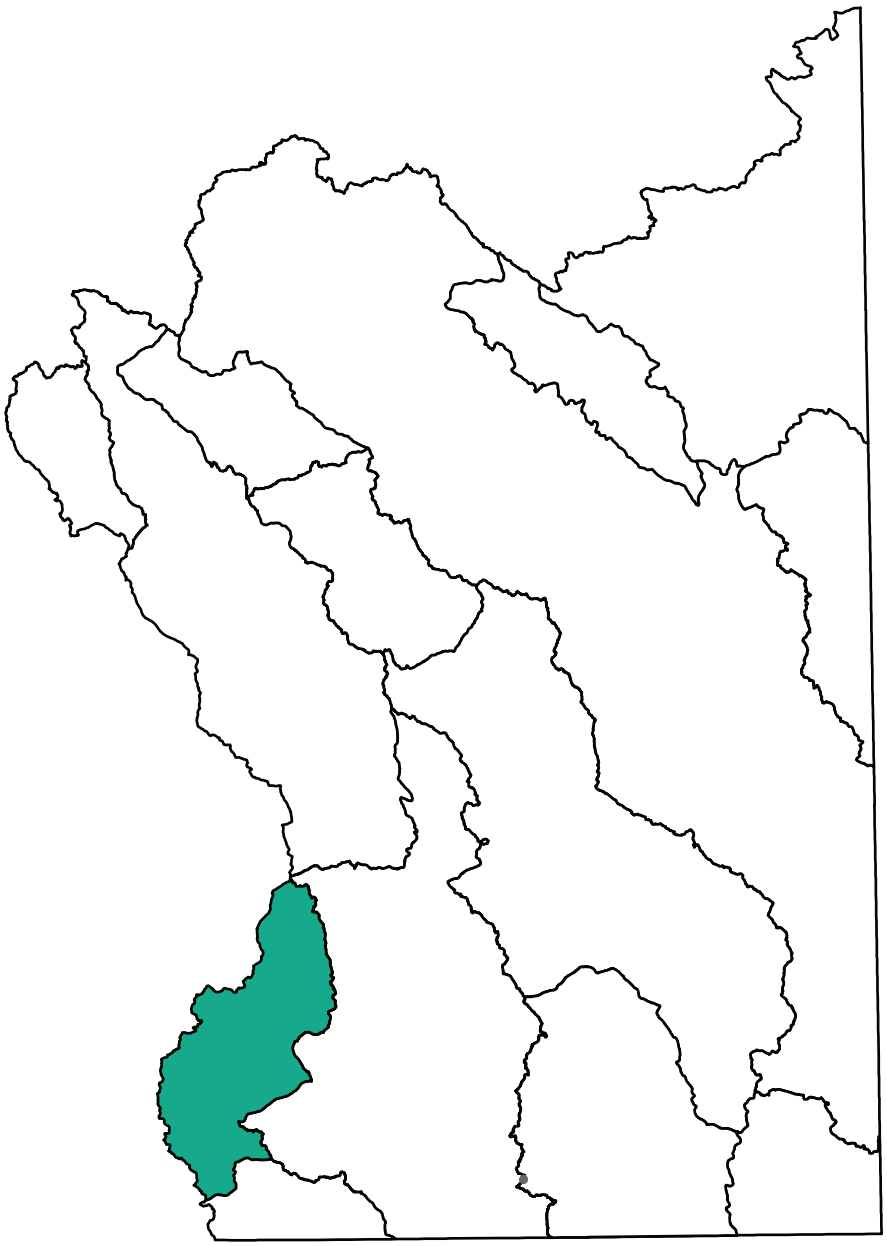
Section 3.3
Cienega Creek Basin



3.3.1 Geography of the Cienega Creek Basin

Cienega Creek is a small, 606 square mile basin in the southwest portion of the planning area. Geographic features and principal communities are shown on Figure 3.3-1. The basin is characterized by a series of mid- to high-elevation mountain ranges, grasslands and woodlands. Vegetation includes plains and great basin and semi-desert grasslands, Chiuahuan desertscrub, madrean evergreen woodland and a small portion of Rocky Mountain and montane madrean conifer forest. (see Figure 3.0-10) Riparian vegetation includes mixed broadleaf and strand on Red Rock Canyon and mixed broadleaf, mesquite and strand on Sonoita and Cienega Creeks.

- Principal geographic features shown on Figure 3.3-1 are:
  - Cienega Creek, beginning in T21S, R17E and flowing north toward Interstate 10
  - Sonoita Creek flowing along Highway 82 in the southern portion of the basin
  - Redrock Canyon north of Patagonia
  - Gardner Canyon north of Sonoita
  - Empire Mountains in the northwest
  - Whetstone Mountains in the northeast
  - Patagonia Mountains on the southwestern boundary
  - Santa Rita Mountain range along the southwestern boundary, which include Mt. Wrightson, the highest point in the basin at 9,453 feet
  - The lowest point at 3,200 feet where Cienega Creek exits the basin.

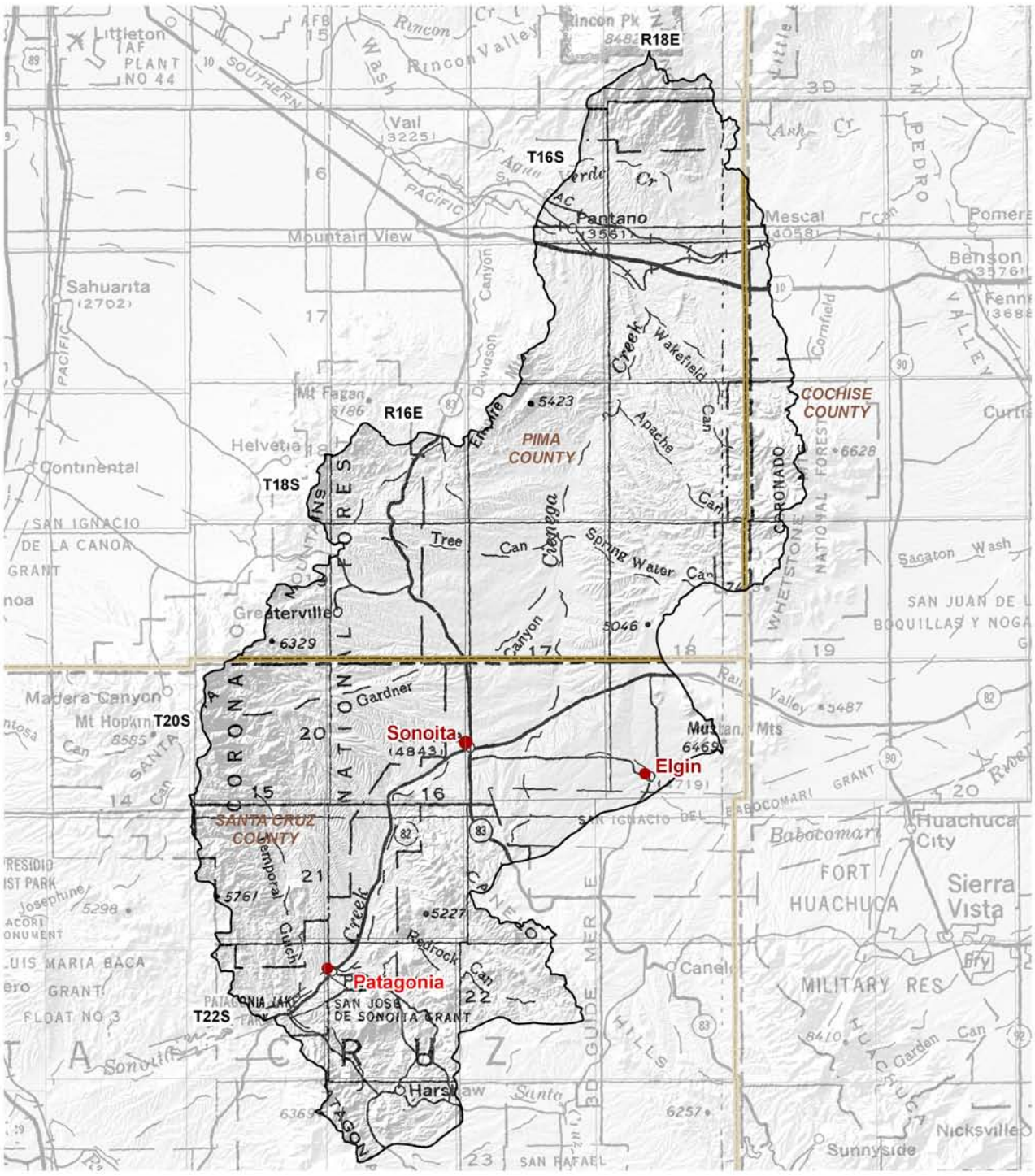


Figure 3.3-1
Cienega Creek Basin
Geographic Features

3.3.2 Land Ownership in the Cienega Creek Basin

Land ownership, including the percentage of ownership in each category, is shown for the Cienega Creek Basin in Figure 3.3-2. Principal features of land ownership are the national forest lands along the boundaries of the basin and relatively large portions of contiguous private and state trust lands. A description of land ownership data sources and methods is found in Volume 1, Appendix A. More detailed information on National Parks, Monuments, Riparian, Conservation, Wildlife and Wilderness Areas is found in Section 3.0.3. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

National Forest

- 41.4% of land is federally owned and managed by the United States Forest Service (USFS).
- All forest lands in the basin, although they are not contiguous, are in the Coronado National Forest. There are two ranger districts in the basin, Nogales Ranger District west of Patagonia and Sierra Vista Ranger District east of Patagonia and northeast of Sonoita.
- A portion of the Mt. Wrightson Wilderness area is located in T19S and T20S, R15E. (see Figure 3.0-13)
- Primary land uses are grazing, recreation and timber production.

State Trust

- 23.5% of land in this basin is held in trust for public schools, penitentiaries and state charitable penal reform.
- The majority of the state land ownership is contiguous, but there are a number of small isolated parcels in the southern portion of the basin.
- Primary land use is grazing.

Private

- 23.2% of land is private.
- Most private land in the basin is contiguous and located in the vicinity of the three principal basin communities of Sonoita, Patagonia and Elgin.
- A number of private land in-holdings exist in national forest land in the Nogales Ranger District west of Patagonia and in the southern portion of the Sierra Vista Ranger District east of Patagonia.
- Primary land uses are domestic, ranching and farming.

U.S. Bureau of Land Management (BLM)

- 11.8% of land is federally owned and managed by the Safford Field Office of the Bureau of Land Management.
- The majority of the BLM land in this basin is the Las Cienegas National Conservation Area, a 42,000 acre area north of Sonoita along Cienega Creek. (see Figure 3.0-13)
- Primary land uses are recreation and grazing.

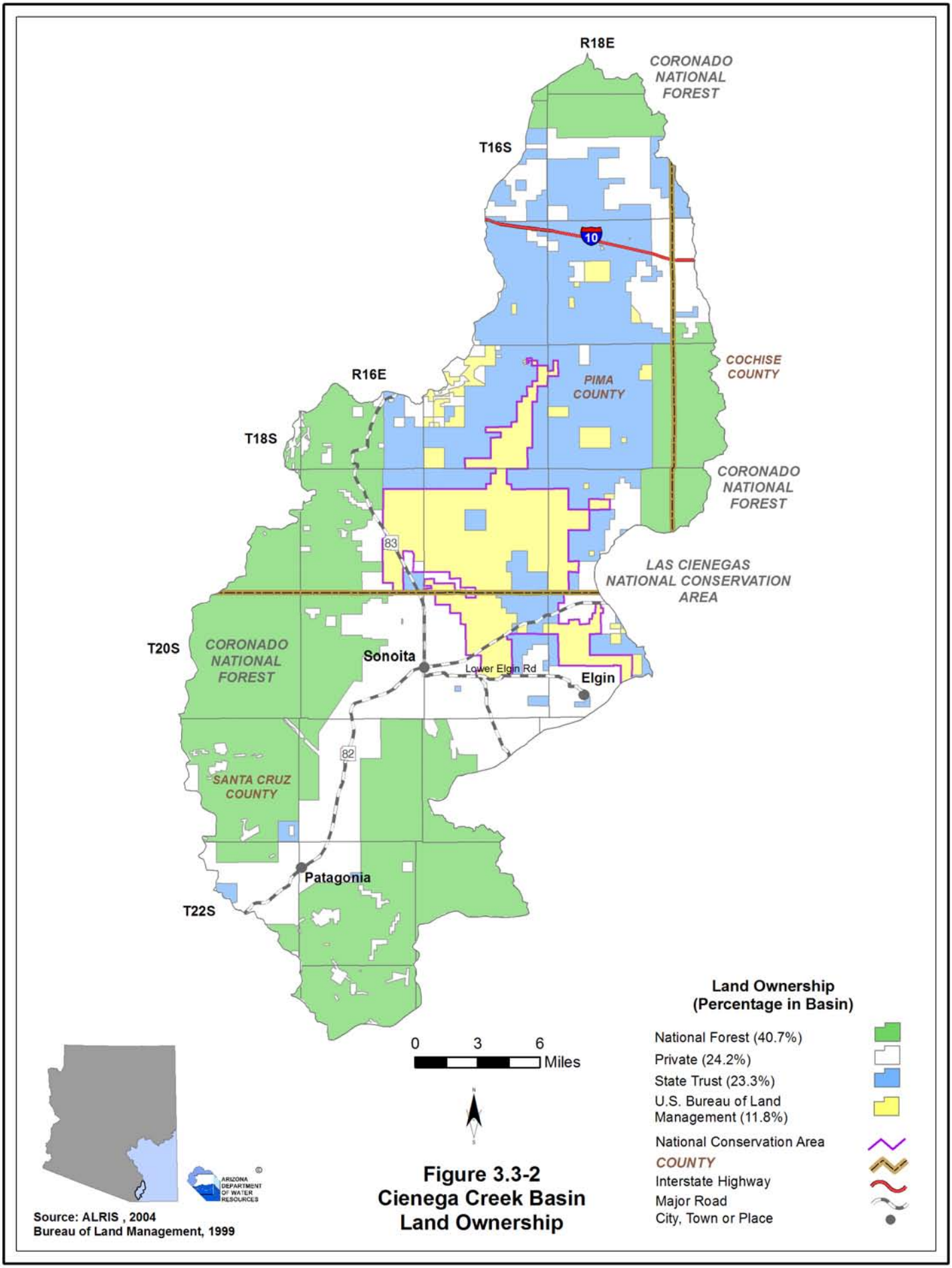


Figure 3.3-2
Cienega Creek Basin
Land Ownership

3.3.3 Climate of the Cienega Creek Basin

The Cienega Creek Basin does not contain any NOAA/NWS Coop Network, Evaporation Pan, AZMET or SNOTEL/Snowcourse stations. Figure 3.3-3 also shows precipitation contour data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. More detailed information on climate is found in Section 3.0.4. A description of this and other climate data sources and methods is found in Volume 1, Appendix A.

SCAS Precipitation Data

- See Figure 3.3-3
- Precipitation data shows average annual rainfall is as high as 40 inches in the vicinity of McCleary Peak in the Santa Rita Mountains and as low as low as 16 inches at the Mescal Arroyo north of Interstate 10.
- Compared to other basins in the planning area, the Cienega Creek Basin has a high overall average annual precipitation with the lowest averages higher than 14 inches.

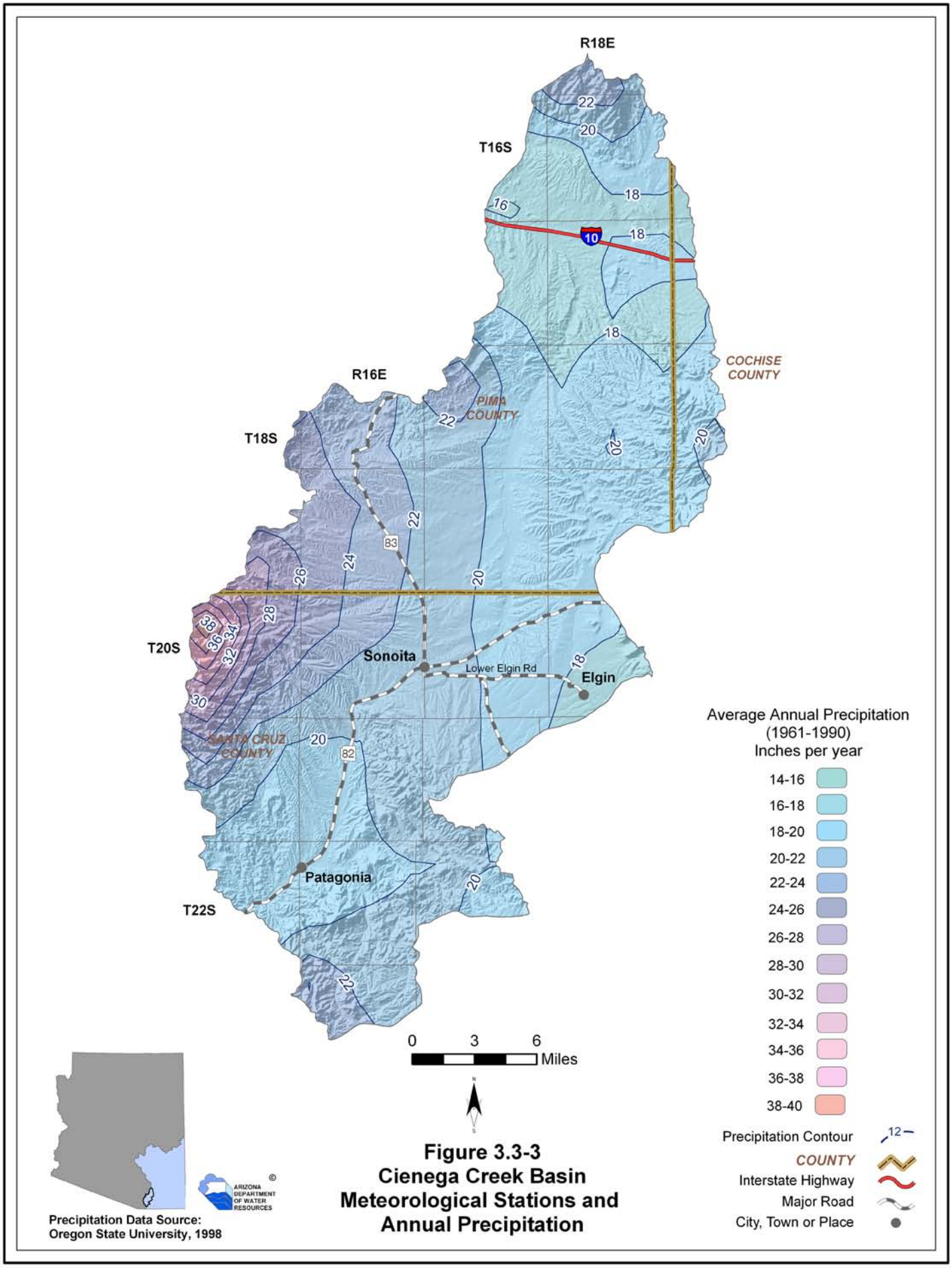


Figure 3.3-3
Cienega Creek Basin
Meteorological Stations and
Annual Precipitation

3.3.4 Surface Water Conditions in the Cienega Creek Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 3.3-1. Flood ALERT equipment in the basin is shown on Table 3.3-2. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 3.3-3. The location of streamflow gages identified by USGS number, flood ALERT equipment, USGS runoff contours and large reservoirs are shown on Figure 3.3-4. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Streamflow Data

- Refer to Table 3.3-1
- Data from two stations, one discontinued and one real-time, located at Cienega Creek are shown on the table and on Figure 3.3-4.
- The average seasonal flow for the discontinued Pantano station is highest in the Summer (July-September) and lowest in the Spring (April-June) and the Fall (October-December). As of 2005 a full three years of data were not available for the other station, therefore no statistics were run.
- Maximum annual flow was 4,496 acre-feet in 1974 and minimum annual flow was 608 acre-feet in 1968 at the station near Pantano.

Flood ALERT Equipment

- Refer to Table 3.3-2.
- There are seven stations in the basin as of October 2005, all but one is located in Pima County.

Reservoirs and Stockponds

- Refer to Table 3.3-3.
- Surface water is stored or could be stored in four small reservoirs in the basin.
- There are an estimated 426 stockponds in this basin.

Runoff Contour

- Refer to Figure 3.3-4.
- Average annual runoff is two inches per year, or 106.6 acre-feet per square mile in the northwestern portion of the basin and decreases to 0.5 inches per year, or 26.65 acre-feet per square mile, in the central and southern part of the basin.

Table 3.3-1 Streamflow Data for the Cienega Creek Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Gage 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	
9484550	Cienega Creek near Sonoita	NA	4,180	10/2001- current (real time)	No statistics run, less than 3 years data								2
9484560	Cienega Creek near Pantano	289	3,560	3/1968-9/1975 (discontinued)	5	1	93	1	608 (1969)	1,408	1,919	4,496 (1974)	6

Source: USGS (NWIS) 2005 & 2008

Notes:
NA= Not available
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
In Period of Record, current equals November 2008
Seasonal and annual flow data used for the statistics was retreived in 2005

Table 3.3-2 Flood ALERT Equipment in the Cienega Creek Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
2520	Sonoita Creek @ Casa Blanca Canyon	Precipitation	10/16/2001	ADWR
4270	Salcido Place	Precipitation	3/1/1993	Pima County FCD
4280	Cienega I-10	Precipitation/Stage	3/1/1993	Pima County FCD
4290	Mescal	Precipitation	3/1/1993	Pima County FCD
4300	Doppler Tower	Weather Station	9/1/1997	Pima County FCD
4320	Empire Mountain Repeater	Repeater/Precipitation	3/1/1993	Pima County FCD
4410	Haystack Mountain	Precipitation	3/1/1993	Pima County FCD

Source: ADWR 2005b

Notes:
ADWR = Arizona Department of Water Resources
FCD = Flood Control District

Table 3.3-3 Reservoirs and Stockponds in the Cienega 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					

Source: Compilation of databases from ADWR & others

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

Total number: 2
Total maximum storage: 68 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[1]

Total number: 2
Total surface area: 10 acres

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

Total number: 426 (from water right filings)

Notes:
[1]Capacity data not available to ADWR

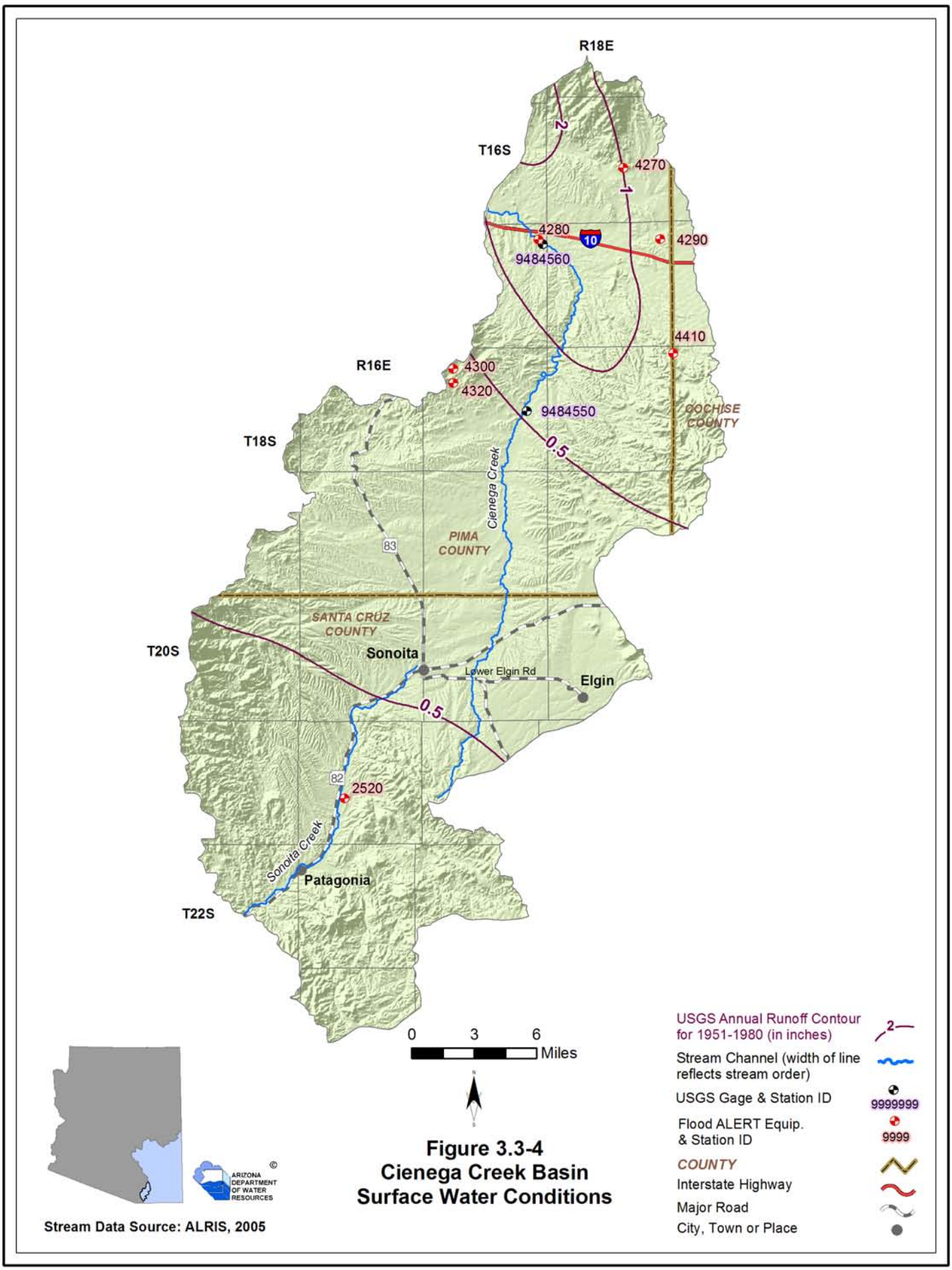


Figure 3.3-4
Cienega Creek Basin
Surface Water Conditions

3.3.5 Perennial/Intermittent Streams and Major Springs in the Cienega 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 3.3-4. The locations of major springs as well as perennial and intermittent streams are shown on Figure 3.3-5. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- There are three streams with perennial reaches, Sonoita Creek, Cienega Creek and Redrock Canyon.
- There are a number of intermittent streams as well as intermittent reaches of perennial streams in the basin.
- There are eight major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time. The largest discharge rate is 430 gpm at Monkey spring.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 3.3-4B. There are two minor springs identified in this basin.
- Listed discharge rates may not be indicative of current conditions. All of the spring measurements in the basin were taken prior to 1983.
- The total number of springs identified by the USGS is 78.

Table 3.3-4 Springs in the Cienega Creek Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Monkey	313803	1104212	430	NA
2	Cottonwood	313910	1104225	150	3/18/1982
3	Apache	314310	1104450	90	04/1941
4	Unnamed	313158	1104553	70	4/1/1982
5	Unnamed	314716	1103820	40	3/25/1982
6	Unnamed	313135	1104740	14	4/1/1982
7	Barrell	315203	1104054	13	3/31/1981
8	Scholefield	315144	1104311	10	NA

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Apache	315012	1102926	4	3/24/1982
Bootlegger	315424	1103252	3	12/23/1981

Source: Compilation of databases from ADWR & others

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005a and USGS, 2006a): 78

Notes:
NA = Not Available
[1]Most recent measurement identified by ADWR

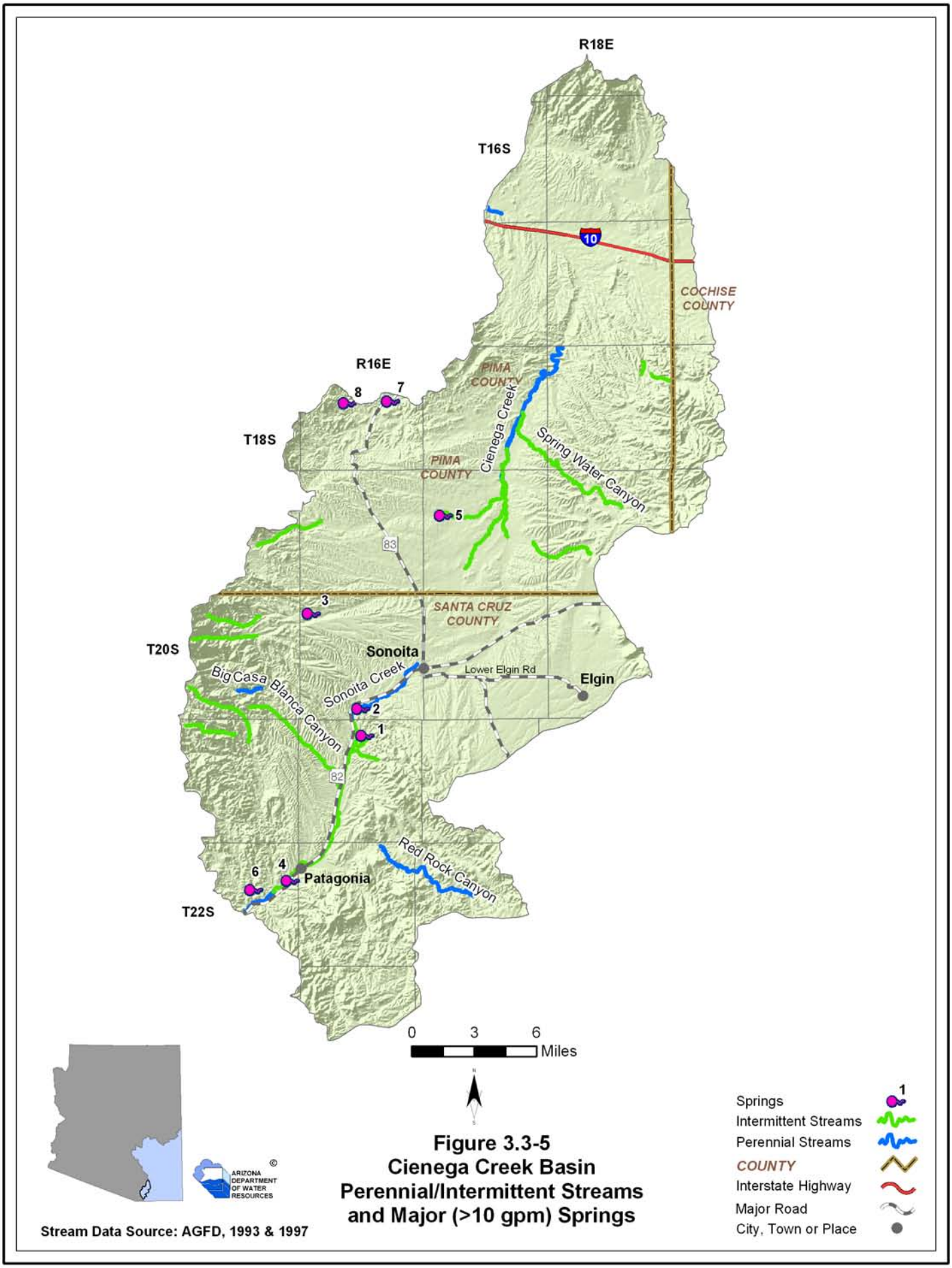


Figure 3.3-5
Cienega Creek Basin
Perennial/Intermittent Streams and Major (>10 gpm) Springs

3.3.6 Groundwater Conditions of the Cienega 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 3.3-5. Figure 3.3-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 3.3-7 contains hydrographs for selected wells shown on Figure 3.3-6. Figure 3.3-8 shows well yields in four yield categories. Descriptions of aquifer and well data sources and methods, including water-level changes and well yields, are found in Volume 1, Appendix A.

Major Aquifers

- Refer to Table 3.3-5 and Figure 3.3-6.
- Major aquifers in the basin include recent stream alluvium and basin fill.
- In the central valley the principal aquifer is the basin-fill alluvium.
- From "the Narrows" south of Interstate 10 there are three aquifers: stream alluvium, basin fill and the Pantano formation. The main aquifer in this section is the stream alluvium.
- In the southwestern portion of the basin the main aquifer is the stream alluvium that forms the floodplain of Sonoita Creek and its tributaries.
- Flow direction south of Sonoita is generally from north to southwest and north of Sonoita it is from the southwest to the northeast.

Well Yields

- Refer to Table 3.3-5 and Figure 3.3-8.
- As shown on Figure 3.3-8 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 35 reported wells, indicates that the median well yield in this basin is 250 gpm.

Natural Recharge

- Refer to Table 3.3-5.
- Natural recharge estimates range from 8,500 acre-feet per year to 25,500 acre-feet per year.

Water in Storage

- Refer to Table 3.3-5.
- Storage estimates for this basin range from 5.1 million acre-feet to 11 million acre-feet to a depth of 1,200 feet.

Water Level

- Refer to Figure 3.3-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures 14 index wells in this basin. Hydrographs for two index wells (B and C) and one other well are shown in Figure 3.3-7.
- The deepest recorded water level in 2003-2004 is 207 feet in Sonoita and the shallowest is 21 feet in the vicinity of Elgin.

Table 3.3-5 Groundwater Data for the Cienega Creek Basin

Basin Area, in square miles:	606	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Recent Stream Alluvium	
	Basin Fill	
	Range 25-600 Median 250 (35 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 2-1,500	ADWR (1994b)
	Range 0-2,500	Anning and Duet, USGS (1994)
Estimated Natural Recharge, in acre-feet:	8,500 - 25,500 (does not include Sonoita Creek section)	ADWR (1994b)
	11,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	5,100,000 (to 1,200 ft)	ADWR (1994b)
	6,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	11,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	14	
Date of Last Water-level Sweep:	2005 (118 wells measured)	

Notes:
[1]Predevelopment Estimate

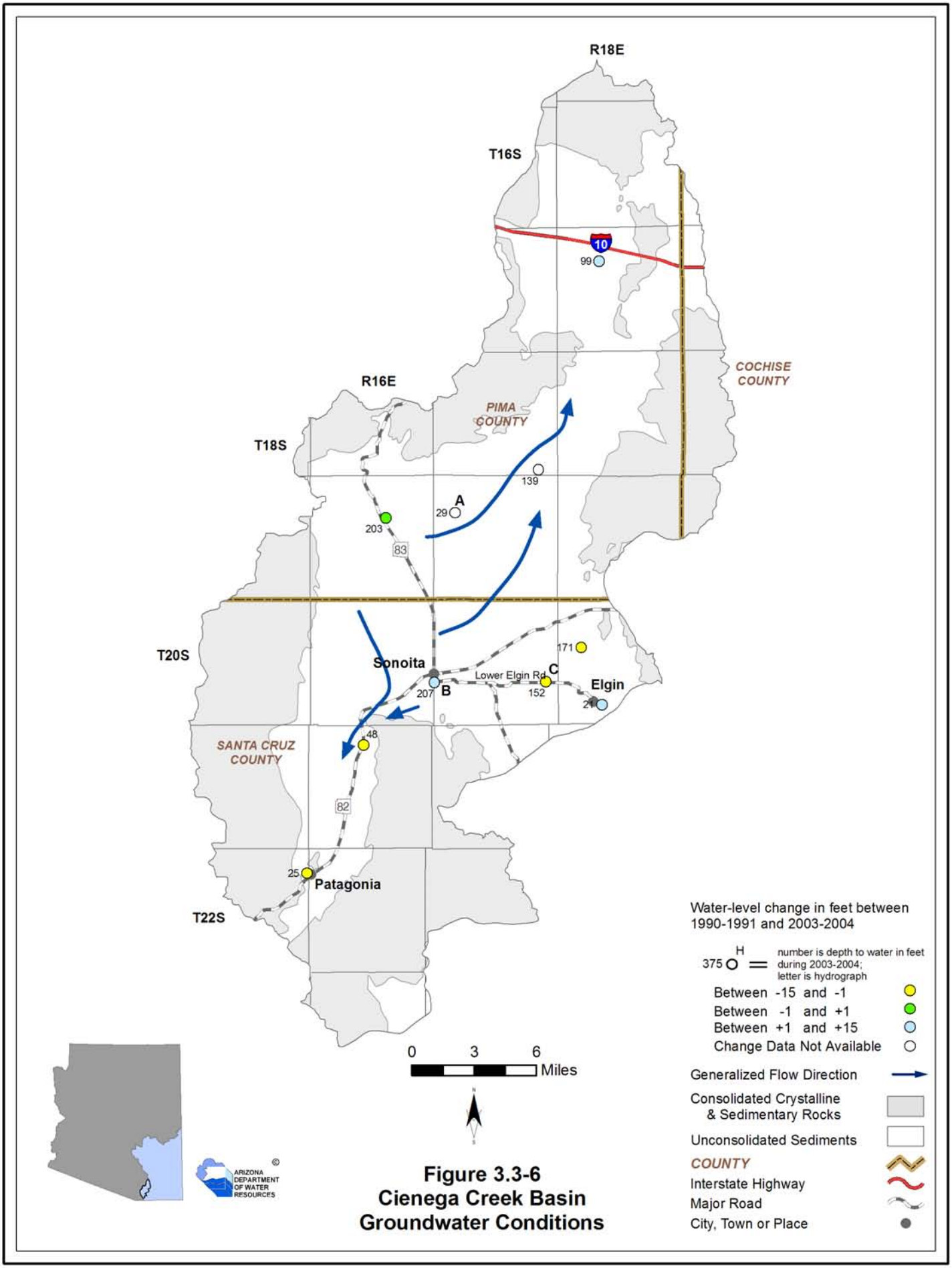
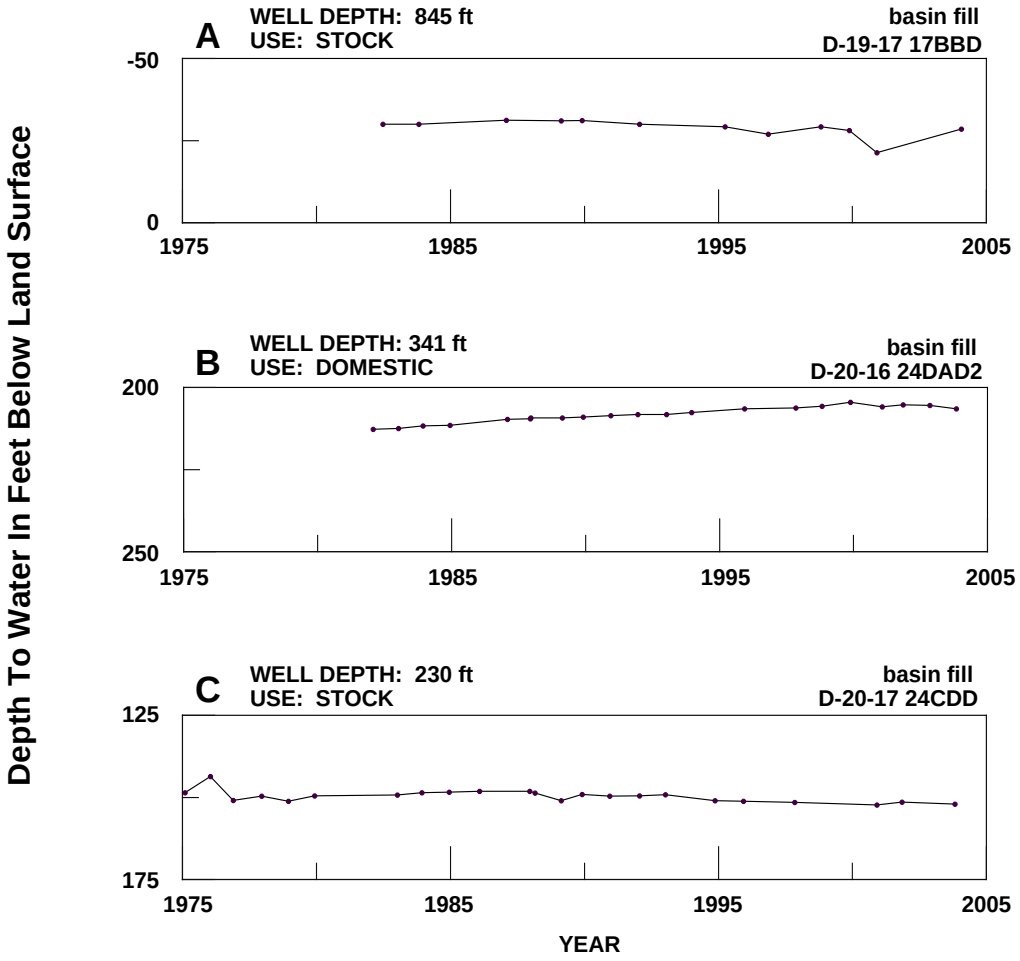


Figure 3.3-6
Cienega Creek Basin
Groundwater Conditions

Figure 3.3-7
Cienega Creek Basin
Hydrographs Showing Depth to Water in Selected Wells



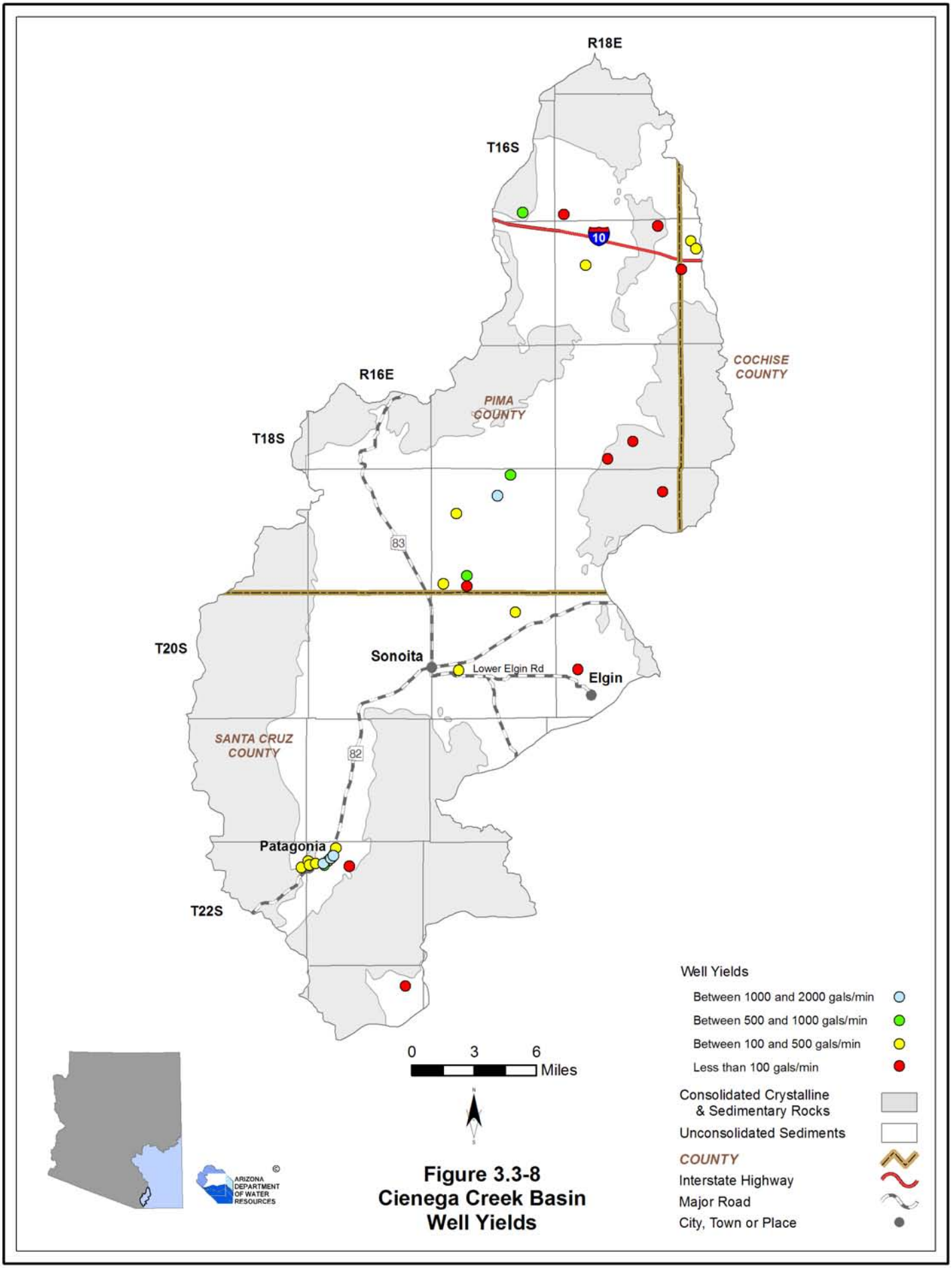


Figure 3.3-8
Cienega Creek Basin
Well Yields

3.3.7 Water Quality of the Cienega Creek Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) are shown in Table 3.3-6A. Impaired lakes and streams with site type, name, length of impaired stream reach, area of impaired lake, designated use standard and parameter(s) exceeded is shown in Table 3.3-6B. Figure 3.3-9 shows the location of exceedences and impairment keyed to Table 3.3-6. All community water systems are regulated under the Safe Drinking Water Act and treat water supplies to meet drinking water standards. Not all parameters were measured at all sites; selective sampling for particular constituents is common. A description of water quality data sources and methods is found in Volume 1, Appendix A.

Well, Mine or Spring sites that have equaled or exceeded drinking water standards (DWS)

- Refer to Table 3.3-6A.
- Forty-six sites have parameter concentrations that have equaled or exceeded DWS.
- Frequently equaled or exceeded parameters include cadmium and copper. Almost all of these sites are in the vicinity of Patagonia.
- Other parameters commonly equaled or exceeded in the sites measured in this basin were arsenic, fluoride and lead.

Lakes and Streams with impaired waters

- Refer to Table 3.3-6B.
- Water quality standards were equaled or exceeded in two reaches of Alum Gulch, the entire length of Harshaw Creek, a tributary of the Endless Mine tributary and Humbolt Canyon.
- The parameters exceeded in every stream were copper and pH levels. Other parameters exceeded include cadmium and zinc.
- Harshaw Creek and Alum Gulch are part of the ADEQ water quality improvement effort called the Total Maximum Daily Load (TMDL) program. The TMDL report for both streams was accepted by the EPA in 2003. USFS has completed remediation of the World's Fair and Humboldt Canyon mines on Alum Gulch and a draft TMDL Implementation Plan is available.

Effluent Dependent Reaches

- Refer to Figure 3.3-9.
- There is one small portion of Sonoita Creek in the vicinity of Patagonia that is effluent dependent.

Table 3.3-6 Water Quality Exceedences in the Cienega 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	17 South	19 East	17	F
2	Well	18 South	16 East	32	Rad
3	Well	18 South	17 East	26	As, Cu, Pb
4	Well	19 South	17 East	3	As
5	Well	19 South	18 East	29	Rad
6	NR	22 South	15 East	9	NO3
7	NR	22 South	15 East	12	As
8	NR	22 South	15 East	12	As
9	NR	22 South	15 East	14	Cd
10	NR	22 South	15 East	14	Cd
11	NR	22 South	15 East	14	Cd
12	NR	22 South	15 East	23	As
13	NR	22 South	15 East	23	Cd, Cu, Pb
14	NR	22 South	15 East	23	Cd, Cu, Pb
15	NR	22 South	15 East	23	As
16	NR	22 South	15 East	23	Cd, Cu, Pb
17	NR	22 South	15 East	23	Cd, Cu, Pb
18	NR	22 South	15 East	23	As
19	NR	22 South	16 East	9	As, F, Pb
20	NR	22 South	16 East	14	Cd, Cu
21	NR	22 South	16 East	20	Cd, F
22	NR	22 South	16 East	20	Cd, Cu
23	NR	22 South	16 East	20	Cd, Cu
24	NR	22 South	16 East	20	Cd, Cu
25	NR	22 South	16 East	20	Cd, Cu
26	NR	22 South	16 East	20	Cd, Cu
27	NR	22 South	16 East	26	F
28	NR	22 South	16 East	27	As
29	NR	22 South	16 East	27	Cd
30	NR	22 South	16 East	28	Cd, Tl
31	NR	22 South	16 East	32	Cd, Cu, Pb
32	NR	22 South	16 East	32	Cd, F
33	NR	22 South	16 East	32	As, Cd, Cu, F, Pb
34	NR	22 South	16 East	32	Cd, F, Pb
35	NR	22 South	16 East	32	Cd, Cu, F, Pb
36	NR	22 South	16 East	32	Cd, Cu, Pb
37	NR	22 South	16 East	32	As, Cd, Cu, Pb
38	Well	23 South	16 East	3	As
39	NR	23 South	16 East	4	As
40	NR	23 South	16 East	5	Cd, Cu, Pb
41	NR	23 South	16 East	5	Cd, Cu
42	NR	23 South	16 East	5	Cd, Cu
43	NR	23 South	16 East	5	Cd, Pb
44	NR	23 South	16 East	6	Cd, Cu
45	NR	23 South	16 East	6	Cd, Cu
46	NR	23 South	16 East	6	Cd, Cu

Source: Compilation of databases from ADWR & others

Table 3.3-6 Water Quality Exceedences in the Cienega Creek Basin (Cont)[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	Alum Gulch (headwaters to Latitude 312820, Longitude 1104351)	1	NA	A&W, AgL, PBC	Cd, Cu, pH, Zn
b	Stream	Alum Gulch (Latitude 312820, Longitude 1104351 to Latitude 312917, Longitude 1104425)	1	NA	A&W, AgL, FBC, FC	Cd, Cu, pH, Zn
c	Stream	Harshaw Creek (headwaters to Sonoita Creek)	14	NA	A&W, AgL, PBC	Cu, pH
d	Stream	Headwaters of unnamed tributary of Harshaw Creek to Endless Chain Mine tributary	2	NA	A&W, PBC	Cu, pH
e	Stream	Humbolt Canyon	2	NA	A&W, FBC, FC	Cd, Cu, pH, Zn

Source: ADEQ 2005b

Notes:
NR = Information not available to ADWR
NA = Not applicable
Because of map scale feature locations may appear different than the location indicated on the table

[1] Water quality samples collected between 1982 and 2001.

[2] As = Arsenic
Cd = Cadmium
Cu = Copper
F= Fluoride
Pb = Lead
Hg = Mercury
pH = Measurement of acidity or alkalinity
NO3 = Nitrate
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium
Tl = Thallium
Zn = Zinc

[3] A&W = Aquatic and Wildlife
AgL = Agricultural Livestock Watering
FBC = Full Body Contact
FC = Fish Consumption
PBC = Partial Body Contact

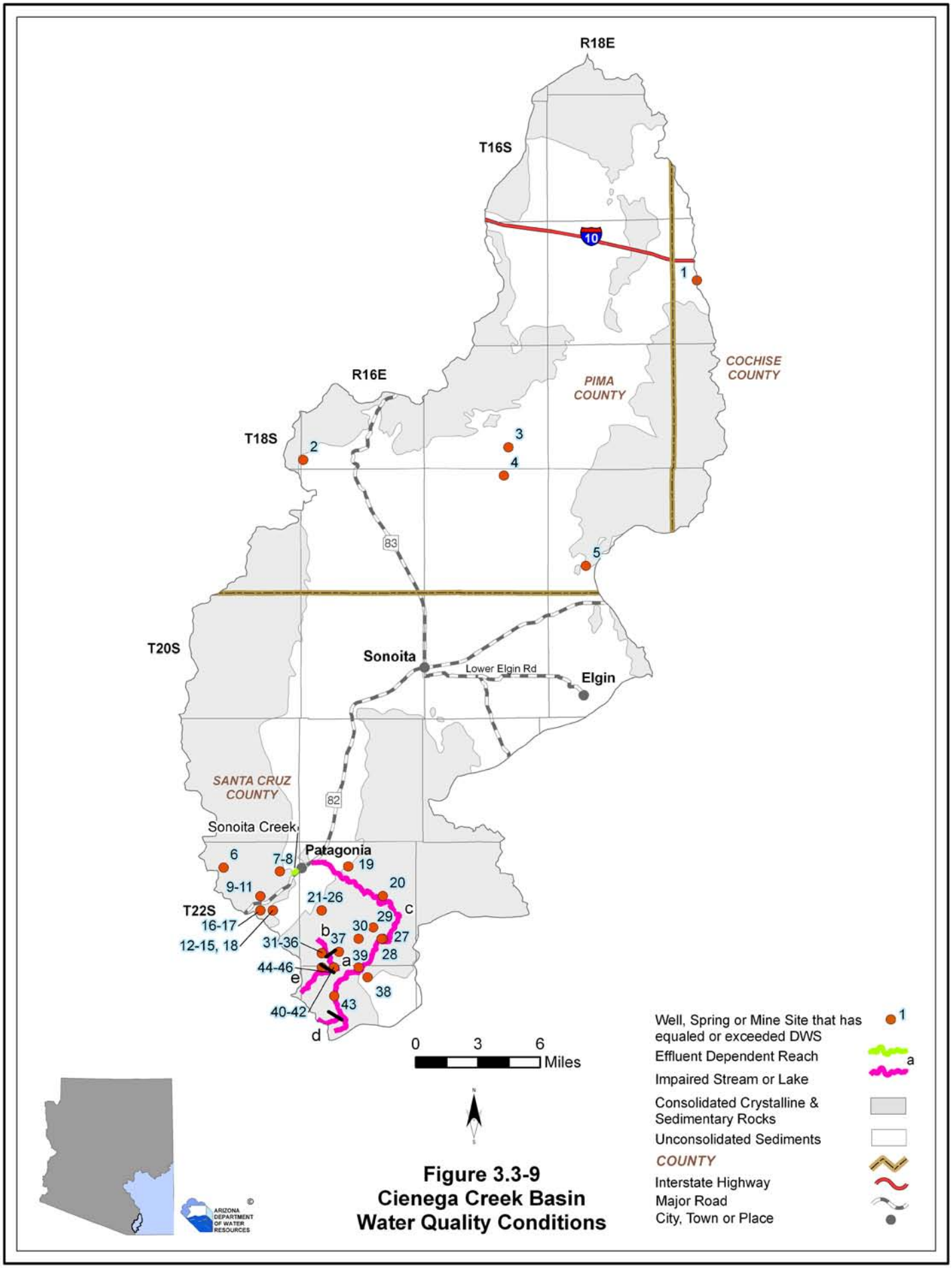


Figure 3.3-9
Cienega Creek Basin
Water Quality Conditions

3.3.8 Cultural Water Demands in the Cienega 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 3.3-7. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown on Table 3.3-8. Figure 3.3-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Appendix A. More detailed information on cultural water demands is found in Section 3.0.7.

Cultural Water Demands

- Refer to Table 3.3-7 and Figure 3.3-10.
- Population in this basin is small but has more than doubled since 1980, increasing from 1,695 in 1980 to 4,355 in 2000.
- Overall groundwater pumping is estimated to be comparable to historic pumping with an annual average of about 1,400 acre-feet per year from 2001-2005.
- All water use in this basin is groundwater, there are no recorded surface water diversions.
- Most concentrations of municipal and industrial demand are either around Patagonia or along Interstate 10 along the Cochise County line.
- Both municipal and industrial groundwater demand has remained fairly constant since 1991, with municipal demand about 550 acre-feet per year and industrial demand less than 300 acre-feet per year.
- Agricultural demand has also remained relatively constant since 1992 with less than 500 acre-feet per year. The only agricultural demand center shown on the map is located along Highway 82 in T21S, R16E.
- In addition to the agricultural demand center shown on the map there are approximately 170 acres of vineyards in this basin. Most vineyards are located in the Elgin area and all are irrigated with groundwater.
- As of 2005 there were 1,874 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 169 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 3.3-8.
- There is one wastewater treatment facility, the Patagonia Wastewater Treatment Facility, located at Patagonia.
- 945 people are served by this facility.
- 73 acre-feet of effluent per year is generated by the facility and discharged into Sonoita Creek.

Table 3.3-7 Cultural Water Demands in the Cienega Creek Basin[1]

Year	Estimated and Projected Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						Data Source
				Well Pumpage			Surface-Water Diversions			
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial	Agricultural	Municipal	Industrial	Agricultural	
1971		759[2]	91[2]	1,200			NR			ADWR (1994a) USGS (2007)
1972										
1973										
1974										
1975										
1976				1,200			NR			
1977										
1978										
1979										
1980	1,695									
1981	1,792	136	15	1,200			NR			
1982	1,888									
1983	1,985									
1984	2,082									
1985	2,178									
1986	2,275	249	22	1,200			NR			
1987	2,372									
1988	2,468									
1989	2,565									
1990	2,662									
1991	2,831	226	17	500	<300	500	NR			USGS (2007) ADWR (2005a) ADWR (2008b)
1992	3,000									
1993	3,170									
1994	3,339									
1995	3,508									
1996	3,678	247	6	550	<300	500	NR			
1997	3,847									
1998	4,016									
1999	4,186									
2000	4,355									
2001	4,460	256	18	600	<300	500	NR			
2002	4,565									
2003	4,670									
2004	4,775									
2005	4,880									
2010	5,404									
2020	6,672									
2030	7,820									
	WELL TOTALS:	**1,874**	**169**							

Notes:
NR = Not reported
[1] Does not include evaporation losses from stockponds and reservoirs, or effluent
[2] Includes all wells through June 1980.

Table 3.3-8 Effluent Generation in the Cienega Creek Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet/year)	Disposal Method								Treatment Level		Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf/ Landscape	Wildlife Area	Industrial Use	Discharge to Another Facility	Infiltration Basins	Current	Projected		
Patagonia WWTF	Town of Patagonia	Patagonia	945	73	Sonoita Creek								Secondary	Adv.Trt.I	NA	2000

Source: Compilation of databases from ADWR & others

Notes:
NA: Data not currently available to ADWR
WWTF: Wastewater Treatment Facility
Adv. Tr. I: Advance Treatment Level I

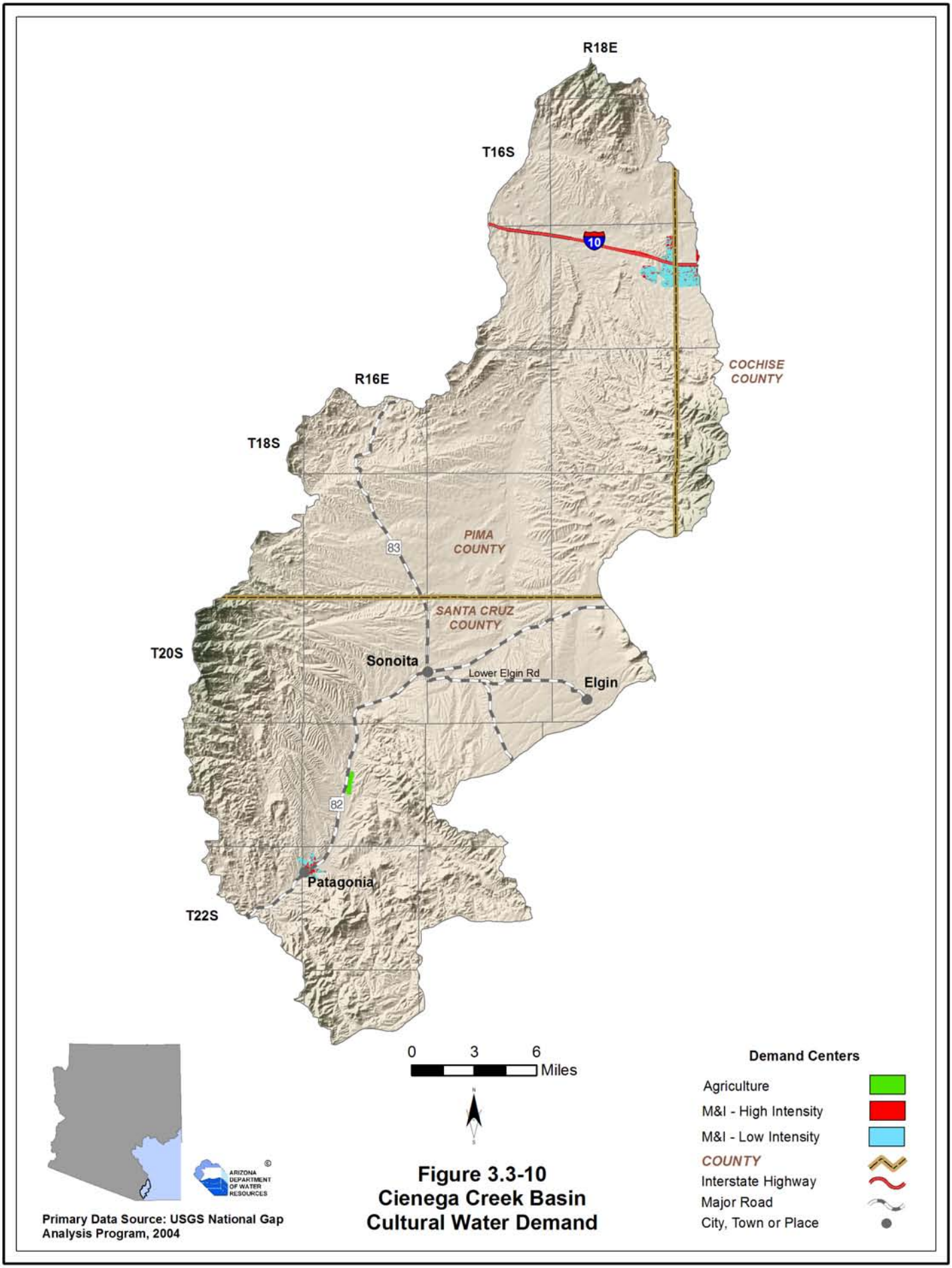


Figure 3.3-10
Cienega Creek Basin
Cultural Water Demand

3.3.9 Water Adequacy Determinations in the Cienega 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 3.3-9A and B for water reports and analysis of adequate water supply. Designated water provider information is shown in Table 3.3-9C with date of application, date the designation was issued and projected or annual estimated demand. Figure 3.3-11 shows the locations of subdivisions and designated providers keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix C. Adequacy determination data sources and methods are found in Volume 1, Appendix A.

- Thirteen water adequacy determinations have been made in this basin through December 2008.
- Eight determinations of inadequacy have been made, all in the vicinity of Sonoita and Patagonia.
- All eight determinations of inadequacy were because of the applicant chose not to submit necessary information and/or available hydrologic data were insufficient to make a determination. One inadequacy determination was also due to poor water quality.
- There is one analysis of adequate water supply for 189 lots.
- There is one designated water provider, Empirita Water Company, with a projected or annual estimated demand of 427 acre-feet.
- 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
Cochise	269	269	100
Santa Cruz	>767	598	~77%

Table 3.3-9 Adequacy Determinations in the Cienega Creek Basin[1]

A. Water Adequacy Reports

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	Empirita Highlands at the J-6 Ranch	Cochise	17 South	19 West	19	91	53-400432	Adequate		12/8/2000	Anderson Water Company
2	Mesa, The	Santa Cruz	22 South	16 West	7, 18	NA	53-500971	Inadequate	A1	6/22/1989	Dry Lot Subdivision
3	Mescal Lakes #4,5	Cochise	17 South	19 West	7, 8	117	53-500205	Adequate		8/21/1973	Verde Utilities
4	Ranch Oasis	Santa Cruz	20 South	17 West	19, 20	13	53-300122	Inadequate	A1	3/22/1996	Dry Lot Subdivision
5	Red Mountain Mesas Development	Santa Cruz	22 South	16 East	7,18	44	NA	Inadequate	A1	4/1/1981	Unformed Homeowners Association
6	Red Rock Acres	Santa Cruz	22 South	16 West	5, 8	33	53-501289	Inadequate	A1	7/7/1982	Redrock Acres Homeowners Association
7	Rolling Hills Subdivision Lots 1 61	Cochise	17 South	19 West	7	61	53-400866	Adequate		1/24/2003	Mescal Lakes Water System
8	Sonoita Estates	Santa Cruz	20 South	17 West	25	NA	53-501437	Inadequate	A1	12/18/1989	Dry Lot Subdivision
9	Sonoita Hills	Santa Cruz	20 South	17 West	20, 29, 32	31	53-501438	Inadequate	A1	10/10/1994	Dry Lot Subdivision
10	Sonoita Meadows	Santa Cruz	20 South	16 West	25	24	53-501439	Inadequate	A1	4/11/1984	Dry Lot Subdivision
11	Starr View Estates	Santa Cruz	20 South	17 West	20	400	53-501457	Adequate		8/6/1979	Dry Lot Subdivision
13	Three Canyons	Santa Cruz	21 South	16 West	17, 20, 21, 29, 30, 32	198	53-401928	Adequate		12/19/2005	Three Canyons Domestic Water Improvement District
14	Valley of Thousand Oaks	Santa Cruz	22 South	15 West	24	11	53-501599	Inadequate	A1,C	10/16/1980	Subdivision Wells

B. Analysis of Adequate Water Supply

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No[2]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section				
12	Three Canyons	Santa Cruz	22 South	16 West	17, 20, 21, 29, 30, 32	189	43-401865	12/19/2005	Three Canyons Domestic Water Improvement District

C. Designated Adequate Water Supply

Map Key	Water Provider Name	County	Designation No.	Projected or Annual Estimated Demand *(af/yr)*	Date Application Received	Date Application Issued	Year of Projected or Annual Demand
a	Empirita Water Company	Cochise	41-401435.0001	427	6/28/2006	12/10/2008	2024

Source: ADWR 2008a

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. Between 1995-2006 all applications for adequacy were given a file number with a 22 prefix. In 2006 a 53 prefix was assigned to all water adequacy reports and applications regardless of their issue date.

[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= Data not currently available to ADWR

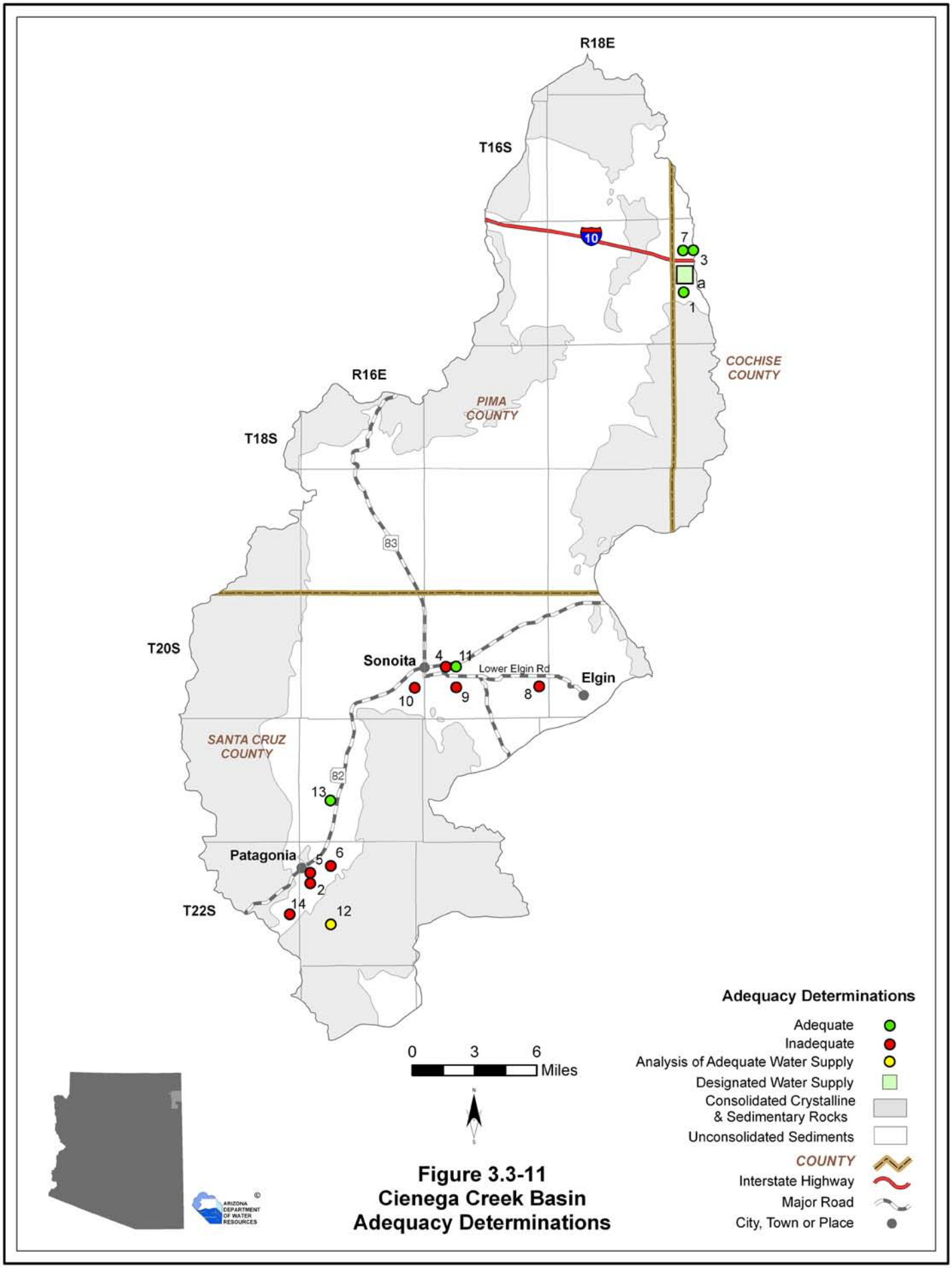


Figure 3.3-11
Cienega Creek Basin
Adequacy Determinations

CIENEGA CREEK BASIN
References and Suggested Reading

A

Anning, D.W. and N.R. Duet, 1994, Summary of ground-water conditions in Arizona, 1987-90, USGS Open-file Report 94-476.

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

Arizona Department of Environmental Quality (ADEQ), 2005a, Effluent dependent waters: GIS cover, received December 2005.

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

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

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

_____, 2003, Status of Water Quality in Arizona in 2002, Vol. 2.

Arizona Department of Water Resources (ADWR), 2008a, Assured and adequate water supply applications: Project files, ADWR Hydrology Division.

_____, 2008b, Industrial demand outside of the Active Management Areas 1991-2007: Unpublished analysis by ADWR Office of Resource Assessment Planning.

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

_____, 2005b, Automated recorder sites: Data files, ADWR Basic Data Unit.

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

_____, 2005d, Flood warning gages: Database, ADWR Office of Water Engineering.

_____, 2005e, Groundwater Site Inventory (GWSI): Database, ADWR Hydrology Division.

_____, 2005f, Wells55: Database.

_____, 2004, Rural Water Resources 2003 Questionnaire Report: Rural water resources study, ADWR Office of Regional Strategic Planning.

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

_____, 1994b, 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 (AGFD), 2005, Arizona Waterways: Data file, received April 2005.

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

Arizona Land Resource Information System (ALRIS), 2005a, Springs: GIS cover, accessed January 2006 at http://www.land.state.az.us/alris/index.html.

_____, 2005b, Streams: GIS cover, accessed 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 Water Commission, 1975, Summary, Phase I, Arizona State Water Plan, Inventory of resource and uses.

B

Bureau of Land Management (BLM), 1999, National Monuments: GIS cover.

D

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

F

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

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

G

Gebert, W.A., D.J. Graczyk and W.R. Krug, 1987, Average annual runoff in the United States, 1951-1980: GIS Cover, accessed March 2006 at http://aa179.cr.usgs.gov/metadata/wrdmeta/runoff.htm.

M

Montgomery & Assoc., 1999, Hydrological investigations of groundwater movement and sources of base flow to Sonoita Creek near Patagonia Arizona, Santa Cruz County, Arizona.

Murphy, B.A. and J.D. Hedley, 1984, Map showing groundwater conditions in the Upper Santa Cruz Basin area, Pima, Santa Cruz, Pinal, and Cochise counties Arizona 1982: ADWR Hydrologic Map Series # 11.

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., P.D. Rigas and C.F. Smith, 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

United States Geological Survey, 2008, National Water Information System (NWIS) data for Arizona: Accessed October 2008 at http://waterdata.usgs.gov/nwis.

_____, 2007, Water withdrawals for irrigation, municipal, mining, thermoelectric-power, and drainage uses in Arizona outside of the active management areas, 2000-2005: Data file, received November 2007.

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

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

_____, 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., J.A. Wennerlund, R.A. Winstead, S. Woods, L. Rile, E. Swanson and S. Olson, 1993, Arizona riparian inventory and mapping project: Arizona Game and Fish.

W

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

Supplemental Reading

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

Arizona Department of Environmental Quality, 2007, TMDL Implementation Plan for Cadmium, Copper, Zinc and Acidity: Alum Gulch, ADEQ OFR 07-03.

_____, 2003, Total Maximum Daily Load For: Upper Harshaw Creek, Sonoita Creek Basin, Santa Cruz River Watershed, Coronado National Forest, near Patagonia, Santa Cruz County, Arizona, ADEQ OFR 07-09.

_____, 2003, Total Maximum Daily Load For: Upper Alum Gulch, Sonoita Creek Basin, Santa Cruz River Watershed, Coronado National Forest near Patagonia, Santa Cruz County, Arizona, ADEQ OFR 07-08.

Arizona Geological Survey, 1996, Refinement of geologic model, lower Cienega basin, Pima County, Arizona: Arizona Water Protection Fund Project 95-016.

Blomgren, N.F., 1999, Water Law and Policy in the Sonoita Creek Basin: University of Arizona, M.S. thesis.

Bota, L., 1997, Modeling of Groundwater Flow and Surface/Groundwater Interaction for Upper Cienega Creek Basin: University of Arizona, M.S. thesis.

Bureau of Reclamation, 1990, Upper Gila water supply analyses and sizing studies: Arizona Projects Office, draft report, April 1990.

Chong-Diaz, D., 1995, Modeling of Stream Aquifer Interaction in Lower Cienega Creek Basin Using a Finite Element Technique: University of Arizona, M.S. thesis.

Ellett, W.J., 1994, Geologic Controls on the Occurrence and Movement of Water in the Lower Cienega Creek Basin: University of Arizona, M.S. thesis.

Fluid Solutions, 2005 Hydrologic Study - Smith Ranch Master Planned Community.
Haley & Aldrich Inc., 2000, Hydrologic Study, Empirita Highlands at the J-6 Ranch, Cochise/Pima County Arizona.

Gangadean, D., 1999, Storm Response of Sonoita Creek Watershed: University of Arizona, M.S. thesis.

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.

Grahn, H.L., 1995, A Hydrogeochemical Evaluation of the Lower Cienega Creek Sub-Basin, Pima County, Arizona: University of Arizona, M.S. thesis.

Hess, G.S., Zucker, C.L., Karrer, C.A., Kusher, G.F., Radtke, D.B., 1998, Groundwater and streamflow monitoring in the Cienega Creek Nature Preserve, Pima County, 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. 92.

Huth, H.J., 1997, Hydrogeochemical Modeling of Western Mountain Front Recharge, Upper Cienega Creek Sub-Basin, Pima County, Arizona: University of Arizona, M.S. thesis.

Kennard, M., A.E. Johnson and T.W. Perry, 1988, Preliminary Report on the Hydrology of the Cienega Creek Groundwater Basin: Arizona Department of Water Resources Division of Hydrology, Special Studies.

Knight, E.L., 1996, A Water Budget and Land Management Recommendations for Upper Cienega Creek Basin: University of Arizona, M.S. thesis.

Matt, C.E., 1995, Water Resource Administration of Lower Cienega Creek near Tucson: University of Arizona, M. S. thesis.

Megdal, S., K. Mott Lacroix, and A. Schwarz, 2006, Projects to Enhance Arizona's Environment: An Examination of their Functions, Water Requirements and Public Benefits: University of Arizona, Water Resources Research Center.

Morton, E.S., 2001, Arid lands, watersheds, and mining: Sonoita Creek watershed: In Proceedings from the 14th annual Arizona Hydrological Society Symposium, September 2001, Tucson, Arizona, p. 119.

Nature Conservancy, 1999, Hydrogeologic investigation of groundwater movement and sources of base flow to Sonoita Creek and implementation of long term monitoring program: Arizona Water Protection Fund Project 96-0006.

Roudebush, E.M., 1996, The Influence of Bedrock on Perennial Stream flow in the Upper Cienega Creek Basin, Pima County, Arizona: University of Arizona, M.S. thesis

Williams, M.D., 1996, Evapotranspiration in Southeast Arizona Semi-Arid Watersheds: Walnut Gulch and Cienega Creek: University of Arizona, M.S. thesis.

Wittler, R. J., Klawon, J.E., and Collins, K.L., 2004, Upper Gila River fluvial geomorphology study: Bureau of Reclamation final report.

Zucker, C., 2004. Geologic influences on the hydrology of Cienega Creek: in The Value of Water; Proceedings from the 17th annual Arizona Hydrological Society Symposium, September 2004, Tucson Arizona.