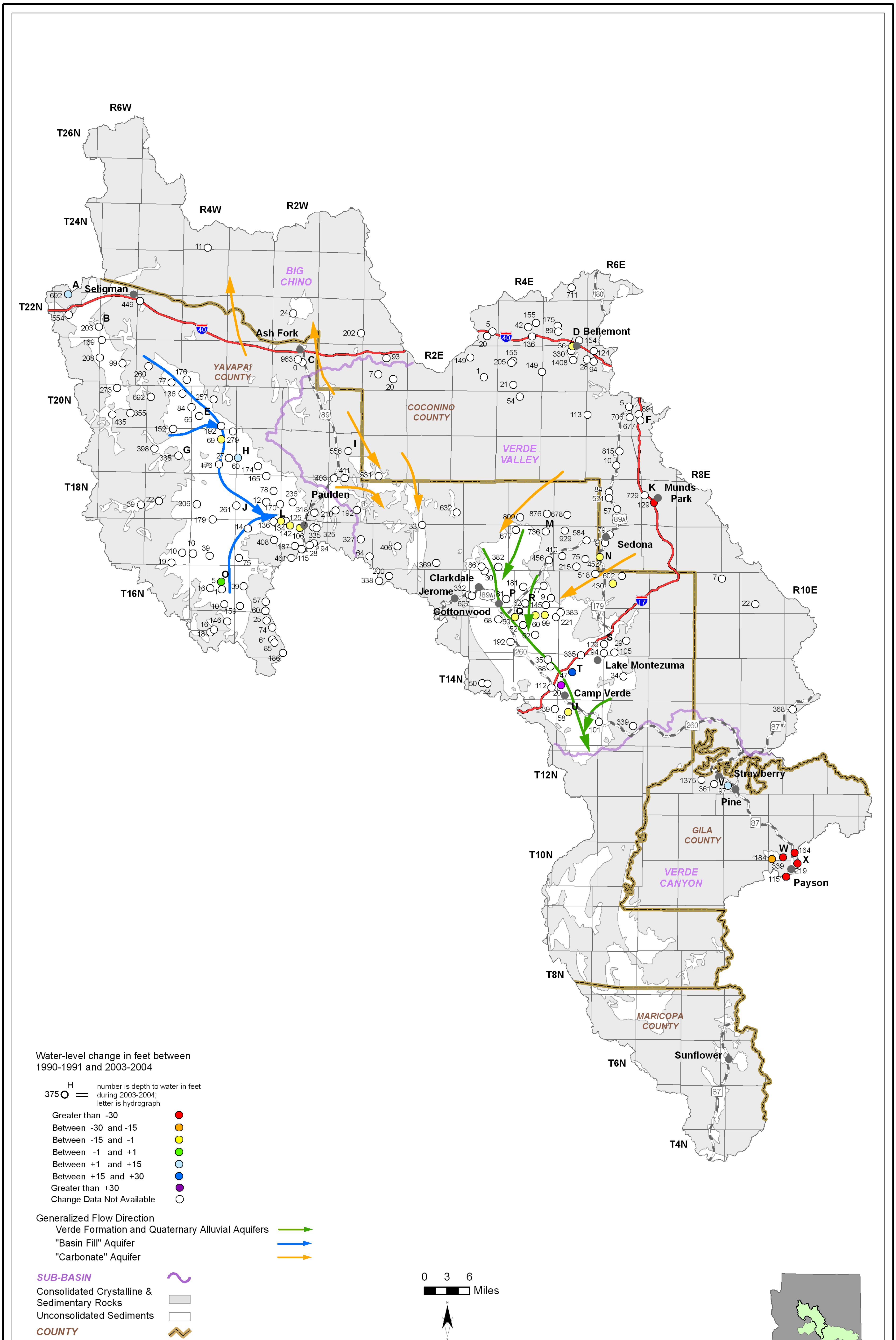


Figure 5.5-6
Verde River Basin
Groundwater Conditions

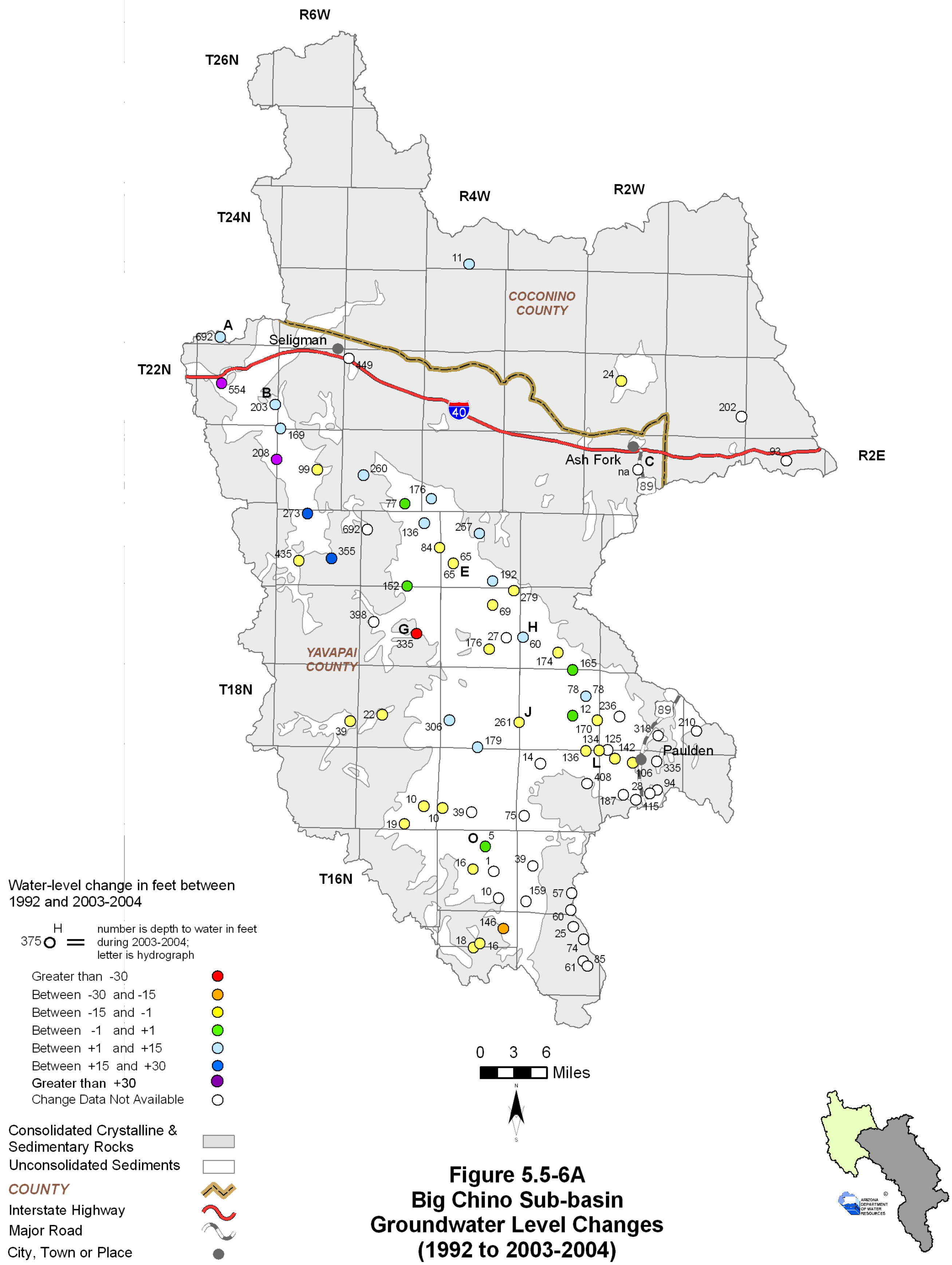
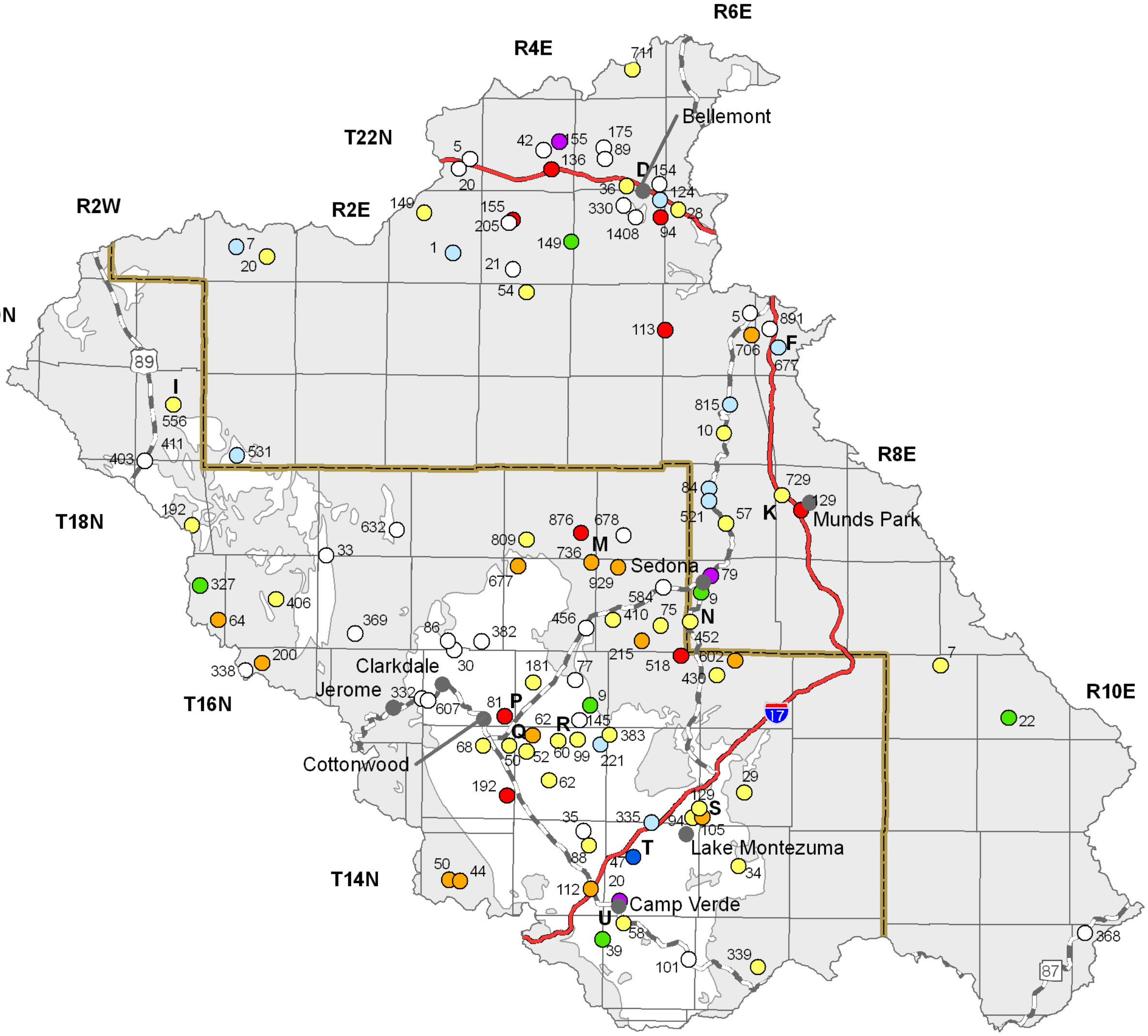


Figure 5.5-6A
Big Chino Sub-basin
Groundwater Level Changes
(1992 to 2003-2004)



Water-level change in feet between 1994 and 2003-2004

375 ○ H = number is depth to water in feet during 2003-2004; letter is hydrograph

- Greater than -30
- Between -30 and -15
- Between -15 and -1
- Between -1 and +1
- Between +1 and +15
- Between +15 and +30
- Greater than +30
- Change Data Not Available

- Consolidated Crystalline & Sedimentary Rocks
- Unconsolidated Sediments
- COUNTY
- Interstate Highway
- Major Road
- City, Town or Place

0 3 6 Miles

Figure 5.5-6B
Verde Valley Sub-basin
Groundwater Level Changes
(1994 to 2003-2004)

Figure 5.5-7
Verde River Basin
Hydrographs Showing Depth to Water in Selected Wells

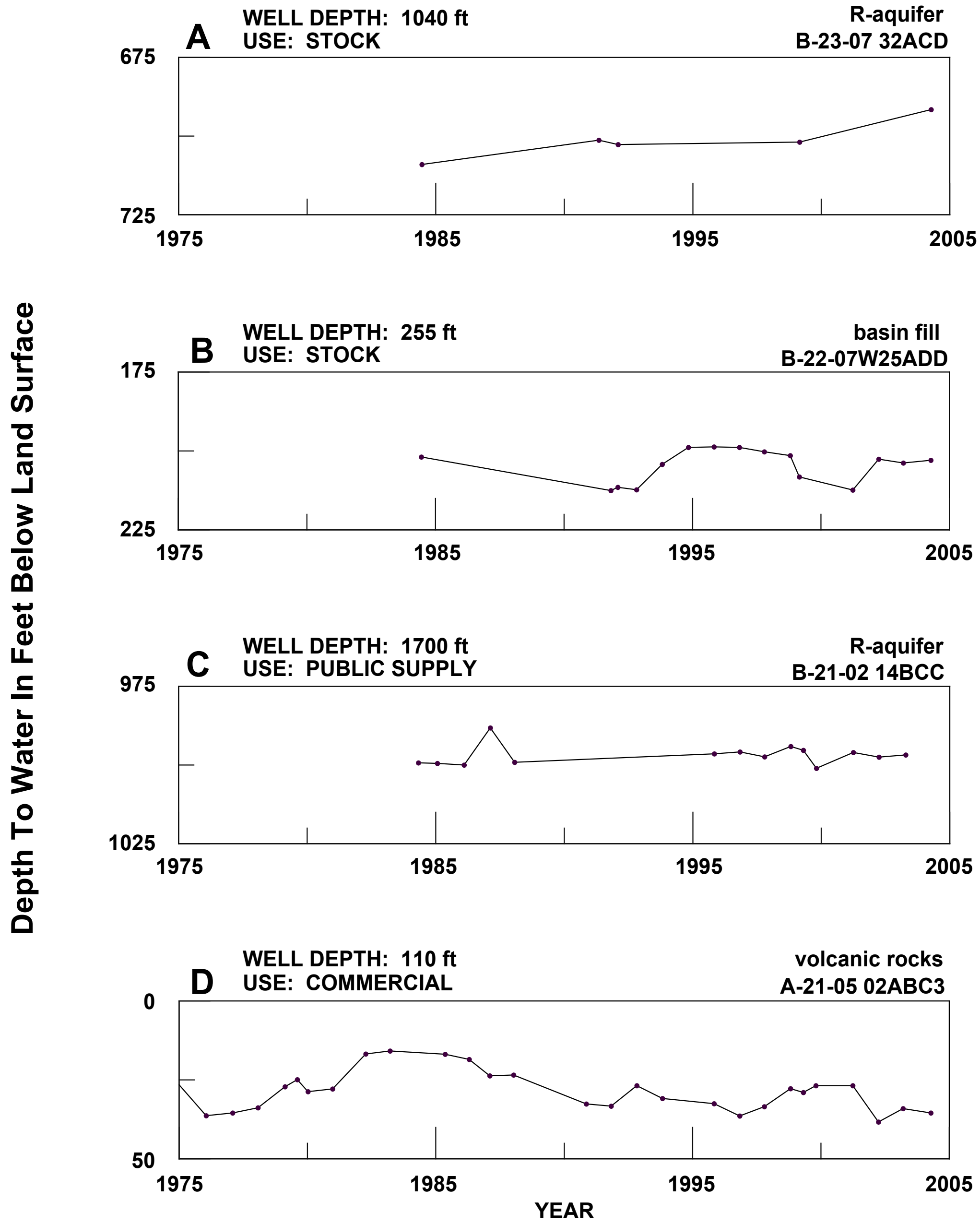


Figure 5.5-7 (Con't.)
Verde River Basin
Hydrographs Showing Depth to Water in Selected Wells

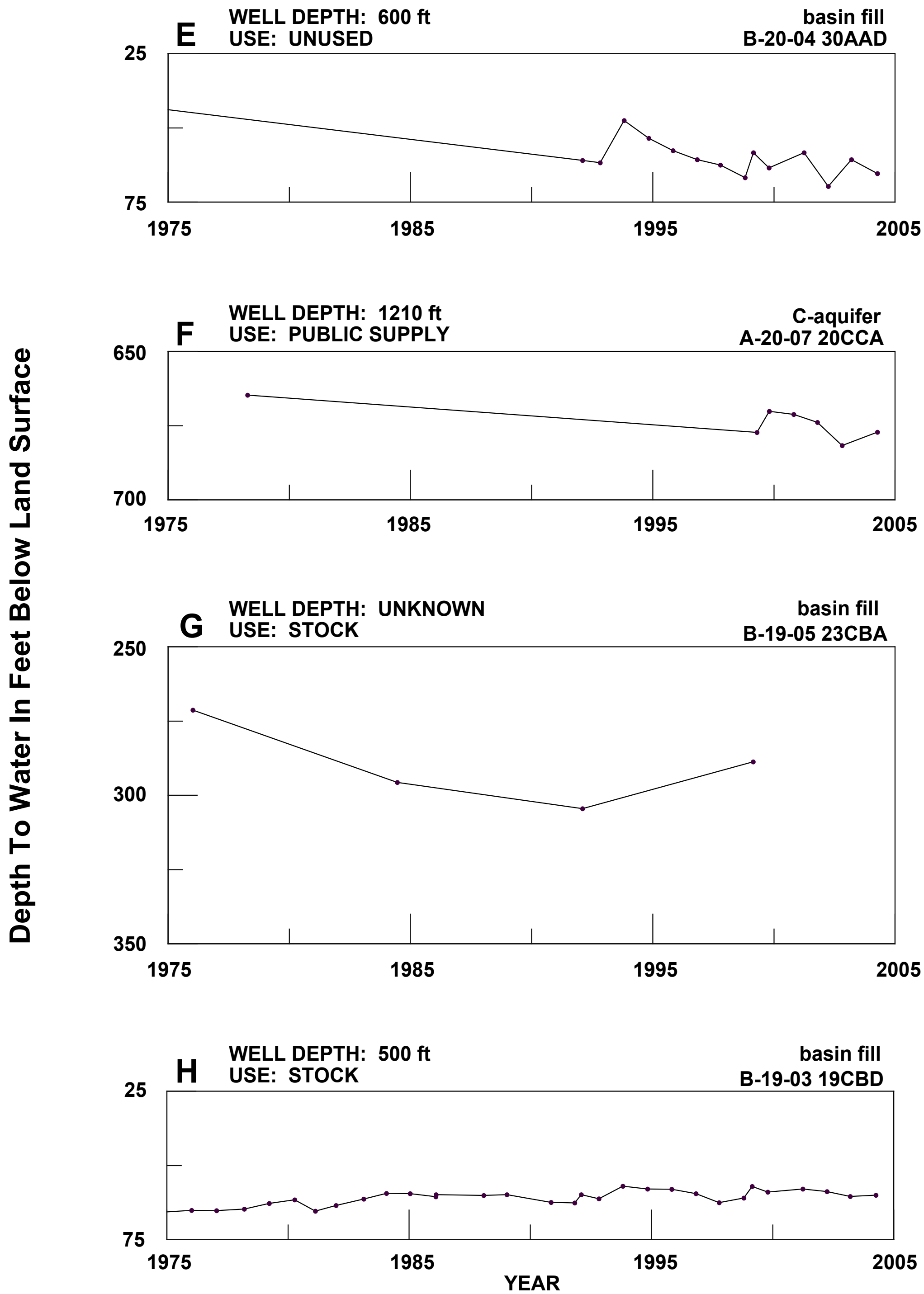


Figure 5.5-7 (Con't.)
Verde River Basin
Hydrographs Showing Depth to Water in Selected Wells

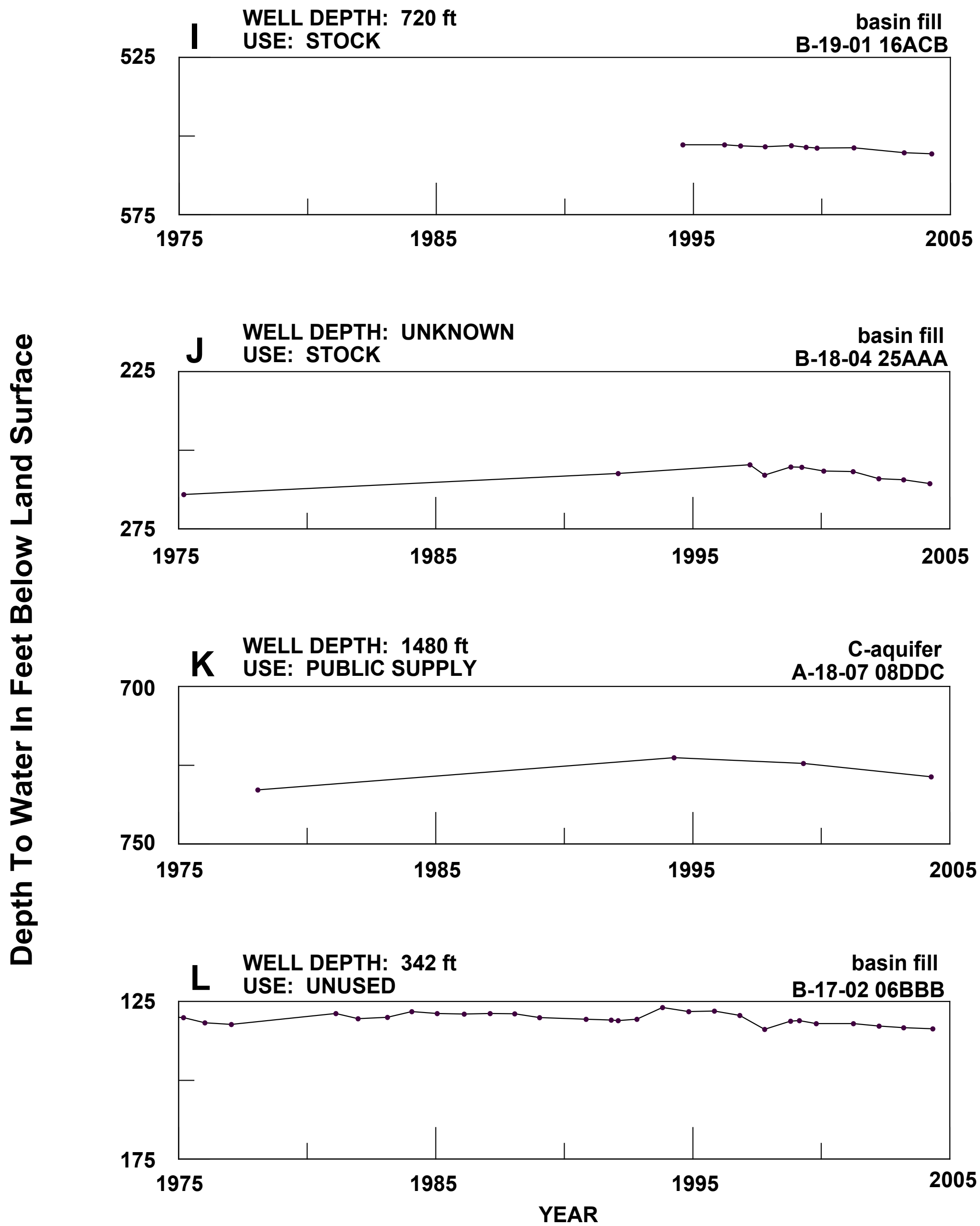


Figure 5.5-7 (Con't.)
Verde River Basin
Hydrographs Showing Depth to Water in Selected Wells

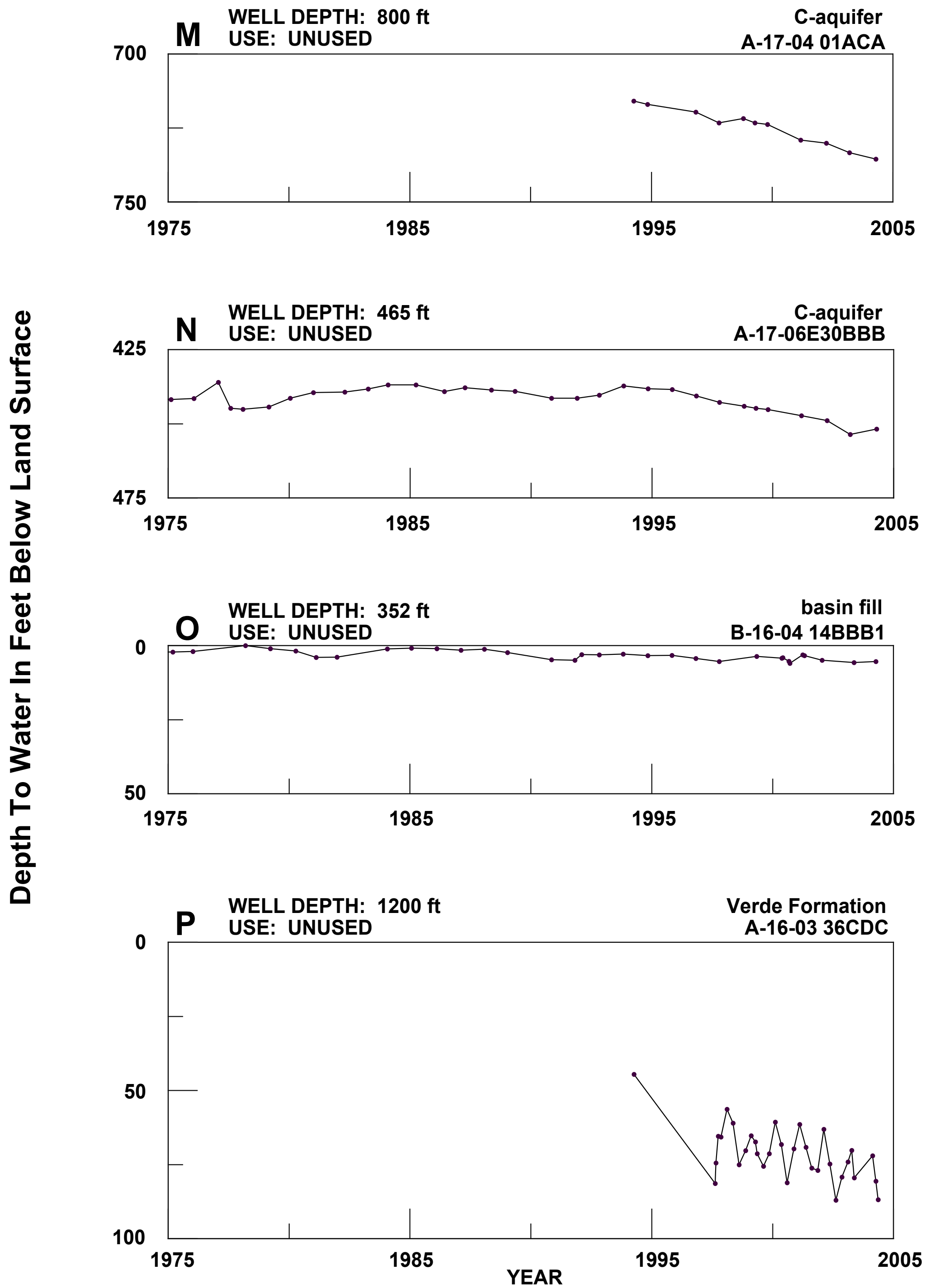


Figure 5.5-7 (Con't.)
Verde River Basin
Hydrographs Showing Depth to Water in Selected Wells

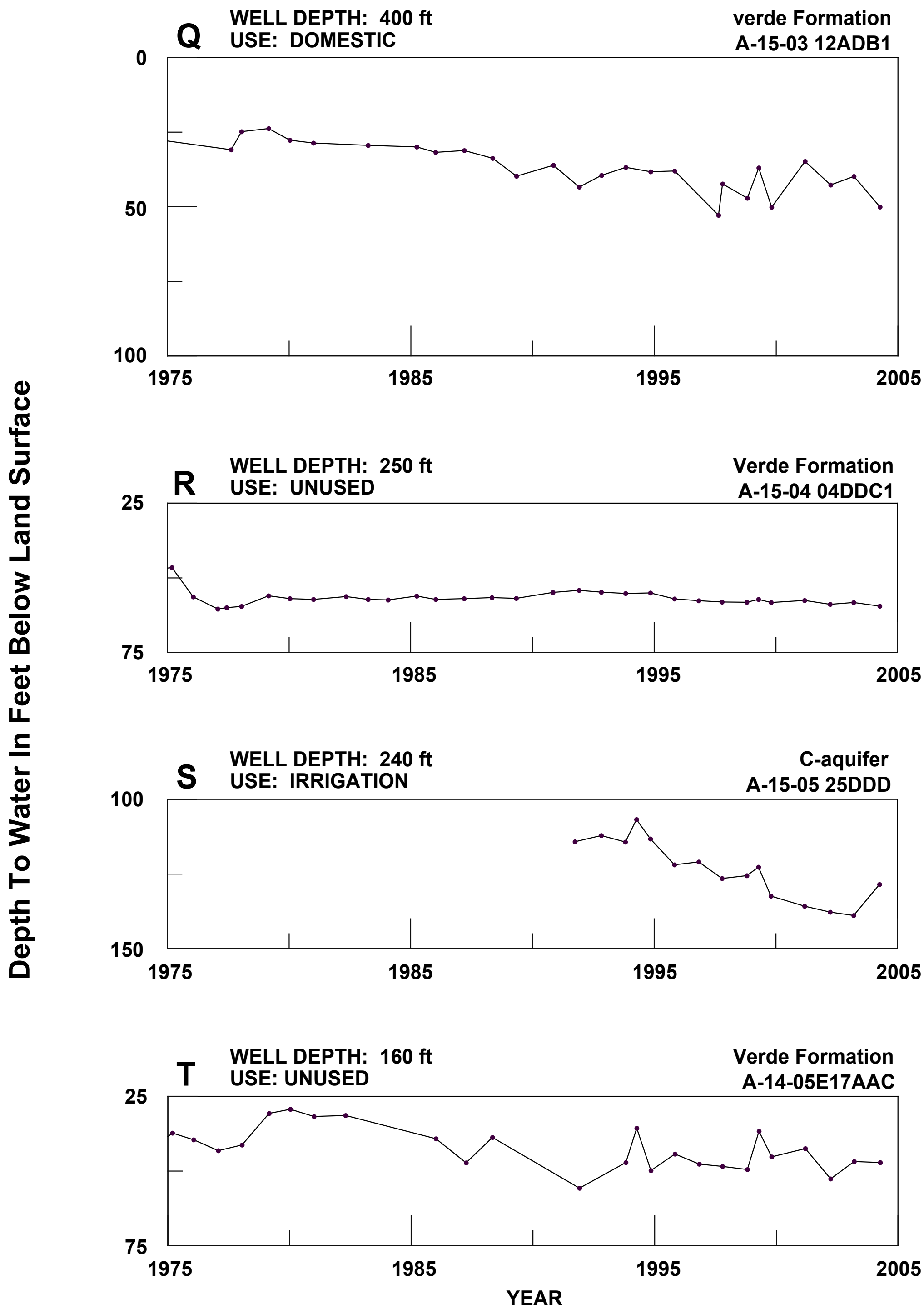


Figure 5.5-7 (Con't.)
Verde River Basin
Hydrographs Showing Depth to Water in Selected Wells

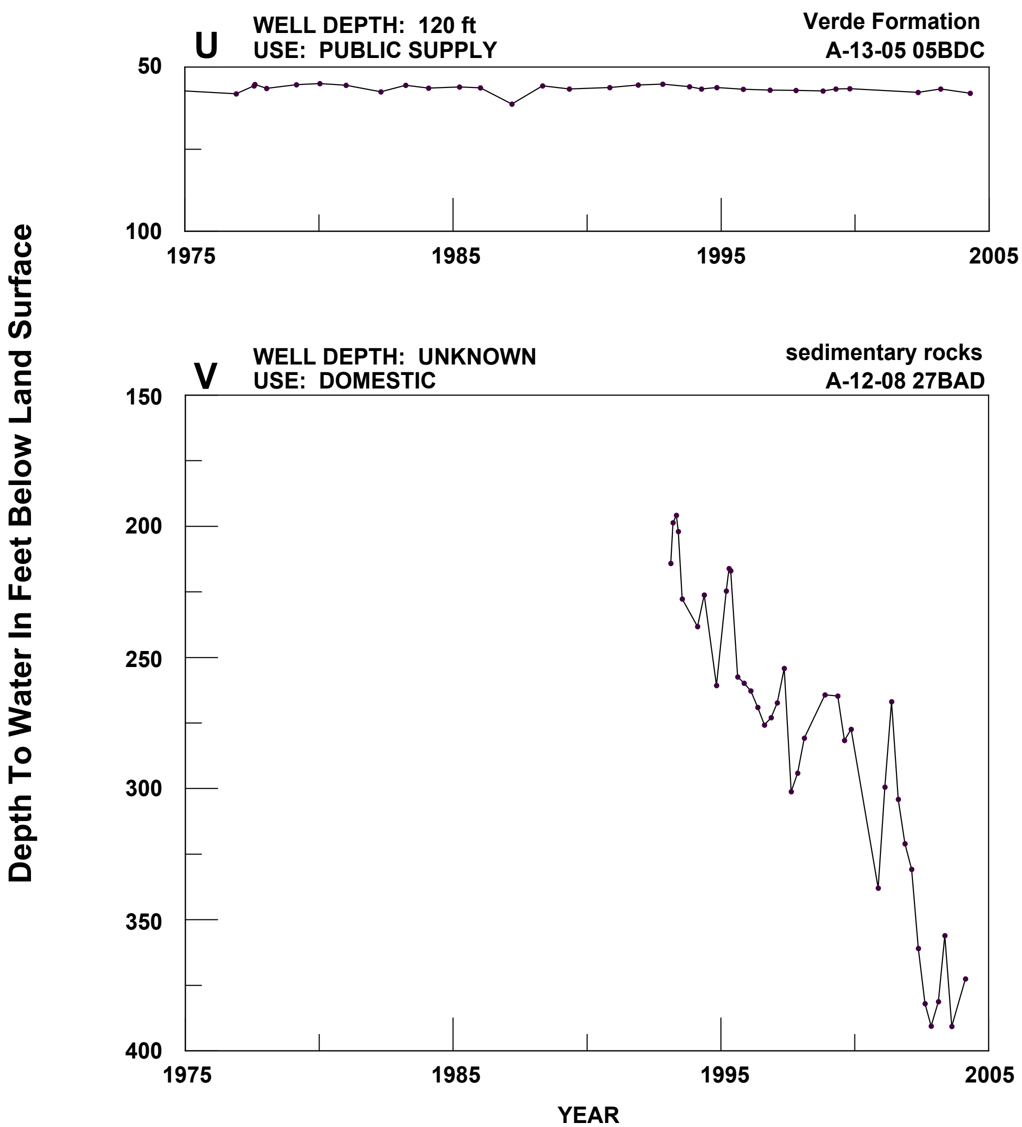
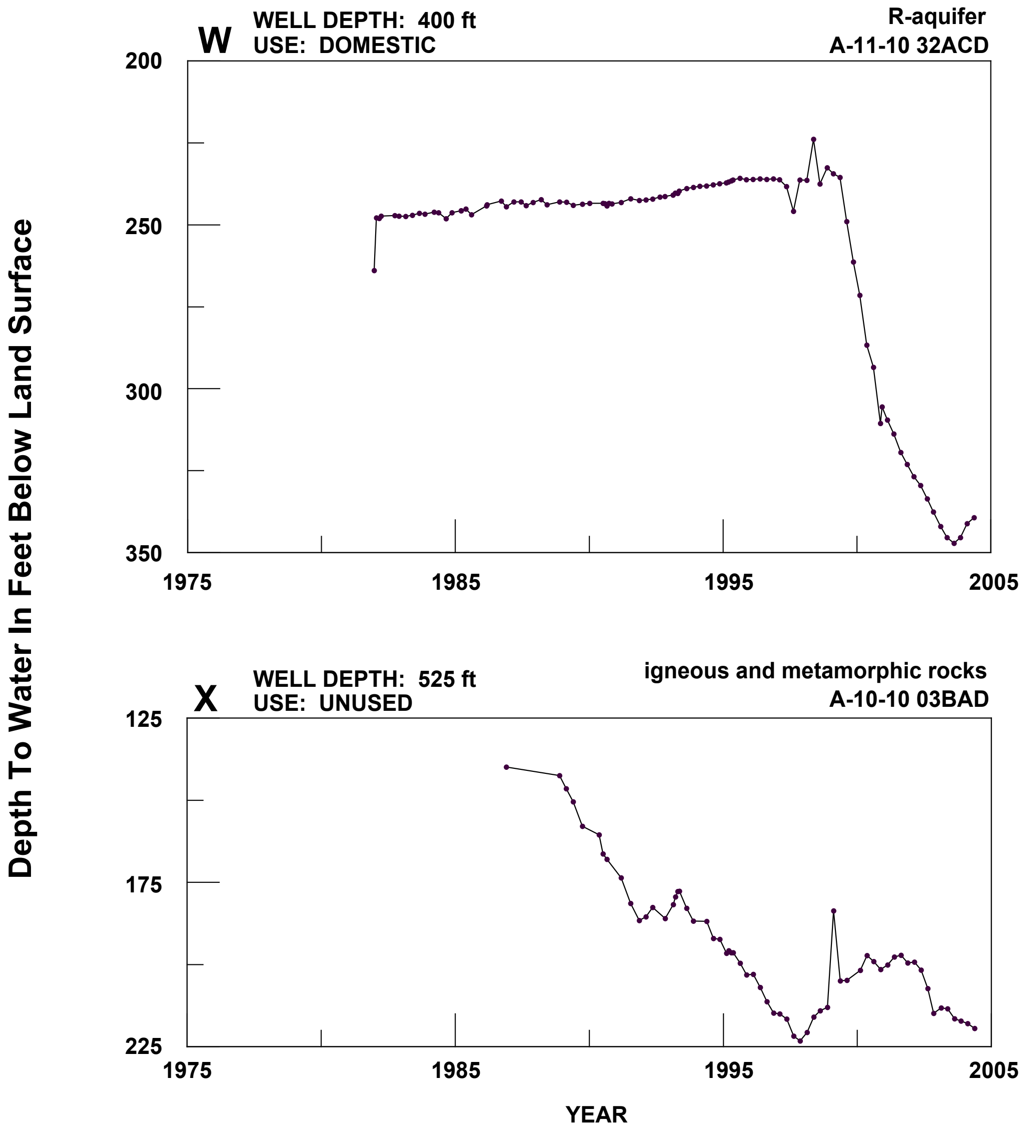


Figure 5.5-7 (Con't.)
Verde River Basin
Hydrographs Showing Depth to Water in Selected Wells



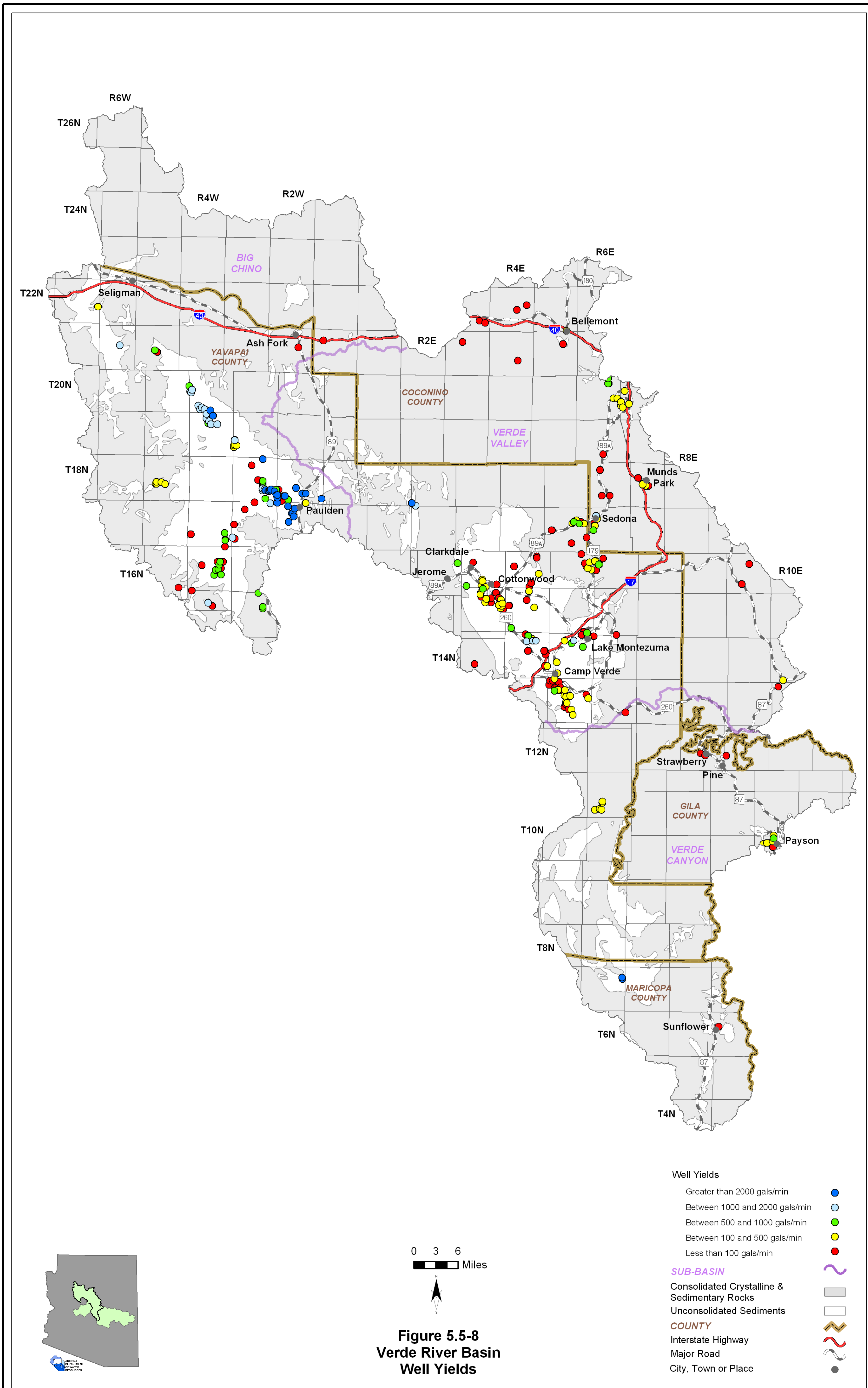


Figure 5.5-8
Verde River Basin
Well Yields

5.5.7 Water Quality of the Verde River Basin

Wells, springs and mine sites with parameter concentrations that have equaled or exceeded drinking water standard(s), including location and parameter(s) are shown in Table 5.5-7A. Impaired lakes and streams with site type, name, length of impaired reach, area of impaired lake, designated use standard and parameter(s) exceeded is shown in Table 5.5-7B. Figure 5.5-9 and 5-5.0A show the location of water quality occurrences keyed to Table 5.5-7. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mines

- Refer to Table 5.5-7A.
- Four hundred and thirty sites have parameter concentrations that have equaled or exceeded drinking water standards
- The parameter most frequently equalled or exceeded in the sites measured was arsenic.
- Many of the wells in the Payson area equalled or exceed the standards for arsenic, beryllium, cadmium, lead, volatile organic compounds and selenium.
- Other parameters equalled or exceeded in this basin include fluoride, nitrates and total dissolved solids.

Lakes and Streams

- Refer to Table 5.5-7B.
- Water quality standards were exceeded in three lakes in the basin and five stream reaches on three streams.
- Three stream reaches, totaling 37.5 miles, on the Verde River exceeded the water quality standard for turbidity.
- Whitehorse Lake and Pecks Lake exceeded in dissolved oxygen and Stoneman Lake exceeded in arsenic and pH.
- Pecks Lake and Stoneman Lake are part of the ADEQ water quality improvement effort called the Total Maximum Daily Load (TMDL) program. Final TMDL reports have been completed for the lakes.
- Impaired reaches on the East Verde River, Oak Creek and Verde River and Whitehorse Lake are not part of the TMDL program at this time.

Table 5.5-7 Water Quality Exceedences in the Verde River Basin[1]

A. Wells, Springs and Mines

Map Key	Map Location[2]	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
			Township	Range	Section	
1	M	Well	21 North	4 East	5	NO3
2	M	Well	19 North	1 East	33	As
3	M	Well	18 North	1 East	36	As
4	M	Spring	18 North	3 East	8	Cd
5	M	Spring	17 North	1 East	7	As
6	M	Spring	17 North	3 East	5	As
7	M	Well	17 North	3 East	33	As
8	M	Well	17 North	4 East	15	NO3
9	M	Well	17 North	4 East	15	NO3
10	M	Well	17 North	5 East	11	As, Pb
11	M	Well	17 North	5 East	11	Cd
12	M	Well	17 North	5 East	12	As
13	M	Well	17 North	5 East	13	As
14	M	Well	17 North	5 East	15	As, Cd
15	M	Well	17 North	5 East	19	As
16	M	Well	17 North	5 East	25	As, Cd, Pb
17	M	Well	17 North	5 East	26	Pb
18	M	Well	17 North	5 East	26	Pb
19	M	Well	17 North	5 East	29	As
20	M	Well	17 North	5 East	35	As
21	M	Well	17 North	6 East	8	Cu
22	M	Well	17 North	6 East	19	As
23	A	Well	16 North	2 East	24	As
24	M	Spring	16 North	2 East	34	As
25	A	Well	16 North	3 East	21	As
26	A	Spring	16 North	3 East	22	As
27	A	Well	16 North	3 East	22	As
28	A	Well	16 North	3 East	27	As
29	A	Well	16 North	3 East	28	As
30	A	Well	16 North	3 East	28	As
31	A	Well	16 North	3 East	29	As
32	A	Well	16 North	3 East	30	As
33	A	Well	16 North	3 East	33	As
34	A	Well	16 North	3 East	33	As
35	A	Well	16 North	3 East	33	As, Be
36	A	Well	16 North	3 East	33	As
37	A	Well	16 North	3 East	34	As
38	A	Well	16 North	3 East	34	As
39	A	Well	16 North	3 East	34	As
40	A	Well	16 North	3 East	34	As, Cd
41	A	Well	16 North	3 East	34	As
42	A	Well	16 North	3 East	35	As
43	A	Well	16 North	4 East	11	As
44	A	Spring	16 North	4 East	23	As
45	A	Well	16 North	4 East	27	As
46	A	Well	16 North	4 East	27	As
47	A	Well	16 North	4 East	34	As
48	A	Well	16 North	4 East	35	As
49	A	Well	16 North	5 East	11	As
50	A	Well	16 North	5 East	13	As
51	A	Well	16 North	5 East	14	As
52	M	Well	16 North	6 East	8	As
53	M	Well	16 North	6 East	9	As
54	M	Well	16 North	6 East	13	As
55	M	Well	16 North	6 East	17	As
56	M	Well	16 North	6 East	18	As
57	M	Well	16 North	6 East	18	As
58	M	Well	16 North	6 East	18	As
59	M	Spring	15 North	2.5 East	13	As

Table 5.5-7 Water Quality Exceedences in the Verde River Basin (cont'd)[1]

A. Wells, Springs and Mines

Map Key	Map Location[2]	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
			Township	Range	Section	
60	A	Well	15 North	3 East	4	As
61	A	Well	15 North	3 East	4	As
62	A	Well	15 North	3 East	5	As
63	A	Well	15 North	3 East	5	As
64	A	Well	15 North	3 East	11	As
65	A	Well	15 North	3 East	11	As
66	A	Well	15 North	3 East	12	As
67	A	Well	15 North	3 East	12	As
68	A	Well	15 North	3 East	12	As
69	A	Well	15 North	3 East	12	As
70	A	Well	15 North	3 East	12	As
71	A	Well	15 North	3 East	12	As
72	A	Well	15 North	3 East	13	As
73	A	Well	15 North	3 East	13	As
74	A	Well	15 North	3 East	13	As
75	A	Well	15 North	3 East	13	As
76	A	Well	15 North	3 East	13	As
77	A	Well	15 North	3 East	13	As
78	A	Well	15 North	3 East	13	As
79	A	Well	15 North	4 East	2	As
80	A	Well	15 North	4 East	2	As
81	A	Well	15 North	4 East	3	As
82	A	Well	15 North	4 East	3	As
83	A	Well	15 North	4 East	3	As
84	A	Well	15 North	4 East	3	As
85	A	Well	15 North	4 East	3	As
86	A	Well	15 North	4 East	3	As
87	A	Well	15 North	4 East	3	Pb
88	A	Well	15 North	4 East	4	As
89	A	Well	15 North	4 East	4	As
90	A	Well	15 North	4 East	6	As
91	A	Well	15 North	4 East	9	As
92	A	Well	15 North	4 East	10	As
93	A	Well	15 North	4 East	15	As
94	A	Well	15 North	4 East	15	Pb
95	A	Well	15 North	4 East	18	As
96	A	Well	15 North	4 East	18	As
97	A	Well	15 North	4 East	18	As
98	A	Well	15 North	4 East	18	As
99	A	Well	15 North	4 East	19	As
100	A	Well	15 North	4 East	19	As
101	A	Well	15 North	4 East	21	As, Pb
102	A	Well	15 North	4 East	22	As
103	A	Well	15 North	4 East	31	As
104	A	Well	15 North	4 East	33	As
105	A	Well	15 North	5 East	20	As
106	A	Well	15 North	5 East	24	Pb
107	A	Well	15 North	5 East	34	As
108	A	Well	15 North	5 East	35	As
109	A	Well	15 North	5 East	36	As
110	A	Well	15 North	5 East	36	As
111	A	Well	15 North	5 East	36	As
112	A	Well	15 North	5 East	36	As
113	A	Well	15 North	5 East	36	As
114	A	Well	15 North	5 East	36	As
115	A	Well	15 North	5 East	36	As
116	A	Well	15 North	5 East	36	As
117	A	Well	15 North	5 East	36	As, Pb
118	M	Well	15 North	6 East	29	As
119	M	Spring	15 North	6 East	31	As, Pb
120	M	Well	15 North	6 East	31	As

Table 5.5-7 Water Quality Exceedences in the Verde River Basin (cont'd)[1]

A. Wells, Springs and Mines

Map Key	Map Location[2]	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
			Township	Range	Section	
121	A	Spring	14 North	3 East	5	As
122	A	Spring	14 North	3 East	14	As
123	A	Well	14 North	3 East	21	NO3
124	A	Well	14 North	4 East	2	As
125	A	Well	14 North	4 East	3	As
126	A	Well	14 North	4 East	3	As
127	A	Well	14 North	4 East	3	As
128	A	Well	14 North	4 East	3	As, Se
129	A	Well	14 North	4 East	3	As
130	A	Well	14 North	4 East	11	As, Pb
131	A	Well	14 North	4 East	11	As
132	A	Well	14 North	4 East	11	As
133	A	Well	14 North	4 East	12	As
134	A	Well	14 North	4 East	13	As
135	A	Well	14 North	4 East	13	As
136	A	Well	14 North	4 East	13	As
137	A	Well	14 North	4 East	13	As
138	A	Well	14 North	4 East	13	As
139	A	Well	14 North	4 East	13	As
140	A	Well	14 North	4 East	13	As
141	A	Well	14 North	4 East	13	As
142	A	Well	14 North	4 East	13	As
143	A	Well	14 North	4 East	13	As
144	A	Well	14 North	4 East	14	As, TDS
145	A	Well	14 North	4 East	14	As
146	A	Well	14 North	4 East	14	As
147	A	Well	14 North	4 East	14	As
148	A	Well	14 North	4 East	24	As
149	A	Well	14 North	4 East	24	As, Cd
150	A	Well	14 North	5 East	1	As
151	A	Well	14 North	5 East	1	As
152	A	Well	14 North	5 East	1	As
153	A	Well	14 North	5 East	1	As
154	A	Well	14 North	5 East	1	As
155	A	Well	14 North	5 East	2	As
156	A	Well	14 North	5 East	2	As
157	A	Well	14 North	5 East	2	As
158	A	Well	14 North	5 East	2	As
159	A	Well	14 North	5 East	2	As
160	A	Well	14 North	5 East	2	As
161	A	Well	14 North	5 East	2	As
162	A	Well	14 North	5 East	2	As
163	A	Well	14 North	5 East	2	As
164	A	Well	14 North	5 East	4	As
165	A	Well	14 North	5 East	4	As
166	A	Well	14 North	5 East	17	As, Pb
167	A	Well	14 North	5 East	18	As
168	A	Well	14 North	5 East	18	As
169	A	Well	14 North	5 East	19	As
170	A	Well	14 North	5 East	19	As
171	A	Well	14 North	5 East	19	As, Se
172	A	Well	14 North	5 East	19	As
173	A	Well	14 North	5 East	19	As
174	A	Well	14 North	5 East	19	As
175	A	Well	14 North	5 East	19	As
176	A	Well	14 North	5 East	19	As
177	A	Well	14 North	5 East	31	As
178	A	Well	14 North	5 East	31	As
179	A	Well	14 North	5 East	31	As
180	A	Well	14 North	5 East	32	As
181	A	Well	14 North	5 East	32	As

Table 5.5-7 Water Quality Exceedences in the Verde River Basin (cont'd)[1]

A. Wells, Springs and Mines

Map Key	Map Location[2]	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
			Township	Range	Section	
182	A	Well	14 North	5 East	32	As, Pb
183	A	Well	14 North	5 East	32	As
184	A	Well	14 North	5 East	32	As
185	A	Well	14 North	5 East	32	As
186	A	Well	14 North	5 East	32	As
187	A	Well	13 North	4 East	12	As
188	A	Well	13 North	5 East	4	As, NO3
189	A	Well	13 North	5 East	5	As
190	A	Well	13 North	5 East	5	As
191	A	Well	13 North	5 East	5	As
192	A	Well	13 North	5 East	5	As
193	A	Well	13 North	5 East	5	As
194	A	Well	13 North	5 East	5	As
195	A	Well	13 North	5 East	5	As
196	A	Well	13 North	5 East	5	As
197	A	Well	13 North	5 East	6	As
198	A	Well	13 North	5 East	6	As
199	A	Well	13 North	5 East	6	As, Pb
200	A	Well	13 North	5 East	6	As
201	A	Well	13 North	5 East	6	As
202	A	Well	13 North	5 East	6	As
203	A	Well	13 North	5 East	6	As
204	A	Well	13 North	5 East	6	As
205	A	Well	13 North	5 East	6	As
206	A	Well	13 North	5 East	6	As
207	A	Well	13 North	5 East	6	As
208	A	Well	13 North	5 East	6	As
209	A	Well	13 North	5 East	6	As
210	A	Well	13 North	5 East	6	As
211	A	Well	13 North	5 East	6	As
212	A	Well	13 North	5 East	6	As
213	A	Well	13 North	5 East	6	As
214	A	Well	13 North	5 East	6	As, TDS
215	A	Well	13 North	5 East	6	As
216	A	Well	13 North	5 East	6	As
217	A	Well	13 North	5 East	6	As
218	A	Well	13 North	5 East	6	As
219	A	Well	13 North	5 East	6	As
220	A	Well	13 North	5 East	7	As
221	A	Well	13 North	5 East	7	As
222	A	Well	13 North	5 East	7	As
223	A	Well	13 North	5 East	7	As, Pb
224	A	Well	13 North	5 East	7	As
225	A	Well	13 North	5 East	7	As
226	A	Well	13 North	5 East	7	As
227	A	Well	13 North	5 East	7	As
228	A	Well	13 North	5 East	7	As
229	A	Well	13 North	5 East	7	As, Pb
230	A	Well	13 North	5 East	7	As, TDS
231	A	Well	13 North	5 East	7	As
232	A	Well	13 North	5 East	7	As
233	A	Well	13 North	5 East	7	As
234	A	Well	13 North	5 East	7	As
235	A	Well	13 North	5 East	7	As
236	A	Well	13 North	5 East	7	As
237	A	Well	13 North	5 East	7	As
238	A	Well	13 North	5 East	7	As
239	A	Well	13 North	5 East	7	As
240	A	Well	13 North	5 East	7	As
241	A	Well	13 North	5 East	7	As
242	A	Well	13 North	5 East	7	As

Table 5.5-7 Water Quality Exceedences in the Verde River Basin (cont'd)[1]

A. Wells, Springs and Mines

Map Key	Map Location[2]	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
			Township	Range	Section	
243	A	Well	13 North	5 East	7	As
244	A	Well	13 North	5 East	7	As
245	A	Well	13 North	5 East	7	As
246	A	Well	13 North	5 East	7	As
247	A	Well	13 North	5 East	7	As
248	A	Well	13 North	5 East	7	As
249	A	Well	13 North	5 East	7	As
250	A	Well	13 North	5 East	7	F
251	A	Well	13 North	5 East	8	As
252	A	Well	13 North	5 East	8	As
253	A	Well	13 North	5 East	8	As
254	A	Well	13 North	5 East	8	As
255	A	Well	13 North	5 East	8	As
256	A	Well	13 North	5 East	8	As
257	A	Well	13 North	5 East	8	As
258	A	Well	13 North	5 East	8	As
259	A	Well	13 North	5 East	8	As
260	A	Well	13 North	5 East	8	As
261	A	Well	13 North	5 East	8	As
262	A	Well	13 North	5 East	8	As
263	A	Well	13 North	5 East	8	As
264	A	Well	13 North	5 East	8	As
265	A	Well	13 North	5 East	8	As
266	A	Well	13 North	5 East	8	As
267	A	Well	13 North	5 East	8	As
268	A	Well	13 North	5 East	8	As, Pb
269	A	Well	13 North	5 East	9	As
270	A	Well	13 North	5 East	9	As
271	A	Well	13 North	5 East	9	As, Pb
272	A	Well	13 North	5 East	9	As
273	A	Well	13 North	5 East	12	As
274	A	Well	13 North	5 East	13	As
275	A	Well	13 North	5 East	15	As
276	A	Well	13 North	5 East	15	As
277	A	Well	13 North	5 East	15	TDS
278	A	Well	13 North	5 East	16	As
279	A	Spring	13 North	5 East	16	As, Pb
280	A	Well	13 North	5 East	16	As
281	A	Well	13 North	5 East	16	As
282	A	Well	13 North	5 East	16	As
283	A	Well	13 North	5 East	17	As
284	A	Well	13 North	5 East	17	As
285	A	Well	13 North	5 East	17	As
286	A	Well	13 North	5 East	17	As
287	A	Well	13 North	5 East	17	As
288	A	Well	13 North	5 East	17	As
289	A	Well	13 North	5 East	17	As
290	A	Well	13 North	5 East	20	As
291	A	Well	13 North	5 East	21	TDS
292	A	Well	13 North	5 East	21	As
293	A	Well	13 North	5 East	21	As
294	A	Well	13 North	5 East	21	As
295	A	Well	13 North	5 East	27	As
296	A	Well	13 North	5 East	27	As
297	A	Well	13 North	5 East	27	As
298	A	Well	13 North	5 East	27	As
299	A	Well	13 North	5 East	28	As
300	A	Well	13 North	5 East	28	As
301	A	Well	13 North	5 East	28	As
302	A	Well	13 North	5 East	28	As, Pb
303	A	Well	13 North	5 East	28	TDS

Table 5.5-7 Water Quality Exceedences in the Verde River Basin (cont'd)[1]

A. Wells, Springs and Mines

Map Key	Map Location[2]	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
			Township	Range	Section	
304	A	Well	13 North	5 East	28	As
305	A	Well	13 North	5 East	28	As
306	A	Well	13 North	5 East	28	As
307	A	Well	13 North	5 East	28	As
308	A	Well	13 North	5 East	28	As
309	A	Well	13 North	5 East	34	As
310	A	Well	13 North	5 East	34	As
311	A	Well	13 North	5 East	34	As
312	M	Well	13 North	6 East	29	As
313	M	Spring	12 North	6 East	11	As
314	M	Spring	12 North	6 East	11	As
315	M	Well	12 North	8 East	26	As
316	M	Well	12 North	8 East	26	As
317	M	Well	12 North	8 East	26	As
318	M	Well	12 North	8 East	26	As
319	M	Well	11.5 North	10 East	35	As
320	M	Spring	11 North	6 East	10	As, TDS
321	I	Well	10 North	10 East	3	As, Be, Cd, Pb, Organics, Se
322	I	Well	10 North	10 East	4	As, Be, Cd, Pb, Organics, Se
323	I	Well	10 North	10 East	4	As, Be, Cd, Pb, Organics, Se
324	I	Well	10 North	10 East	4	Organics
325	I	Well	10 North	10 East	4	Organics
326	I	Well	10 North	10 East	4	Organics
327	I	Well	10 North	10 East	4	Organics
328	I	Well	10 North	10 East	4	As, Be, Cd, Pb, Organics, Se
329	I	Well	10 North	10 East	4	NO3
330	I	Well	10 North	10 East	4	As, Be, Cd, Pb, Organics, Se
331	I	Well	10 North	10 East	4	As, Be, Cd, Pb, Organics, Se
332	I	Well	10 North	10 East	4	As
333	M	Well	10 North	10 East	8	As
334	M	Well	10 North	10 East	8	Pb
335	I	Well	10 North	10 East	9	As, Organics
336	I	Well	10 North	10 East	9	Pb
337	I	Well	10 North	10 East	9	As, NO3
338	I	Well	10 North	10 East	9	As
339	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Se
340	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
341	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
342	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
343	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
344	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
345	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
346	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
347	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
348	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, NO3, Se
349	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
350	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Se
351	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
352	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
353	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
354	I	Well	10 North	10 East	9	Organics
355	I	Well	10 North	10 East	9	Organics
356	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
357	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
358	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
359	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
360	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
361	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se

Table 5.5-7 Water Quality Exceedences in the Verde River Basin (cont'd)[1]

A. Wells, Springs and Mines

Map Key	Map Location[2]	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
			Township	Range	Section	
362	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
363	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
364	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
365	I	Well	10 North	10 East	9	As
366	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
367	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
368	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
369	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
370	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
371	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
372	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
373	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
374	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
375	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
376	I	Well	10 North	10 East	9	Organics
377	I	Well	10 North	10 East	9	Organics
378	I	Well	10 North	10 East	9	NO3
379	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
380	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
381	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
382	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
383	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
384	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
385	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
386	I	Well	10 North	10 East	9	Organics
387	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
388	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
389	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
390	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
391	I	Well	10 North	10 East	9	Organics
392	I	Well	10 North	10 East	9	Organics
393	I	Well	10 North	10 East	9	Organics
394	I	Well	10 North	10 East	9	Organics
395	I	Well	10 North	10 East	9	Organics
396	I	Well	10 North	10 East	9	Organics
397	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Organics, Se
398	I	Well	10 North	10 East	9	Organics
399	I	Well	10 North	10 East	9	As
400	I	Well	10 North	10 East	9	As, Be, Cd, Pb, Se
401	I	Well	10 North	10 East	9	Organics
402	I	Well	10 North	10 East	9	Organics
403	I	Well	10 North	10 East	9	Organics
404	I	Well	10 North	10 East	9	Organics
405	I	Well	10 North	10 East	10	As, Be, Cd, Pb, Organics, Se
406	I	Well	10 North	10 East	10	As, Be, Cd, Pb, Organics, Se
407	I	Well	10 North	10 East	10	As, Be, Cd, Pb, Organics, Se
408	I	Well	10 North	10 East	10	As
409	I	Well	10 North	10 East	10	As, NO3
410	I	Well	10 North	10 East	10	As, Be, Cd, Pb, Se
411	M	Well	6 North	7 East	28	F
412	M	Well	22 North	7 West	8	As
413	M	Well	22 North	7 West	25	NO3
414	M	Well	19 North	4 West	4	As
415	M	Well	19 North	4 West	10	As
416	M	Well	18 North	1 West	6	NO3
417	M	Well	18 North	1 West	6	NO3
418	M	Well	18 North	2 West	27	As
419	M	Well	18 North	2 West	27	As
420	M	Well	18 North	3 West	11	As
421	M	Well	18 North	3 West	25	As
422	M	Spring	18 North	6 West	27	As
423	M	Well	17 North	2 West	2	As

Table 5.5-7 Water Quality Exceedences in the Verde River Basin (cont'd)[1]

A. Wells, Springs and Mines

Map Key	Map Location[2]	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
			Township	Range	Section	
424	M	Well	17 North	2 West	3	As
425	M	Well	17 North	2 West	3	As
426	M	Well	17 North	2 West	4	As
427	M	Well	17 North	2 West	9	As
428	M	Well	17 North	2 West	15	As
429	M	Well	17 North	2 West	22	As
430	M	Spring	17 North	4 West	8	As

B. Lakes and Streams

Map Key	Map Location[2]	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard[4]	Parameter(s) Exceeding Use Standard[3]
a	M	Stream	East Verde River - Ellison Creek to American Gulch	20	NA	A&W	Se
b	M	Stream	Oak Creek - Slide Rock State Park	1	NA	FBC	Escherichia coli
c	A	Lake	Pecks Lake	NA	95	A&W	DO, pH and nutrients
d	M	Lake	Stoneman Lake[5]	NA	14	A&W	DO, pH and nutrients
e	A	Stream	Verde River - Beaver Creek to HUC boundary	0.5	NA	A&W	Turbidity
f	A	Stream	Verde River - Oak Creek to Beaver Creek	13	NA	A&W	Turbidity
g	A	Stream	Verde River - West Clear Creek to Fossil Creek	24	NA	A&W	Turbidity
h	M	Lake	Whitehorse Lake	NA	41	A&W	DO

Notes:

[1] Water quality samples collected between 1975 and 2004.
[2]M = Figure 5.5-9; I = Inset; A = Figure 5.5-9A
[3]As = Arsenic
Be = Beryllium
Cd = Cadmium
DO = Dissolved oxygen
F= Fluoride
Pb = Lead
NO3 = Nitrate/Nitrite
Organics = One or more of several volatile and semi-volatile organic compounds and pesticides
pH = Measurement of acidity or alkalinity
Se = Selenium
TDS = Total Dissolved Solids
[4]A&W = Aquatic and Wildlife
FBC = Full Body Contact
[5]Lake has been dry or nearly dry since 2002

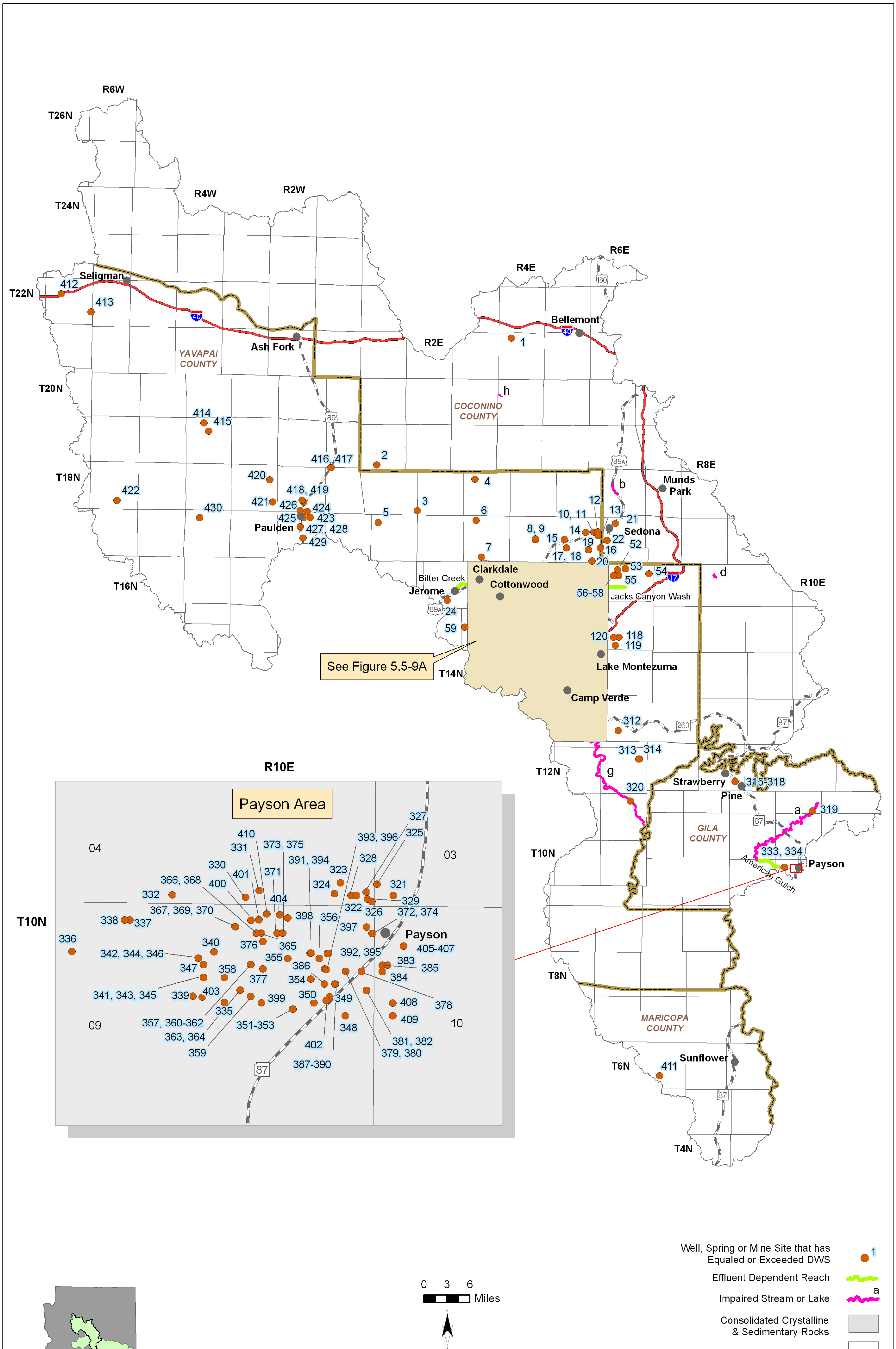


**Figure 5.5-9
Verde River Basin
Water Quality Conditions**

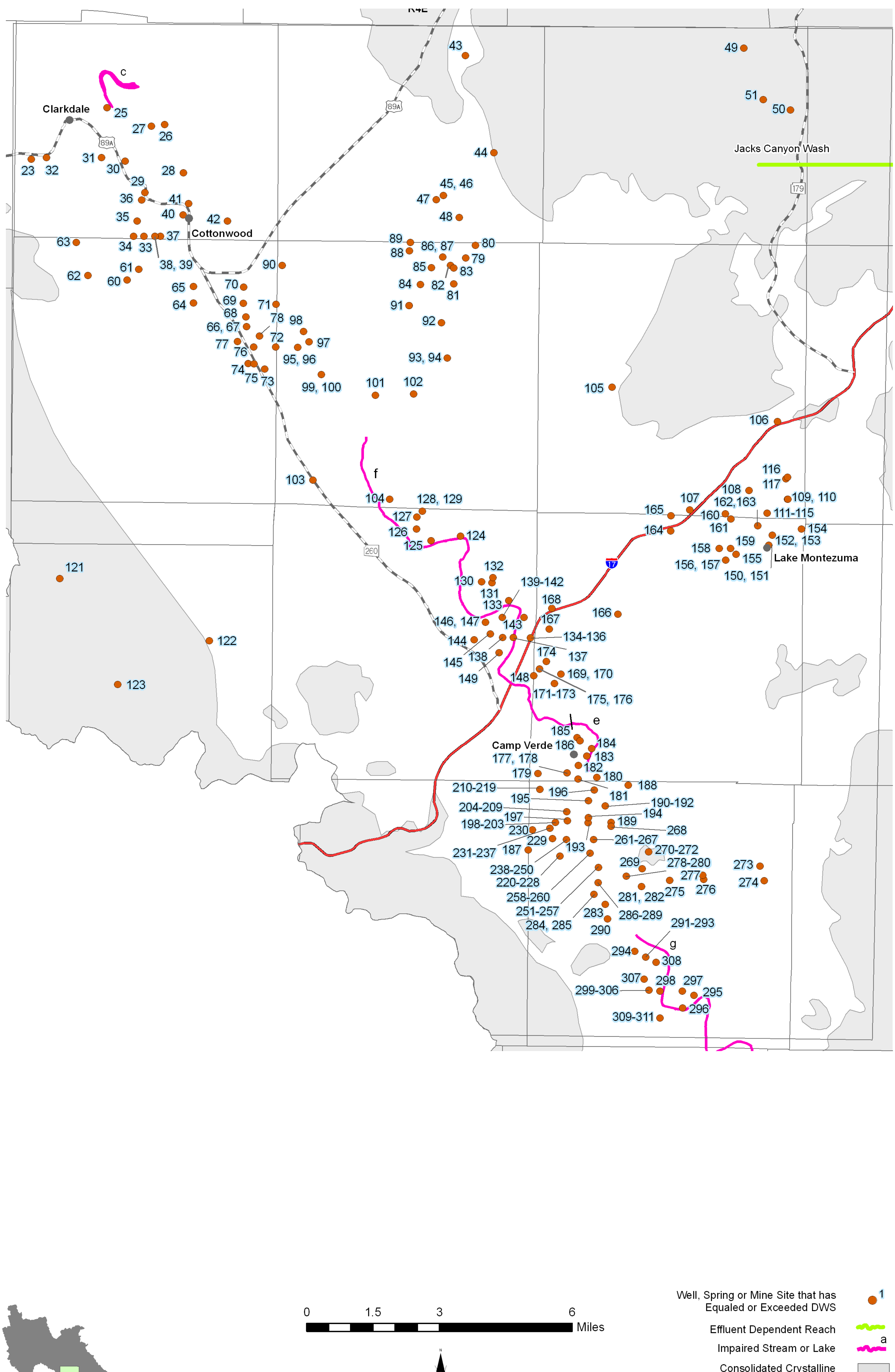


Figure 5.5-9A
Verde River Basin
Water Quality Conditions

5.5.8 Cultural Water Demands in the Verde River Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 5.5-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 5.5-9. Figure 5.5-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 5.0.7.

Cultural Water Demands

- Refer to Table 5.5-8 and Figure 5.5-10.
- Population in this basin has more than doubled from 36,049 in 1980 to 88,242 in 2000. Projections suggest a slightly smaller rate of growth through 2050 to 165,314.
- In general, groundwater use has increased since 1971, from an average of 16,000 acre-feet per year in 1971-1975 to an average of 23,900 acre-feet per year in 2001-2003. The highest average annual groundwater demand was in 1986-1990 when 33,000 acre-feet per year was used.
- Total surface water diversions in this basin have decreased slightly from an average of 18,000 acre-feet per year in 1971-1990 to an average of 17,400 acre-feet per year in 2001-2003.
- Municipal groundwater demand has increased from an average of 7,200 acre-feet per year in 1991-1995 to 10,000 acre-feet per year in 2001-2003. Municipal surface water demand is about 600 acre-feet per year.
- Industrial groundwater use has increased slightly from 2,100 acre-feet per year on average in 1991-1995 to 2,400 acre-feet per year on average in 2001-2003. Industrial surface water use has remained a constant 800 acre-feet per year during this time.
- Groundwater use for irrigation has increased from an average of 8,100 acre-feet per year in 1991-1995 to an average of 11,500 acre-feet per year in 2001-2003. Most of the surface water use in the basin is for irrigation with 11,500 acre-feet per year on average used in 1991-1995 and 16,000 acre-feet per year on average used in 2001-2003.
- Municipal and industrial demand centers are found primarily in the central portion of the basin.
- The only low intensity municipal and industrial demand center identified by the USGS is the National Guard installation at Camp Navajo near Bellemont.
- The majority of the agricultural use is found along the Verde River.
- There are two large mines, Clarkdale Cement and the closed United Verde copper mine, and two small mines or quarries located in the vicinity of Clarkdale and Jerome. An additional small mine or quarry is located north of Sunflower.
- As of 2003 there were 10,654 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 708 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 5.5-9.
- There are 24 wastewater treatment facilities in this basin.
- Information on population served was available for 12 facilities and information on effluent generation was available for 13 facilities. These facilities serve over 43,000 people and generate almost 6,650 acre-feet of effluent per year.
- Of the 13 facilities with information on the effluent disposal method: three discharge to evaporation ponds; three discharge for golf or turf irrigation; one discharges effluent to unlined impoundments that recharge the aquifer; five discharge to a watercourse; and seven discharge for irrigation. In Payson, treated effluent is delivered to a 10.5 acre recreational lake where it is stored to irrigate turf and recharges the aquifer.

Table 5.5-8 Cultural Water Demands in the Verde Basin[1]

<table>
<tr><th rowspan="3">Year</th><th rowspan="3">Recent (Census) and Projected (DES) Population</th><th colspan="2" rowspan="2">Number of Registered Water Supply Wells Drilled</th><th colspan="7">Average Annual Demand (in acre-feet)</th></tr>
<tr><th colspan="3">Well Pumpage</th><th colspan="3">Surface-Water Diversions</th><th rowspan="2">Data Source</th></tr>
<tr><th>Q ≤ 35 gpm</th><th>Q > 35 gpm</th><th>Municipal</th><th>Industrial</th><th>Irrigation</th><th>Municipal</th><th>Industrial</th><th>Irrigation</th></tr>
<tr><td>1971</td><td></td><td rowspan="10">4,624[2]</td><td rowspan="10">503[2]</td><td colspan="3" rowspan="5">16,000</td><td colspan="3" rowspan="5">18,000</td><td rowspan="20">ADWR (1994)</td></tr>
<tr><td>1972</td><td></td></tr>
<tr><td>1973</td><td></td></tr>
<tr><td>1974</td><td></td></tr>
<tr><td>1975</td><td></td></tr>
<tr><td>1976</td><td></td><td colspan="3" rowspan="5">16,000</td><td colspan="3" rowspan="5">18,000</td></tr>
<tr><td>1977</td><td></td></tr>
<tr><td>1978</td><td></td></tr>
<tr><td>1979</td><td></td></tr>
<tr><td>1980</td><td>36,049</td></tr>
<tr><td>1981</td><td>38,093</td><td rowspan="5">1,219</td><td rowspan="5">79</td><td colspan="3" rowspan="5">19,000</td><td colspan="3" rowspan="5">18,000</td></tr>
<tr><td>1982</td><td>40,137</td></tr>
<tr><td>1983</td><td>42,181</td></tr>
<tr><td>1984</td><td>44,225</td></tr>
<tr><td>1985</td><td>46,269</td></tr>
<tr><td>1986</td><td>48,313</td><td rowspan="5">1,018</td><td rowspan="5">51</td><td colspan="3" rowspan="5">33,000</td><td colspan="3" rowspan="5">18,000</td></tr>
<tr><td>1987</td><td>50,357</td></tr>
<tr><td>1988</td><td>52,401</td></tr>
<tr><td>1989</td><td>54,445</td></tr>
<tr><td>1990</td><td>56,489</td></tr>
<tr><td>1991</td><td>59,664</td><td rowspan="5">1,161</td><td rowspan="5">27</td><td rowspan="5">7,200</td><td rowspan="5">2,100</td><td rowspan="5">8,100</td><td rowspan="5">600</td><td rowspan="5">800</td><td rowspan="5">11,500</td><td rowspan="13">USGS (2005) ADWR (2005)</td></tr>
<tr><td>1992</td><td>62,839</td></tr>
<tr><td>1993</td><td>66,015</td></tr>
<tr><td>1994</td><td>69,190</td></tr>
<tr><td>1995</td><td>72,365</td></tr>
<tr><td>1996</td><td>75,541</td><td rowspan="5">1,555</td><td rowspan="5">27</td><td rowspan="5">8,800</td><td rowspan="5">2,200</td><td rowspan="5">8,400</td><td rowspan="5">600</td><td rowspan="5">800</td><td rowspan="5">12,500</td></tr>
<tr><td>1997</td><td>78,716</td></tr>
<tr><td>1998</td><td>81,891</td></tr>
<tr><td>1999</td><td>85,067</td></tr>
<tr><td>2000</td><td>88,242</td></tr>
<tr><td>2001</td><td>89,963</td><td rowspan="3">490</td><td rowspan="3">13</td><td rowspan="3">10,000</td><td rowspan="3">2,400</td><td rowspan="3">11,500</td><td rowspan="3">600</td><td rowspan="3">800</td><td rowspan="3">16,000</td></tr>
<tr><td>2002</td><td>91,683</td></tr>
<tr><td>2003</td><td>93,404</td></tr>
<tr><td>2010</td><td>105,449</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2020</td><td>124,325</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2030</td><td>140,300</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2040</td><td>152,941</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2050</td><td>165,314</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">ADDITIONAL WELLS:[3]</td><td>587</td><td>8</td><td colspan="7"></td></tr>
<tr><td colspan="2">WELL TOTALS:</td><td>10,654</td><td>708</td><td colspan="7"></td></tr>
</table>

Notes:
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes all wells through 1980.
[3] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are sumr

Table 5.5-9 Effluent Generation in the Verde River Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet/year)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf Irrigation	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
American Gulch	Northern Gila County SD	Payson	8,000	2,240	X		X	Payson, Chaparral & Rim			X	Adv. Trt II & Nutrient Removal	200	2004
American Ranch WWTF	NA	Prescott	NA											
Big Park ID	Yavapai County	Sedona	2,500	224			X					Secondary	NA	1999
Camp Verde WWTF	Camp Verde SD	Camp Verde	2,500	194		X						Secondary	7,400	2000
Clarkdale WWTF	Clarkdale	Clarkdale	1,920	291		X	X					Secondary	1,600	2002
Cottonwood WWTF	Cottonwood	Cottonwood	8,500	1,008			X					Adv. Trt. I	1,000	2002
Crimson View WWTP	NA	Sedona	NA											
Cross Creek Ranch WWTF	NA	Sedona	NA											
Flagstaff Meadows	NA	Bellemont	NA	NA	X							NA		
Houston Creek Landing WWTP	NA	Star Valley	NA											
Inscription Canyon Ranch	Private	Prescott	NA					Talking Rock				NA		2002
Jerome WWTF	Jerome	Jerome	700	56	Bitter Creek							Secondary	45	2004
Lolo Mai Springs	Private	NA	420	34	NA									2001
Munds Park/Kay Blackman WWTP	Pinewood SD	Munds Park	10,000	1,176	Munds Creek		X	Pinewood				Adv. Trt.I & Nutrient Removal	2,500	1999
Oak Creek Property Owners	Private	Oak Creek	NA											
Pine Creek Domestic WWTF	Private	Pine	NA											
Portal Pine Creek WWTP	NA	Strawberry/Pine	NA											

Table 5.5-9 Effluent Generation in the Verde River Basin (cont'd)

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet/year)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf Irrigation	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
Sedona Venture WWTF	Private	Sedona	240	45	Unnamed tributary to Oak Cr.							NA	NA	2003
Sedona WWTF	Sedona	Sedona	8,000	1,288			X					Adv. Trt. II & Nutrient Removal	2,500	2001
Seligman WWTF	Yavapai County SD	Seligman	84	9		X						Secondary	324	2004
Shelby Dr. WWTP	Private	Sedona	NA	NA										
Thunder Mountain Ranch WWTP	NA	Sedona	NA	NA										
Verde Santa Fe	Private	Cornville	NA	55			X							2004
Totals			42,64	6,617										

NA: Data not currently available to ADWR
WWTF: Waste Water Treatment Facility
WWTP: Waste Water Treatment Plant
WRP: Water Reclaimation Plant
SD: Sanitation District
ID: Improvement District

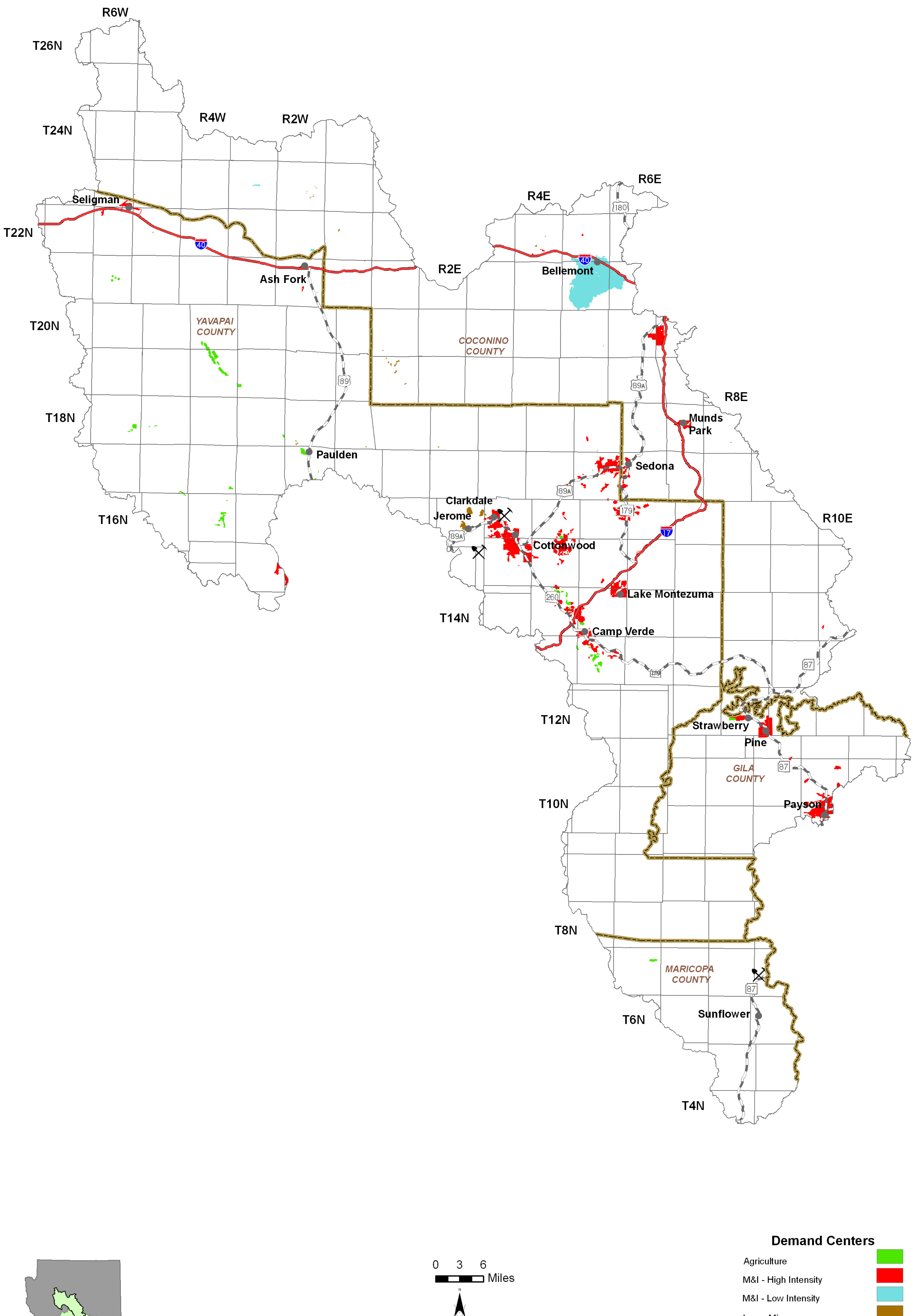


Figure 5.5-10
Verde River Basin
Cultural Water Demand

Primary Data Source: USGS National Gap Analysis Program, 2004

5.5.9 Water Adequacy Determinations in the Verde River Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 5.5-10. Figure 5.5-11 and 5.5-11A show the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

Water Adequacy Reports

- See Table 5.5-10
- A total of 375 water adequacy determinations have been made in this basin through May, 2005.
- 110 determinations of inadequacy have been made.
- The most common reason for an inadequacy determination in Gila and Coconino counties is because the applicant did not submit the necessary information and/or the available hydrologic data was insufficient to make a determination. The most common reason for an inadequacy determination in Yavapai County is water quality.
- Other reasons for an inadequacy determination included: the existing supply was unreliable or physically unavailable or groundwater exceeds the depth-to-water criteria; and the applicant failed to demonstrate a legal right to use the water or failed to demonstrate their legal authority to serve the subdivision. For three subdivisions the reason for the inadequacy determination is unknown because the records could not be located.
- The number of lots receiving a water adequacy determination, by county, are:

County	Number of Subdivision Lots	Number of Lots Determined to be Adequate	Percent Adequate
Coconino County	6,188	5,668	92%
Gila County	>4,652	>717	~15%
Maricopa County	20	20	100%
Yavapai County	>18,645	>16,153	~87%

Table 5.5-10 Adequacy Determinations in the Verde River Basin[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
1	A	Aerie I and Aerie II	Yavapai	17 North	5 East	5	74	22-401588	Adequate		07/06/05	The Aerie Conservancy
2	I	Alpine Ridge	Gila	11 North	10 East	34	7		Inadequate	A1, A2	01/12/82	Town of Payson
3	I	Alpine Village # 1	Gila	11 North	10 East	33	312		Inadequate	A1, A2	07/16/85	Town of Payson
4	A	Amigos Rancheros	Yavapai	17 North	5 East	29	105		Inadequate	B	08/20/87	NA
5	A	Anasazi	Coconino	17 North	6 East	7	11		Adequate		05/01/81	Arizona Water Company
6	M	Antelope Lakes # 1	Yavapai	18 North	2 West	27	22	22-300068	Adequate		11/06/95	co-op water system
7	M	Antelope Lakes # 2	Yavapai	18 North	2 West	27	655		Adequate		02/19/97	Antelope Lakes Water Company, Inc.
8	M	Antelope Lakes # 3	Yavapai	18 North	2 West	28	44		Adequate		03/14/88	Dry Lot Subdivision
9	A	Arena del Loma Estates	Yavapai	14 North	5 East	19	11	22-300031	Adequate		07/28/95	Dry Lot Subdivision
10	M	Arizona Homes # 3	Coconino	22 North	1 East	22	NA		Adequate		06/07/73	Northwest Water Company
11	M	Arizona Homes # 4	Coconino	22 North	1 East	22	NA		Adequate		04/08/77	Northwest Water Company
12	A	Arnold Terrace	Yavapai	14 North	5 East	31	18		Adequate		07/09/74	Camp Verde Water System
13	A	Arroyo Roble Resort	Coconino	17 North	6 East	8	72		Adequate		05/18/83	Arizona Water Company
14	A	Arroyo Seco	Yavapai	17 North	5 East	10	46		Adequate		07/12/91	Arizona Water Company
15	A	Arroyo Sienna	Yavapai	17 North	6 East	18	12	22-400647	Adequate		02/12/02	Arizona Water Company
16	A	Aspen Shadows	Yavapai	16 North	3 East	34	36	22-300478	Adequate		07/22/98	Cottonwood Water Works, Inc.
17	A	Back'O Beyond Ranch	Coconino	17 North	6 East	30	80	22-300211	Adequate		10/23/96	Arizona Water Company
18	A	Beaver Creek Acres	Yavapai	14 North	5 East	11	36	22-401502	Adequate		01/20/05	Dry Lot Subdivision
19	A	Beaver Creek Golf Club	Yavapai	14 North	5 East	1	137	22-401848	Adequate		10/18/05	Arizona Water Company - Rimrock
20	M	Beaver Valley Estates	Gila	11.5 North	10 East	35	8		Inadequate	A1, A2	03/05/86	Beaver Valley Water Company
21	A	Bell Rock Vista	Yavapai	16 North	6 East	18	6		Adequate		06/15/89	Big Park Water Company
22	A	Bella Terra on Oak Creek	Yavapai	17 North	5 East	26	106	22-401631	Adequate		03/01/05	Arizona Water Company - Sedona
23	A	Black Hill Industrial Park	Yavapai	16 North	3 East	33	24		Adequate		05/13/87	Cottonwood Water Works, Inc.
24	A	Black Hills Estates	Yavapai	16 North	3 East	32	66		Adequate		06/20/74	Cottonwood Water Works, Inc.
25	A	Black Hills Estates # 2	Yavapai	16 North	3 East	32	80		Adequate		10/31/81	Cottonwood Water Works, Inc.
26	A	Black Hills Terrace	Yavapai	16 North	3 East	32, 33	18		Adequate		05/08/80	Cottonwood Water Works, Inc.
27	M	Bonita Creek	Gila	12 North	11 East	32	38		Inadequate	A1	06/06/75	Dry Lot Subdivision
28	M	Boynton Canyon Ranch	Yavapai	18 North	5 East	20, 29	12		Adequate		06/27/80	Homeowners Association Wells
29	A	Butler Subdivision	Yavapai	14 North	5 East	30	9		Inadequate	C	03/25/80	Dry Lot Subdivision
30	A	Butterfield Plaza	Yavapai	16 North	5 East	13	46		Adequate		06/06/83	Big Park Water Company
31	A	Camp Verde Acres	Yavapai	13 North	5 East	34	53		Adequate		06/24/81	Dry Lot Subdivision
32	A	Camp Verde Townsite, Block 7	Yavapai	14 North	5 East	31	5		Adequate		10/04/93	Camp Verde Water System

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
33	A	Canyon Mesa Country Club	Yavapai	16 North	6 East	18	109		Adequate		08/27/84	Big Park Water Company
34	A	Canyon Mesa Country Club # 2	Yavapai	16 North	6 East	18	44		Adequate		12/12/85	Big Park Water Company
35	A	Canyon Mesa Country Club # 3	Yavapai	16 North	6 East	18	20	22-400072	Adequate		05/21/99	Big Park Water Company
36	A	Canyon Shadows	Yavapai	17 North	5 East	1	21		Adequate		07/07/80	Arizona Water Company
37	A	Casa Bonita	Yavapai	17 North	5 East	12	22		Adequate		04/17/81	Arizona Water Company
38	A	Casa Del Sol Condominiums	Yavapai	16 North	3 East	34	28	22-400548	Adequate		08/14/01	Cottonwood Water Works, Inc.
39	A	Casa Del Sol Condominiums - South	Yavapai	16 North	3 East	34	52	22-401223	Adequate		04/07/04	Cottonwood Water Works, Inc.
40	A	Castle Rock Plaza	Yavapai	16 North	5 East	13	4		Adequate		12/18/85	Big Park Water Company
41	A	Castle Rock Plaza # 2	Yavapai	16 North	5 East	13	6		Adequate		09/20/82	Big Park Water Company
42	A	Cathedral Rock Ranchos	Yavapai	17 North	5 East	35, 36	99		Adequate		09/01/81	Dry Lot Subdivision
43	A	Cathedral View # 2	Yavapai	16 North	6 East	18	15		Adequate		07/19/91	Big Park Water Company
44	A	Cave View Estates	Yavapai	13 North	5 East	11	13	22-400595	Adequate		11/01/01	Verde Lakes Water Corp.
45	A	Cedar Ridge	Yavapai	17 North	5 East	11	49		Adequate		12/26/78	Arizona Water Company
46	I	Cedar Ridge Phase 1	Gila	11 North	10 East	32	8	22-401441	Inadequate	A1	10/21/04	Town of Payson Water Company
47	I	Chalet Village	Gila	11 North	10 East	33, 34	48		Inadequate	A1, A2	12/27/74	United Utilities Company
48	A	Chapel View	Yavapai	17 North	6 East	30	17		Adequate		08/21/73	Arizona Water Company
49	M	Cimmaron Pines	Gila	12 North	9 East	30	64		Inadequate	A1	07/06/82	E & R Water Company
50	A	Clarkdale Palisades	Yavapai	16 North	3 East	29	50		Adequate		04/17/75	Cottonwood Water Company
51	A	Clarkdale Palisades # 3	Yavapai	16 North	3 East	29	84		Adequate		09/26/75	Cottonwood Water Company
52	A	Clarkdale Palisades # 4	Yavapai	16 North	3 East	29	112		Adequate		08/25/75	Cottonwood Water Company
53	A	Cliffs at Cup of Gold	Yavapai	17 North	5 East	33	8	22-300060	Adequate		11/01/95	Dry Lot Subdivision
54	A	Cliffs, The	Yavapai	14 North	5 East	31	42		Adequate		09/02/94	Camp Verde Water System
55	A	Cliffs, Unit 2 North	Yavapai	14 North	5 East	31	29	22-300164	Adequate		07/23/96	Camp Verde Water System
56	A	Cliffs, Unit 2 South	Yavapai	14 North	5 East	31	30	22-400433	Adequate		12/05/00	Camp Verde Water System
57	A	Coffee Pot Lodge	Yavapai	17 North	5 East	1	27		Adequate		02/10/84	Arizona Water Company
58	A	Copper Vista Estates	Yavapai	17 North	5 East	13	42		Adequate		07/06/79	Oak Creek Water Company, #1
59	A	Cottages at Coffee Pot	Yavapai	17 North	5 East	1	37		Adequate		06/27/86	Arizona Water Company
60	A	Cottonwood Airpark	Yavapai	16 North	3 East	33	18		Adequate		07/19/85	Cottonwood Water Works, Inc.
61	A	Cottonwood Business Park	Yavapai	16 North	3 East	34	10		Adequate		10/09/81	Clemenceau Water Company
62	A	Cottonwood Commons/Cottonwood	Yavapai	15 North	3 East	2	178	22-400318	Adequate		06/01/00	Cottonwood Water Works, Inc.
63	A	Cottonwood Ranch	Yavapai	16 North	3 East	32, 33	627	22-300096	Adequate		05/13/96	Cottonwood Water Works, Inc.
64	A	Cottonwood Springs	Yavapai	15 North	3 East	17, 20	n/a		Adequate		08/04/80	Quail Springs Ranch Water Company

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
65	A	Country Estates # 3	Yavapai	13 North	5 East	7	19		Inadequate	C	12/04/73	Dry Lot Subdivision
66	A	Country Estates # 4	Yavapai	13 North	5 East	7	14		Inadequate	C	03/14/84	Dry Lot Subdivision
67	A	Courthouse Butte Estates	Yavapai	17 North	5 East	27	60		Adequate		06/15/79	Community well
68	A	Crestview	Yavapai	15 North	3 East	3	91	22-300022	Adequate		06/16/95	Cottonwood Water Works
69	A	Crestview Phase 3	Yavapai	15 North	3 East	3	40	22-400345	Adequate		07/19/00	Cottonwood Water Works, Inc.
70	A	Crimson View	Yavapai	17 North	5 East	11	91	22-300088	Adequate		02/29/96	Arizona Water Company
71	A	Cross Creek Ranch	Yavapai	17 North	5 East	33	84	22-400694	Adequate		04/09/03	Cross Creek Ranch Community Association
72	A	Diamond Creek Ranch	Yavapai	13 North	5 East	8	27	22-400199	Inadequate	C	11/02/99	Dry Lot Subdivision
73	A	Diamond Creek Ranch North	Yavapai	13 North	5 East	8	22	22-401353	Inadequate	C	06/10/04	NA
74	A	Distant Drums	Yavapai	17 North	5 East	9	6		Adequate		02/06/76	Arizona Water Company
75	A	Doodlebug # 2	Coconino	17 North	6 East	19	42		Adequate		04/15/74	Arizona Water Company
76	M	Eagle Glen Townhouses	Gila	12 North	8 East	36	57		Inadequate	A1	02/16/84	E & R Water Company
77	A	Eagle Rock Subdivision	Yavapai	17 North	5 East	11	26	22-401545	Adequate		02/02/05	Arizona water Company - Sedona
78	M	Elusive Acres	Gila	11 North.5	10 East	20	30		Inadequate	A1, A2	03/22/88	United Utilities Company
79	M	Enchantment, John Gardiner's	Yavapai	18 North	5 West	20, 29	118		Adequate		04/18/86	Homeowners Association Wells
80	A	Equestrian Estates	Yavapai	14 North	4 East	14	44	22-401613	Adequate		04/20/05	Camp Verde Water System
81	A	Estrella Noche Ranch	Yavapai	17 North	4 East	1, 36	10	22-300591	Adequate		01/14/99	Homeowners Association Wells
82	A	Fairfield Sedona	Yavapai	17 North	5 East	11, 14	114	22-400109	Adequate		08/02/99	Arizona Water Company
83	A	Fairway Oaks	Yavapai	16 North	5 East	13	8		Adequate		01/07/87	Big Park Water Company
84	I	Fairway Oaks Estates replat	Gila	10 North	10 East	5, 6	23		Inadequate	A1, A2	03/10/83	Town of Payson
85	I	Falcon View	Gila	11 North	10 East	33	57	22-300027	Inadequate	A2	10/03/95	Town of Payson
86	M	Flagstaff Meadows Unit 1	Coconino	21 North	5 East	1	133	22-400692	Inadequate	A1	03/22/02	Homeowners Association Wells
87	M	Flagstaff Meadows Unit 2	Coconino	21 North	5 East	1	88	22-401174	Inadequate	A1	02/04/04	Utility Source LLC
88	A	Foothill Terrace	Yavapai	16 North	3 East	29	140		Adequate		05/05/83	Cottonwood Water Works, Inc.
89	A	Foothills North	Yavapai	17 North	5 East	3, 7	21		Adequate		02/20/79	Arizona Water Company
90	A	Foothills South	Yavapai	17 North	5 East	10	64		Adequate		06/18/74	Arizona Water Company
91	A	Foothills South # 2 Amended	Yavapai	17 North	5 East	15	n/a		Adequate		12/22/82	Arizona Water Company
92	A	Foothills South Unit 3	Yavapai	17 North	5 East	15	25	22-401029	Adequate		09/18/03	Arizona Water Co.
93	A	Foothills South Unit 4	Yavapai	17 North	5 East	15	8	22-401826	Adequate		09/08/05	Arizona Water Company
94	M	Forest Highlands	Coconino	20 North 20 North	7 East 6 East	19 24	655		Adequate		03/24/88	Forest Highlands Water Company
95	M	Forest Highlands Unit Five	Coconino	20 North	7 East	18	170	22-300321	Adequate		08/22/97	Forest Highlands Water Company

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
96	I	Forest Park	Gila	10 North	10 East	3	12		Adequate		08/08/73	United Utilities Company
97	I	Forest Park # 1	Gila	10 North	10 East	4	28		Inadequate	A1, A2	05/20/80	United Utilities Company
98	I	Forest Park # 2	Gila	10 North	10 East	3	121		Inadequate	A1, A2	02/08/80	United Utilities Company
99	I	Forest Park # 3	Gila	10 North	10 East	4	10		Inadequate	A1, A2	08/11/88	Town of Payson
100	M	Forest Ranch # 1	Coconino	22 North	4 East	13, 24	10		Inadequate	A2, A3	01/13/87	Dry Lot Subdivision
101	I	Four Seasons North	Gila	11 North	10 East	34	48		Inadequate	A1, A2	05/18/83	Town of Payson
102	M	FoxBoro Ranch Estates	Coconino	17 North	7 East	3	57	22-401577	Adequate		02/10/05	FoxBoro Ranch Domestic Water Improvement District
103	I	Frontier Condominiums	Gila	10 North	10 East	4	42	22-300091	Inadequate	A2	01/16/96	Town of Payson
104	I	Frontier Townhouses	Gila	10 North	10 East	9	8		Inadequate	A1, A2	06/17/80	United Utilities Company
105	A	Gateway Commercial Complex Unit 1	Yavapai	14 North	4 East	23	8	22-401794	Adequate		08/04/05	Camp Verde Water System
106	A	Golden Heights	Yavapai	14 North	4 East	12, 13	44		Adequate		07/17/80	Camp Verde Water System
107	I	Green Valley Estates	Gila	10 North	10 East	8, 9	53		Inadequate	A1, A2	04/26/94	Town of Payson
108	I	Green Valley Estates 2	Gila	10 North	10 East	8, 9	14	22-400849	Inadequate	A1	11/25/02	Town of Payson
109	I	Greenfaire	Gila	10 North	10 East	8	11		Inadequate	A1, A2, C	10/27/94	Town of Payson
110	I	Greenfaire # 2	Gila	10 North	10 East	8	8	22-300216	Inadequate	A1	10/31/96	Town of Payson
111	M	Guevremont	Gila	12 North	8 East	21	10		Inadequate	A1	07/17/84	E & R Water Company
112	A	Harmony Heights North	Yavapai	17 North	5 East	11	45		Adequate		01/18/78	Arizona Water Company
113	A	Haskell Springs	Yavapai	16 North	3 East	32	150	22-300011	Adequate		05/24/95	Cottonwood Water Works
114	M	Headwaters Ranch Country Club	Yavapai	17 North	2 West	2	765		Adequate		06/18/93	Juniper Wells Water Company
115	M	Headwaters Ranch Country Club 2	Yavapai	18 North	2 West	35	620		Adequate		06/18/93	Juniper Wells Water Company
116	M	Hidden Pines	Gila	12 North	8 East	25	49		Inadequate	A1	10/19/1995	Williamson Waterworks, Inc.
117	M	Hidden Pines Phase II	Gila	12 North	8 East	25	18	22-300182	Inadequate	A1, A2	08/08/96	Williamson Waterworks, Inc.
118	A	Highland Estates # 2	Yavapai	16 North	5 East	11	47		Adequate		11/01/79	Little Park Water Company
119	A	Hillcrest Villa	Yavapai	15 North	3 East	2	10		Adequate		03/22/94	Cottonwood Water Works, Inc.
120	M	Holiday Lake Estates	Yavapai	18 North	2 West	33, 34	1543	22-300240	Inadequate	A1,B	02/07/97	Abra Water Company, Inc.
121	M	Homestead at Camp Verde	Yavapai	14 North	4 East	25, 30, 31, 36	165	22-400441	Adequate		12/18/00	Camp Verde Water System
122	M	Homestead, The	Gila	12 North	8 East	20	25		Inadequate	A1	01/18/84	E & R Water Company
123	M	Hunt Ranch # 01	Gila	12 North	8 East	20	8		Inadequate	A1	07/21/93	E & R Water Company
124	A	Hyatt Pinon Point/The Y Project	Coconino	17 North	6 East	7	218	22-400946	Adequate		05/16/03	Arizona Water Company - Sedona
125	A	Indian Cliffs	Coconino	17 North	6 East	30	41		Adequate		09/15/92	Arizona Water Company
126	M	Inscription Canyon Ranch	Yavapai	16 North	3 West	27, 28	323	22-300021	Adequate		11/15/95	ICR Water Users Association
127	M	Inscription Canyon Ranch Unit 5	Yavapai	16 North	3 West	27, 28	46	22-400551	Adequate		09/14/01	ICR Water Users Association

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
128	A	J.D. Stump Subdivision	Yavapai	14 North	5 East	2	8		Adequate		09/27/88	Dry Lot Subdivision
129	M	John Gardiner's Enchantment Resort	Yavapai	18 North	5 East	20, 29	19	22-400266	Adequate		02/28/00	Boynton Canyon Enchantment Homeowners
130	A	Jordan Meadows # 2	Yavapai	13 North	5 East	7	10		Inadequate	A1	02/24/76	Dry Lot Subdivision
131	A	Jordan Meadows # 3	Yavapai	13 North	5 East	7	6		Inadequate	A1	03/26/79	Dry Lot Subdivision
132	A	Jordan Park Glen	Coconino	17 North	6 East	6	20		Adequate		12/06/91	Arizona Water Company
133	A	Jordan Park Ridge	Coconino	17 North	6 East	5	39		Adequate		12/29/93	Arizona Water Company
134	A	Jordan Road Condominiums	Coconino	17 North	6 East	5	4		Adequate		04/30/81	Arizona Water Company
135	A	Jordan Road Condominiums B	Coconino	17 North	6 East	8	9	22-400722	Adequate		6/14/2002	Arizona Water Company
136	A	Jordan Road, 540	Coconino	17 North	6 East	8	8		Adequate		11/15/82	Arizona Water Company
137	M	Juniper Meadows	Yavapai	17 North	5 West	29	42		Adequate		05/07/92	Juniper Meadows Water Users'
138	M	Junipine Oak Creek	Coconino	18 North	6 East	5, 8	50		Adequate		03/21/86	Junipine Community Property Owners
139	M	Kachina Village	Coconino	20 North	7 East	20	3000		Adequate		08/25/75	Flagstaff, City of
140	A	Kindra Heights	Yavapai	16 North	3 East	28	21	22-401150	Adequate		01/28/04	Cottonwood Water Works, Inc.
141	A	Kinsey Estates at Western Hills	Yavapai	17 North	5 East	11	9	22-401397	Adequate		09/15/04	Arizona Water Company-Sedona
142	A	Kinsey Estates Two at Western Hills	Yavapai	17 North	5 East	11	9	22-401603	Adequate		03/30/05	Arizona Water Company - Sedona
143	A	Koch Ranch Estates	Yavapai	15 North	4 East	15	35	22-401913	Adequate		12/01/05	Dry Lot Subdivision
144	A	La Barranca	Yavapai	16 North	6 East	17, 18	76	22-300502	Adequate		09/08/98	Big Park Water Company
145	A	Lakeside Townhouses	Yavapai	14 North	5 East	2	10		Adequate		05/27/83	Arizona Water Company
146	A	Las Estancias	Yavapai	14 North	4 East	14	26	22-400398	Adequate		10/25/00	Camp Verde Water System
147	A	Las Oficinas Office Building	Yavapai	17 North	5 East	12	6		Adequate		10/22/84	Arizona Water Company
148	A A	Las Piedras	Yavapai	16 North 16 North	6 East 5 East	19 24	152 156	22-300413	Adequate		05/15/98	Big Park Water Company
149	A	Les Springs	Coconino	17 North	6 East	7, 18	106		Adequate		08/28/85	Arizona Water Company
150	A	Loma Sinagua	Yavapai	15 North	3 East	2	195	22-300084	Adequate		01/10/96	Cottonwood Water Works, Inc.
151	M	Long Meadow Ranch - Unit 3	Yavapai	16 North	3 West	19	6	22-401596	Inadequate	A1	12/29/04	Dry Lot Subdivision
152	A	Los Abrigados Timeshare	Coconino	17 North	6 East	18	175		Adequate		12/09/88	Arizona Water Company
153	A	Los Lomas	Yavapai	17 North	5 East	15	92		Adequate		11/09/82	Arizona Water Company
154	I	Lovett Place	Gila	11 North	10 East	28	18	22-300113	Inadequate	A2	03/15/96	Town of Payson
155	A	Lucky Canyon Estates	Yavapai	13 North	4 East	1	6	22-401490	Inadequate	A1	12/08/04	Dry Lot Subdivision
156	M	Maine Townsite	Coconino	22 North	4 East	26	9		Inadequate	A2, A3	07/29/77	Dry Lot Subdivision
157	M	Malapai Ridge Estates	Yavapai	17 North	2 West	9	25		Adequate		07/11/88	Dry Lot Subdivision

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
158	I	Manzanita Hills # 1	Gila	10 North	10 East	5	11		Inadequate	A1, A2, C	01/17/95	Town of Payson
159	A	Manzanita Hills # 2	Coconino	17 North	6 East	7	14		Adequate		04/15/74	Arizona Water Company
160	M	Manzanita Hills # 2	Gila	11 North	10 East	5	22		Inadequate	A1, A2, C	01/18/95	Town of Payson
161	I	Manzanita Hills # 3	Gila	10 North	10 East	5	7	22-300461	Inadequate	A1	05/15/98	Town of Payson
162	I	Manzanita Hills # 4	Gila	10 North	10 East	5	19	22-400739	Inadequate	A1	06/18/02	Town of Payson
163	I	Manzanita Hills # 5	Gila	11 North	10 East	32	8	22-400905	Inadequate	A1	03/31/03	Town of Payson
164	I	Manzanita Woods	Gila	11 North	10 East	32	6	22-300462	Inadequate	A1	05/15/98	Town of Payson
165	A	Maybelle Estates	Yavapai	13 North	5 East	6	5		Adequate		10/11/74	Camp Verde Water System
166	I	Mazatzal Mountain Airpark # 1	Gila	11 North	10 East	32	26	22-300173	Inadequate	A1, A2	08/23/96	Town of Payson
167	I	Mazatzal Mountain Airpark # 2 Phase 2	Gila	11 North	10 East	32	17	22-400805	Inadequate	A1	09/17/02	Town of Payson
168	I	Mazatzal Mountain Airpark # 3 Phase 1	Gila	11 North	10 East	32	12	22-401032	Inadequate	A1	09/03/03	Town of Payson Water Department
169	A	Mel Glo Estates #2	Yavapai	15 North	4 East	3	8		Inadequate	C	02/25/76	Dry Lot Subdivision
170	M	Mesa Del Caballo Tracts, plats 3, 5 & 6	Gila	11 North	10 East	23, 24	12	22-400038	Inadequate	A1, C	03/26/99	Brooke Utilities
171	A	Mesa Verde Estates	Yavapai	14 North	5 East	19, 30	16		Inadequate	C	04/15/80	Dry Lot Subdivision
172	A	Mingus Shadows	Yavapai	16 North	3 East	29	121		Adequate		05/21/82	Cottonwood Water Works, Inc.
173	A	Mingus View Estates	Yavapai	16 North	3 East	32	70		Adequate		01/13/94	Cottonwood Water Works, Inc.
174	M	Mint Creek Ranch	Yavapai	15 North	3 West	2, 11	74		Adequate		11/29/93	Dry Lot Subdivision
175	A	Mission Hills	Yavapai	17 North	5 East	12	81		Adequate		09/26/80	Arizona Water Company
176	A	Morning Sun Condominiums	Yavapai	17 North	5 East	13	74		Adequate		12/31/87	Oak Creek Water Company
177	A	Mountain Estates	Yavapai	13 North	4 East	1	15	22-401186	Adequate		02/02/04	Camp Verde Water System, Inc.
178	A	Mountain Gate	Yavapai	16 North	3 East	19	606	22-401660	Adequate		06/03/05	Cottonwood Water Works, Inc.
179	M	Mountain Rose Ranch	Coconino	21 North	3 East	3	32	22-400914	Inadequate	A1, A2, A3	04/17/03	Individual Wells
180	A	Mountain View Ranchos	Yavapai	15 North	4 East	11	47		Adequate		03/26/79	Dry Lot Subdivision
181	M	Mountainaire # 5	Coconino	20 North	7 East	28	522		Adequate		07/29/83	Ponderosa Utility Corporation
182	I	Mountain-Aire Condominiums	Gila	11 North	10 East	34	4		Inadequate	A1, A2	06/14/82	Town of Payson
183	I	Mountain-Aire Condominiums # 3	Gila	11 North	10 East	34	8		Inadequate	A1, A2	09/10/85	Town of Payson
184	M	Mountainaire Meadows	Coconino	20 North	7 East	28	20		Adequate		05/05/83	Ponderosa Utility Corporation
185	A	Mystic Hills	Coconino	17 North	6 East	19	144		Adequate		09/15/92	Arizona Water Company
186	A	Nepenthe	Yavapai	17 North	5 East	14	182	22-300083	Adequate		01/16/96	Arizona Water Company
187	A	Nizhoni Village	Yavapai	16 North	5 East	13	40		Adequate		11/07/80	Big Park Water Company
188	A	North Slopes # 3, Lots 33-55	Yavapai	17 North	5 East	3	23	22-300258	Adequate		07/03/97	Arizona Water Company

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
189	A	Northern Shadows	Yavapai	17 North	5 East	12	NA		Adequate		07/18/83	Arizona Water Company
190	A	Northview	Yavapai	17 North	5 East	13	121		Adequate		11/29/73	Oak Creek Water Company, #1
191	I	Northwoods	Gila	11 North	10 East	34	72	22-300199	Inadequate	A1, A2	11/08/96	Town of Payson
192	A	Oak Bend # 2	Yavapai	15 North	4 East	10, 15	12		Adequate		02/04/88	Dry Lot Subdivision
193	A	Oak Creek Country Club Estates	Yavapai	16 North	5 East	13	63		Adequate		02/06/80	Arizona Water Company
194	A	Oak Creek Country Club Estates # 2	Yavapai	16 North	5 East	13	40		Adequate		11/23/81	Arizona Water Company
195	A	Oak Creek Country Club Estates # 3	Yavapai	16 North	5 East	23, 24	57		Adequate		11/23/81	Arizona Water Company
196	A	Oak Creek Estados	Yavapai	16 North	5 East	13	136		Adequate		06/03/81	Big Park Water Company
197	A	Oak Creek Palisades	Yavapai	16 North	4 East	35	15		Inadequate	A1	08/26/73	Dry Lot Subdivision
198	M	Oak Creek Valley # 1 & 3	Yavapai	16 North	4 West	34	135		Adequate		06/21/77	Dry Lot Subdivision
199	M	Oak Creek Valley # 2	Yavapai	16 North	4 West	34	185		Adequate		08/08/79	Oak Creek Valley Water & Sewer
200	A	Orchards # 2	Coconino	17 North	6 East	6	34		Adequate		08/30/74	Arizona Water Company
201	A	Palisades	Coconino	17 North	6 East	18	86		Adequate		10/17/78	Arizona Water Company
202	A	Panorama	Yavapai	16 North	3 East	19, 30	22		Adequate		10/30/75	Cottonwood Water Company
203	A	Papago Highlands	Yavapai	17 North	5 East	10, 15	192		Adequate		09/23/74	Arizona Water Company
204	I	Paradise Heights	Gila	10 North	10 East	8, 9	16	22-401022	Inadequate	A1	09/03/03	Town of Payson
205	I	Paradise Heights Phase Two	Gila	10 North	10 East	9	20	22-401547	Inadequate	A1	11/18/04	Town of Payson
206	A	Park Place Condominium	Yavapai	17 North	5 East	15	88	22-401834	Adequate		11/14/05	Arizona Water Company
207	M	Parks Pine	Coconino	22 North	4 East	26	26		Inadequate	A2, A3	09/20/73	Dry Lot Subdivision
208	M	Paulden Farms	Yavapai	17 North	2 West	4	15		Adequate		03/12/92	Dry Lot Subdivision
209	I	Payson Industrial Park	Gila	10 North	10 East	4	13		Inadequate	D	11/08/88	Town of Payson
210	I	Payson Meadows	Gila	11 North	10 East	27, 28	32		Inadequate	A1, A2	08/07/86	Town of Payson
211	I	Payson Pines	Gila	11 North	10 East	28	127	22-300364	Inadequate	A1	09/30/97	Town of Payson
212	I	Payson Pines Unit 2	Gila	11 North	10 East	28	22	22-400740	Inadequate	A1	06/25/02	Town of Payson
213	A	Pebble Rock	Yavapai	13 North	5 East	5	10	22-401538	Adequate		03/07/05	
214	A	Pecan Acres	Yavapai	16 North	3 East	35	28		Adequate		05/09/79	Cottonwood Water Works, Inc.
215	A	Penny Acres # 2	Yavapai	15 North	3 East	1, 2	8		Adequate		07/27/78	Dry Lot Subdivision
216	A	Piedras Del Rojo Condominiums	Yavapai	17 North	5 East	15	18	22-401854	Adequate		11/14/05	Arizona Water Company - Sedona
217	I	Pine Aire	Gila	10 North	10 East	3	28		Inadequate	A1, A2	03/18/80	United Utilities Company
218	M	Pine Mountain Acres	Gila	12 North	9 East	30	32		Inadequate	A1, A2, B	11/26/74	Dry Lot Subdivision
219	M	Pinewood Fairway Condos # 1	Coconino	18 North	7 East	15	44		Inadequate	A1	01/29/79	Arizona Water Company

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
220	M	Pinewood Fairway Condos # 2	Coconino	18 North	7 East	15	18		Inadequate	A1	05/14/81	Arizona Water Company
221	M	Pinewood Fairway Condos # 3	Coconino	18 North	7 East	15	8		Inadequate	A1	06/08/81	Arizona Water Company
222	M	Pinewood Fairway Condos # 4	Coconino	18 North	7 East	15	18		Inadequate	A1	11/25/81	Arizona Water Company
223	M	Pinewood Fairway Condos # 5	Coconino	18 North	7 East	15	20		Inadequate	A1	12/09/81	Arizona Water Company
224	A	Pinon Valley Estates	Yavapai	16 North	6 East	18	8		Adequate		08/09/93	Big Park Water Company
225	A	Pinon Woods	Yavapai	16 North	6 East	18	120		Adequate		08/15/83	Big Park Water Company
226	A	Pinon Woods # 2	Yavapai	16 North	6 East	18	28		Adequate		04/05/93	Big Park Water Company
227	A	Pinon Woods # 3	Yavapai	16 North	6 East	18	70	22-300005	Adequate		03/30/95	Big Park Water Company
228	A	Playa del Rio	Yavapai	14 North	4 East	13, 14	183		Adequate		05/13/87	Camp Verde Water Company
229	A	Plaza Wes	Yavapai	17 North	5 East	11	33		Adequate		11/08/84	Arizona Water Company
230	A	Poco Diablo Villas	Coconino	17 North	6 East	19	18		Adequate		10/11/74	Arizona Water Company
231	A	Poco Diablo Villas # 2	Coconino	17 North	6 East	19	33		Adequate		09/28/78	Arizona Water Company
232	M	Ponderosa Paradise # 2	Coconino	16 North	8 East	16	9		Inadequate	D	08/21/89	Stoneman Lake Water Company
233	M	Portal # 3, Pine Canyon	Gila	12 North	8 East	24	NA		Adequate		08/08/99	Myers Water Company
234	M	Portal (Canyon Shadows)	Gila	12 North	8 East	25	NA		Adequate		07/17/73	developer-supplied
235	M	Portal at Pine Creek Canyon # 2	Gila	12 North	8 East	25	208		Adequate		08/12/76	Myers Water Company
236	M	Portal at Pine Creek Canyon # 3	Gila	12 North	8 East	24	190		Adequate		10/23/81	Myers Water Company
237	M	Portal at Pine Creek Canyon # 4, Phase 1	Gila	12 North	8 East	25	73		Inadequate	A1, A2	07/19/94	Williamson Water Works
238	M	Portal at Pine Creek Canyon # 4, Phase 2	Gila	12 North	8 East	25	7	22-400396	Inadequate	A1	09/22/00	Pine Creek Canyon Domestic Water
239	A	Quail Canyon	Yavapai	15 North	3 East	15	59	22-401819	Adequate		09/08/05	Quail Canyon Domestic Water Improvement District
240	A	Quail Ridge	Yavapai	15 North	3 East	15, 22	53	22-400381	Inadequate	A1, A2	09/18/00	Dry Lot Subdivision
241	M	Quail Springs Ranches	Yavapai	15 North	2 East	15	16		Inadequate	A2	03/25/75	Dry Lot Subdivision
242	A	Rainbow Subdivision	Yavapai	16 North	3 East	34	5		Adequate		01/06/88	Cottonwood Water Works, Inc.
243	A	Ranch Acres	Yavapai	14 North	5 East	30, 31	75		Adequate		10/26/73	Camp Verde Water System
244	M	Ranch at Hidden Valley	Yavapai	17 North	2 West	29	56	22-400349	Inadequate	A2	08/21/00	Dry Lot Subdivision
245	M	Rancho del Oro	Yavapai	18 North	5 East	27	200		Adequate		04/01/81	Rancho del Oro
246	M	Rancho Shangri La	Coconino	18 North	6 East	21	20		Adequate		08/19/81	Shangri La Property Owners Association
247	M	Ravencrest	Yavapai	18 North	2 West	19, 30	29	22-400573	Adequate		09/11/01	Dry Lot Subdivision
248	M	Red Rock Cove	Yavapai	12 North	5 East	13	6		Adequate		01/22/82	Big Park Water Company
249	A	Red Rock Vista	Yavapai	16 North	5 East	23	6		Adequate		03/21/94	Arizona Water Company
250	A	Ridge at Sedona	Yavapai	16 North	5 East	24	8	22-300360	Adequate		10/10/97	Arizona Water Company

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
251	A	Ridge at Sedona, The	Yavapai	16 North	5 East	24	50		Adequate		02/28/85	Arizona Water Company
252	A	Ridge Casitas # 1	Yavapai	16 North	5 East	24	48		Adequate		10/11/85	Arizona Water Company
253	A	Ridge on Sedona Golf Resort, The	Yavapai	16 North	5 East	24	106	22-300330	Adequate		08/05/97	Arizona Water Company
254	A	Ridge View	Yavapai	16 North	5 East	13	8		Adequate		09/27/89	Big Park Water Company
255	I	Rim Ranch	Gila	11 North	10 East	32	20	22-300547	Inadequate	A1	10/19/98	Town of Payson
256	A	Rim Rock Heights	Yavapai	15 North	5 East	36	36	22-400653	Adequate		02/26/02	Dry Lot Subdivision
257	A	Rim Shadows	Yavapai	17 North	5 East	1	32		Adequate		07/07/80	Arizona Water Company
258	M	Rimrock # 1	Yavapai	17 North	2 West	14, 15, 23	35	22-300008	Adequate		05/26/95	Dry Lot Subdivision
259	M	Rimrock # 2	Yavapai	17 North	2 West	23	52	22-300079	Adequate		12/08/95	Dry Lot Subdivision
260	M	Rimrock North	Yavapai	17 North	2 West	15	17	22-300329	Adequate		07/30/97	Dry Lot Subdivision
261	A	Rio Verde Condominiums	Yavapai	16 North	3 East	34	12		Adequate		11/17/81	Cottonwood Water Works, Inc.
262	A	Rio Verde Ranchos	Yavapai	13 North	5 East	6	34		Inadequate	C	03/17/89	Dry Lot Subdivision
263	A	River Ranch Estates	Yavapai	14 North	4 East	3	18	22-300144	Adequate		06/28/96	Dry Lot Subdivision
264	A	Saddlerock Homes	Yavapai	17 North	5 East	13	116		Adequate		09/11/78	Oak Creek Water Company, #1
265	A	San Carlos Condominium	Yavapai	17 North	5 East	12	40		Adequate		07/24/80	Oak Creek Water Company, #1
266	A	San Patricio Estates	Yavapai	17 North	5 East	12	40		Adequate		09/26/75	Arizona Water Company
267	M	Santa Fe Industrial Sites	Yavapai	18 North	2 West	34	200		Adequate		04/11/94	Abra Water Company, Inc.
268	A	Sawmill Cove	Yavapai	15 North	3 East	2	36		Adequate		01/18/94	Cottonwood Water Works, Inc.
269	A	Sawmill Gardens Patio Homes	Yavapai	15 North	3 East	2	59		Adequate		11/13/85	Cottonwood Water Works, Inc.
270	A	Schuerman Estates	Yavapai	17 North	5 East	26	2		Adequate		01/27/76	Dry Lot Subdivision
271	M	Secluded Homesites	Gila	12 North	9 East	31	NA		Inadequate	A1	03/28/80	Dry Lot Subdivision
272	A	Sedona Gardens	Yavapai	17 North	5 East	15	1		Adequate		11/23/81	Arizona Water Company
273	A	Sedona Golf Resort 1	Yavapai	16 North	5 East	24	19	22-300071	Adequate		12/04/95	Arizona Water Company
274	A	Sedona Golf Resort 2	Yavapai	16 North	5 East	24	94	22-300148	Adequate		06/11/96	Arizona Water Company
275	A	Sedona Golf Resort, Phase 2	Yavapai	16 North	5 East	23, 24	192	22-300401	Adequate		03/31/98	Arizona Water Company
276	A	Sedona Golf Resort Hotel	Yavapai	16 North	5 East	24	225	22-300340	Adequate		08/25/97	Arizona Water Company
277	A	Sedona Heights	Yavapai	17 North	5 East	12	16	22-300273	Adequate		03/25/97	Arizona Water Company
278	A	Sedona San Carlos	Yavapai	17 North	5 East	12	40		Adequate		09/24/90	Oak Creek Water Company
279	M	Sedona Seven Canyons Units I, II, and III	Yavapai	18 North	5 East	27	118	22-400907	Adequate		08/28/03	Seven Canyons Water Company
280	A	Sedona Summit II, Phase 3	Yavapai	17 North	5 East	15	39	22-400124	Adequate		08/24/99	Arizona Water Company
281	A	Sedona Vista Estates	Coconino	17 North	6 East	7	12		Adequate		08/21/80	Arizona Water Company

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
282	M	Seven Canyons of Sedona	Yavapai	18 North	5 East	27	300	22-300262	Adequate		10/29/97	
283	A	Shadow Rock	Yavapai	17 North	5 East	1	34		Adequate		03/21/80	Arizona Water Company
284	A	Shadowbrook Condominium	Yavapai	17 North	5 East	11	54		Adequate		02/22/88	Arizona Water Company
285	A	Sierra Verde Estates	Yavapai	13 North	5 East	15, 16	30		Inadequate	C	04/12/82	Dry Lot Subdivision
286	A	Silver Springs # 1	Yavapai	15 North	3 East	3	80		Adequate		11/12/80	Cottonwood Water Works, Inc.
287	A	Silver Springs Development	Yavapai	15 North	3 East	3	48		Adequate		10/29/86	Cottonwood Water Works, Inc.
288	A	Silver Springs Garden Homes	Yavapai	15 North	3 East	3	26		Adequate		07/11/94	Cottonwood Water Works, Inc.
289	A	Silver Springs Terrace # 1	Yavapai	15 North	3 East	3	22		Adequate		04/07/81	Cottonwood Water Works, Inc.
290	A	Silverado at Simonton Ranch	Yavapai	14 North	4 East	25	252	22-401916	Adequate		11/14/05	Camp Verde Water System
291	A	Sky Line Estates	Coconino	17 North	6 East	17	11		Adequate		06/21/91	Arizona Water Company
292	I	Sky Park Industrial	Gila	11 North	10 East	32	64		Inadequate	A1, A2	12/29/83	Town of Payson
293	A	Skyline Estates	Yavapai	15 North	3 East	3	34	22-401481	Adequate		12/13/04	Cottonwood Water Works, Inc.
294	A	Solair Estates	Yavapai	15 North	4 East	11	42		Adequate		10/23/79	Dry Lot Subdivision
295	A	Solair Estates # 1	Yavapai	15 North	4 East	11	2		Adequate		04/28/83	Dry Lot Subdivision
296	M	Solitude Pines # 1	Gila	12 North	9 East	31	115		Inadequate	A1	07/30/84	E & R Water Company
297	M	Solitude Pines # 2,5	Gila	12 North	9 East	31	255		Inadequate	A1	09/11/85	E & R Water Company
298	M	Solitude Trails	Gila	12 North	9 East	31	73		Inadequate	A1	09/28/94	E & R Water Company
299	M	Solitude Trails Unit Four	Gila	12 North	9 East	31	10	22-300580	Adequate		08/16/99	Solitude Trails Domestic Water Improvement District
300	A	Starlight Village # 2	Yavapai	15 North	3 East	3	32		Adequate		01/16/81	Cottonwood Water Works, Inc.
301	I	Stone Creek at Payson	Gila	10 North	10 East	4, 5	130	22-400061	Inadequate	A1	04/21/99	Town of Payson
302	A	Stoneridge	Yavapai	14 North	5 East	31	54	22-400904	Adequate		07/21/03	Camp Verde Water System Inc.
303	M	Strawberry Creek Foothills	Gila	12 North	8 East	20	96		Adequate		03/13/80	Myers Water Company
304	M	Strawberry Hollow, Phase I	Gila	12 North	8 East	26	41	22-400383	Inadequate	A1	09/12/00	Strawberry Hollow Development, Inc.
305	M	Strawberry Mountain Shadows # 2, 3	Gila	12 North	8 East	35	134		Adequate		03/31/77	E & R Water Company
306	M	Strawberry Mountain Shadows # 4	Gila	11.5 North	9 East	35	264		Inadequate	A1	02/11/81	E & R Water Company
307	M	Strawknolls # 4 (amended)	Gila	12 North	8 East	22	8		Inadequate	C	11/12/82	Arizona Water Company
308	I	Streams at Payson # 1	Gila	10 North	10 East	4	72		Inadequate	A1, A2	09/06/85	Town of Payson
309	A	Sun Dance Townhouses	Yavapai	16 North	5 East	13	58		Adequate		02/28/80	Big Park Water Company
310	M	Sundown Acres	Yavapai	15 North	3 West	24	8		Adequate		12/16/74	Dry Lot Subdivision
311	A	Sunrise Cliffs	Yavapai	17 North	5 East	1	6		Adequate		08/21/86	Arizona Water Company
312	A	Sunset Hills	Yavapai	17 North	5 East	19	466		Adequate		03/21/74	Big Park Water Company

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
313	A	Sunset Plaza	Yavapai	17 North	5 East	11	8		Adequate		05/14/76	Arizona Water Company
314	A	Sunup Ranch	Yavapai	16 North	5 East	14	16	22-401418	Adequate		09/15/04	Arizona Water Company
315	A	Swinging Bridge Estates	Yavapai	16 North	4 East	34	18		Adequate		06/12/79	Dry Lot Subdivision
316	A	Sycamore Farms	Yavapai	16 North	3 East	35	17		Adequate		01/01/79	Cottonwood Water Works, Inc.
317	A	Sycamores II	Yavapai	14 North	5 East	1	6		Adequate		08/26/83	Arizona Water Company
318	M	Talking Rock Ranch Phase 1	Yavapai	16 North	3 West	15, 16, 22	198	22-400519	Adequate		08/17/01	ICR Water Users Association
319	M	Talking Rock Ranch Phase 2 & 3	Yavapai	16 North	3 West	15, 22	127	22-400675	Adequate		03/14/02	ICR Water Users Association, Inc.
320	M	Talking Rock Ranch Phase 4a	Yavapai	16 North	3 West	19	10	22-400758	Adequate		07/30/02	ICR Water Users Associations, Inc.
321	M	Talking Rock Ranch Phase 5a, 5b & 6	Yavapai	16 North	3 West	15, 22	73	22-400831	Adequate		10/08/02	ICR Water Users Association, Inc.
322	M	Talking Rock Ranch Phase 8	Yavapai	16 North	3 West	22	80	22-401206	Adequate		02/18/04	ICR Water Users Association
323	M	Talking Rock Ranch Phase 9	Yavapai	16 North	3 West	15	107	22-401417	Adequate		09/08/04	ICR Water Users Association
324	M	Talking Rock Ranch Phase 26	Yavapai	16 North	3 West	33	38	22-401355	Adequate		09/08/04	ICR Water Users Association
325	M	Talking Rock Ranch Phase 27	Yavapai	16 North	3 West	22	38	22-401175	Adequate		02/18/04	ICR Water Users Association
326	M	Terra Pine	Gila	12 North	8 East	36	30		Adequate		01/02/80	E & R Water Company
327	A	Thunder Mountain Ranch	Yavapai	17 North	5 East	10, 11	100	22-300070	Adequate		11/21/95	Arizona Water Company
328	A	Thunder Mountain Ranch # 2	Yavapai	17 North	5 East	10	43	22-300509	Adequate		09/01/98	Arizona Water Company
329	A	Thunder Ridge	Yavapai	15 North	5 East	25	230	22-300118	Adequate		07/12/96	Dry Lot Subdivision
330	A	Thunderbird Hills East # 2	Yavapai	17 North	5 East	14	16		Adequate		10/07/75	Arizona Water Company
331	A	Thunderbird Hills South # 2	Yavapai	17 North	5 East	14	8		Adequate		10/15/75	Arizona Water Company
332	A	Tierra Sienna Condominium	Yavapai	17 North	5 East	13	32		Adequate		11/25/87	Oak Creek Water Company
333	A	Tierra Verde Subdivision	Yavapai	15 North	3 East	3	39	22-300586	Adequate		12/22/98	Cottonwood Water Works, Inc.
334	I	Timber Ridge Estates II	Gila	10 North	10 East	4	22	22-300147	Inadequate	A2	05/22/96	Town of Payson
335	I	Town & Country Estates	Gila	10 North	10 East	3	19	22-400231	Inadequate	A1, C	01/26/00	Town of Payson
336	M	Town Homes at Flagstaff Meadows	Coconino	21 North	5 East	1	105	22-401224	Inadequate	A1	03/15/04	Utility Source, LLC
337	I	Trailwood # 1	Gila	10 North	10 East	4	104		Inadequate	A1, A2	04/14/94	Town of Payson
338	I	Trailwood # 2	Gila	10 North	10 East	4	86		Inadequate	A1, A2, C	12/07/94	Town of Payson
339	I	Trailwood # 3	Gila	10 North	10 East	4	123	22-300028	Inadequate	A2	07/26/95	Town of Payson
340	A	Two Ponds Estates	Yavapai	14 North	4 East	12	4		Adequate		07/24/80	Dry Lot Subdivision
341	A	Valley Shadows	Yavapai	17 North	5 East	14	158		Adequate		03/21/74	Arizona Water Company
342	A	Valley View Estates	Yavapai	16 North	3 East	17	28	22-300469	Inadequate	A1	06/17/98	Dry Lot Subdivision
343	A	Ventana Vista	Yavapai	15 North	3 East	15	69		Inadequate	B, C	01/18/94	Cordes Lakes Water Company

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Map Key	Map Location[2]	Subdivision Name	County	Location			No. of Lots	ADWR File No.[3]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[4]	Date of Determination	Water Provider at the Time of Application
				Township	Range	Section						
344	A	Verde Cliffs	Yavapai	14 North	5 East	31	208	22-401354	Inadequate	D	07/21/04	Camp Verde Water System, Inc.
345	A	Verde Monterey	Yavapai	15 North	3 East	11	14		Adequate		10/01/84	Cordes Lakes Water Company
346	A	Verde Outpost	Yavapai	14 North	5 East	31	28		Adequate		03/12/80	Camp Verde Water System
347	A	Verde Park	Yavapai	13 North	5 East	9, 16	59		Inadequate	C	01/26/82	Dry Lot Subdivision
348	A	Verde Ranchettes	Yavapai	15 North	4 East	17	17		Adequate		02/04/85	Dry Lot Subdivision
349	A	Verde Santa Fe	Yavapai	15 North	4 East	6	103	22-300257	Adequate		02/21/97	Verde Santa Fe Water Company
350	A	Verde Valley Business Park	Yavapai	14 North	4 East	15	23	22-401142	Adequate		01/12/04	Camp Verde Water System
351	A	Verde Village # 6	Yavapai	15 North	3 East	10, 11	19	22-300170	Adequate		09/06/96	Cordes Lakes Water Company
352	A	Verde West Acres # 2	Yavapai	14 North	4 East	14	16		Inadequate	C	06/09/75	Dry Lot Subdivision
353	A	Village Park	Yavapai	16 North	6 East	18	25		Adequate		09/10/80	Big Park Water Company
354	A	Villages Estates	Yavapai	16 North	5 East	13	25	22-401469	Adequate		12/03/04	Arizona Water Company
355	A	Villas on Elm	Yavapai	15 North	3 East	2	110	22-401483	Adequate		12/01/04	Cottonwood Water Works
356	A	Vista Grande Ranch	Yavapai	15 North	3 East	3	48	22-300488	Adequate		07/22/98	Cottonwood Water Works, Inc.
357	A	Vista Montana	Yavapai	17 North	5 East	12	60		Adequate		04/08/81	Arizona Water Company
358	A	Vista Ridge Manor	Coconino	17 North	6 East	18	8		Adequate		09/20/82	Arizona Water Company
359	M	Walnut Glen	Gila	12 North	8 East	29	29		Adequate		12/12/74	E & R Water Company
360	A	Western Hills	Yavapai	17 North	5 East	2, 11	79		Adequate		08/15/77	Arizona Water Company
361	A	Western Hills # 2	Yavapai	17 North	5 East	11	63		Adequate		06/12/79	Arizona Water Company
362	I	Western Manor	Gila	11 North	10 East	33, 34	26		Inadequate	A1, A2	12/27/74	United Utilities Company
363	A	Westward	Yavapai	17 North	5 East	2, 11	25		Adequate		03/25/80	Arizona Water Company
364	M	Whispering Canyon	Yavapai	16 North	3 West	33, 34	400	22-400580	Adequate		03/07/02	ICR Water Users Association
365	M	Whitney Ranch Estates	Maricopa	6 North	9 East	7	20	22-300033	Adequate		08/19/97	Whitney Ranch Estates Property Owners'
366	A	Wild Turkey Townhouses # 2	Yavapai	16 North	5 East	13	82		Adequate		12/26/78	Big Park Water Company
367	I	Wildwood	Gila	10 North	10 East	5	99		Inadequate	A1, A2	07/20/83	Town of Payson
368	A	Wilma Overal Property	Yavapai	17 North	5 East	27	1		Adequate		08/10/89	Dry Lot Subdivision
369	M	Wineglass Lake Estates	Yavapai	18 North	3 West	13	117		Inadequate	A1	10/15/93	Dry Lot Subdivision
370	M	Wonder Valley	Gila	11 North	10 East	11	8		Adequate		08/22/75	Co-op water system
371	I	Woodhill #1-8	Gila	11 North	10 East	33	396		Inadequate	A2, C	05/31/95	Town of Payson
372	I	Woodland Meadows # 1 (amended)	Gila	10 North	10 East	4, 5	102		Inadequate	A1, A2	01/06/81	Town of Payson
373	I	Woodland Meadows # 2	Gila	10 North	10 East	4, 5	91		Inadequate	A1, A2	11/09/82	Town of Payson
374	I	Woodland Meadows # 3	Gila	10 North	10 East	4	84		Inadequate	A1, A2	06/20/84	Town of Payson
375	I	Woodland Meadows # 4	Gila	10 North	10 East	4, 5	24		Inadequate	A1, A2	04/12/88	Town of Payson

Table 5.5-10 Adequacy Determinations in the Verde River Basin (cont'd)[1]

Notes:

[1] Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.

[2] M = Figure 5.5-11; I = Inset; A = Figure 5.5-11A

[3] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[4] A. Physical/Continuous
  1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
  2) Insufficient Supply (existing water supply unreliable or physically unavaible;for groundwater, depth-to-water exceeds criteria)
  3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)

B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)

C. Water Quality

D. Unable to locate records

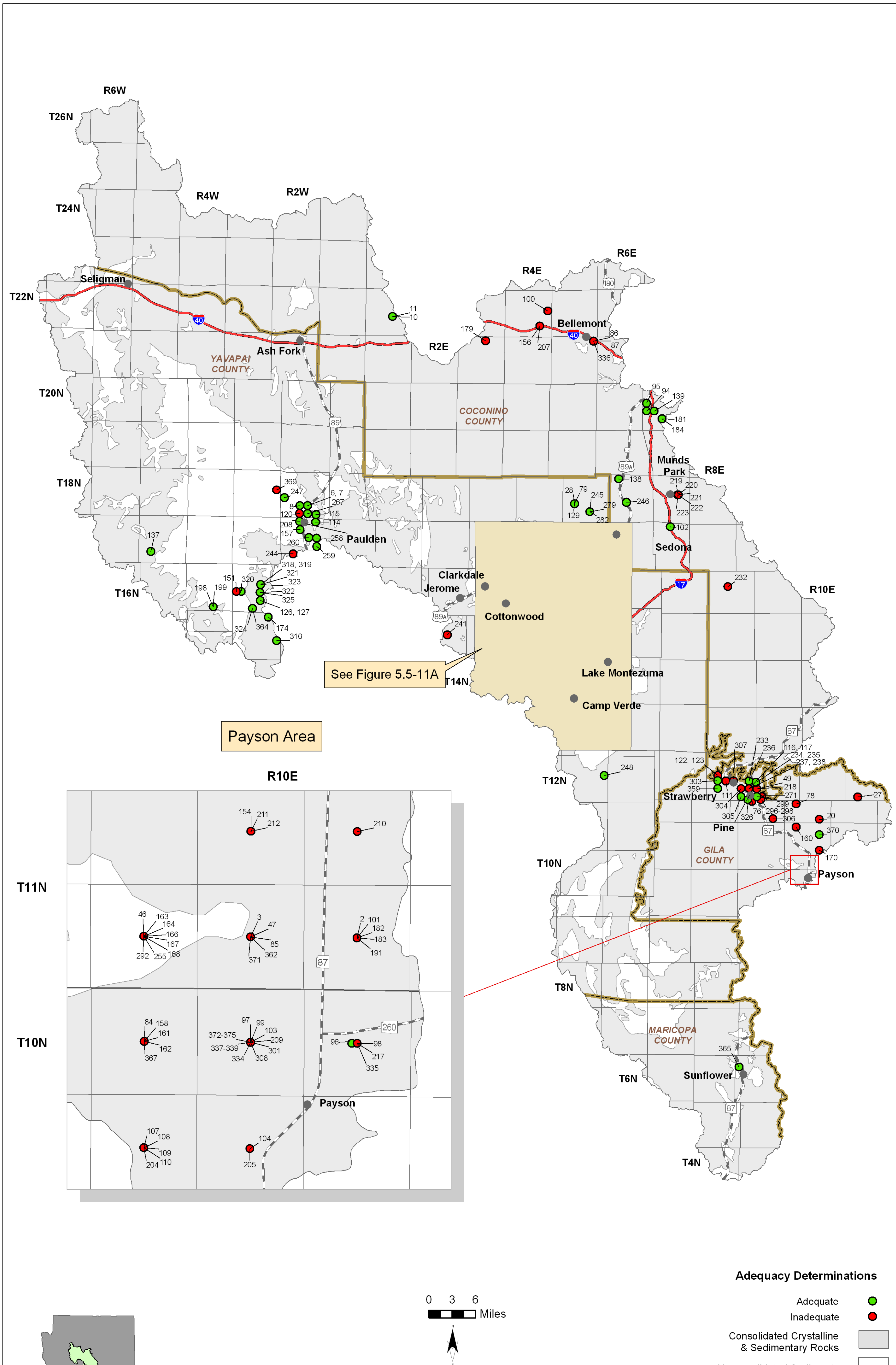


Figure 5.5-11
Verde River Basin
Adequacy Determinations

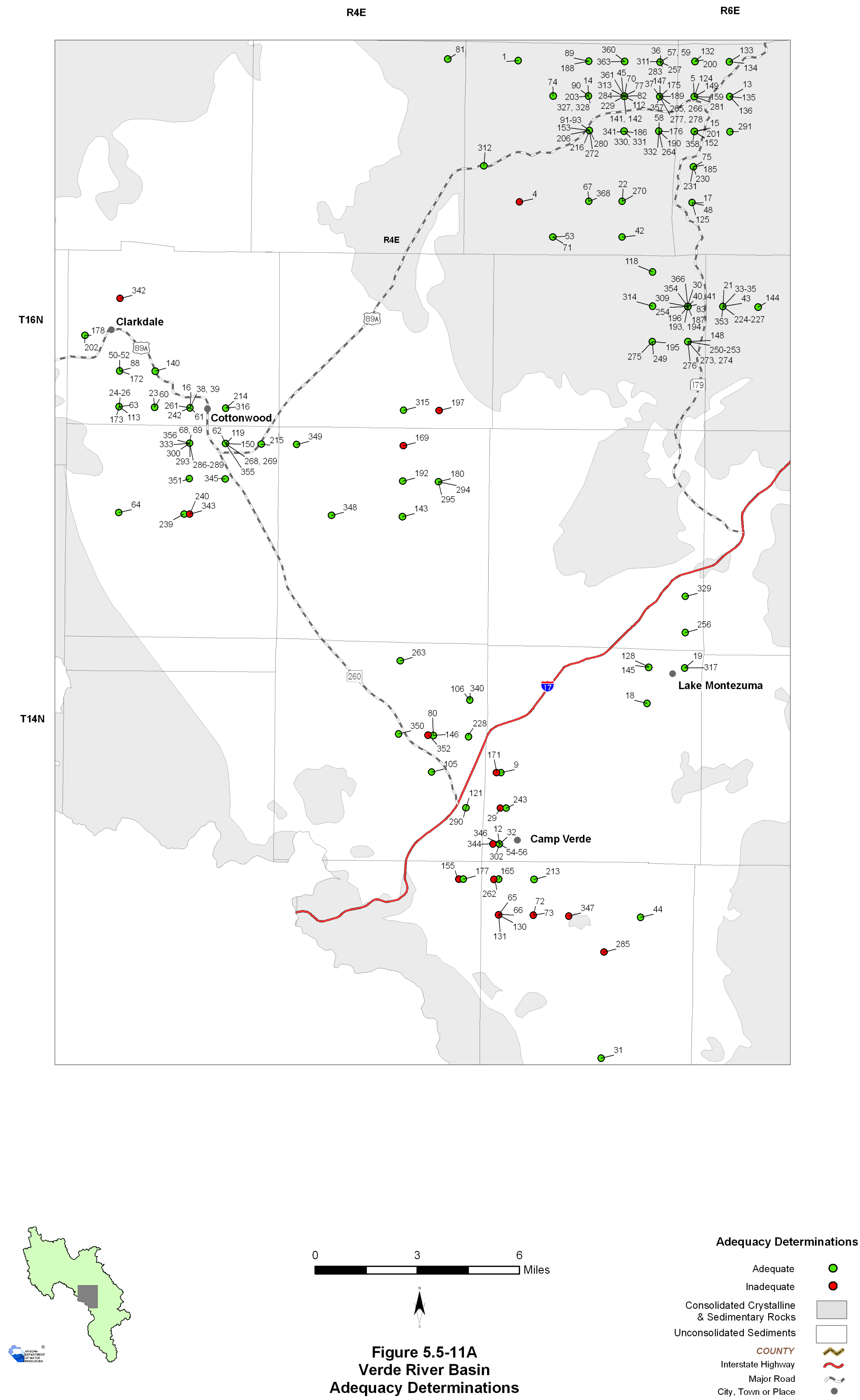


Figure 5.5-11A
Verde River Basin
Adequacy Determinations

Verde River Basin
References and Supplemental Reading

References

A

Anderson, T.W., and Freethey, G.W., 1995, Simulation of groundwater flow in alluvial basins in south central Arizona and parts of adjacent states: USGS Professional Paper 1406-D.*

Arizona Corporation Commission (ACC), 2005, Annual reports, Private Sewer companies, 1990 to 2005: ACC Utilities Division.*

______, 2005, Annual reports, Small water providers, 1990 to 2005: ACC Utilities Division.*

Arizona Crop and Livestock Reporting Service, 1973, 1972 Arizona Agricultural Statistics: Bulletin S-8.

Arizona Department of Economic Security (DES), 2005, Workforce Informer: Data file, accessed August 2005, http://www.workforce.az.gov.*

Arizona Department of Environmental Quality, 2005, Active dairy farms & feedlots: Data file, received October 2005.

______, 2005, ADEQSWI: Data file, received September 2005.*

______, 2005, ADEQWATP: Data file, received May 2005.*

______, 2005, ADEQWWTP: Data file, received August 2005.*

______, 2005, Azurite: Data file, received September 2005.

______, 2005, Effluent dependent waters: GIS cover, received December 2005.*

______, 2005, Impaired lakes and reaches: GIS cover, received January 2006.*

______, 2005, Surface water sources used by water providers: Data file, received June 2005.*

______, 2005, WWTP and permit files: Miscellaneous working files, received July 2005.*

______, 2004, Water providers with arsenic concentrations in wells over 10 ppb: Data file, received August 2004.*

______, 2004, Water quality exceedences by watershed: Data file, received June 2004.*

______, 2004, Water quality exceedences for drinking water providers in Arizona: Data file, received September 2004.

______, 2001, TMDL report: Peck's Lake.

______, 2001, Verde River TMDL for Turbidity.

______, 2002, TMDL report: Stoneman Lake.

______, 1999, TMDL report: Munds Creek - headwaters to Oak Creek.

______, 1987, TMDL report: Oak Creek - headwaters to Verde River.

Arizona Department of Mines and Mineral Resources (ADMMR), 2005, Active mines in Arizona: Database, accessed at http:// www.admmr.state.az.us.*

Arizona Department of Water Resources (ADWR), 2006, Assured and adequate water supply applications: Project files, ADWR Hydrology Division.*

______, 2006, Statement of claimants filed by the Indian tribes or the United States on their behalf in the Gila and Little Colorado River adjudications: Data files, ADWR Office of Planning and Adjudications Support.

______, 2005, Agricultural Surface Water Use Estimates: Unpublished analysis, ADWR Office of Resource Assessment Planning.

______, 2005, Automated recorder sites: Data files, ADWR Basic Data Unit.*
______, 2005, 2004 rural water provider questionnaire: Data files, ADWR Office of Resource Assessment Planning.*
______, 2005, Assured and adequate water supply determinations: Database, ADWR Office of Assured and Adequate Water Supply.*
______, 2005, Flood warning gages: Database, ADWR Office of Water Engineering.*
______, 2005, Inspected dams: Database, ADWR Office of Dam Safety.*
______, 2005, Non-jurisdictional dams: Database, ADWR Office of Dam Safety.
______, 2005, Groundwater Site Inventory (GWSI): Database, ADWR Hydrology Division.*
______, 2005, Registry of surface water rights: ADWR Office of Water Management.
______, 2005, Water Protection Fund: Database, ADWR Office of Drought, Conservation and Riparian Planning.
______, 2005, Water use by golf courses in rural Arizona: Unpublished analysis, ADWR Office of Regional Strategic Planning.*
______, 2005, Wells55: Database.*
______, 2002, Groundwater quality exceedances in rural Arizona from 1975 to 2001: Data file, ADWR Office of Regional Strategic Planning.*
______, 1994, Arizona Water Resources Assessment, Vol. I, Inventory and Analysis.*
______, 1994, Arizona Water Resources Assessment, Vol. II, Hydrologic Summary. *
______, 1990, Draft outline of basin profiles for the state water assessment: ADWR Statewide Planning Division, Memorandum to L. Linser, January, 16, 1990.*
Arizona Game and Fish Department (AGF), 2005, Arizona Waterways: Data file, received April 2005.
______, 1997 & 1993, Statewide riparian inventory and mapping project: GIS cover.*
______, 1982, Arizona Lakes Classification Study.
Arizona Land Resource Information System (ALRIS), 2005, Springs: GIS cover, accessed January 2006 at http://www.land.state.az.us/alris/index.html.*
______, 2005, Streams: GIS cover, accessed 2005 at http://www.land.state.az.us/alris/index.html.*
______, 2005, Water features: GIS cover, accessed July 2005 at http://www.land.state.az.us/alris/index.html.*
______, 2004, Land ownership: GIS cover, accessed in 2004 at http://www.land.state.az.us/alris/index.html.*
Arizona Meteorological Network (AZMET), 2005, Arizona climate stations: Pan evaporation data, accessed December 2005 at http://www.ag.arizona.edu/azmet/locate.html.*
Arizona Water Commission, 1975, Summary, Phase I, Arizona State Water Plan, Inventory of resource and uses.

B

Blasch, K., Hoffman, J., Bryson, J., Flint, A., and Graser, L. 2006, Hydrologic investigations of the upper and middle Verde watersheds: USGS Scientific Investigations Report 2005-5198.*

D

Diroll, M., and Marsh, D., 2006, Status of water quality in Arizona-2004 integrated 305(b) assessment and 303(d) listing report: ADEQ report.*
Diroll, M., and Marsh, D., 2003, Status of Water Quality in Arizona – 2004: ADEQ draft report.*

E

Environmental Protection Agency (EPA), 2005, Surf Your Watershed: Facility reports, accessed April 2005 at http://oaspub.epa.gov/enviro/ef_home2.water.*

______, 2005, 2000 and 1996, Clean Watershed Needs Survey: datasets, accessed March 2005 at http://www.epa.gov/owm/mtb/cwns/index.htm.*

F

Fisk, G.G., Duet, D.W., Evans, C.E., Angernoth, N.K., and Longsworth, S.A., 2004, Water Resources Data, Arizona Water Year 2003: USGS Water-Data Report AZ-03-1.*

Freethey, G.W. and Anderson, T.W. 1986, Predevelopment hydrologic conditions in the alluvial basins of Arizona and adjacent parts of California and New Mexico: USGS Hydrologic Investigations Atlas-HA664.*

K

Konieczki, A.D. and Wilson, R.P., 1992, Annual summary of ground-water conditions in Arizona, spring 1986 to spring 1987: USGS Open File Report 92-54.*

M

McCormack, H.F., Fisk, G.G., Duet, N.R., Evans, D.W., Roberts, W.P., and Castillo, N.K., 2002, Water resources data Arizona, water year 2002: USGS Water Data Report AZ-02-1.*

N

Natural Resources Conservation Service (NRCS), 2005, SNOTEL (Snowpack Telemetry) stations: Data file, accessed December 2005 at http://www3.wcc.nrcs.usda.gov/nwcc/sntlsites.jsp?state=AZ.*

______, 2005, Snow Course stations: Data file, accessed December 2005 at http://www.wcc.nrcs.usda.gov/nwcc/snow-course-sites.jsp?state=AZ*

O

Oregon State University, Spatial Climate Analysis Service (SCAS), 2006, Average annual precipitation in Arizona for 1961-1990: PRISM GIS cover, accessed in 2006 at www.ocs.orst.edu/prism.*

P

Parker, J., Steinkampf, W. and Flynn, M., 2005, Hydrogeology of the Mogollon Highlands, central Arizona: USGS Scientific Investigations Report 2004-5294.*

Pope, G.L., Rigas, P.D., and Smith, C.F., 1998, Statistical summaries of streamflow data and characteristics of drainage basins for selected streamflow-gaging stations in Arizona through water year 1996: USGS Water Resources Investigations Report 98-4225.*

S

Southwest Groundwater Consultants Inc., 2005, Big Chino ranch hydrology study.*

T

Tadayon, S., 2004, Water withdrawals for irrigation, municipal, mining, thermoelectric-power, and drainage uses in Arizona outside of the active management areas, 1991-2000: USGS Scientific Investigations Report 2004-5293, 27 pp.*

U

US Army Corps of Engineers, 2004 and 2005, National Inventory of Dams: Arizona Dataset, accessed November 2004 to April 2005 at http://crunch.tec.army.mil/nid/webpages/nid.cfm*

US Geological Survey (USGS), 2006, Average annual runoff in the United States, 1951-1980: Data file, accessed March 2006 at http://aa179.cr.usgs.gov/metadata/wrdmeta/runoff.htm.*

______, 2006, Springs and spring discharges: Dataset, received November 2004 and January 2006 from USGS office in Tucson, AZ.*

______, 2006, National Hydrography Dataset: Arizona dataset, accessed at http://nhd.usgs.gov/.*

______, 2005, National Water Information System (NWIS): Arizona dataset, accessed December 2005 at http://waterdata.usgs.gov/nwis.*

______, 2004, Southwest Regional Gap analysis study- land cover descriptions: Electronic file, accessed January 2005 at http://earth.gis.usu.edu/swgap.*

______, 1981, Geographic digital data for 1:500,000 scale maps: USGS National Mapping Program Data Users Guide.*

V

Valencia, R.A., Wennerlund, J.A., Winstead, R.A., Woods, S., Riley, L., Swanson, E., and Olson, S., 1993, Arizona riparian inventory and mapping project: Arizona Game and Fish Department.*

W

Wahl, C.R., Boe, S.R., Wennerlund, R.A., Winstead, R.A., Allison, L.J., Kubly, D.M., 1997, Remote sensing mapping of Arizona intermittent stream riparian areas: Arizona Game and Fish Technical Report 112.*

Water Infrastructure Finance Authority of Arizona (WIFA), 2005, Clean Watershed Needs Survey-2004: Unpublished data sheets, received July 2005.*

Western Regional Climate Center (WRCC), 2005, Pan evaporation stations: Data file accessed December 2005 at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~GetCity~USA.*

______, 2005, Precipitation and temperature stations: Data file, accessed December 2005 at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~GetCity~USA.*

Wilson, R.P., 1992, Summary of groundwater conditions in Arizona 1985 to 1986: USGS Water Resources Investigation Report, 90-4179.*

Wirt, L., DeWitt, E., Langenheim, V. eds., 2005, Geologic framework of aquifer units and groundwater flowpaths, Verde River headwaters, north central Arizona: USGS Open –file report 2004-1411.*

*All references marked with an asterisk contain information that was directly used in the basin summaries, tables or maps.

Supplemental Reading

Alam, J., 1997, Irrigation in the Verde Valley: A report on the irrigation diversion improvement project: Verde Natural Resource Conservation District, 96 pp.

Amentt, M.A., 2002, Hydrogeology and evapotranspiration of the herbaceous understory at a high-elevation riparian community, Hart Prairie, Arizona: Northern Arizona University, M.S. thesis, 170 pp.

Amentt, M., Springer, A.E., and DeWald, L., 2000, Restoration of perched aquifer system through manipulation of transpiration at the watershed scale: Geol. Soc. Abstracts with Programs: v. 32, p. A-141.

Andersen, Mark, 2005, Assessment of water availability in the Lower Colorado River basin: in Conservation and Innovation in Water Management: Proceedings of the 18th annual Arizona Hydrological Society Symposium, Flagstaff, Arizona, September, 2005.

Anning, D.W., 2004, Effects of natural and human factors on stream water quality in central Arizona: USGS Water Resource Supplement Jan.-Feb.

Anning, D.W., 2003, Assessment of selected inorganic constituents in streams in the central basins study area, Arizona and northern New Mexico, through 1998: USGS Water Resource Investigations Report 03-4063.

Anning, D.W., 2003, Evaluation of low flow data from three streamflow gaging stations on the Upper Verde River, Arizona: in Sustainability Issues of Arizona's Regional Watersheds: Proceedings from the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona.

Anning, D., 1998, Sources of nitrogen and phosphorus in drainage basins of central Arizona: in Water at the Confluence of Science, Law, and Public Policy: Proceedings from the 11th annual Arizona Hydrological Society Symposium, September 1998, Tucson, Arizona, p. 8.

Arizona Department of Health Services, 1981, Arizona Water Quality Control Council Unique Waters Policy: Arizona Department of Environmental Quality, April 1981.

Arizona Department of Water Resources, 2000, Verde River watershed study, 473 pp.

Arizona Department of Water Resources, 1996, Water supplies in the Payson, Pine Strawberry area: Information packet from ADWR, April 1996, 2 pp.

Arizona Rivers Coalition, 1991, Arizona rivers, life blood of the desert – a citizen's proposal for the protection of rivers in Arizona: March

Arizona State Parks, 1991, Verde River Corridor Project Final Report and Plan of Action.

Arizona Water Company, 2007, System Water Plan: Pinewood Water System, Submitted to the Arizona Department of Water Resources.

Arizona Water Company, 2007, System Water Plan: Sedona Water System and Valley Vista Water System, submitted to the Arizona Department of Water Resources.

Armour, C.L., Duff, D.A., & Elmor, W., 1991, The effects of livestock grazing on riparian and stream ecosystems: Fisheries, vol.16, no. 1.

Averitt, E. M., 1990, Verde River corridor - Clarkdale, an ecological inventory and analysis: Department of Planning, College of Architecture and Environmental Design, Arizona State University, April 1990.

Averitt, E. M., 1991, Verde River corridor environmental planning recommendations: Department of Planning, College of Architecture and Environmental Design, Arizona State University, Spring 1992.

Baker, M.B., 1999, History of watershed research in the central Arizona highlands: USDA Rocky Mountain Research Station, Report GTR-29.

Baldys, S., 1990, Trend analysis of selected water-quality constituents in the Verde River basin, central Arizona: USGS Water-Resources Investigations Report 90-4128.

Baldys, S., and Hjalmarson, H.W. 1994, Effects of controlled burning of chaparral on stream flow and sediment characteristics, east fork Sycamore Creek, central Arizona: USGS Water Investigations Report 93-4102, 33 pp.

Barnett, L.O., and Hawkins, R.H., 2002, Reconnaissance watershed analysis on the upper and middle Verde watershed: School of Renewable Resources, University of Arizona, 116 pp.

Big Park Water Company (Sedona, AZ), 2007, Water Supply Plan: Big Park Water Company and Little Park Water Company, Submitted to the Arizona Department of Water Resources.

Black Canyon City Water Improvement District, 2006, System Water Plan, Submitted to the Arizona Department of Water Resources.

Black and Vetch, 2006, Town of Payson Blue Ridge Reservoir Water Supply Pipeline and Treatment Plant.

Black, C. Ajami, H., Guertin, P., Levick, L and Uhlman, K., 2005, NEMO Watershed Based

Plan: Verde Watershed, available at www.ArizonaNEMO.org

Bouchard and Associates, 1994, Fossil Creek hydrology and travertine geomorphology: Arizona Public Service Report.

Breninger, J.O., 2002, Perceptions of water supply in the Pine Strawberry area: Pine – Strawberry Water Improvement District, August 2002, 10 p.

Brooks, P, 2004, Recent findings on snow/vegetation impacts on runoff: in The Value of Water: Proceedings from the 17th annual Arizona Hydrological Society Symposium, September 2004, Tucson Arizona.

BRW Inc., 1990, Camp Verde land use and transportation study: Final report, March 15.

Bryson, J., 2004, Determination of groundwater flow paths by the use of geochemical Tracers - upper and middle Verde River watersheds, Arizona: in The Value of Water: Proceedings from the 17th annual Arizona Hydrological Society symposium, September 2004, Tucson Arizona.

Byrkit, J. W., 1978, A log of the Verde: The taming of an Arizona river: Journal of Arizona History, vol. 19, no. 1, p. 31-54.

Camp Verde Water System, Inc. 2006, System Water Plan, Submitted to the Arizona Department of Water Resources.

Carpenter, T.L., 2001, The origin of isotopically anomalous waters of the Mogollon Rim region of Arizona: Arizona State University, M.S. thesis, 107 pp.

Clifton, C., 1989, Effects of vegetation and land use on channel morphology: In Practical Approaches to Riparian Resource Management, An Educational Workshop, Bureau of Land Management publication.

City of Cottonwood, 2006, Drought and Water Shortage Preparedness Plan, Chapter 13.16 Cottonwood Municipal Code.

City of Cottonwood, 2003, Cottonwood General Plan: Water Resources Element, Adopted December 16, 2003.

City of Sedona, 2002, Sedona Community Plan: Water Resources Element, Adopted December 10, 2002

Cook, E.A., et al., 1991, Verde River corridor - Environmental planning recommendations: Department of Planning, Arizona State University, Spring, 1991.

Cordy, G.E., Gellenbeck, D.J., Gebler, J.B., Anning, D.W., Coes, A.L., Edmonds, R.J.

Rees, J.A., and Sanger, H.W., 2000, Water quality in the central Arizona basins, Arizona, 1995-1998: USGS Circular 1213.

Corkhill, F., 2000, Report on the drilling of an exploratory borehole near Strawberry, Arizona: ADWR Hydrology section investigation for the Northern Gila County Water Plan Alliance, 33 p. 145.

Darr, M., J., 1989, Hydrogeology of Oak Creek, Verde Valley Arizona: Northern University of Arizona, M. S. thesis.

Dava and Associates, Inc., 2003, Yavapai County General Plan: Water Resources Element.

Dent, C.L., 1999, The effects of ecosystem configuration on nutrient dynamics in a Sonoran Desert stream ecosystem: Arizona State University, Ph. D. dissertation, 267 pp.

Deslauriers, E.C., 1977, Geophysics and hydrology of the lower Verde River valley, Maricopa County, Arizona: Arizona State University, M.S. thesis, 61 p.

Enzel, Y., Ely, L.L., House, P.K., Baker, V.R., and Webb, R.H., 1993, Paleoflood evidence for a natural upper bound to flood magnitudes in the Colorado River Basin: Water Resources Research, vol. 29, no. 7, p. 2287-2297.

Flora, S., and Springer, A., 2003, Variability of discharge for selected springs in the Verde River watershed, central Arizona: Implications for regional hydrogeology: in Sustainability Issues of Arizona's Regional Watersheds: Proceedings from the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona.

Flora, S., and Springer, A., 2003, Summary table of physical parameters of middle Verde watershed springs: Department of Geology, Northern Arizona University, 1 pp.

Flora, S. P., and Springer, A. E., 2003, Implications for regional hydrogeology of an Arizona rural watershed based on spring discharge variability and recharge response: Geological Society of America Abstracts with Programs, v. 35.

Flora, S.P. and Springer A.E. 2002. Hydrogeological characterization of springs in the Verde River watershed, central Arizona: Geological Society of America Abstracts with Programs, v. 34, no. 6, p. 25.

Garrett, L.G., and Petersen, R., 1996, Green Valley Park Groundwater Recharge Project: in Wanted: Water for Rural Arizona: Proceedings from the 9th annual Arizona Hydrologic Society Symposium, September 1996, p.107.

Gavin, A.J., 1998, Hydrogeology and numerical simulation of a spring-dominated high-elevation riparian community, Hart Prairie, Arizona: Northern Arizona University, M.S. thesis, 177 pp.

Gavin, A.J., and Springer, A.E., 1997, Conservation of a rare riparian community through hydrological restoration: Geological Society of America Abstracts with Programs, v. 29, p. 178.

Gavin, A.J., Springer, A.E., DeWald, L., Silbert, S., Smith, E., 1996, Restoration of the volcanic hydrogeology of a critical high-elevation riparian community in Arizona: Geological Society of America, 28th annual meeting. Denver, CO, United States, Oct. 28-31, 1996, Abstracts with Programs - Geological Society of America. 28; 7, p. 347-348.

Gebler, 2000, Organochloride compounds in streambed sediments and in biological tissue from streams and their relation to land use, central Arizona: USGS Water Resource Investigations Report 00-4041, 21 pp.

Gellenbeck, D.J., and Anning, D.W., 2001, Occurrence and distribution of pesticides and volatile organic compounds in groundwater and surface water in central Arizona basins, 1996-1998, and their relation to land use: USGS Water Resources Investigations Report 01-4144, 107 pp.

Geraghty, and Miller Inc, 1992, Water resources plan, town of Camp Verde, phase I- current management, legal framework and short and long term strategies: consultant report for town of Camp Verde, 68 pp .

Goodwin, P.G., Olade, M., and Ruddiman, W., 1996, Characterization and interim remediation of tetrachloroethene plume in the Payson Granite aquifer:in Wanted: Water for Rural Arizona: Proceedings from the 9th annual Arizona Hydrological Society Symposium, September 1996, p.115.

Governor's Riparian Habitat Task Force, 1990, Streams and riparian resources: Final report and recommendations.

Graybill, D.A., 1989, The reconstruction of prehistoric Salt River stream flow: in The 1982-1984 Excavations at Las Colinas: Environment and Subsistence: Arizona State Museum Archaeological Series No.162.

Hanrahan, C., 1997, Modeling the Beaver Creek research watershed, Apache-Sitgreaves National Forests: University of Arizona, M.S. thesis.

Hart, R.J., Ward, J.J., Bills, D.J., and Flynn M.E., 2002, Generalized hydrology and groundwater budget for the C aquifer, Little Colorado River basin, and parts of Verde and Salt River basin, Arizona and New Mexico: USGS Water Resources Investigations Report 02-4026, 47 pp.

Hirschboeck, K.K., 2004, Using tree rings to determine the long-term record of synchronous extreme stream flow episodes in the Salt-Verde and upper Colorado River basins: in The

Value of Water: Proceedings from the 17th annual Arizona Hydrological Society symposium, September 2004, Tucson Arizona.

Jones, C., 2003, Public policy, cows, riparian areas, drought, sustainability and the Tonto National Forest: in Sustainability Issues and Arizona's Regional Watersheds: Proceedings from the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona .

Kaczmarek, M., 2003, Investigation of groundwater availability for the Pine-Strawberry Water Improvement District: Morrison Maierle Inc.

Keadle, D.A., Brown, C.A., Eichberg, S., Musielak, W.D., Whitmer, T., Rall, K.L., 1999, Verde River watershed study: in Water Issues and Partnerships for Rural Arizona: Proceedings from the 12th annual Arizona Hydrological Society Symposium, September 1999, Pinetop, Arizona.

Kelly, S., Springer, A., and Vanderbilt, M., 1999, Recharge mechanisms for the Coconino-Schnebly Hill aquifer in the Lake Mary area, Coconino County, Northern Arizona: 12th Annual Symposium of the Arizona Hydrological Society, September 9-10, 1999, Pinetop, Arizona.

Knauth, P., and Greebie, M., 1997, Stable isotope investigation of groundwater-surface water interactions in the Verde River headwaters area: Arizona Department of Water Resources Report

Konieczki, A.D., and Leake, S.A., 1997, Hydrogeology and water chemistry of Montezuma well in Montezuma Castle National Monument and surrounding area, Arizona: USGS Water Resources Investigations Report 97-4156.

Langenheim, V.E., DeWitt, E., and Wirt, L., 2006, Geophysical framework based on analysis of aeromagnetic and gravity data, Upper and Middle Verde River watershed, Yavapai County, Arizona: USGS Scientific Investigations Report 2005-5278, 25 p.

Leon, E., 2004, Numerical groundwater flow model of the Verde River headquarters area, Arizona: in The Value of Water: Proceedings from the 17th annual Arizona Hydrological Society symposium, September 2004, Tucson, Arizona.

Lopez, S.M., and Springer, A.E., 2001, Upper Verde Valley riparian area historical analysis: Department of Geology, Northern Arizona University, 18 pp.

Lopez, S.M., and Springer, A.E., 2001, Assessment of human influence on riparian change in the Verde Valley, Arizona: Department of Geology, Northern Arizona University, 43 pp.

Maguire, Rita, 2005, An Analysis of the Water Budgets of Buckeye, Payson and Prescott Valley, Think AZ.

Mclaughlin, C., 2003, Evaporation as a nutrient retention mechanism in Sycamore Creek: Arizona: Arizona State University, M.S. thesis, 56 pp.

McGavock, E., 2003 Big Chino Aquifer: Knowns, unknowns and conflicting interpretations: Errol L Montgomery & Assoc., Tri-City Water Forum, 2003, 4 pp.

McGavock, E., 2002, Water in the Verde River watershed: in Water Transfers, Past, Present and Future: Proceedings from the 15th annual Arizona Hydrological Society Symposium, September 2002, Flagstaff, Arizona.

McGavock, E., 1996, Overview of groundwater conditions in the Verde Valley, Arizona: in Wanted: Water for Rural Arizona: Proceedings from the 9th annual Arizona Hydrological Society Symposium, September 1996, Prescott, Arizona, p. 65.

Manera, P.A., 1994, Geohydrologic evaluation of the Portal IV subdivision, Pine, Gila County, Arizona: Austin Myers Development Co., March 1994, 22 pp.

Melis, T.S., 1990, Evaluation of Flood Hydrology on Twelve Drainage Basins in the Central Highlands Region of Arizona: An Integrated Approach: Northern Arizona University, M.S. thesis, 135 pp.

Mondry, Z., 2002, Drought, storms, and stream flow and temperature observations from the Coconino and Prescott National Forests: in Sustainability Issues of Arizona's Regional Watersheds: Proceedings from the 15th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona.

Moore, D., 1989, Opportunities for riparian ecosystem preservation in the Verde River Basin, Arizona: in Headwaters' Hydrology: American Water Resources Association's Symposium, June 1989, Missoula, MT.

Navarro, L.F., Springer, A.E., Maslansky, S.P., 2000, Modeling sustainable yield in a semi-arid, shallow groundwater basin supporting riparian vegetation and perennial springs: Geological Society of America, Abstracts with Programs, 32 p. 141.

Navarro, L.F., 2002, Characterization and ground-water flow modeling of the Mint Wash/ Williamson Valley area, Yavapai County: Northern Arizona University, M.S. thesis, 158 pp.

Navarro, L.F., Springer, A.E., and Maslansky, S.P., 1999, Characterizing the impacts of the conversion of a semi-arid ground water basin from rural to suburban development: Geological Society of America, Abstracts with Programs, vol. 31, p. 351.

Nemecek, E.A., 2003, Sustainability of Arizona's few remaining perennial streams:

in Sustainability Issues of Arizona's Regional Watersheds: Proceedings from the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona.

Northern Arizona University, 2001, Proceedings, Verde watershed symposium-state of the watershed in 2001:Verde Watershed Research and Education Program, Center for Sustainable Environments.

Ostenaa, D.A., Schimschal, U.S., King, C.E., Wright, J.W., Furgerson, R.B., Harrel, H.C., and Throner, R.H., 1993, Big Chino Valley Groundwater Study: Bureau of Reclamation, Denver office, Geologic Framework Investigations, 31 pp.

Qureshi, T. and Baker, L.A., 1994, Sources and implications of arsenic in the Salt and Verde river watersheds: in Approaching the Millennium- Evolving Perspectives in Water Resources: Proceedings from the 7th annual Arizona Hydrological Society Symposium, September 1994, Scottsdale, Arizona, p. 67.

Oureshi, M.T.A., 1995, Sources of arsenic in the Verde River and the Salt River watersheds, Arizona: Arizona State University, M.S. thesis, 116 pp.

Pearthree, P.A. 1996, Historical geomorphology of the Verde River: AZGS Open-File Report 96-13, 26 pp.

Pearthree, P.A., 1993, Geologic and geomorphic setting of the Verde River from Sullivan Lake to Horseshoe Reservoir: AZGS Open – File Report 93-4, 25 pp.

Pedler, W. H., and Kennard, M. 1992, Hydro-physical logging: an advance wellbore technology for hydrologic and containment characterization of aquifers: in Arizona Water 2000: Proceedings from the 5th annual Commission on the Arizona Environment and Arizona Hydrological Society Symposium, September 1992, , p. 259-265. *Discusses Payson*

Pierce, H.A., 2001, Structural controls on groundwater conditions and estimated aquifer properties near Bill Williams Mountain, Williams Arizona: USGS Water Resources Investigation Report 01- 4058.

Pierce, H.A., 1996, Groundwater availability in the vicinity of Payson, Arizona-transition zone between the Colorado Plateau and Basin and Range: in Wanted: Water for Rural Arizona: Proceedings from the 9th annual Arizona Hydrological Society Symposium, September 1996, p.103.

Pine Water Company, Inc., 2006, System Water Plan, Submitted to the Arizona Department of Water Resources.

Ploughe, M., and Conway, C.M., 2002, Finding water in the cracks, Payson, Arizona: in Water Transfers: Past, Present and Future: Proceedings from the 15th annual Arizona Hydrological Society Symposium, September 2002, Flagstaff, Arizona.

Raney, W., 1989, Verde Valley, a geological history: Plateau Vol. 60, No. 3.

Reiboldt, A., Schlinger, C., and Springer, A., 2002, Wastewater treatment plant effluent discharges in northern Arizona: Perennial flow as a successor to ephemeral flow in a fractured and faulted setting: in Water Transfers: Past, Present and Future: Proceedings from the 15th annual Arizona Hydrological Society Symposium, September 2002, Flagstaff, Arizona.

Robertson, F.N., 1991, Geochemistry of groundwater in alluvial basins of Arizona and adjacent parts of Nevada, New Mexico and California: USGS Professional Paper 1406-C, 87 pp.

Rogers, S.B., 1999, Geochemistry and Natural Attenuation of Acid Mine Drainage at the Iron King Mine, Cottonwood, Arizona: Northern Arizona University, M.S. thesis, 121 p.

Rusinek, W., 1986, Battle for the Verde River: Water, power and politics in Arizona, 1890-1934: Arizona Historical Society Symposium, May 1987, Douglas, Arizona.

Sayers, R.C., 1994, Potential impact of stream flow diversion on riparian vegetation: Fossil Creek, Arizona: Northern Arizona University, M. .S. thesis.

Schlinger, C., 2003, Sediment transport evaluation for dam removal scenarios, Fossil Springs Diversion Dam, Arizona: in Sustainability Issues of Arizona's Regional Watersheds: Proceedings from the 16th annual Arizona Hydrological Society Symposium, September 2003, Mesa, Arizona.

Schwab, K.J., 1995, Maps showing groundwater conditions in the Big Chino sub-basin of the Verde River Basin, Coconino and Yavapai Counties, Arizona, Arizona Department of Water Resources HMS No. 28 - 000243

Sommerfield, M.R., Athey, P.V., and Mueller, B.C., 1980, Impact of recreation on the water quality of the East Verde River: in Water Quality Monitoring and Management: Proceedings from the Arizona Water Resources Association Symposium, October 1980, Tucson, Arizona, p. 51-69.

Springer, A.E., Bills, D., 1998, Exploration for and ecological importance of shallow and deep ground-water around San Francisco Mountain: in Duebendorfer, E.M., ed., Geologic excursions in northern and central Arizona, p. 27-33.

Steiner, F., et al, 1990, Verde River Corridor-Clarkdale: Arizona State University, Department of Planning, December 1990.

Steiner, F., et.al, 1991, Draft environmental impact statement, Central Arizona Project, Verde River water transfers, Yavapai County, Arizona: Arizona State University, Department of Planning.

Sullivan, M.E., 1993, Functions and values of the Verde River riparian ecosystem and an assessment of adverse impacts to these resources: Supporting document for the initiation of the Verde River advance identification: USEPA, Region 9, March, 364 pp.

Thornburg, T. and Tabor, P., 1991, Verde River corridor project, final report and plan of action: Arizona State Parks, June 1991.

Town of Camp Verde, 2005, General Plan: Water Resources Element, Ratified by Voters March 8, 2005.

Town of Payson Water Department, 2006, System Water Plan, Submitted to the Arizona Department of Water Resources.

Town of Payson Water Department, 2006, Town of Payson Water Resources Management 2005 Status Report.

Town of Payson Water Department, 2005, Town of Payson Water Resources Management 2005 Status Report.

U.S. Bureau of Reclamation, 2003, Water Use Projections Verde Valley Arizona.

U.S. Bureau of Reclamation, 2000, Appraisal level study of Water Delivery System Analyses: North Central Arizona Regional Water Supply Project.

United States Congress, 1990, The Fort McDowell Indian Community Water Rights Settlement Act of1990: 161st Congress, 2nd session, Senate committee on Indian Affairs, Report no. 101-479.

U.S. Department of Agriculture, 1982, Verde River: Wild and Scenic River Study Report and Environmental Impact Statement: USFS, Southwestern Region, September 1982.

U.S. Geological Survey, 2004, Aquifer framework and groundwater flow paths in the Big and Little Chino basin: Arizona Water Protection Fund Project 99-078.

U.S. Geological Survey, 1991, Basin characteristics and stream flow statistics in Arizona as of 1989: USGS Water Resources Investigations Report 91-4041.

U.S. Fish and Wildlife Service, 1991, Advance identification of functions and values of the Verde River, Arizona: Final Study Plan

Verde Watershed Association and the USDA, 1996, Summary report, Verde Cooperative River Basin Study, Coconino, Gila, Maricopa, and Yavapai counties, Arizona, 34 pp.

Verde Watershed Symposium, 2001, State of the Watershed in 2001: Proceedings, Cliff Castle Lodge and Conference Center, Camp Verde, Arizona.

Whitmore, W., Cook, E. A., and Steiner, F., 1991, Verde River visual assessment: Verde River Corridor Study, Tapico to Beasley Flat: Arizona State University, Department of Planning, draft report, May 1991.

Weiztman, M., 2002, Geology and hydrology of the Payson, Strawberry, Diamond Ridge areas, Gila and Coconino counties, central Arizona: AZGS Bulletin CR-02-B, 17 pp.

Wilkinson, R.W., 2000, Water resources of Bellemont Park, Coconino County, Arizona: Northern Arizona University, M.S. thesis, 263 pp.

Wirt, L., 2004, Hydrogeologic Review of the Drake Cement Project, Yavapai County Arizona: USGS Open File Report 2004-1439.

Wirt, L., and Hjalmarson, H.W., 2000, Sources of springs supplying base flow to the Verde River headwaters, Yavapai County, Arizona: USGS Open File Report 99-0378, 47 pp.

Wirt, L., and Hjalmarson, H.W., 1999, Geologic controls on groundwater movement, upper Verde River headwaters, Yavapai County, Arizona: in Water Issues and Partnerships for Rural Arizona: Proceedings from the 12th annual Arizona Hydrological Society Symposium, September 1999, Pinetop, Arizona.

Wirt, L., 1992, The use of stable isotopes and water chemistry to determine movement of water in the upper Verde River basin, Yavapai County, Arizona: in Protecting Riparian Systems-Meeting the Challenges of Urban Needs: Abstracts from the 6th annual meeting of the Arizona Riparian Council, April 1992, Cottonwood Arizona, p. 16-17.

Woodhouse, B.G, and Flynn, M.E., 2002, Investigation of the geology and hydrology of the upper and middle Verde River watershed of central Arizona: A project of the Rural Arizona Initiative, USGS Fact Sheet 059-02.

Woodhouse, B.G., Parker, J.T.C., Bills, D.J., and Flynn, M.E., 2000, USGS investigation of rural Arizona watersheds: Coconino Plateau, upper and middle Verde River, and Fossil Creek- East Verde River -Tonto Creek: in Environmental Technologies for the 21st Century: Proceedings from the 13th annual Arizona Hydrological Society Symposium, September 2000, Phoenix, Arizona, p. 97.

Yavapai County Water Advisory Committee, 2004, Big Chino sub-basin historical and current water uses and water use projections: Draft, Feb.2004, 38 pp.

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ACRONYMS AND ABBREVIATIONS

AAWS	Analysis of Adequate Water Supply
ACC	Arizona Corporation Commission
ADMMR	Arizona Department of Mines and Mineral Resources
ADWR	Arizona Department of Water Resources
ADEQ	Arizona Department of Environmental Quality
AGFD	Arizona Game and Fish Department
ALERT	Automated Local Evaluation in Real Time
ALRIS	Arizona Land Resource Information System
AMA	Active Management Area
AWPF	Arizona Water Protection Fund
AZMET	Arizona Meteorological Network
BIA	United States Bureau of Indian Affairs
BLM	United States Bureau of Land Management
CAP	Central Arizona Project
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CLIMAS	Climate Assessment for the Southwest
CPC	Center for Plant Conservation
DES	Arizona Department of Economic Security
DOD	United States Department of Defense
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCD	Flood Control District
GIS	Geographic Information System
gpcd	Gallons per capita per day
gpm	Gallons per minute
GWSI	Groundwater Site Inventory System
HIA	Historically Irrigated Acres
HSR	Hydrographic Survey Report
HUC	Hydrologic Unit Code
ITCA	Intertribal Council of Arizona
LUST	Leaking Underground Storage Tank
maf	Million acre-feet
M&I	Municipal and Industrial
NEMO	Non-point Education for Municipal Officials
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NPS	United States National Park Service
NRCD	Natural Resources Conservation District
NRCS	Natural Resources Conservation Service
NWIS	National Water Information System
NWS	National Weather Service
Pan ET	Pan Evaportranspiration
PCE	tetrachloroethene

PDO	Pacific Decadal Oscillation
SNOTEL	SNOpack TELemetry
SRP	Salt River Project
TDS	Total Dissolved Solids
USBOR	United States Bureau of Reclamation
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	Unites States Fish and Wildlife Service
USGS	United States Geological Survey
VRP	Voluntary Remediation Program
WAC	Yavapai County Water Advisory Committee
WIFA	Water Infrastructure Finance Authority
WQARF	Water Quality Assurance Revolving Fund
WRCC	Western Regional Climate Center
WWTF	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

Appendix A

Appendix A
Arizona Water Protection Fund Projects in the Central Highlands Planning Area through 2005[1]

CENTRAL HIGHLANDS PLANNING AREA			
Groundwater Basin	**AWPF Grant #**	**Project Title**	**Project Category**
Agua Fria	96-0007	Ash Creek Riparian Protection Project	Stream Restoration
Agua Fria	03-117	Lynx Creek Restoration at Sediment Trap #2	Stream Restoration
Salt River	95-021	Lofer Cienega Restoration Project	Fencing & Habitat Protection
Salt River	95-022	Gooseberry Watershed Restoration Project	Stream Restoration
Salt River	99-083	Cherry Creek Enhancement Demonstration Project	Stream Restoration
Salt River	05-128	Canyon Creek Riparian Restoration Project, Reach 4-5	Fencing & Habitat Protection
Tonto Creek	95-019	Quantifying Anti-Erosion Traits of Streambank Graminoids	Research
Tonto Creek	99-097	Dakini Valley Riparian Project	Fencing & Revegetation
Upper Hassayampa	99-088	Wickenburg High School Stream Habitat Creation	Constructed Wetland Restoration
Verde River	95-001	Stable Isotope Assessment of Groundwater and Surface Water Interaction – Application to the Verde River Headwaters	Research
Verde River	95-003	Sycamore Creek Riparian Management Area	Fencing
Verde River	95-004	Road Reclamation to Improve Riparian Habitat Along the Hassayampa and Verde Rivers	Revegetation
Verde River	95-006	Critical Riparian Habitat Restoration Along a Perennial Reach of a Verde River Tributary	Stream Restoration
Verde River	95-017	Restoration of Fossil Creek Riparian Ecosystem	Research
Verde River	97-030	Walnut Creek Center for Education and Research – Biological Inventory	Research

[1] A map with all Arizona Water Protection Fund grant locations can be found in Volume 1, Appendix C

CENTRAL HIGHLANDS PLANNING AREA (con't.)			
Groundwater Basin	**AWPF Grant #**	**Project Title**	**Project Category**
Verde River	98-047	Upper Verde Adaptive Management Unit	Fencing
Verde River	98-050	Watershed Restoration of a High Elevation Riparian Community	Watershed & Stream Restoration
Verde River	98-055	Horseshoe Allotment: Verde Riparian Project II	Fencing & Upland Water Developments
Verde River	98-057	Upper Verde Valley Riparian Area Historical Analysis	Research
Verde River	98-058	Effects of Removal of Livestock Grazing on Riparian Vegetation and Channel Conditions of Selected Reaches of the Upper Verde River	Research
Verde River	98-059	Verde River Headwaters Riparian Restoration Demonstration Project	Channel Restoration
Verde River	99-078	Aquifer Framework and Ground-Water Flow Paths in Big and Little Chino Basins	Research
Verde River	99-091	Effects of Livestock Use Levels on Riparian Trees on the Verde River	Research
Verde River	03-118	Verde River Riparian Area Partnership Project	Exotic Species Control
Verde River	04-120	Verde River Headwaters 3-D Hydrogological Model Framework and Visualization	Research
Verde River	05-133	Verde Wild and Scenic River Fence Exclosure	Fencing

Appendix B

APPENDIX B
Rural Watershed Partnerships in the Central Highlands Planning Area (2005)

MULTI-PLANNING AREA - Eastern Plateau, Western Plateau and Central Highlands

Watershed Partnership	Primary Participants	Projects & Accomplishments	Issues
Coconino Plateau Water Advisory Council	Flagstaff, Coconino County Williams, Sedona Page, Tusayan TNC, Grand Canyon Trust Doney Park Water Co. Navajo Nation, Hopi Tribe Havasupai Tribe, Hualapai Tribe ADWR, ADEQ State Land, NRCD NAU USBoR, USGS USFS, BLM Grand Canyon National Park Glen Canyon NRA NRCS	• 4 categories of potential water augmentation projects have been identified along with their associated costs. • Groundwater study and conceptual model completed • Phase I Water Demand Study for Coconino Plateau • Growth Impacts Study • Western Navajo Pipeline Study • Development of study for importing C aquifer groundwater east of Flagstaff has been completed. • Flagstaff, Hopi and Navajo are exploring cooperative opportunities for developing C aquifer groundwater. • Flagstaff purchased Red Gap Ranch for possible future development of groundwater. • Hopi HSR initiated. • Conducting Water Appraisal Study to identify current & future demands and alternatives for meeting projected demands. • Developing numeric model	• Excessive growth throughout entire plateau region from Williams to Winslow and from Munds Park to Page • Limited and deep groundwater supplies. • Drought sensitive surface water supplies of Williams, Flagstaff and others • Unsafe dam issues in Williams • Groundwater salinity issues in northeastern part of plateau • Numerous water haulers with few hauling stations that are sometimes cutoff during drought • Unable to get adequate water supply designation under current definition • Growth in Page with no means of additional supply • ESA issues with groundwater usage and impacts on perennial streams • Potential limitation of groundwater usage resulting from reserved groundwater rights of Indians • Uncertainty of Indian water right settlements (LCR & Colorado River) • Proposed San Juan Paiute reservation west of Flagstaff • Potential impacts on springs in Grand Canyon and also on supplies to Havasupai and Hualapai reservations • Access to water development on public lands • Limited groundwater data for entire region • Minor Arsenic issues in Woody Mtn. Well field (9-14 ppb) • Unregulated lot splits • Limited funding resources for planning, projects, infrastructure and studies • Extremely high cost of water augmentation projects

MULTI-PLANNING AREA - Eastern Plateau, Western Plateau and Central Highlands (continued)

Watershed Partnership	Primary Participants	Projects & Accomplishments	Issues
Northern Arizona Municipal Water Users Association (NAMWUA)	Prescott Flagstaff Cottonwood Sedona Chino Valley Prescott Valley Williams Clarkdale Payson	• Projected water demands through 2040 have been identified • A request for 70,000 acre-feet of CAP reallocation water has been submitted to ADWR for consideration.	• Limited supplies to meet projected demands • ESA issues impacting potential ground and surface water supplies • Limited funding resources for planning, projects, infrastructure and studies • Competition from Phoenix/Tucson for CAP reallocation water • Funding for Colorado River infrastructure • Water quality issues in Verde Valley and Flagstaff • Upper Basin/Lower Basin issues with Colorado River affect potential for use

CENTRAL HIGHLANDS PLANNING AREA

Watershed Partnership	Primary Participants	Projects & Accomplishments	Issues
Northern Gila County Partnership- (Mogollon Highlands)	Payson Pine Strawberry Gila County Brooks Utilities Rim Trails WID Pine Strawberry WID Local citizens and special interests Tonto Apache Nation ADWR SRP USFS USBoR USGS	• Comprehensive groundwater study and conceptual model completed. • Conducting Water Resources Management Appraisal Study to identify current & future demands and alternatives for meeting projected demands. • Strategic Plan completed • Feasibility study and cost estimates for Blue Ridge Reservoir pipeline • Obtained approximately 3,500 ac-ft of surface water from Blue Ridge Reservoir. • Development of a numeric groundwater model initiated.	• Limited water resources to meet current demands. • Environmental, supply, treatment, transportation and financing costs associated with augmentation from Blue Ridge reservoir • Numerous private water companies, Arizona Corporation Commission and Domestic Water Improvement District conflicts • Interbasin transfer conflicts resulting from Payson's ability to pump from two different basins • Seasonal demand issues; peaking problems • County encouragement of growth in Pine and Strawberry • Unresolved Indian water rights settlements • Environmental issues pertaining to Fossil Creek • Limited groundwater data for entire region • Costs associated with hauling water • Access to water development on public lands • Infrastructure needs for private water companies • Limited funding resources for planning, projects, infrastructure and studies
Upper Agua Fria Watershed Partnership	Mayer Black Canyon City Cordes Lakes Yavapai County Spring Valley Local Citizens ADWR ADEQ Cooperative Extension State Lands BLM/Agua Fria Nat. Monument USFS	• Watershed Reconnaissance studies • Active recharge site identification study.	• Proposed growth in the Mayer, Bensch Ranch and Spring Valley areas • Limited groundwater supplies • Little or no groundwater data • Groundwater and surface water supplies are very drought sensitive • Potential water quality attributed to local septic systems and discharges from Prescott Valley • Poorly constructed and maintained infrastructure in some areas • Limited funding resources for planning, projects, infrastructure and studies

CENTRAL HIGHLANDS PLANNING AREA (continued)

Watershed Partnership	Primary Participants	Projects & Accomplishments	Issues
Upper and Middle Verde Watershed Groups (Yavapai County Water Advisory Council) (Verde Watershed Authority)	Prescott Prescott Valley Chino Valley Paulden Yavapai County Sedona Camp Verde Clarkdale Cottonwood Jerome 24 local special interest groups TNC Yavapai Apache Yavapai Prescott ADWR ADEQ SRP NRCD Cooperative Extension NAU USFS USGS USBoR USF&W	• Comprehensive groundwater study and conceptual model • Study of geologic framework of aquifer units and groundwater flow paths of Verde River headwaters using aeromagnetic and gravity data. • Verde River Watershed Study. • Water educational forum conducted for WAC and public with ultimate goal of developing water management plan for Verde watershed area. • Big Chino Subbasin Historical and Current Water Uses and Water Use Projections study. • Riparian demand study of Middle Verde • Numeric groundwater model project initiated. • Prescott AMA groundwater model. • Study of groundwater flow paths for upper and middle Verde using stable isotopes. • Prescott purchased JWK Ranch in Big Chino to import 8,717 ac-ft annually to Prescott and Prescott Valley • Groundwater monitoring program in Big Chino initiated.	• Potential impacts resulting from the transfer of 8,717 ac-ft from Big Chino to Prescott and Prescott Valley • 25,000 to 30,000 approved lots still outstanding in Prescott AMA • Multiple developments currently under construction in the tri-city region of the AMA • ESA issues associated with the Verde • Proposed critical habitat area in Verde Valley for Willow Fly Catcher • New Arsenic standards • Pending Subflow decision • Political and philosophical differences between AMA and Verde Valley • Countywide growth and unregulated lot splits • Indian water rights • Yavapai Ranch Land exchange and Title II implementation (Verde Basin Partnership) • Thousands of private domestic wells already permitted and more being requested daily • Potential water quality impacts on groundwater system from the thousands of septic systems • Potential development rumors of the CVCF Ranch in the Big Chino • Limited funding resources for planning, projects, infrastructure and studies