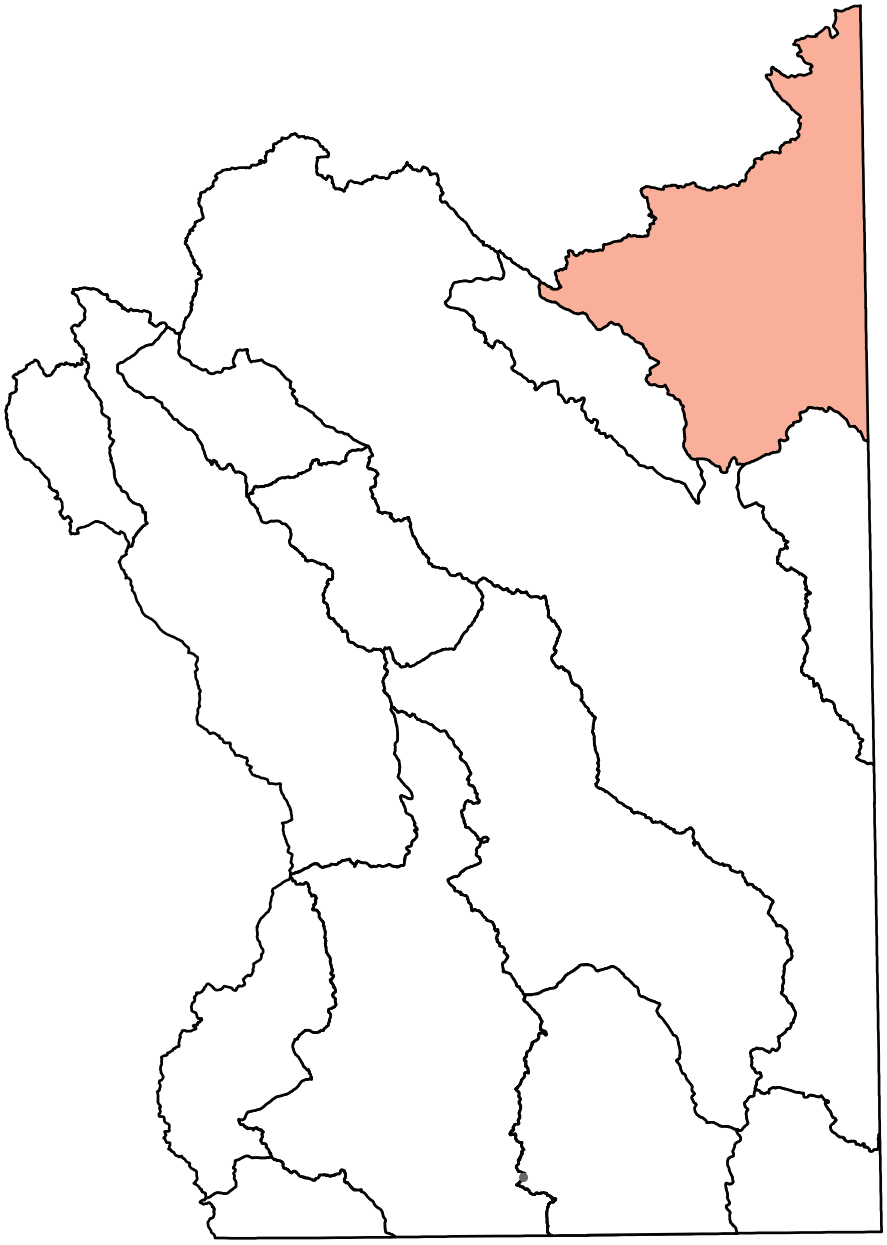
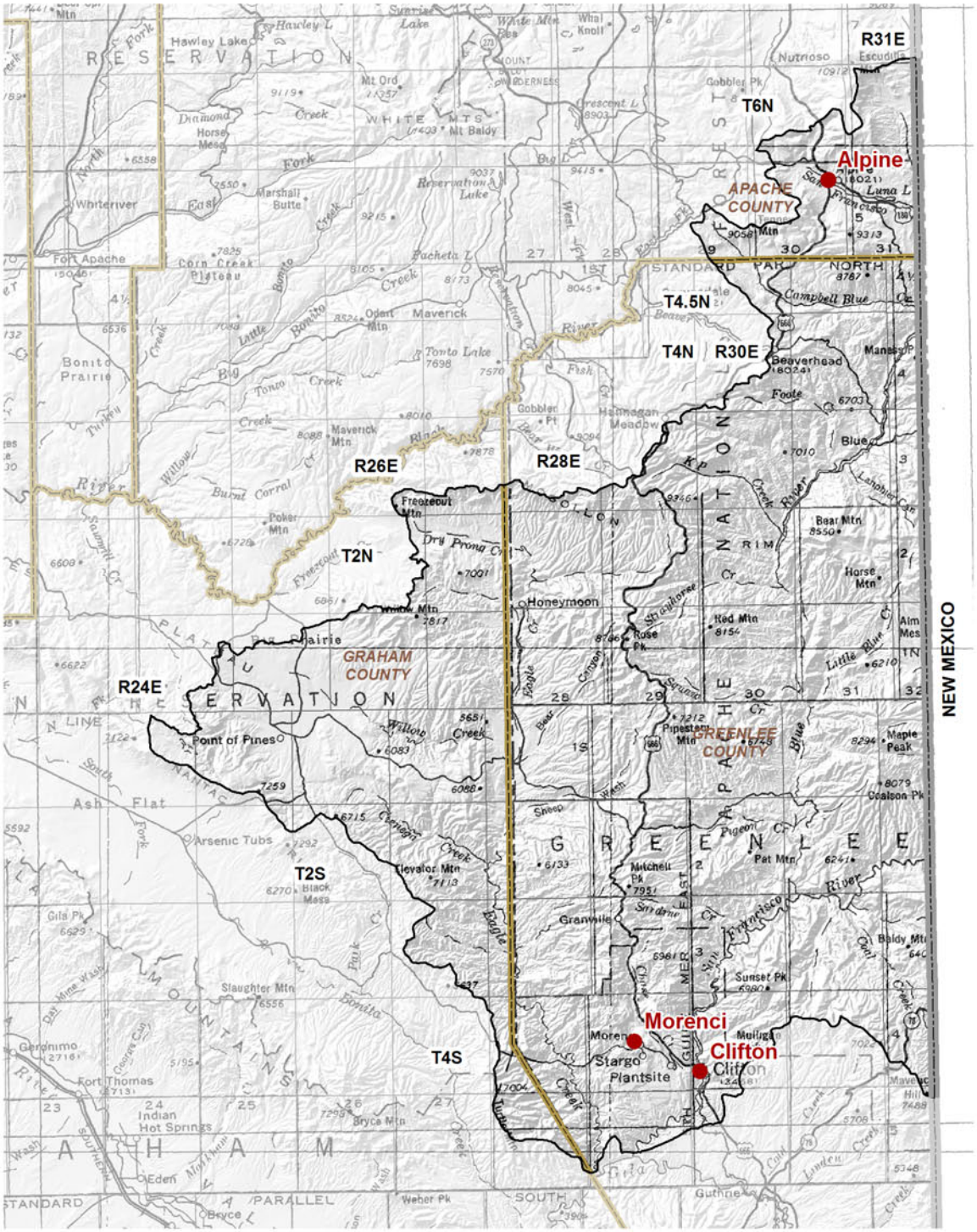
Section 3.9
Morenci Basin



3.9.1 Geography of the Morenci Basin

The Morenci Basin is a medium-size, 1,599 square mile basin in the northeast portion of the planning area. Geographic features and principal communities are shown on Figure 3.9-1. The basin is characterized by high-elevation mountain ranges and a diversity biotic communities including Rocky Mountain and montane conifer forest, Great Basin conifer, madrean evergreen woodland, plains and Great Basin grassland, interior chaparral, Chihuahuan desertscrub and semi-desert grassland vegetation. (see Figure 3.0-10) Riparian vegetation includes: wet meadow and mountain scrub on the San Francisco River near Alpine; mixed broadleaf and cottonwood/willow on the Campbell Blue Creek; cottonwood/willow, mixed broadleaf and mesquite on the Blue River; mixed broadleaf on Cienega and Willow Creeks; and mesquite and mixed broadleaf on Eagle Creek and the San Francisco River north of Clifton.

- Principal geographic features shown on Figure 3.9-1 are:
    - San Francisco River running from the west to the east in Apache County and from the east to the south near Clifton
    - Blue River south of the Apache County line, which flows south through the basin and joins the San Francisco River
    - Eagle Creek in the vicinity of the boundary between Graham and Greenlee Counties
  - The lowest point at approximately 3,600 feet where the San Francisco River exits the basin.
- Not well shown on Figure 3.9-1 is the Mogollon Rim, which includes the highest point in the basin at 9,346 feet.


R31E
T6N
Alpine
APACHE COUNTY
T4.5N
T4N
R30E
R28E
R26E
T2N
GRAHAM COUNTY
R24E
GREENLEE COUNTY
NEW MEXICO
T2S
T4S
Morenci
Clifton
Stargo Plantsite
Honeymoon
Point of Pines
Fort Apache
Whiteriver
Beaverhead
Blue
Bear Mtn
Horse Mtn
Red Mtn
Pat Mtn
Sunset Pk
Granville
Maverick
Bonito Prairie
Arsenic Tubs
Slaughter Mtn
Fort Thomas
Indian Hot Springs
Eden
Bryce
Guthrie
Campbell Blue
Manassas
Maple Peak
Ocalson Pk
Mitchell Pk
Elevator Mtn
Freezeout Mtn
Poker Mtn
Maverick Mtn
Odart Mtn
Tonto Lake
Reservation Lake
Hawley Lake
Mt Ord
Mt Baldy
Marshall Butte
Corn Creek Plateau
Gobbler Pk
Nutrioso
Escudilla
Luna L
Crescent L
Big L
Sunrise Lake
White Mtn Res
Whal Knoll
Pacheta L
Hannagan Meadow
Pipestem Mtn
Rose Pk
Strawberry
Little Blue
Maverick
Willow Creek
Sheep Wash
Pigeon Cr
Eagle Creek
Bonita Creek
Dry Prong Cr
Burnt Corral
Tonto Creek
Big Bonito Creek
Little Bonito Creek
Black Mesa
Gila Pk
Gerónimo
Bryce Mtn
Weber Pk
Ash Flat
Bear Prairie
Tonto Basin
Kohls Ranch
Pinetop
Lakeside
Show Low
Springerville
Eagle Creek
Morenci
Clifton
Stargo
Plantsite
Mulligan
Blue River
Gila River
San Francisco River
Little Colorado River
Campbell Blue Cr
Foote Cr
Lanphier Cr
Kp Creek
Strawberry Cr
Little Blue Cr
Pigeon Cr
Sheep Wash
Eagle Creek
Bonita Creek
Dry Prong Cr
Burnt Corral
Tonto Creek
Big Bonito Creek
Little Bonito Creek
Willow

3.9.2 Land Ownership in the Morenci Basin

Land ownership, including the percentage of ownership in each category, is shown for the Morenci Basin in Figure 3.9-2. Primary land ownership features are the large block of national forest land, a significant amount of tribal land and the relatively large contiguous portion of private land around Morenci used predominantly for mining activities. 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.

A key land ownership feature of this basin is the large amount of National Forest Service land in the Apache-Sitgreaves National Forest. This basin contains a one-third of the two million acre forest. This forest is unique in Arizona because it contains more than 680 miles of rivers and streams and 34 lakes and reservoirs, more than any other Southwestern National Forest. The basin also includes the entire 172,762 acre Blue Range Primitive Area, the only primitive area in the United States (USFS, 2006). Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

National Forest

- 67.6% of the land is federally owned and managed by the United States Forest Service (USFS).
- All national forest land in the basin is in the Apache-Sitgreaves National Forest in two ranger districts, the Alpine Ranger District in the northern portion of the basin and the Clifton Ranger District in the southern portion of the basin.
    - A portion of the Escudilla Wilderness is located at the northernmost tip of the basin. (see Figure 3.0-13)
- Primary land uses are recreation, wildlife protection and timber production.

Indian Reservations

- 21.7% of the land is under ownership of the San Carlos Apache Tribe.
- Primary land use is grazing.

Private

- 5.8% of land is private.
- The majority of private land is surrounding Morenci.
- Private in-holdings are scattered throughout the National Forest lands.
- Primary land uses are mining, domestic and commercial.

U.S. Bureau of Land Management (BLM)

- 3.8% of land is federally owned and managed by the Safford Field Office of the Bureau of Land Management.
- The basin contains a small portion of the Gila Box Riparian National Conservation Area in T5S, R29E.
- All BLM land is in the southern-most tip of the basin and is interspersed with private and state trust lands.

- Primary land use is grazing.

State Trust

- 1.6% of land in this basin is held in trust for public schools and to a lesser extent the University of Arizona, hospital for disabled miners and the Arizona Hospital.
- All state owned land is in the southernmost-tip of the basin and is interspersed with BLM and private lands.
- Primary land use is grazing.

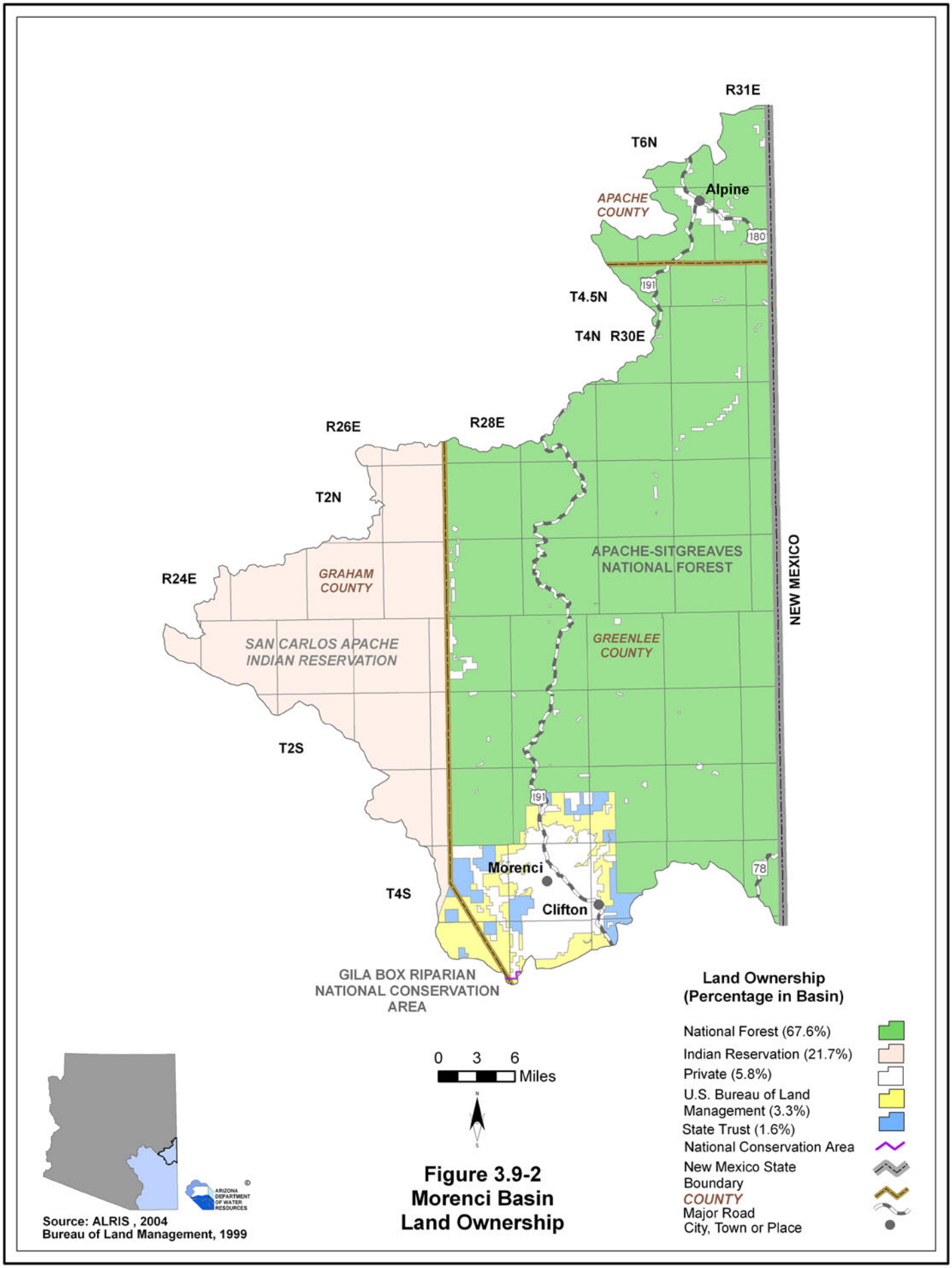


Figure 3.9-2
Morenci Basin
Land Ownership

3.9.3 Climate of the Morenci Basin

Climate data from NOAA/NWS Coop Network and SNOTEL/Snowcourse stations are complied in Table 3.9-1 and the locations are shown on Figure 3.9-3. Figure 3.9-3 also shows precipitation contour data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Morenci Basin does not contain Evaporation Pan and AZMET stations. More detailed information on climate is found in Section 3.0.4. A description of the climate data sources and methods is found in Volume 1, Appendix A.

NOAA/NWS Coop Network

- Refer to Table 3.9-1A.
- There are four NOAA/NWS Coop Network stations in the basin. The average monthly maximum temperature occurs in July at all stations and ranges from 61.6°F in Alpine to 84.7°F in Clifton. The average monthly minimum temperature occurs in December or January and ranges from 29.1°F in Alpine to 45.8°F in Clifton.
- Highest average seasonal rainfall occurs in both the summer (July-September) and fall (October – December). For the period of record used, the highest annual rainfall is 21.66 inches at Alpine and the lowest is 13.29 inches at Morenci.

SNOTEL/Snowcourse

- Refer to Table 3.9-1D.
- The Morenci Basin is the only basin in the planning area with SNOTEL/Snowcourse data.
- There are five SNOTEL/Snowcourse stations in the basin.
- The highest average monthly snowpack at most stations is in March.

SCAS Precipitation Data

- See Figure 3.9-3
- Additional precipitation information shows rainfall as high as 32 inches along the Mogollon Rim near Highway 191 and as low as 12 inches in the vicinity of Clifton.

Table 3.9-1 Climate Data for the Morenci 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
Alpine	8050	1971-2000	61.6/Jul	29.1/Jan	3.94	2.24	10.31	5.17	21.66
Blue	5420	1971-2000	70.5/Jul	36.0/Dec	4.37	1.86	9.82	5.09	21.14
Granville	6800	1955-1975[1]	70.2/Jul	34.7/Jan	3.03	3.25	5.73	6.47	17.19
Clifton	3480	1971-2000	84.7/Jul	45.8/Dec	3.00	1.10	5.77	3.42	13.29

Source: WRCC, 2005

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			

C. AZMET:

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

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record	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	8,000	1938 - current	1.4 *(27)*	2.7 *(67)*	2.8 *(68)*	1.1 *(64)*	0.4 *(1)*	0 *(0)*
Coronado Trail	8,350	1938 - current	1.3 *(29)*	2.8 *(69)*	*2.9 (69)*	1.0 *(65)*	0 *(1)*	0 *(0)*
Coronado Trail SNOTEL	8,400	1983 - current	1.8 *(24)*	3.2 *(24)*	3.1 *(24)*	0.4 *(23)*	0 *(24)*	0 *(24)*
Hannagen Meadows	9,090	1964 - 2000 (discontinued)	4.5 (23)	7.3 *(36)*	9.8 *(36)*	9.3 *(36)*	8.1 *(2)*	0 *(0)*
Nutrioso	8,500	1938 - current	0.9 *(29)*	1.8 *(69)*	1.78 *(69)*	0.5 *(69)*	0 *(1)*	0 *(0)*

Source: Natural Resources Conservation Service, 2006

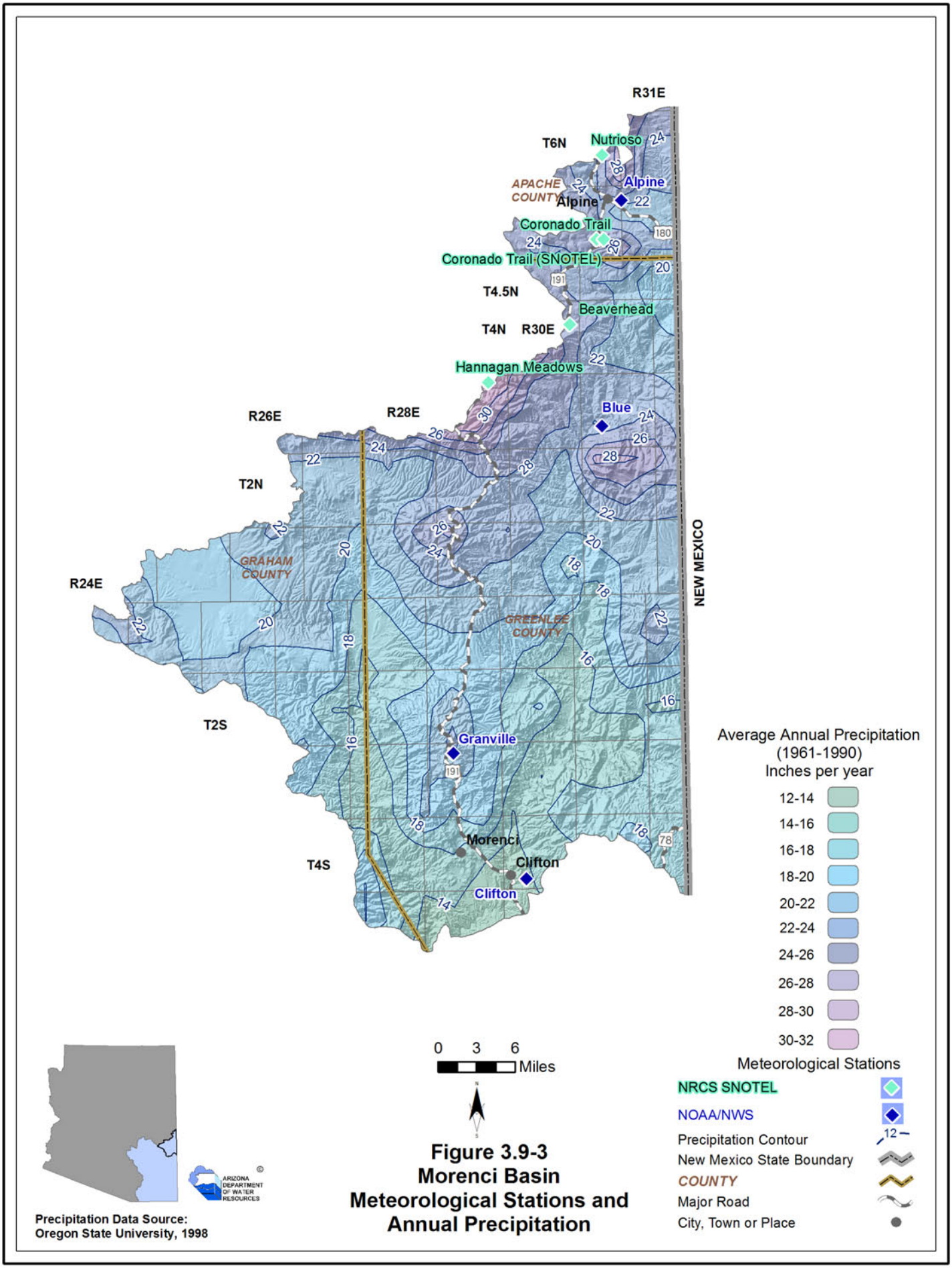


Figure 3.9-3
Morenci Basin
Meteorological Stations and Annual Precipitation

3.9.4 Surface Water Conditions in the Morenci Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 3.9-2. Flood ALERT equipment in the basin is shown on Table 3.9-3. Reservoir and stockpond data, including maximum storage or maximum surface area of large reservoirs and type of use of the stored water, are shown in Table 3.9-4. The location of streamflow gages identified by USGS number, flood ALERT equipment, USGS runoff contours and large reservoirs are shown on Figure 3.9-5. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Streamflow Data

- Refer to Table 3.9-2.
- Data from six stations on four watercourses are shown on the table and on Figure 3.9-5. Three stations have been discontinued and three are real-time stations.
- The average seasonal flow for most of the stations is highest in the Winter (January-March) and lowest in the Spring (April-June) or Summer (July-September).
- Maximum annual flow in this basin was 678,755 acre-feet in 1915 on the San Francisco River, see Figure 3.9-4, and minimum annual flow was 724 acre-feet in 1964 on Willow Creek.

Flood ALERT Equipment

- Refer to Table 3.9-3.
- There are seven stations in the basin as of October 2005.

Reservoirs and Stockponds

- Refer to Table 3.9-4
- There are four large and 16 small reservoirs in this basin.
- The largest reservoir, the Silver Basin, has a maximum storage capacity of 5,200 acre-feet.
- The reservoirs are used for irrigation, recreation and other purposes.
- There are an estimated 673 stockponds in this basin.

Runoff Contour

- Refer to Figure 3.9-5.
- Average annual runoff increases from 0.5 inches, or 26.65 acre-feet per square mile, in the vicinity of Clifton and Morenci to two inches, or 106.6 acre-feet per square mile, as you move north toward the Mogollon Rim.

Figure 3.9-4 Annual Flows (in acre-feet) at San Francisco River at Clifton (Station # 9444500) Water Years 1914-2007

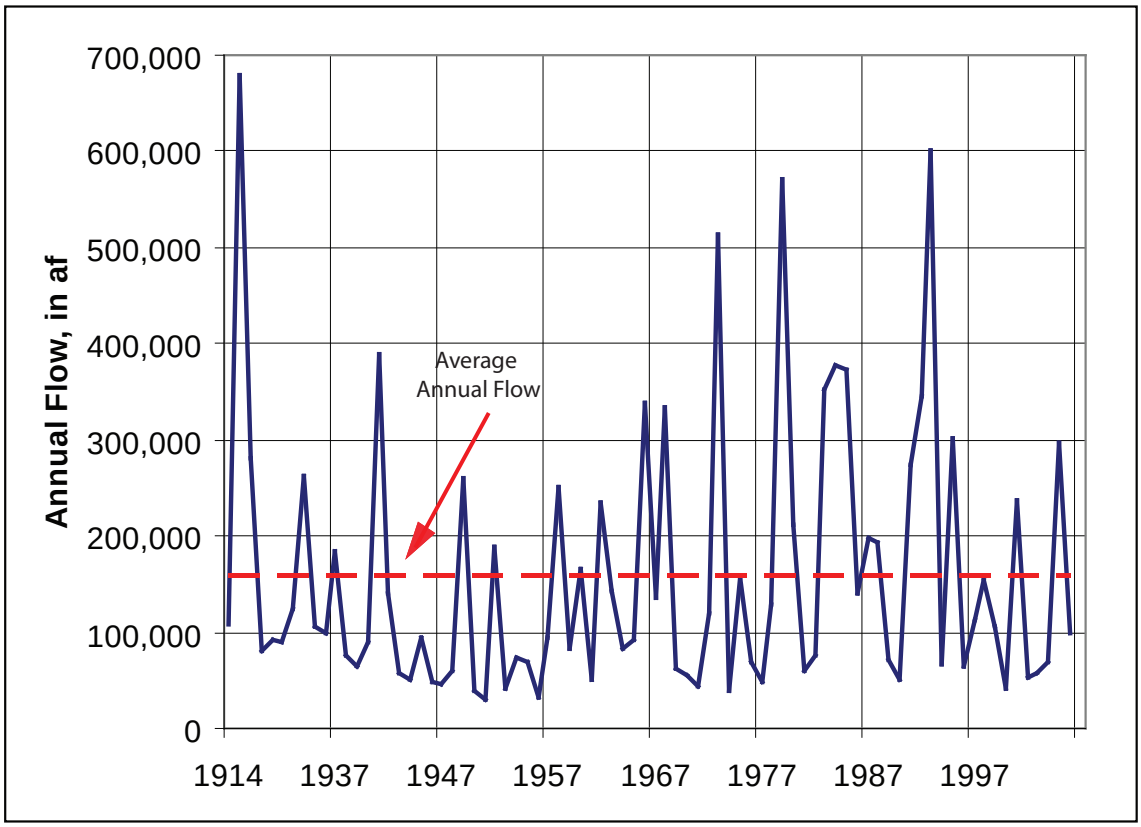


Table 3.9-2 Streamflow Data for the Morenci Basin

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	
9444200	Blue River near Clifton	506	4,160	11/1967-current (real time)	39	22	14	25	9,487 (2002)	38,091	50,373	176,695 (1983)	30
9444500	San Francisco River at Clifton	2,766	3,436	10/1910-current (real time)	41	20	16	22	30,415 (1951)	91,606	146,532	678,755 (1915)	79
9445500	Willow Creek near Point of Pines near Morenci	102	5,804	8/1944-9/1967 (discontinued)	26	27	27	20	724 (1964)	7,855	8,433	19,403 (1965)	22
9446000	Willow Creek near Double Circle Ranch near Morenci	149	4,969	8/1944-9/1967 (discontinued)	27	22	29	22	2,013 (1964)	8,688	9,929	28,018 (1965)	22
9446500	Eagle Creek near Double Circle Ranch near Morenci	377	4,722	8/1944-9/1967 (discontinued)	33	19	26	22	8,181 (1953)	14,914	18,906	48,579 (1965)	22
9447000	Eagle Creek above Pumping Plant near Morenci	622	3,673	4/1944-current (real time)	49	14	15	22	12,311 (1953)	34,398	48,850	405,530 (1993)	58

Source: USGS (NWIS) 2005 & 2008

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
In Period of Record, current equals November 2008
Seasonal and annual flow data used for the statistics was retreived in 2005

Table 3.9-3 Flood ALERT Equipment in the Morenci Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
510	Sardine Saddle	Precipitation	11/15/1993	Town of Clifton
515	Maverick Hill	Precipitation	NA	Town of Clifton
525	Blue River	Precipitation/Stage	1/1/1993	Town of Clifton
560	Clifton	Precipitation/Stage	NA	Town of Clifton
575	Blue Vista	Precipitation	1/1/1996	Town of Clifton
580	Escudilla Mountain	Precipitation	10/23/1996	Town of Clifton
610	Clifton ADOT Weather Station	Weather Station	8/31/2001	ADWR

Source: ADWR 2005a

Notes:
NA = Not available
ADOT = Arizona Department of Transportation
ADWR = Arizona Department of Water Resources

Table 3.9-4 Reservoirs and Stockponds in the Morenci 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	Silver Basin	Phelps Dodge-Morenci	5,200	O	State
2	Luna	Luna Irrigation	1,800	I	State
3	Columbine	Phelps Dodge-Morenci	522[2]	O	State

B. Other Large Reservoirs (50 acre surface area or greater)[3]

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE[1]	JURISDICTION
4	Dry	San Carlos Apache Tribe	229	R	Tribal

Source: Compilation of databases from ADWR & others

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

Total number: 4
Total maximum storage: 1,327 acre-feet

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

Total number: 12
Total surface area: 138 acres

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

Total number: 673 (from water right filings)

Notes:
[1]I=irrigation; O=other; R=recreation
[2]Normal capacity < 500acre-feet
[3]Capacity data not available to ADWR

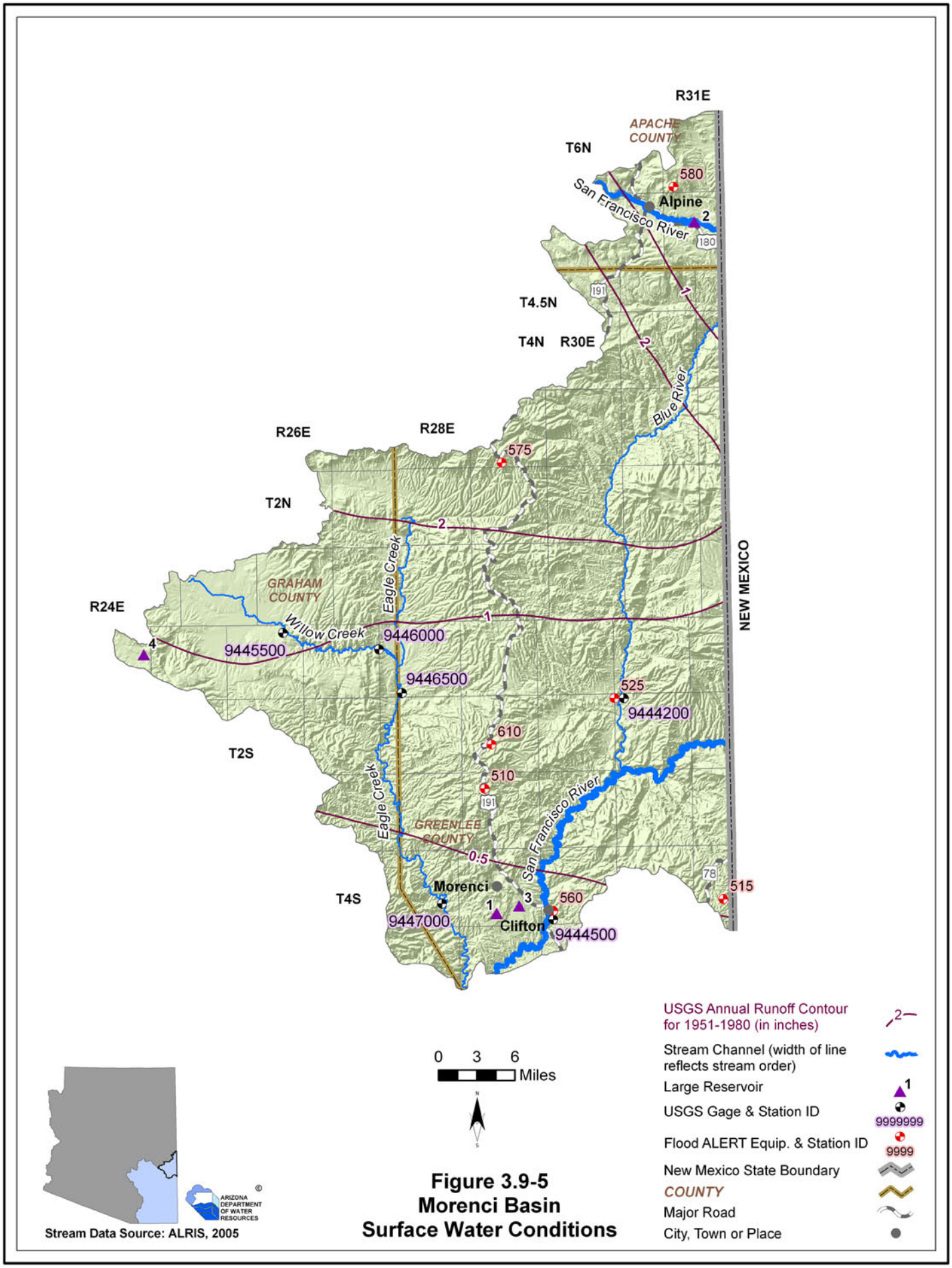


Figure 3.9-5
Morenci Basin
Surface Water Conditions

3.9.5 Perennial/Intermittent Streams and Major Springs in the Morenci 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 3.9-5. The locations of major springs as well as perennial and intermittent streams are shown on Figure 3.9-6. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- There are many perennial stream reaches located throughout the basin. Some of these streams are the San Francisco River, Blue River, Grant Creek, Strayhorse Creek, KP Creek, Willow Creek, Cienega Creek and Eagle Creek.
- Numerous intermittent streams are also located throughout the basin.
- There are nine major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time. The largest discharge rate was 200 gpm at an unnamed spring along the San Francisco River north of Clifton.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 3.9-5. There are eight minor springs identified in this basin.
- Listed discharge rates may not be indicative of current conditions. All springs measurements are over 10 years old; seven springs were measured before 1982 and one has no date.
- The total number of springs identified by the USGS varies from 308 to 358, depending on the database reference.

Table 3.9-5 Springs in the Morenci Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Unnamed[2]	331603	1091053	200	6/16/1978
2	Unnamed[2]	331922	1091123	100	NA
3	Unnamed	331735	1091603	100	6/16/1978
4	Eagle Creek Hot	330249	1092623	50	During or prior to 1982
5	Hannah	332401	1090907	50	During or prior to 1982
6	KP Cienega (multiple)	333428	1092116	50	6/26/1973
7	Rock Basin	331302	1090748	20	During or prior to 1982
8	Smuggler[2]	325653	1092041	20	07/1992
9	Unnamed[2]	334448	1090404	10	6/14/1978

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Coronado	331002	1092202	5	6/17/1978
Gulch[2,3]	331000	1092109	3	04/1980
Sycamore Gulch[2,3]	330854	1091837	3	12/1981
Metcalf [2,3]	331047	1092050	2	04/1980
Judges[2,3]	330919	1092249	2	12/1991
Strayhorse	332638	1092131	2	6/26/1978
Sycamore[2,3]	330026	1091857	1	04/1980
Burnt Corral	333124	1091808	1	6/26/1978

Source: Compilation of databases from ADWR & others

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005a and USGS, 2006a): 308 to 358

Notes:
NA = Not Available
[1]Most recent measurement identified by ADWR
[2]Spring not displayed on current USGS topo map
[3]Location approximated by ADWR

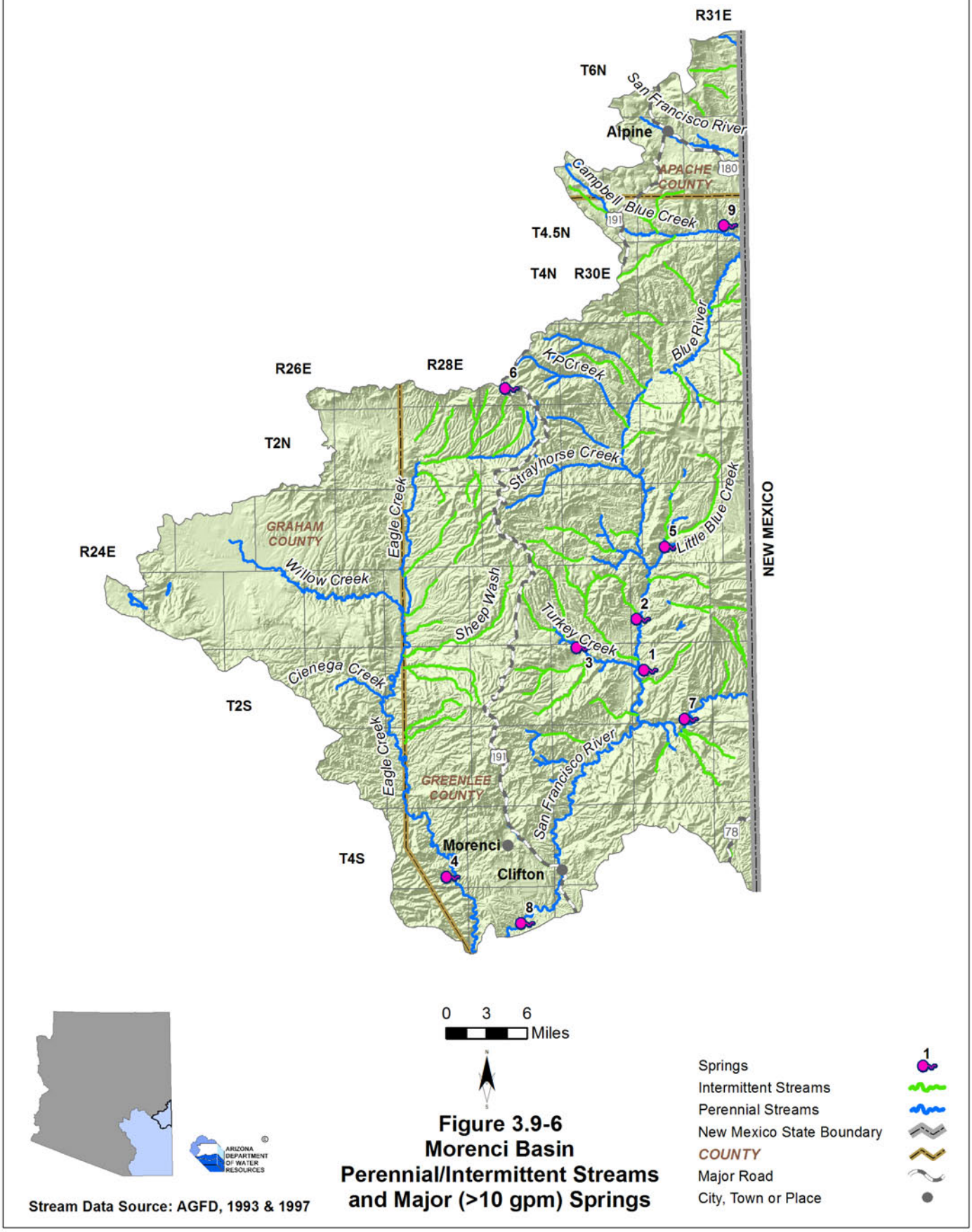


Figure 3.9-6
Morenci Basin
Perennial/Intermittent Streams and Major (>10 gpm) Springs

3.9.6 Groundwater Conditions of the Morenci 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 3.9-6. Figure 3.9-7 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 3.9-8 contains hydrographs for selected wells shown on Figure 3.9-7. Figure 3.9-9 shows well yields in five yield categories. A description of aquifer data sources and methods as well as well data sources and methods, including water-level changes and well yields are found in Volume 1, Appendix A.

Major Aquifers

- Refer to Table 3.9-6 and Figure 3.9-7.
- The major aquifers in this basin are recent stream alluvium and volcanic rock.
- Flow direction is generally from north to south.

Well Yields

- Refer to Table 3.9-6 and Figure 3.9-9.
- As shown on Figure 3.9-9 well yields in this basin range from less than 100 gallons per minute (gpm) to more than 2,000 gpm.
- One source of well yield information, based on 53 reported wells, indicates that the median well yield in this basin is 600 gpm.

Natural Recharge

- Refer to Table 3.9-6.
- The only natural recharge estimate in this basin is 15,000 acre-feet per year.

Water in Storage

- Refer to Table 3.9-6.
- The only storage estimate is three million acre-feet to a depth of 1,200 feet.

Water Level

- Refer to Figure 3.9-7. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures four index wells in this basin. A hydrograph for one of these two wells is shown in Figure 3.9-8.
- The deepest recorded water level in the basin in 2003-2004 is 78 feet and the shallowest is eight feet. All recorded water level changes are in the vicinity of Alpine.

Table 3.9-6 Groundwater Data for the Morenci Basin

Basin Area, in square miles:	1,599	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Recent Stream Alluvium	
	Volcanic Rock	
Well Yields, in gal/min:	Range 2 - 5,900 Median 600 (53 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 0 - 2,500	Anning and Duet (1994)
Estimated Natural Recharge, in acre-feet/year:	15,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	3,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
Current Number of Index Wells:	4	
Date of Last Water-level Sweep:	1978 (6 wells measured)	

[1]Predevelopment Estimate

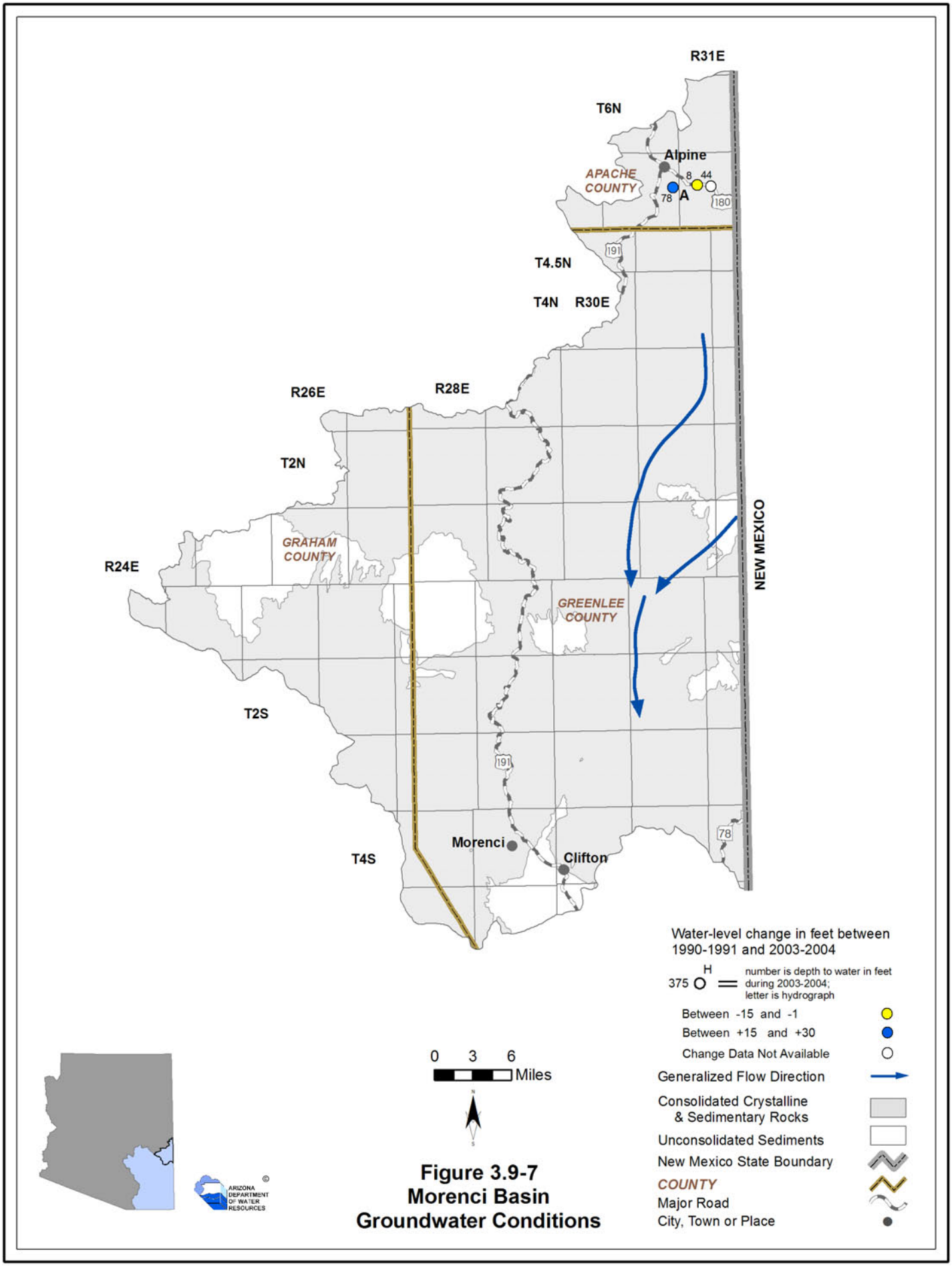
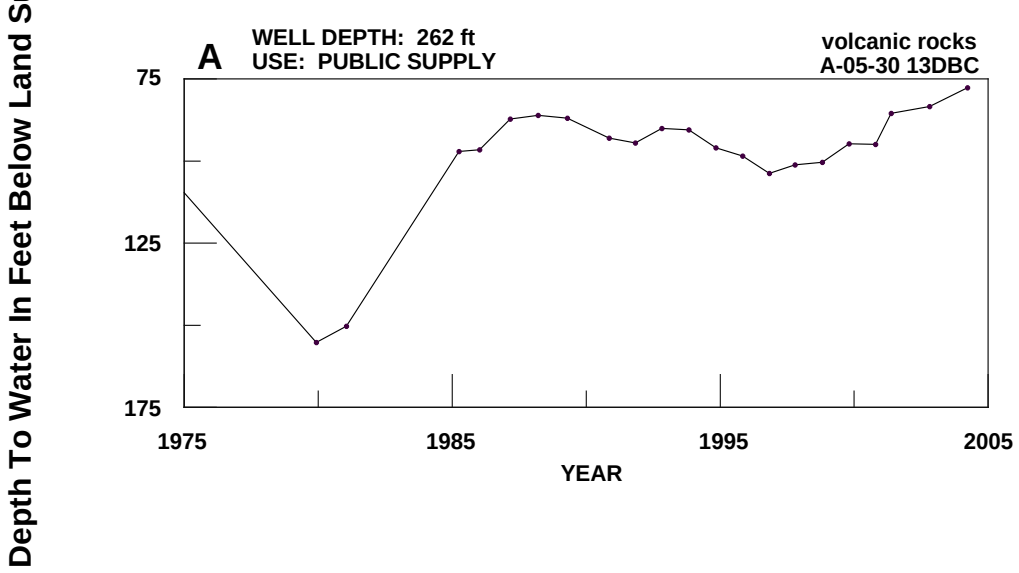


Figure 3.9-7
Morenci Basin
Groundwater Conditions

Figure 3.9-8
Morenci Basin
Hydrographs Showing Depth to Water in Selected Wells



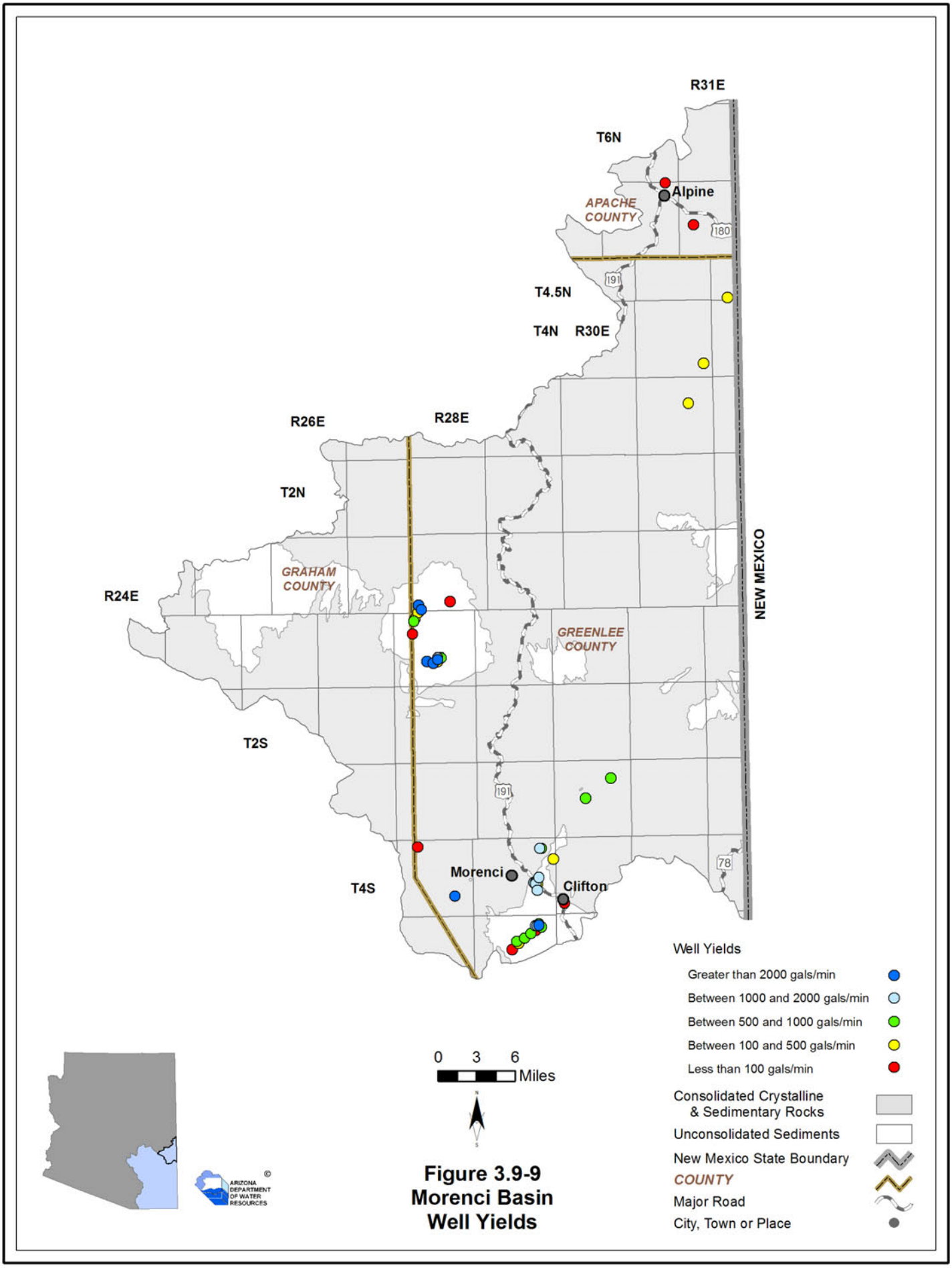


Figure 3.9-9
Morenci Basin
Well Yields

3.9.7 Water Quality of the Morenci Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) are shown in Table 3.9-7A. 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 3.9-7B. Figure 3.9-10 shows the location of exceedences and impairment keyed to Table 3.9-7. 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 3.9-7A.
- Three sites have parameter concentrations that have equaled or exceeded DWS.
- Parameters equaled or exceeded include beryllium, cadmium, copper, fluoride, arsenic, lead and nitrates

Lakes and Streams with impaired waters

- Refer to Table 3.9-7B.
- Water quality standards were exceeded in one lake, Luna Lake, and one reach of the San Francisco River.
- The parameters exceeded in Luna Lake included dissolved oxygen and pH levels.
- The parameter exceeded in the San Francisco River was sediment.
- Luna Lake has been evaluated under the ADEQ water quality improvement effort called the Total Maximum Daily Load (TMDL) program. The TMDL report for Luna Lake was accepted by the EPA in 2000 and implementation of the water quality improvement plan is underway. There are no TMDL reports for the impaired reach of the San Francisco River.

Table 3.9-7 Water Quality Exceedences in the Morenci 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 South	29 East	2	Be, Cd, Cu, F
2	Well	4 South	29 East	20	As, Pb
3	Well	4 South	32 East	18	NO3

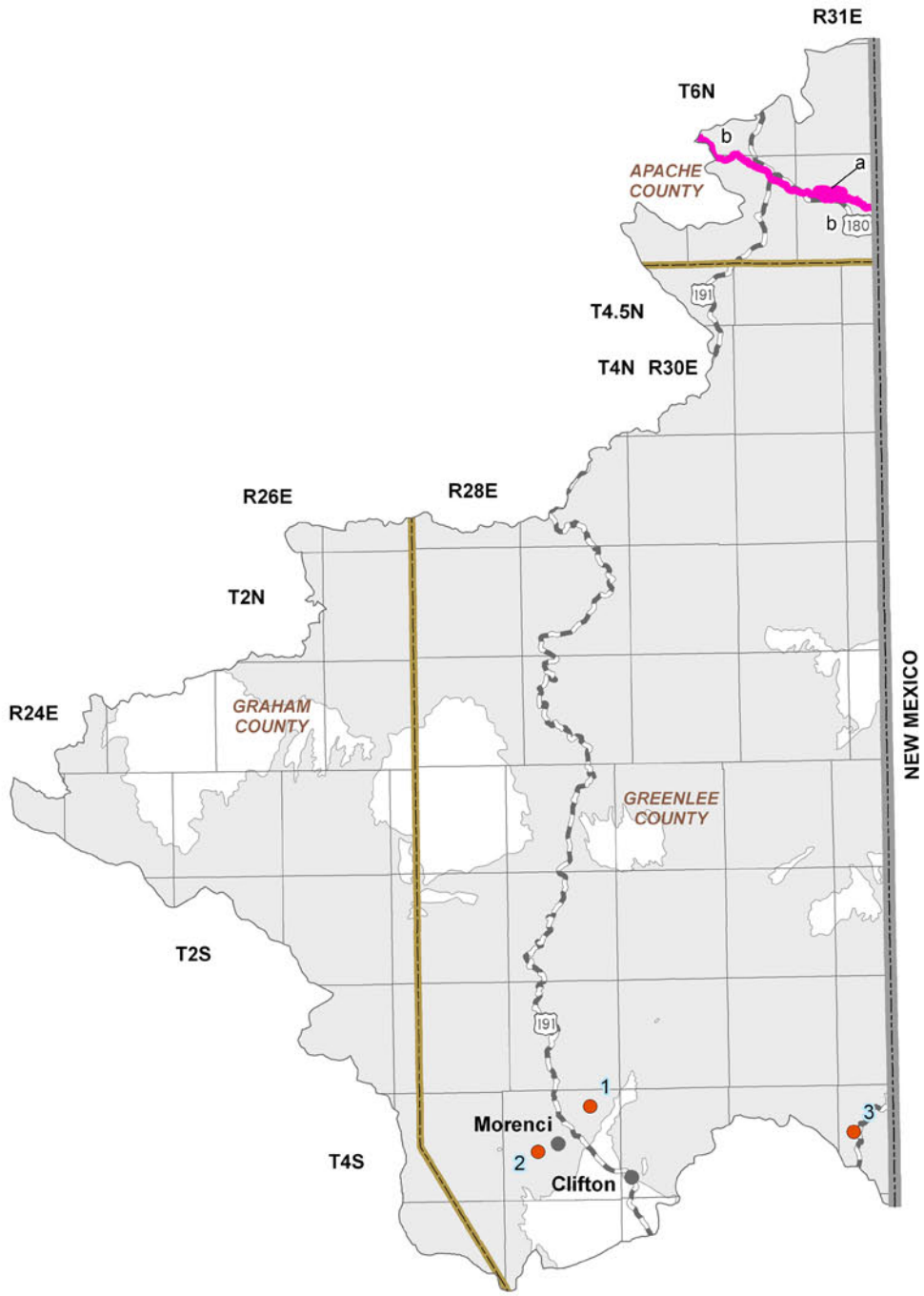
Source: Compilation of databases from ADWR & others

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	Luna	NA	120	A&W, AgL, FBC	DO, pH
b	Stream	San Francisco River (headwaters to New Mexico border)	13	NA	A&W	Sediment

Source: ADEQ 2005d

Notes:
Because of map scale, feature locations may appear different than the location indicated on the table
NA = Not applicable
[1] Water quality samples collected between 1996 and 2004.
[2] As = Arsenic
Be = Beryllium
Cd = Cadmium
Cu = Copper
DO = Dissolved oxygen
F= Fluoride
Pb = Lead
NO3 = Nitrate
pH = Measurement of acidity or alkalinity
[3] A&W = Aquatic and Wildlife
AgL = Agricultural Livestock Watering
FBC = Full Body Contact



0 3 6 Miles

Well, Spring or Mine Site that has equaled or exceeded DWS
Impaired Stream or Lake
Consolidated Crystalline & Sedimentary Rocks
Unconsolidated Sediments
New Mexico State Boundary
COUNTY
Major Road
City, Town or Place

Figure 3.9-10
Morenci Basin
Water Quality Conditions

3.9.8 Cultural Water Demands in the Morenci 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 3.9-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown on Table 3.9-9. Figure 3.9-11 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 3.9-8 and Figure 3.9-11.
- Population decreased from 1980 to 2000.
- Total groundwater use has increased from 1971 to 2003 with an average of 9,600 acre-feet pumped per year in the period from 2001-2005.
- Historical surface-water diversions are not available for this basin, however, surface water diversions have decreased from 1991 to 2005 with 1,700 acre-feet diverted per year in the period from 1991 – 2005.
- All surface-water diversions between 1991 and 2005 were for municipal and industrial uses, however, over 90% of the municipal and industrial water supply is groundwater.
- Almost all municipal and industrial demand is in the vicinity of Clifton and Morenci.
- Also in the Morenci and Clifton area is the active Morenci Mine.
- There is no agricultural demand reported in this basin.
- As of 2005, there were 505 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 145 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 3.9-9.
- There are three wastewater treatment facilities in the basin.
- Two of these facilities serve communities, effluent at the third facility is generated by the copper mining process and used for industrial purposes.
- Over 3,500 people are served by the two municipal facilities.
- 186 acre-feet of effluent from the municipal facilities per year are generated in this basin and discharged into either an evaporation pond or a watercourse.

Table 3.9-8 Cultural Water Demands in the Morenci 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		239[2]	59[2]	3,900			NR			ADWR (1994a) ADWR Show Low Lake Report (2005)
1972										
1973										
1974										
1975										
1976				4,700			NR			
1977										
1978										
1979										
1980	8,620									
1981	8,284	66	16	5,100			NR			
1982	7,948									
1983	7,612									
1984	7,276									
1985	6,940									
1986	6,604	47	24	6,400			NR			
1987	6,268									
1988	5,932									
1989	5,596									
1990	5,260									
1991	5,248	35	13	1,000	13,700	NR	600	2,400	NR	USGS (2007) ADWR (2008b) ADWR (2008c)
1992	5,236									
1993	5,224									
1994	5,212									
1995	5,200									
1996	5,186	46	24	1,000	17,900	NR	600	2,100	NR	
1997	5,177									
1998	5,165									
1999	5,153									
2000	5,141									
2001	5,126	72	9	1,400	8,200	NR	600	1,100	NR	
2002	5,111									
2003	5,096									
2004	5,081									
2005	5,066									
2010	4,990									
2020	5,021									
2030	5,113									
	WELL TOTALS:	**505**	**145**							

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

Table 3.9-9 Effluent Generation in the Morenci 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/ Landscape	Industrial Use	Wildlife Area	Discharge to Another Facility	Infiltration Basins			
Alpine WWTF	Alpine SD	Alpine	570	46		X							Secondary	70	2000
Clifton WWTF	Town of Clifton	Clifton	3,010	140	X								Secondary	70	2000
Morenci WWTF	Phelps Dodge-Morenci Water & Electric Co.	Morenci	NA						X				NA		
Total			**3,580**	**186**											

Source: Compilation of databases from ADWR & others

Notes:
Year of Record is for the volume of effluent treated/generated
NA: Data not currently available to ADWR
WWTF: Wastewater Treatment Facility
SD: Sanitation District

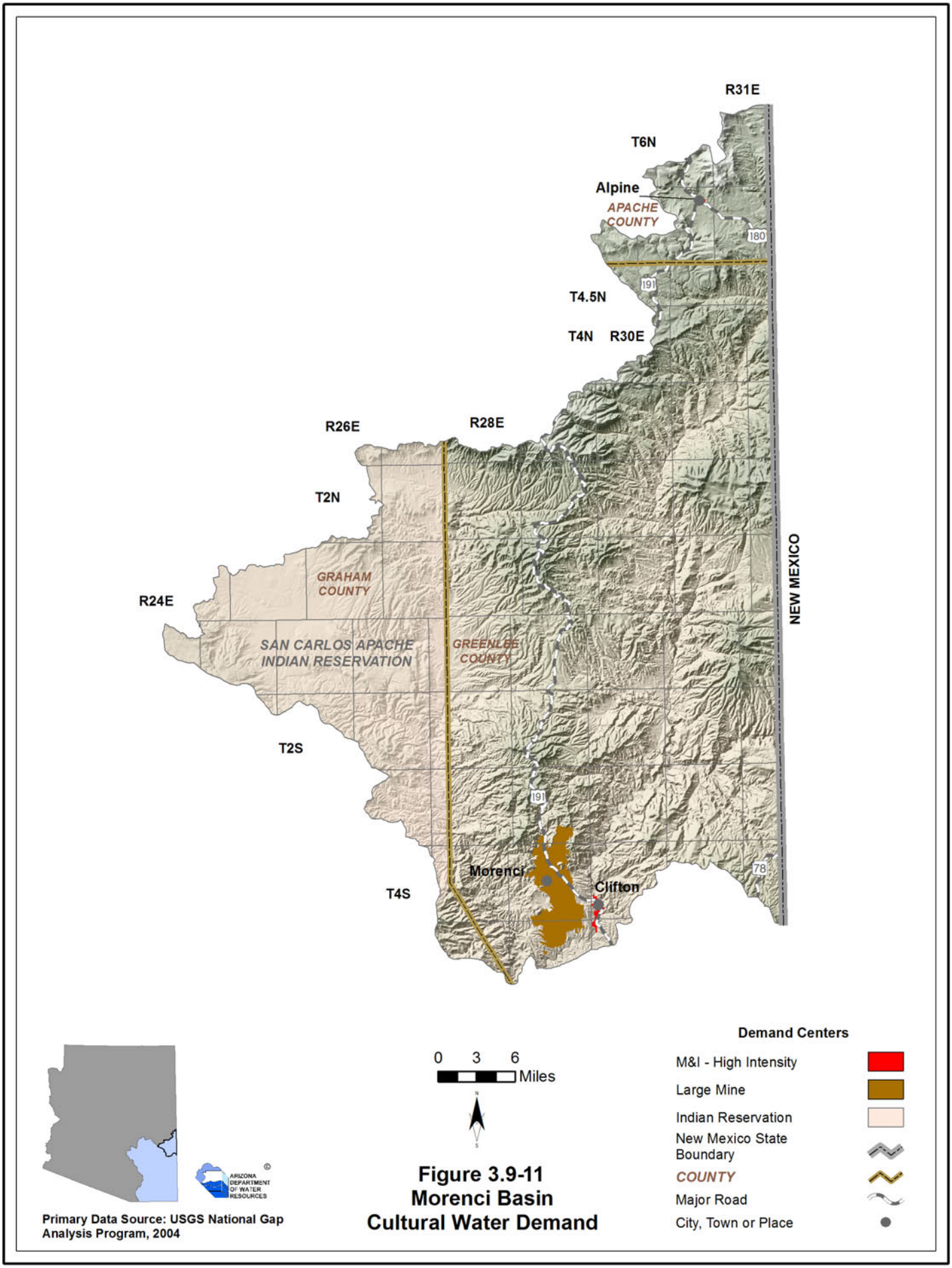


Figure 3.9-11
Morenci Basin
Cultural Water Demand

3.9.9 Water Adequacy Determinations in the Morenci 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 3.9-10. Figure 3.9-12 shows the locations of subdivisions 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.

- All subdivisions receiving an adequacy determination are in Apache County in the vicinity of Alpine. Eleven water adequacy determinations have been made in this basin through December 2008.
- One determination of water inadequacy has been made because the applicant failed to demonstrate the legal right to use the water or failed to demonstrate the provider's legal authority.
- Of the 1,859 lots in 10 subdivisions for which lot information was available, approximately 1,825 lots, or 98%, were determined to be adequate.

Table 3.9-10 Adequacy Determinations in the Morenci 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 Country Club	Apache	5 North	31 East	19, 20	8	53-500257	Adequate		7/18/1984	Alpine Country Club HOA
2	Alpine Forest Estates	Apache	5 North	30 East	11	75	53-402277	Adequate		10/17/2006	Turner Ranches Water Co.
3	Alpine Highlands	Apache	5 North	30 East	13	47	53-500259	Adequate		2/28/1978	Alpine Highlands Water Company
4	Alpine Village Acres	Apache	5 North	30 East	11, 14	1505	NA	Adequate		3/16/1988	Mountain Springs Water Company
5	Alpine Village Acres 2	Apache	6 North	31 East	11, 15	66	53-500262	Adequate		12/16/1993	Mountain Springs Water Company
6	Alpine Village East	Apache	5 North	30 East	14	NA	53-500263	Adequate		7/16/1985	Mountain Springs Water Company
7	Becker Estates	Apache	5 North	31 East	19	29	53-500313	Adequate		3/29/1982	Becker Estates HOA
8	Blue Spruce	Apache	5 North	30 East	12	24	53-500344	Adequate		7/11/1989	Alpine Water System
9	Jackson Spring Estates	Apache	5 North	31 East	18	34	53-500819	Inadequate	B	1/7/1987	Jackson Spring Estates HOA
10	Pine Ridge Estates	Apache	5 North	31 East	18	36	53-501153	Adequate		8/3/1983	Pine Ridge Estates HOA
11	The Ranch at Alpine, Amended	Apache	5 North	31 East	7, 18	35	53-700372	Adequate		8/20/2007	Alpine Domestic Water Improvemnt District

Source: ADWR 2008a

Notes:

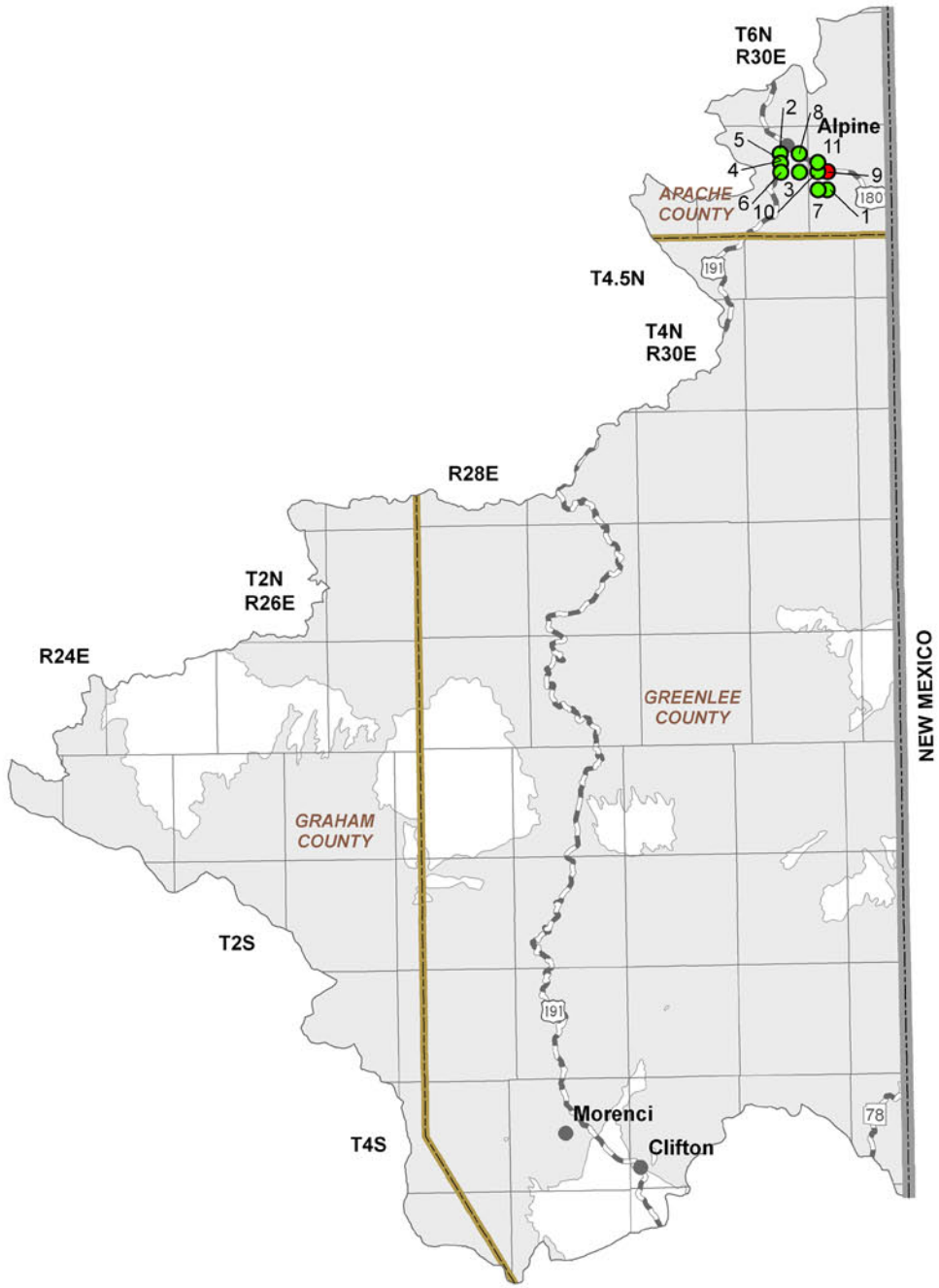
NA = Not Available

[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



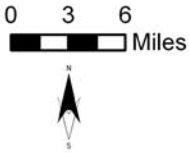


Figure 3.9-12
Morenci Basin
Adequacy Determinations

Adequacy Determinations

- Adequate
- Inadequate
- Consolidated Crystalline & Sedimentary Rocks
- Unconsolidated Sediments
- New Mexico State Boundary
- COUNTY
- Major Road
- City, Town or Place

MORENCI BASIN
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