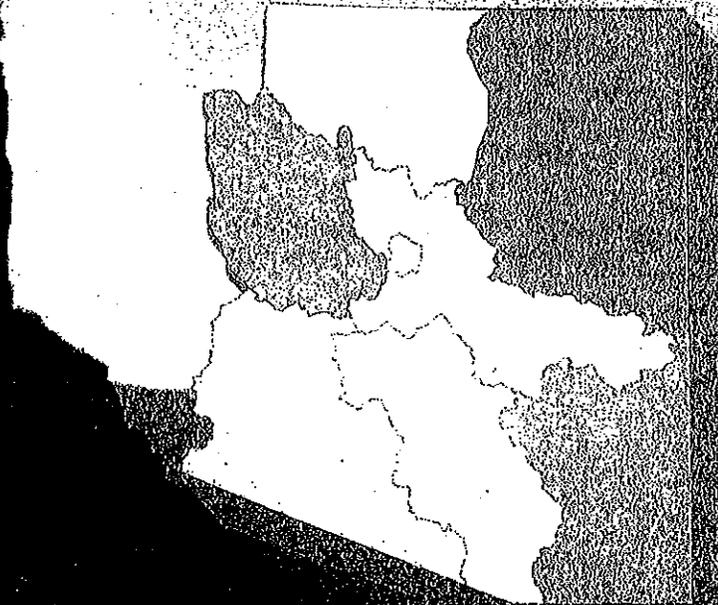


# ARIZONA WATER ATLAS

## VOLUME 1 EXECUTIVE SUMMARY



## APPENDIX B DATA SOURCES AND METHODS

This appendix describes the sources of data and methods of analysis for tables and maps presented in Volumes 1-8 of the Atlas. These descriptions may not completely explain some details of the data sources and analysis in all cases. More detailed information may be obtained by contacting the Department. Also, the references cited here may differ slightly from those presented in Volumes 2-8 if additional and/or more recent data became available.

### B.1 Adequate and Assured Water Supply Determinations

#### *Adequacy Determinations*

Information related to the Department's water adequacy determinations is presented on basin-scale maps (*Adequacy Determinations*) and summarized in a table for each basin (*Adequacy Determinations*) in Volumes 2-7. Where water adequacy reports and requests for analysis of adequate water supply have been filed, the tables include subdivision names, number of lots, locational data, Department file numbers, determination dates, reasons for inadequate determinations, and water providers at the time of application. Where water supplies have been designated for water provider service areas, the tables list information on Department file numbers, projected or estimated annual demand, the year the demand is expected, and designation dates. Adequacy determinations are further summarized in this volume by grouping the data into planning areas (Table 1-8) and by plotting on a statewide map (Figure 1-22).

Sources for this information come from the Department and include electronic databases maintained by the Office of Assured and Adequate Water Supply and paper files stored in the Hydrology Division (ADWR, 2010 and 2008e). Database queries were reviewed and some information was excluded from the Atlas based on subdivision location, duplicate applications, etc. Paper files were also reviewed to complete information that had not been entered into the databases such as number of lots and reasons for inadequate determinations.

Each determination of the adequacy of water supplies available to a subdivision is based on the information available to the Department and the standards of review and policies in effect at the time the determination is made.

#### *Assured Water Supply Determinations*

Information related to the Department's assured water supply determinations is presented on AMA scale maps (*Assured Water Supply Determinations*) and summarized in a table for each AMA (*Assured Water Supply Determinations*) in Volume 8. Where assured water supply certificates, water adequacy reports (pre-1980) and requests for analysis of adequate water supply have been filed, the tables include subdivision names, number of lots, locational data, Department file numbers, determination dates, and water providers at the time of application. Where water supplies have been designated, the tables list Department file numbers, information on projected or estimated annual demand, the year the demand is expected, and designation dates. Assured water supply determinations are further summarized in this volume by grouping the data by AMA (Table 1-9) and by plotting on a statewide map (Figure 1-22).

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#### *Adequacy Determinations*

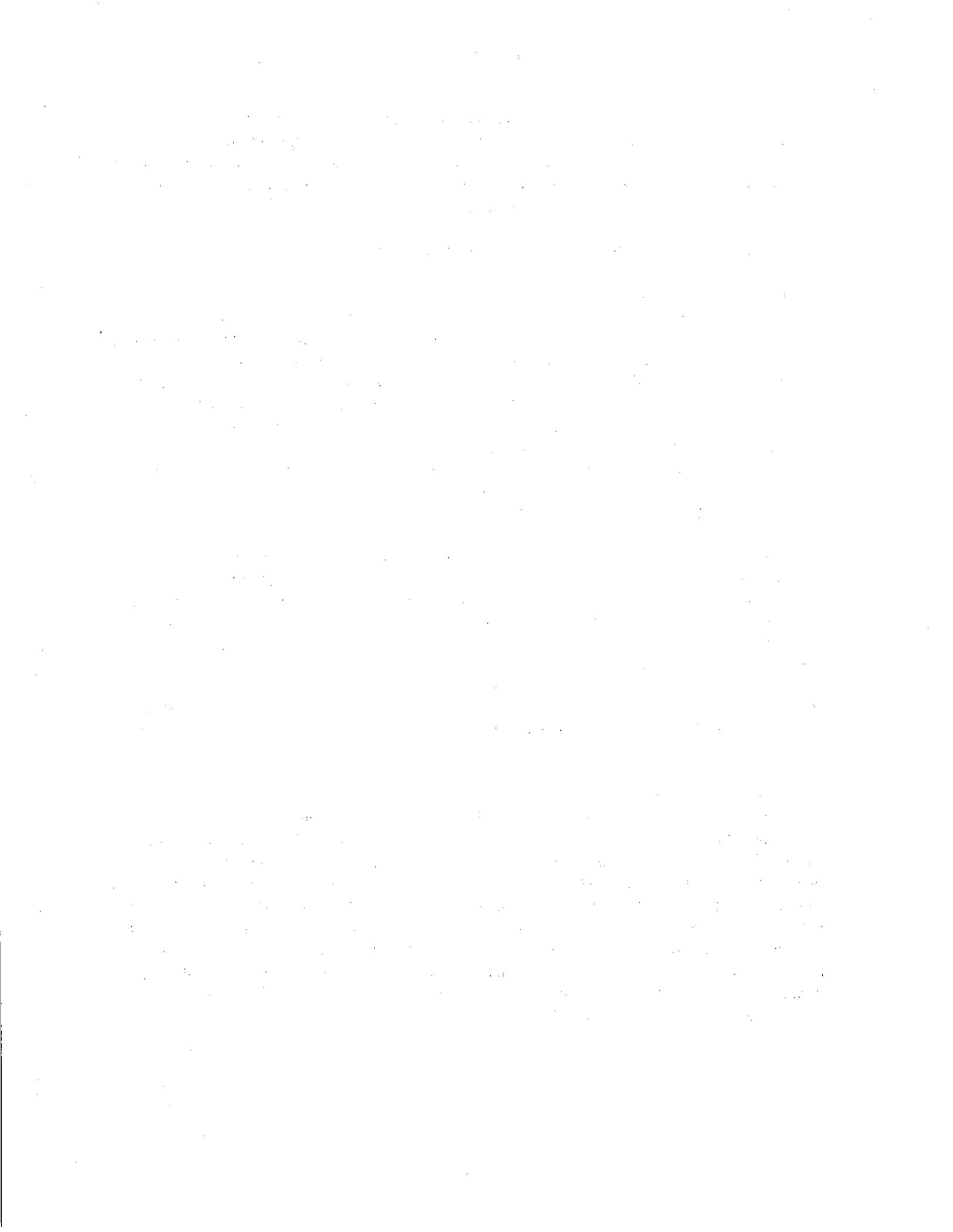
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### ***Snowfall Stations***

Snowfall data from Snowcourse and Snowpack Telemetry (SNOTEL) stations are summarized in a table for each basin (*Climatic Data*) and station locations are shown on basin-scale maps (*Meteorological Stations and Annual Precipitation*) in Volumes 2-8 and on a statewide map in this volume (Figure 1-14). The summary tables list the name and elevation of these stations, their period of record, and snowpack measurements. The average snowpack at the beginning of each month is presented as inches of snow water content, also referred to as the snow water equivalent. Only those months when snow surveys are usually conducted (January through June) are included.

Snowcourse and SNOTEL stations are operated by the Natural Resources Conservation Service (NRCS). Data from these stations have been compiled by NRCS and posted on its website. Statistics presented in the summary tables were downloaded directly from this website (NRCS, 2006 and 2005). Many factors can affect snowpack depths such as aspect, elevation and forest cover and NRCS takes great care to locate snow course and SNOTEL stations that provide representative data. Nevertheless, the data presented in the Atlas represents conditions at the measuring stations and only provides a general indication of average snowfall conditions across the highlands of some basins. Care should be taken when using these data for site-specific studies.

### ***Trends in Precipitation and Temperature***

Long-term trends in precipitation and temperature are shown by Planning Area in Volumes 2-8 and in Section 1.4.3 and Appendix E of this volume. Trend data are presented graphically with explanatory text. This information was primarily contributed by researchers at the University of Arizona, including the Institute for the Study of Planet Earth, which is responsible for the Climate Assessment for the Southwest (CLIMAS) program (CLIMAS, 2008). WRCC (2008) provided trend data for the AMAs.

## **B.4 Contamination Sites**

Contamination sites are shown on planning area and AMA maps (*Contamination Sites*) in Volumes 2-8 and on a statewide map in this volume (Figure 1-27). Included are the locations of U.S. Department of Defense (DOD), Voluntary Remediation Program (VRP), Superfund (listed on the National Priorities List or NPL), Resource Conservation and Recovery Act (RCRA), Water Quality Assurance Revolving Fund (WQARF) and Uranium Mill Tailings Remedial Action (UMTRA) sites as well as leaking underground storage tanks (LUST).

The data were provided by ADEQ and included locations for all LUST sites in Arizona, regardless of reported contaminant levels or whether remediation had been completed (ADEQ, 2006). For purposes of the atlas, LUST sites are only shown where contamination is either suspected or known to exist and remediation is required to meet soil and water quality standards. LUST sites that meet applicable standards and/or have been remediated and closed-out are not included.

## **B.5 Cultural Water Demands**

### ***Location of Major Water Use***

Locations of major water use are shown on basin-scale maps (*Cultural Water Demands*) in Volumes 2-8 and on a statewide map in this volume (Figure 1-31). Included on the maps are agricultural

lands, low- and high-intensity developments, mines and power plants. The primary data source for the water use maps was a land cover study of the southwestern United States, completed by the USGS (2004). Land cover types were mapped in this study at a 5- to 12-acre resolution using Landsat satellite imagery collected between 1999 and 2001. The Department supplemented the data with the locations of active power plants and mines (ADM MR, 2005).

Due to its resolution, use of Landsat imagery to map land cover types requires a high degree of interpretation and some areas of water use, particularly agricultural lands, may be misclassified. The Department reviewed the USGS land covers to ensure that they were reasonable and made edits as needed. It should also be noted that the Landsat imagery used by the USGS is now as much as 10 years old, and some land cover types may have changed since the imagery was taken.

### *Surface Water Diversions*

Annual surface water diversions for agriculture, industrial, and municipal uses are listed in a table for each basin (*Cultural Water Demand*) in Volumes 2-8 and on a statewide table in this volume (Table 1-14). For the AMAs, surface water diversions are grouped with other non-groundwater supplies which can include Central Arizona Project (CAP) water, effluent, and spill and tail waters

Surface water demand data for the period 1971-1990 (and through 1985 in the AMAs) were taken from the Department's 1994 *Assessment* (ADWR, 1994a). A variety of sources were utilized to determine more recent surface water demands for the period 1991 through 2005. ADEQ (2005b) furnished a list of municipal water providers who utilize surface water and the ACC (2005b) supplied annual reports for some of these providers indicating how much surface water they were diverting and/or delivering. USGS (2007) provided data on surface water demands for agriculture for those basins where the diversions have been metered. Most other surface water demands had to be determined by the Department through one or more methods including review of existing Department, BOR, county, and consultant reports; analysis of recent aerial photography; Internet and records research; questionnaires and phone interviews; consultation with the USGS; and, limited fieldwork (ADWR, 2008f). The Department's Colorado River Management Section was an important data source and provided records of Colorado River water users, locations and annual diversion volumes (ADWR, 2006). Department Annual Withdrawal and Use Reports provided data on most surface water demands in the AMAs since 1986 (ADWR, 2008g).

In many cases outside of the AMAs, the Department had to estimate the quantity of surface water demand because the records were nonexistent, imprecise or incomplete (ADWR, 2008f and 2005b). For example, to estimate unmetered surface water diversions for agriculture, the Department made assumptions about the number of cropped acres and water duty. For some irrigated areas, diversion amounts were adjusted to account for basin boundaries. Similarly, for most non-AMA golf courses determined to be using surface water, the Department estimated demand based on the number of holes and local irrigation needs for turf (ADWR, 2008j). The surface water demand of municipal water providers was estimated in some cases based on the number of hookups, an assumed per capita use rate and delivery losses.

As previously mentioned, the surface water demand for agricultural, industrial, and municipal use was often unmetered and had to be estimated by the Department. Historic demands were assumed

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to represent current conditions and vice versa if information was not available. Assumptions were also made where water demands were met by combining surface water diversions and well pumpage, but the precise volume of each was not known. Furthermore, it is likely that several relatively small surface water diversions were simply not identified by the Department and not included in the Atlas. The values presented in the Atlas should, therefore, not be considered precise, but they provide an estimate of these demands and indicate where surface water is an important water source to meet cultural demands. The following conventions were used to round cultural demand values met by surface water:

- 0 to 1,000 acre feet – round to the nearest 50 acre-feet (af);
- 1,000 to 10,000 acre-feet – round to the nearest 100 af;
- 10,000 to 100,000 acre-feet – round to the nearest 500 af; and
- 100,000 to 1,000,000 acre-feet – round to the nearest 1,000 af.

Recent non-groundwater demands in the AMAs were generally rounded to the nearest 100 af.

Finally, it should be noted that surface water stored in reservoirs and stockponds and diverted through fish hatcheries were not included in the cultural demand tables. Practically all of the surface water diverted by fish hatcheries passes through the facilities and is released for use downstream. Surface water stored in reservoirs and stockponds may or may not be released for use downstream and some of this water is lost to evaporation.

### ***Well Pumpage***

Annual well pumpage for agricultural, industrial, and municipal uses is listed in a table for each basin (*Cultural Water Demand*) in Volumes 2-8 and on a statewide table in this volume (Table 1-14). Data on well pumpage are also summarized by planning area in the text of the planning area volumes. Well pumpage data for the period 1971 through 1990 (and through 1985 in the AMAs) are from the Department's 1994 *Assessment* (ADWR, 1994a). Outside of the AMAs, the primary data source for well pumpage for the period 1991 through 2005 was the USGS (2007), which describes its methodology, assumptions, and data limitations in the 2005 report *Water Withdrawals for Irrigation, Municipal, Mining, Thermoelectric-Power, and Drainage Uses in Arizona Outside of Active Management Areas, 1991-2000* (Tadayon, 2004). The Department's Annual Withdrawal and Use Reports provided most well pumpage data for the AMAs since 1986 (ADWR, 2008g).

The Department had to adjust the USGS pumpage values for a few basins where mining companies pump from the same wells to supply both industrial and municipal needs and, in other basins where springs have been identified as a water source. The USGS accounted for water use from springs as well pumpage, whereas the Department considers these to be surface water diversions. In addition, the USGS did not evaluate water use by feedlots and golf courses. The Department considers both to be industrial uses and, for the Atlas, estimated well pumpage following methods similar to those used to estimate surface water diversions (ADWR, 2008j and 2008k). To estimate well pumpage for feedlots, the Department identified feedlots by using ADEQ's list of active feedlots in Arizona (ADEQ, 2005a) and, based on the type and number of animal units at each feedlot, applied a consumptive rate.

Outside of the AMAs, the quantity of well pumpage for agricultural, industrial and municipal use was not always metered, requiring estimation in some cases (ADWR, 2008f). Historic pumpage was assumed to represent current conditions, and vice versa, if information was unavailable.

Assumptions were also made where water demands were met by combining well pumpage and surface water diversions, but the precise volume of each was unknown. Lastly, it is likely that several relatively small well withdrawals were simply not identified by the USGS or the Department and are not included in the Atlas. The values presented in the Atlas should, therefore, not be considered precise, but they provide an estimate of pumpage and indicate where well water is an important water source to meet cultural demands. The following conventions were used to round cultural demand values met by well pumpage:

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In the AMAs, recent well pumpage was rounded to the nearest 100 af.

### ***Community Water System Annual Reports***

Beginning in 2006, all community water systems in the state must submit an annual report of water withdrawals, diversions and deliveries to the Department. Systems in the AMAs have been reporting this information to the Department since 1984 under provisions of the Groundwater Management Act. A community water system is defined as a public water system that serves at least 15 service connections used by year-round residents or that regularly serves at least 25 year-round residents. A.R.S. § 45-341. This information has been compiled by planning area in the Appendices of Volumes 2-7 and data for the largest water providers are included in water demand summary tables in the overview of these volumes.

### ***Planning Area Summaries***

The overview of Volumes 2-8 summarize the basin surface water diversion and well pumpage data described above by planning area. Average cultural water demands during the period 2001-2005 are listed in tables and displayed on graphs and pie charts. For comparison, water demands for the periods 1991-1995 and 1996-2001 are also listed in certain tables and tribal water demands are presented separately. These planning area data are further summarized in Section 1.4.7 of this volume.

## **B.6 Drought**

Drought conditions in the planning areas are discussed under the Climate Section of Volumes 2 through 8 and in Appendix E of this volume. This information was provided by the Department's Drought Planning Section, University of Arizona Cooperative Extension, CLIMAS/Institute for the Study of Planet Earth, and the USGS (CLIMA, 2005).

## **B.7 Effluent**

### ***Facility Data***

Information on facilities that treat and discharge effluent is summarized in a table for each basin (*Effluent Generation*) in Volumes 2-8 and summarized in a planning area table (Table 1-13) of this volume. For each treatment facility, the tables list the name, owner, city/location served, population served, volume of effluent treated/generated annually, effluent disposal methods, levels of treatment, unserved population, and year of record.

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Primary data sources were the Clean Water Needs (CWN) Surveys sponsored by the Water Infrastructure Financing Authority (WIFA), and annual reports provided by the ACC. CWN Surveys are conducted every two to four years and are used to assist treatment facilities in obtaining funding. To capture data for as many treatment facilities as possible, survey results from 1996, 2000, 2004 and 2006 were used for the Atlas (EPA, 2005a, 2005b, 2002, 2000 and 1996). The ACC regulates private treatment plants and requires that operators file annual reports that sometimes included data on effluent production (ACC, 2005). The data were supplemented, when possible, with information from facility operators, from ADEQ (2005c,d,e,f), which issues facility discharge permits), and city, county and Department reports. The latter include Annual Withdrawal and Use Reports (in AMAs) and Community Water System annual reports.

Wastewater treatment is a dynamic industry with frequent changes in plant names, treatment levels and effluent volumes. Although the last CWN survey was conducted in 2006, updated information was not available for all facilities. The Department used the most recent data available, which for some facilities is over 10 years old (WIFA, 2005a and b).

### *Effluent Dependent Waters*

The location of effluent-dependent waters, including lakes and stream reaches, are shown on basin-scale maps (*Water Quality Conditions*) in Volumes 2-8. A GIS cover of effluent-dependent waters in Arizona was provided by ADEQ (2005g). These reaches are also listed and described by ADEQ in their surface water quality rules (A.A.C. R18-11-113).

## **B.8 Environmental Conditions**

### *Biotic Communities and Ecoregions*

Information on biotic communities (Brown and Lowe, 1980) and ecoregions (Olson and others, 2001) are discussed in the overview and shown on planning area-scale maps (*Biotic Communities and Ecoregions*) in Volumes 2-8. A statewide map is presented in Figure 1-18 of this volume.

### *National Parks, Monuments, Wildlife Refuges and Wilderness Areas*

A discussion of National Parks, Monuments, Wildlife Refuges and Wilderness Areas is provided in the overview of Volumes 2-8 and their location is shown on planning area maps (*Protected Areas*) in these volumes (BLM, 2008 and 2006; USFS, 2007). A table of wilderness areas with total acres and brief description of prominent features is also found in the overview of Volumes 2-8.

### *Riparian Areas*

The location of riparian areas (AZGF, 1993) is shown on planning area maps (*Instream Flow Applications*) in Volumes 2-8 and a statewide map is presented in Figure 1-19 of this volume.

### *Threatened and Endangered Species*

A table listing threatened and endangered species (USFWS, 2008) by planning area and their elevation and habitat is found in the overview of Volumes 2-8.

