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ARIZONA

WATER QUALITY

ASSESSMENT

1996

Arizona Department of Environmental Quality

EQR 96-33

Arizona Department of Environmental Quality
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Phoenix, Arizona 85012
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In Arizona 1-800-234-5677

VISION

The Arizona Department of Environmental Quality will be the best environmental agency in the nation. We will be a well trained, motivated team that will:

- Be innovative and supportive
- Provide quality services to our customers
- Align our jobs with the Department's mission, and
- Promote a sustainable environment and economy.

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The Arizona Department of Environmental Quality shall preserve, protect and enhance the environment and public health, and shall be a leader in the development of public policy to maintain and improve the quality of Arizona's air, land and water resources.

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ACKNOWLEDGMENTS

The publication of this report is possible due to the cooperative efforts and contributions by ADEQ staff and by many other state and federal agencies in Arizona.

ADEQ Groundwater Team: Mario Castaneda, Pejman Eshraghi, Charles Hains, Wayne Hood III, Gary McDermott, Doug Towne, and Don Hall.

Surface Water Team: Winston Carter, Virginia Coltman, Susan Fitch, Lee Johnson, Lin Lawson, Richard Meyerhoff, Sam Rector, Patrice Spindler, Tom Trent, Anthony Villocino, and Roland Williams.

Program Reports: Wayne Hood III (Hydrologic Support and Assessment), Melinda Longsworth (Surface Water Monitoring), Richard Meyerhoff (Water Quality Standards), Don Shroyer (Nonpoint Source), Wang Yu (Groundwater Monitoring and Pesticides Program), Tom Trent (Clean Lakes Program), Cara Delvecchio (Superfund Sites), John Hathaway (Watersheds), Robert Simms (Underground Storage Tanks), Ron Frey and Pejman Eshraghi (Lake Havasu), Patrice Spindler (Biocriteria Development), Kris Randall and Virginia Coltman (Wetlands and Riparian Areas), and many more.

Individuals representing numerous other agencies provided data, information, and draft document reviews. A special thanks to Marc Dahlberg (Arizona Game and Fish Department), Steve Markman (U.S. Bureau of Land Management), Laurie Wirt, Steve Longsworth, and Dean Radtke (U.S. Geological Survey), John Rihs (U.S. National Parks Service), Peggy Ulman (Pima County NPDES Stormwater Program), Roland Wass (previously with Maricopa Flood Control District - Stormwater Program), and many more.

As coordinator for the production of this report, I want to thank each of you! And a very special thanks to two State Service Interns who assisted in the necessary (and tedious) data input, data crunching, graph production, and proofreading - Bete Jones and Chandra Chithaluru.

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Published December 1996

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PROLOGUE

"In the space of one hundred and seventy-six years the Lower Mississippi has shortened itself by two hundred and forty-two miles. That is an average of a trifle over one mile and a third per year. Therefore, any calm person, who is not blind or idiotic, can see that in the Old Oolitic Silurian Period, just a million years ago next November, the Lower Mississippi River was upward of one million three-hundred thousand miles long, and stuck out over the Gulf of Mexico like a fishing rod. And by the same token any person can see that seven hundred and forty-two years from now, the lower Mississippi will be only a mile and three-quarters long, and Cairo [Illinois] and New Orleans [Louisiana] will have joined their streets together, and be plodding comfortably along under a single mayor and mutual board of aldermen.

There is something fascinating about science. One gets such a wholesale return of conjecture out of a trifling investment of fact."

Comments by Mark Twain on the practice of extrapolation from limited data taken from *Life on the Mississippi* (1883).

This report is submitted for your use with the admonition that the reader heed Mark Twain's advice. Frequently, small amounts of data were extrapolated for this assessment of water quality. The long appendices and reference list are provided so that you would know the basis of each assessment and could obtain further information for your own application.

Diana Marsh
Assessment Coordinator

EXECUTIVE SUMMARY

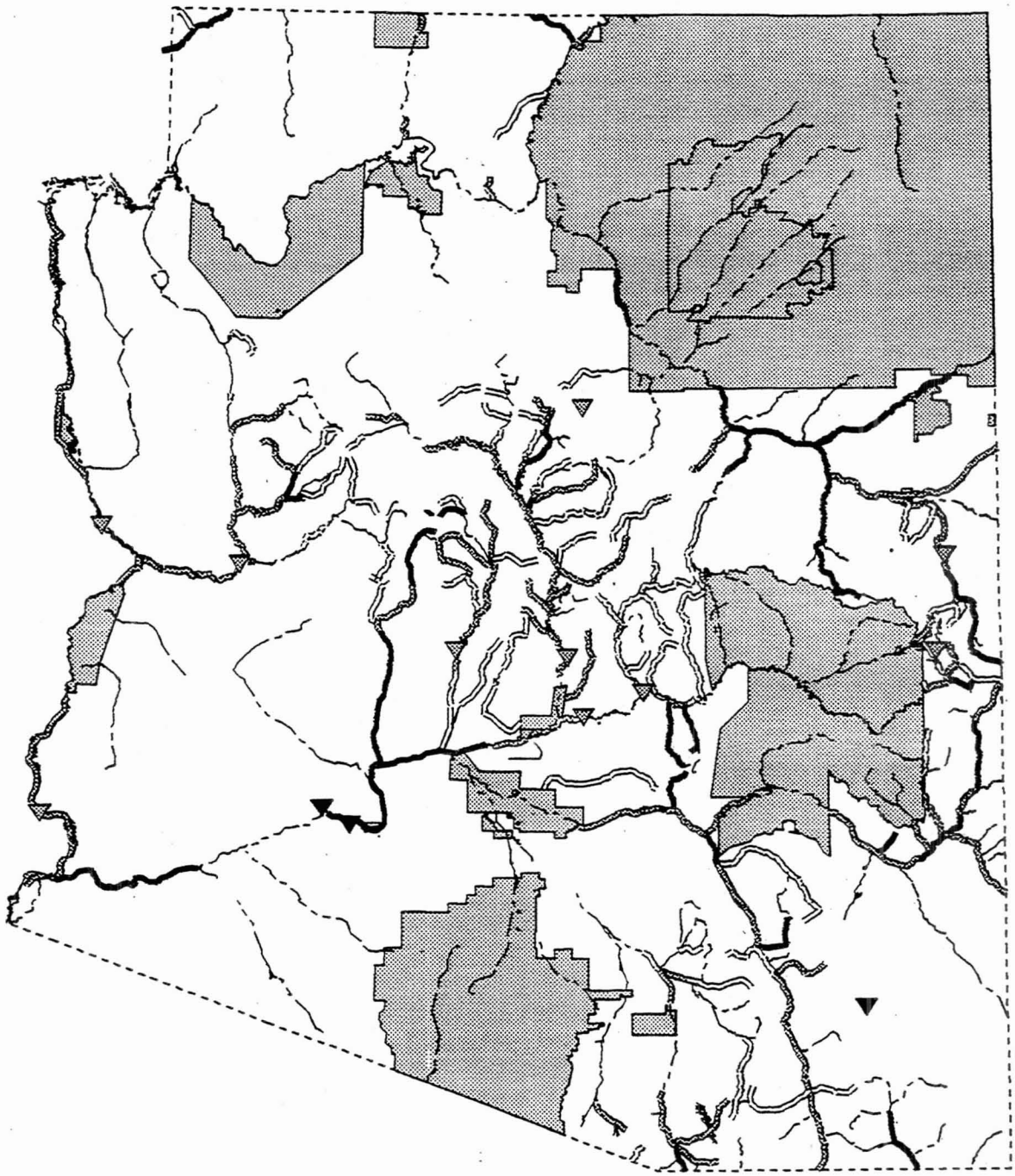
The Arizona Department of Environmental Quality (ADEQ) 1996 Water Quality Assessment Report describes the status of surface water and groundwater quality in Arizona. Assessments were based primarily on data collected during the past five water years -- from October 1, 1990 through September 30, 1995.

Surface Water Assessments--Water column, tissue, and sediment results were the primary basis of the surface water quality assessments. Data were provided by the ADEQ, the U.S. Geological Survey, the Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service (in the Grand Canyon National Park), Arizona Game and Fish Department, the Salt River Project, the University of Arizona, and miscellaneous private consultants. Sample results were compared to surface water standards adopted in 1992 (rather than the standards adopted in 1996) and other criteria **(Appendix A)**. Assessment Criteria **(Appendix C)** were applied to sample results **(Appendix B)** and other information pertaining to water quality **(Appendix E)** to assess individual waterbodies **(Appendix F)**. These assessments were used to update a list of "Water Quality Limited Waters", impaired waters for which "total maximum daily loads" should be investigated for all sources of the contaminant of concern **(Appendix H)**.

In 1996, ADEQ assessed 5,410 stream miles, approximately 6% of the stream miles in Arizona **(Map 1)**. The state has established designated uses in its surface water regulations. Approximately 40% were assessed as in full support of all designated uses (i.e., meeting all water quality standards), while 60% were impaired (i.e., did not meet at least one standard). Monitoring and assessments continue to focus on perennial streams (i.e., streams with some flow year round). Of an estimated 3,528 miles of perennial stream in Arizona, 2,674 miles were assessed (75%). Thirty-one percent of the perennial stream miles assessed were in full support.

Of an approximate 157,000 lake acres inventoried as publicly-owned lakes, 58,860 acres were assessed (37%) **(major reservoirs on Map 1)**. Only 76 of the 364 inventoried lakes were assessed (21%), and many of these were large reservoirs with up to 10,000 acres. Of the 58,860 acres assessed, only 1% were fully supporting all of their designated uses. Impoundments and diversions, which result in shallow lakes with high productivity, cause much of this impairment rather than pollutant dischargers. Under these conditions, algal blooms result in high pH values, low dissolved oxygen, and occasional fish kills. These impoundments also act as sinks for contaminated (and uncontaminated) sediments, and evaporation in these impoundments increase concentrations of total dissolved solids.

Each designated use was assessed separately and **Table ES-1** provides a summary of use support by designated use. Aquatic and Wildlife and Domestic Water Source are the designated uses found most impaired in streams and lakes. Notably, these uses also have the most restrictive standards. Further, the Environmental Protection Agency's secondary maximum contaminant levels for drinking water were used as Domestic Water Source assessment criteria for the following parameters that can reduce the aesthetic quality of the water: total dissolved solids, chloride, sulfate, iron, and manganese. Although many waterbodies may have satisfied surface water standards, they may have exceeded these secondary criteria. High levels of these chemicals frequently result in additional treatment cost to the consumer (i.e., carbon filters, reverse osmosis, softeners or bottled water).



Map 1. Arizona Statewide Surface Water Quality Assessment - 1996

Indian Reservations
Fully Supported/ Threatened Lake
Partially Supported Lake
Not Supported Lake
Streams
Fully Supported or Threatened
Partially Supported
Not Supported

SCALE
MILES 10 0 10 20 30 40
KILOMETERS 10 0 10 30 50

N W E S

Table ES-1. Designated Use Support

	STREAMS		LAKES	
	PERCENT FULL SUPPORT	PERCENT IMPAIRED	PERCENT FULL SUPPORT	PERCENT IMPAIRED
Aquatic and Wildlife	49%	51%	53%	47%
Fish Consumption	68%	32%	92%	7%
Body Contact (Full and Partial)	61%	39%	72%	28%
Domestic Water Source	48%	52%	14%	86%
Agriculture Irrigation	80%	20%	97%	3%
Agriculture Livestock Watering	85%	15%	96%	4%

The top three stream stressors (pollutant categories) were metals, turbidity, and salinity; the top two lake stressors were salinity and metals. Toxicants (stressors which could be considered toxic to man, plants, or other animals) impaired water in 29% of the stream miles assessed and 17% of the lake acres assessed.

Determining pollutant sources is subjective because source data are not usually included with laboratory results. The primary pollutant sources for both lakes and streams were believed to be: natural sources, rangeland management, hydro-habitat modification, resource extraction, and activities outside of Arizona's jurisdiction.

Potential risks to public health and aquatic life have resulted in fishing advisories in four areas, drinking water advisories at two springs in the Grand Canyon National Park, swimming area closures in two areas and studies of the selenium level in fish and wildlife in the Colorado River backwater lakes. Information about each of these actions is summarized in **Appendix E**.

Groundwater Assessments--Monitoring data collected during the past 5 years (October 1990- September 1995) was the basis of the groundwater quality assessments. This data was primarily collected by ADEQ, the Arizona Department of Water Resources, the U.S. Geological Survey, and the Salt River Project. Groundwater quality was considered from three perspectives:

- Wells exceeding Arizona's Aquifer Water Quality Standards,
- Remediation sites, and
- Probable sources of groundwater contamination.

Water quality data were aggregated within groundwater basins to look at regional concerns. The assessment data were also aggregated into watersheds, an area delineated by surface water boundaries, to facilitate water quality management and integrate surface water and groundwater quality concerns.

Among the groundwater monitoring data collected since Water Year 1990, radiochemicals were exceeded aquifer water quality standards more often than any other contaminant group. Almost all of this contamination is derived from natural sources. Even where contamination occurs around uranium mining and processing areas, it is difficult to determine how much of this contamination is caused by man's activities versus natural occurrence. Water quality data from index wells (i.e., 200 wells chosen to characterize regional water quality) indicate that fluoride and metals are also often detected at elevated levels. Such contamination is not surprising with Arizona's heavily

mineralized geology. Other water quality data, collected for a variety of reasons, indicate that volatile organic chemicals (solvents), nitrate, fluoride, and metals also contaminate groundwater in some areas.

Remediation activities are focused on 58 state and federally listed "Superfund" sites, 38 Resource Conservation and Recovery Act (RCRA) corrective action sites, and 2863 leaking underground storage tank sites. **Appendix G** provides site-specific information. Most of the Superfund and RCRA remediation sites are the result of historic storage, handling, and disposal practices that are no longer allowed under existing regulations. Unfortunately, the cleanup of many of these sites will take 25-50 years and millions of dollars.

The primary sources of groundwater contamination in Arizona include (not listed by priority):

- Natural deposits
- Historic misuse of chemicals/solvents
- Septic systems
- Mining operations
- Historic dumps
- Storage tanks
- Fertilizer application
- Irrigation practices
- Mine waste and tailings piles
- Landfills

Water Quality Management Programs

These surface water and groundwater assessments reflect the efforts of a wide range of water quality management programs that are coordinated by the Arizona Department of Environmental Quality. A brief description of 24 of these programs in provided in Chapter 2, Part 1, followed by a status report on the following programs:

- Nonpoint Source Program,
- Clean Lakes Program, and
- Wetlands and Riparian Areas Protection Program.

Arizona implemented a number of special initiatives to protect or improve water quality in Arizona. Examples of special initiates include: Arizona's Watershed Protection Approach, the Arizona Comparative Environmental Risk Project, the National Water Quality Assessment of the Central Arizona Basin, the Wellhead Protection Project, the Constructed Wetlands Initiative, and the Environmental Indicators Project.

Water Quality Limited Waters--Waterbodies assessed as having impaired uses that require more than existing technology and permit controls to achieve or maintain water quality standards are classified as "Water Quality Limited Waters." These waters have been prioritized for the completion of a Total Maximum Daily Load analysis (estimate of contribution by source category or specific discharges). In 1996, 120 waterbodies are listed as Water Quality Limited. ADEQ will address the Water Quality Limited Waters in two watersheds in the next two years: the Verde Watershed and the San Carlos-Safford-Duncan Watershed. The balance will be addressed through the rotation of resources through the remaining eight watersheds.

Cost-Benefit Analysis--Increased population and increased recreation on our waters indicate an increasing demand for high quality water for drinking, industrial, and recreational use. Population pressure has been offset in part by an associated decreased use of water for growing crops and the completion of the Central Arizona Project (that transports water across the State from the Colorado River). Similar additions to future water resources by new impoundments and diversions are not likely because of environmental impacts and water rights issues.

ADEQ has estimated that groundwater remediation at Superfund sites runs approximately $25.5 million per site and many sites may take 50 years or more to finalize the cleanup. These high costs clearly demonstrate the cost effectiveness of water quality management programs and regulations to prevent further contamination.

CHAPTER 1 - ASSESSMENT OF WATER QUALITY

PART I - PURPOSE AND BACKGROUND

Scope of Report

This report describes the status of water quality in Arizona, and includes to the extent known the nature, extent, and causes of groundwater and surface water quality problems. The Arizona Department of Environmental Quality (ADEQ) prepared this report as Arizona's designated state agency for purposes of the federal Clean Water Act. This report fulfills biennial reporting requirements of the Clean Water Act to the U.S. Environmental Protection Agency (EPA) contained in sections 305(b) and 106(e). Other requirements of the Clean Water Act satisfied by this report include: a list of "water quality limited" surface waters [Section 303(d)], status and trends report of publicly owned lakes (Section 314), and an update of waters impaired by nonpoint sources (Section 319).

The period of record for this report is October 1, 1990 through September 30, 1995. Older data were used if the data were believed to still provide an accurate description of current conditions. A two-year period was used for an update of water quality control activities in Arizona, since the 1994 Water Quality Assessment Report (ADEQ 1994d) -- from October 1994 through September 1995.

Information in this report is divided into the following chapters and appendices:

- **Chapter 1** provides an assessment of surface water and groundwater quality, along with background information about Arizona to provide context for this report (i.e., hydrology and ecoregions, land management considerations, monitoring programs, water quality standards, and assessment methods). The waterbody-by-waterbody assessments are presented by watersheds and the groundwater information is presented by groundwater basins within each watershed. The assessments are prefaced by a general description of Arizona's
- **Chapter 2** contains a brief description of major water quality management programs and special initiatives in Arizona during the past two years.
- **Chapter 3** is a discussion of the 1996 "Water Quality Limited Waters" list and a cost/benefit analysis of water quality programs in Arizona.
- **Appendix A** is a series of tables of numeric standards and criteria used in this assessment for surface water, groundwater, sediment and animal tissue.
- **Appendix B** is a summary of surface water monitoring data used in this assessment, organized by watershed.
- **Appendix C** describes the surface water assessment process and criteria used to determine use support (full support, full but threatened, partial support, non-support). These criteria vary according to designated uses.
- **Appendix D** contains a list of the National Pollution Discharge Elimination System (NPDES) wastewater permits in Arizona and the streams receiving their discharges.
- **Appendix E** is a list of aquatic life and public health impacts in Arizona from October 1, 1993 to September 30, 1995.
- **Appendix F** provides waterbody-by-waterbody assessments of designated uses.
- **Appendix G** shows the location and status of known groundwater contamination sites. Site locations are illustrated on maps.
- **Appendix H** is a list of waters classified as "Water Quality Limited Waters," based on requirements of the Clean Water Act Section 303(d). This list shows the priority ranking for completion of Total Maximum Daily Load analyses.
- **Appendix I** provides a glossary of terms, acronyms, and abbreviations used in this report.

Hydrology and Distribution of Water Resources

The Arizona Atlas--Table 1 provides some statewide hydrological statistics. The United States Geological Survey (USGS) classifies surface water streams as "perennial," "intermittent" and "ephemeral" using the following definitions:

Stream Flow Classification

Perennial: Flows continuously.

Intermittent: Flows only at certain times of the year when receiving water from springs or from some surface source such as melting snow in mountainous areas (i.e. seasonal).

Ephemeral: Flows only in direct response to precipitation, and its channel is at all times above the water table.

Surface Water Basins and Reach Numbers--The U.S. Geological Survey divided the United States into surface water hydrologic units (drainage areas) and assigned each unit a code number. All of the drainage areas in Arizona are actually a sub-drainage of the Colorado River, except for some small areas located along the Mexican border which drain to the Gulf of California (Rios de Mexico Basin). ADEQ grouped these "hydrologic units" into 10 "watersheds" **(Map 2 page 7)** for water quality planning purposes (see the discussion of the watershed protection approach in Chapter 2). Surface water and groundwater assessments are organized and discussed within these watersheds throughout this report.

The surface water statistics for these watersheds have been derived from the USGS digitized hydrography at a scale of 1:100,000 **(Table 2)**. There is a total of 104,175 miles of streams, canals, and dry washes, and 302,193 acres of lakes, reservoirs, playas, wetlands, tailings ponds, and cattle tanks in Arizona that are not on Indian lands. The majority of these are "waters of the United States," as defined by Arizona's surface water standards, and are subject to this assessment. The exceptions are manmade waters such as cattle tanks, urban lakes, tailings ponds. A detailed inventory of waterbodies categorized as "waters of the United States" are not available for statistical purposes. Further statistical information about waterbodies and groundwater resources in Arizona (i.e., annual stream flow, record flows, locations of gaging stations, reservoir storage capacities, etc.) is published by USGS and the Arizona Department of Water Resources in annual reports and statistical summaries.

The Environmental Protection Agency has taken the USGS hydrography and attached a unique number, known as **a Reach File Number**, to each stream segment within a Hydrologic Unit area. These numbers are used throughout this report because common stream names (i.e., Sycamore Creek) are repeated across Arizona and the United States, resulting in confusion. Reach Maps that identify stream segment numbers are available from ADEQ or EPA. An ArcInfo cover of stream hydrography with reach numbers is available from the Arizona State Land Department.

Table 1. Arizona Atlas

Population[a]	4,167,000 (1993) (75% of population on 16% of land area in Maricopa and Pima counties)
Surface Area[a]	113,962 square miles
Land Ownership[a]	28% Indian Lands 17% Bureau of Land Management 17% Individual and Corporate 15% Forest Service 13% State of Arizona 10% Other federal, county, municipal
Annual Long Term Average Precipitation[b]	Lowest 2.6 inches (Yuma) Highest 27.2 inches (McNary)
Temperature[b]	Average Daily: Highest -- 88 °F (Yuma); Lowest -- 45 °F (Flagstaff) Record temperatures: Highest -- 128 °F (Lake Havasu City); Lowest -- -40 °F (Hawley Lake)
Average Annual Withdrawal (acre-feet)[c]	Groundwater - 4,264,000 (1971-1990) Surface Water 2,961,000 (1971-1990) Central Arizona Project 739,000 (1990), 1,490,000 (projected for 2040)
Approximate Acres of Riparian Areas[d] - On perennial streams - On non-perennial streams TOTAL ACRES	 266,786.39 acres (on 4,628.95 perennial miles) unknown unknown
Acres of Freshwater Wetlands	unknown

(a) Arizona Arc/Info geographic information system (i.e., census data, land ownership, USGS hydrography at 1:100,000 scale).

(b) Arizona Climatological Laboratory, 1994 (verbal communication)

(c) Arizona Department of Water Resources, 1994.

(d) Arizona Game and Fish Department, 1993.

Table 2. Total Waters by Watershed in Arizona

WATERSHED NAME	STREAMS (miles)						LAKES (acres)		GROUNDWATER ESTIMATED STORAGE TO 1200 FEET BELOW GROUND SURFACE (acre-feet)
	Non-Indian Land			Indian Land			Non-Indian Land	Indian Land	
	Perennial	Inter-mittent	Ephemeral	Perennial	Inter-mittent	Ephemeral			
Bill Williams	187	657	5034	0	0	0	20,167	0	32,500,000
Colorado-Grand Canyon	478	262	14,872	127	7	3,737	90,095	8,503	509,500,000**
Colorado-Lower Gila	374	146	13,545	76	0	535	52,774	3,708	272,300,000
Little Colorado-San Juan	640	1,654	9,633	303	171	15,310	31,698	16,599	413,000,000
Middle Gila	165	1,207	5,462	1	10	1,106	62,810	12,407	222,410,000
Salt	511	1,188	2,784	823	0	4,276	26,797	2,496	***
San Carlos-Safford-Duncan	445	970	6,306	106	49	3,795	5,234	20,228	86,300,000**
San Pedro-Willcox-Yaqui	196	664	6,608	0	0	6,396	35,945	61	112,000,000
Santa Cruz-Magdelena-Sonoyta	85	502	7,243	0	18	34	18,885	1,120	176,900,000**
Verde	447	2,117	5,991	15	6	229	8,183	6	29,550,000
STATE TOTAL	3,528	9,367	77,478	1,451	261	35,418	352,588	65,128	***
			90,371			37,130			
						127,503		417,716	

- Stream miles and lake acres are based on USGS digitized hydrology at 1:100,000, and have been rounded to the nearest whole number. Reservoir acres along the Colorado River include only the acres within Arizona.
- Waters include man-made reservoirs and ponds of any size.
- Groundwater estimates of supply primarily from ADWR, with some estimates from USGS.

** Indicates that no estimate is available for one or more groundwater basins within this watershed (i.e. estimate probably low).

*** Insufficient information to estimate groundwater storage.

Waterbody Identification Numbers For This Report

- Stream Reach ID = the USGS Hydrologic Unit Code plus EPA's three-digit reach file number (e.g. 15060202-001). A reach is a segment of stream, normally from one main tributary confluence to the next one upstream.
  - Streams not yet assigned an EPA reach number are identified by the stream reach to which they discharge plus the word OFF in the ID number (e.g. 15060202-001OFF28).
- Lake ID = the USGS Hydrologic Unit Code plus an Arizona Game and Fish four-digit lake number (e.g. 15060202-1200).
  - Lakes not yet assigned a number by AGFD were given a temporary four digit number normally ending in a digit from 1-9 (e.g. 15060202-0008).

Groundwater Basins--ADEQ uses the groundwater basin boundaries developed by the Arizona Department of Water Resources (ADWR), as a result of the Groundwater Management Act of 1980, which are based on physiography, surface drainage patterns, subsurface geology, and aquifer characteristics **(Map 3)**. Groundwater basins do not delineate aquifers in Arizona. Comparing **Map 2 and Map 3** reveals how the groundwater basin and surface water basin lines correspond.

ADWR has designated five Active Management Areas (AMAs) for groundwater which encompass the largest population centers in the State or where groundwater resources are most imperiled by overdraft. ADWR has also grouped the 51 groundwater basins into five groundwater planning regions based on similarities between water supply, water use, and other considerations of water resource management **(Map 3)**.

Ecoregions--Ecoregions are areas of relative homogeneity based on land use, soils, topography, and potential natural vegetation. Arizona contains portions of five of the 76 ecoregions recognized in the U.S. (Omernik 1987).

Ecoregions in Arizona

The Southern Basin and Range is characterized by desert valleys with desert shrubland associations, separated by low mountains.

The Colorado Plateau contains tablelands with considerable to very high relief, plains with high mountains, grazed open woodland, and some irrigated agriculture.

The Arizona/New Mexico Plateau also contains tablelands with considerable to very high relief and plains with high mountains, but the Plateau is differentiated from the Colorado Plateau by its semi-humid grassland.

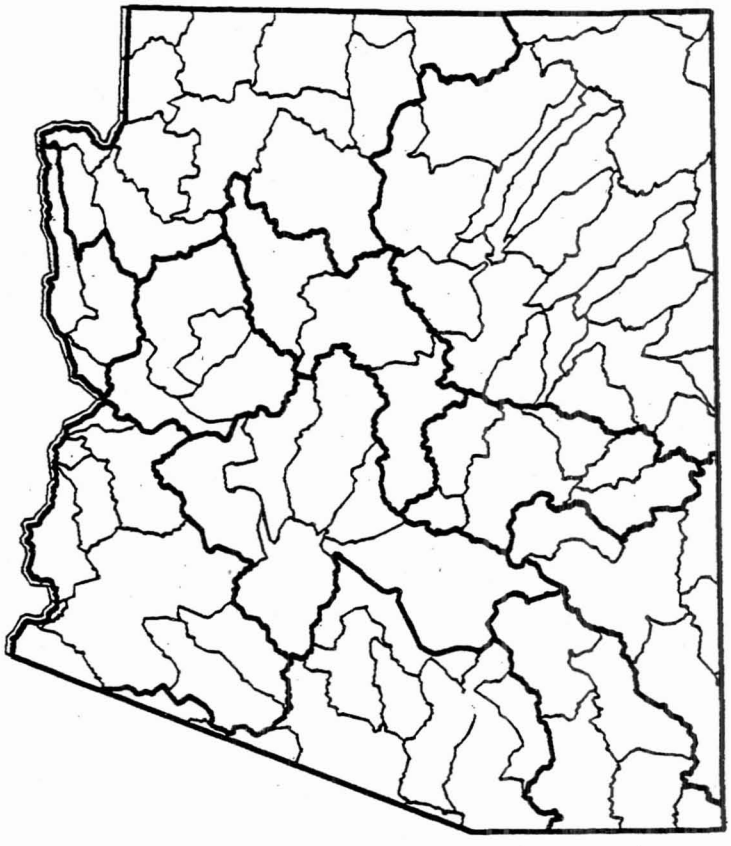
The Arizona/New Mexico Mountains has low to high mountains with grazed forests and woodlands.

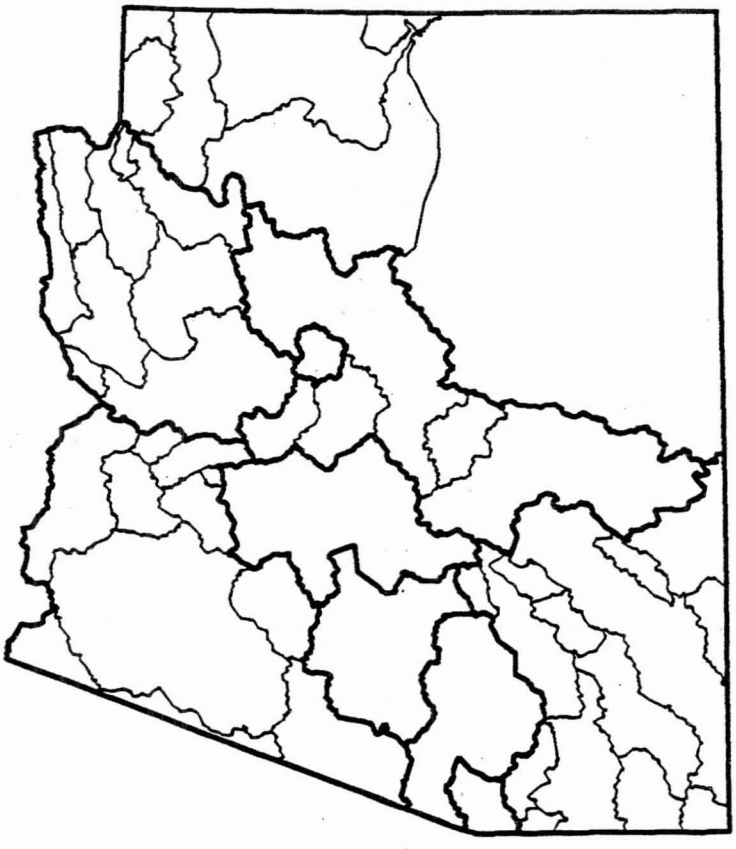
The Southern Deserts has desert shrubland associations on desert plains, with abrupt high mountains providing "sky islands" with higher elevation ecosystem communities.

Map 2. Arizona Surface Water Basins

ADEQ Watershed Zone Boundary

USGS Hydrologic Unit Boundary





Map 3. Arizona Groundwater Basins

ADWR Planning Region and Active Management Area Boundary

Groundwater Basin Boundary

SCALE

MILES 10 30 50 100

KILOMETERS 50 100 150

Ecoregion delineations **(Map 4)** may provide a means of grouping lakes and streams for standards or assessment purposes. For example, ADEQ's Biocriteria Development Program has been investigating the relationship between reference assemblages and ecoregions to determine whether ecoregion-specific biocriteria should be established. (See biocriteria development discussion in Part II of this chapter.)

Physiographic and Hydrographic Provinces--Arizona has also been subdivided by USGS into provinces based on the occurrence of groundwater and surface water and physiographic conditions such as geology and altitude (Anderson et al. 1992) **(Map 5)**.

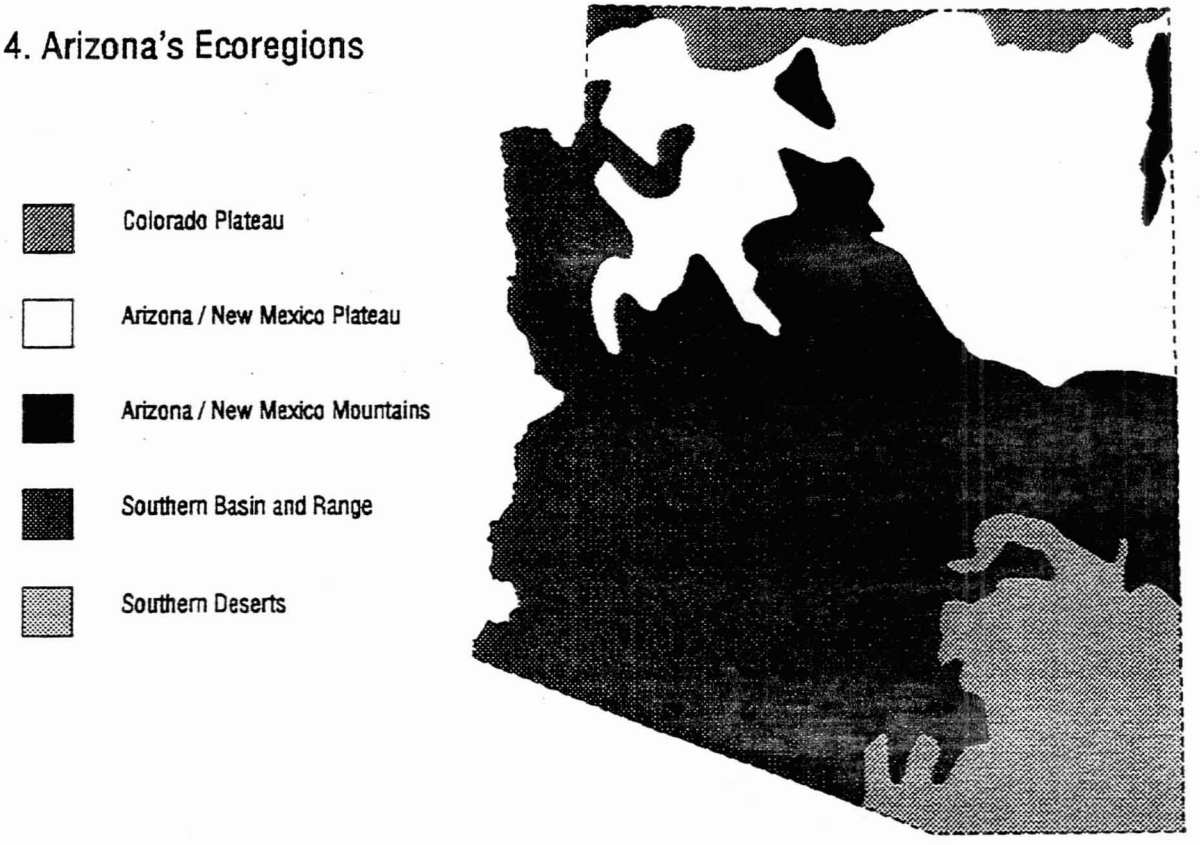
Hydrologic/Physigraphic Provinces in Arizona

The Basin and Range Province is typified by broad, gently sloping valleys, separated by sharply rising mountain ranges. Mountain ranges (sky islands) within this province receive more precipitation (i.e. 20 inch annual average at Chiricahua National Monument) than the desert lowlands (4-12 inches annually). The basins are filled with several thousand feet of sediments overlain with stream alluvium. This basin fill alluvium forms the most productive aquifers in Arizona, from which approximately 97% of all groundwater is pumped (Wilson 1991). Depths to groundwater range from land surface near perennial streams to as much as 1,300 feet below land surface near the mountain front.

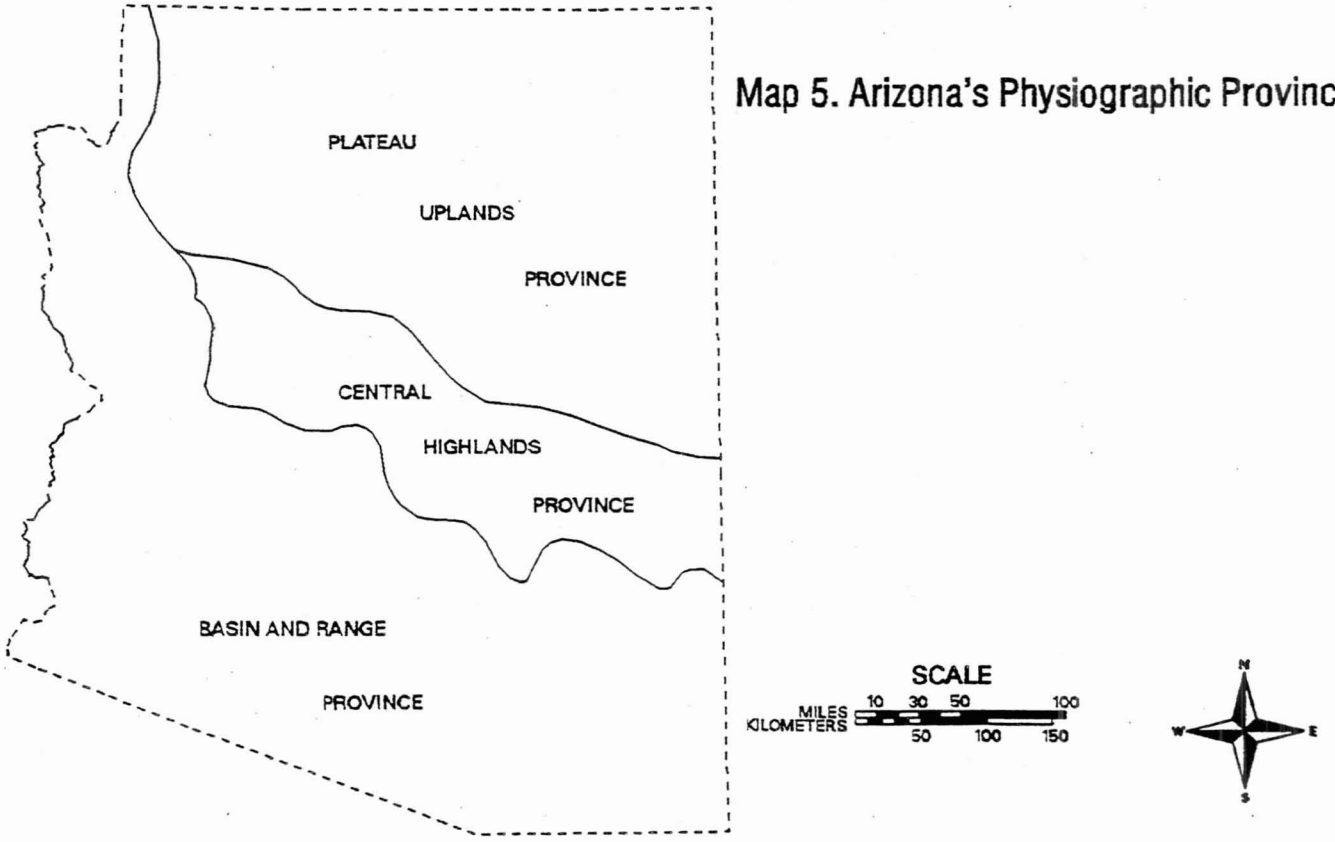
The Central Highlands Province is a geologic and physiographic transition between the two other provinces, with the Mogollon Rim on its northern boundary. The type and distribution of aquifers vary, with alluvial aquifers occupying relatively small basins, aquifers in consolidated sedimentary rocks, and fractured aquifers in hard rocks. Most perennial streams in the State originate in this province, which receives the highest annual precipitation -- 16 to 32 inches.

The Plateau Uplands Province is underlain by extensive consolidated sedimentary rock formations. Most of the groundwater is withdrawn from these formations more than 1,000 feet deep, although localized alluvial aquifers also provide some groundwater. This province has annual precipitation ranging from 10 to 25 inches. The eastern half of the province is a barren plateau, with isolated alluvial deposits occurring only as narrow strips along large drainages, while the western half (north of the Grand Canyon) is wooded plateaus and mountain peaks which rise higher than 8,000 feet in altitude.

Map 4. Arizona's Ecoregions



Map 5. Arizona's Physiographic Provinces



Surface Flow--Understanding flow variability is important to water quality monitoring and assessments because hydrology affects the transport of pollutants. For example, it is difficult to collect samples during runoff events, when discharges from nonpoint sources are likely to occur, because of the sporadic nature of rainfall in Arizona. Also, these nonpoint source discharges can be flushed downstream with the first wave runoff; therefore, the concentration found in the sample may be dependent on previous rain events. Finally, the variation in flows makes it difficult to define "normal" conditions and determine appropriate standards. For example, should the turbidity or total suspended solids standard be the same at 1 cfs and 1,000 cfs in a watershed with highly erodible soils?

The four hydrographs (**Figures A, B, C, D**) are examples of stream flow in Arizona. Typical stream flows vary widely. These sites are in different ecoregions and provinces, yet had similar sized drainage basins (1130-1630 square miles).

- Black River represents the Arizona New Mexico Mountains and the Central Highlands Province.
- Moenkopi Wash is located in the Colorado Plateau Ecosystem and the Plateau Uplands Province.
- The Santa Maria River drainage is in the transition between ecoregions and provinces, with headwaters in the Arizona/New Mexico Mountains Ecosystem or Central Highlands Province, and mainstem in the Southern Basin and Range Ecosystem or Basin and Range Province.
- The San Pedro River is representative of the Southern Desert Ecosystem and Basin and Range Province.

These log-scale graphs illustrate several characteristics of surface water flows in Arizona:

- Surface water flows vary drastically. Base flows were <1 to 100 cubic feet per second (cfs); however, during storm events flow increased to 1,000 to 30,000 cfs.
- Rainfall generally occurs during two seasons: the winter rains/snow (December through February), and the summer "monsoons" (July through September).
- The winter rains may be associated with an extensive weather system, with precipitation falling over a larger area for a longer period of time. Summer rains typically are of short duration, high magnitude, and sporadic in coverage.
- Even very small flows (less than 1 cfs) are recorded, illustrating the importance of water in this arid region.

Figure A. Black River

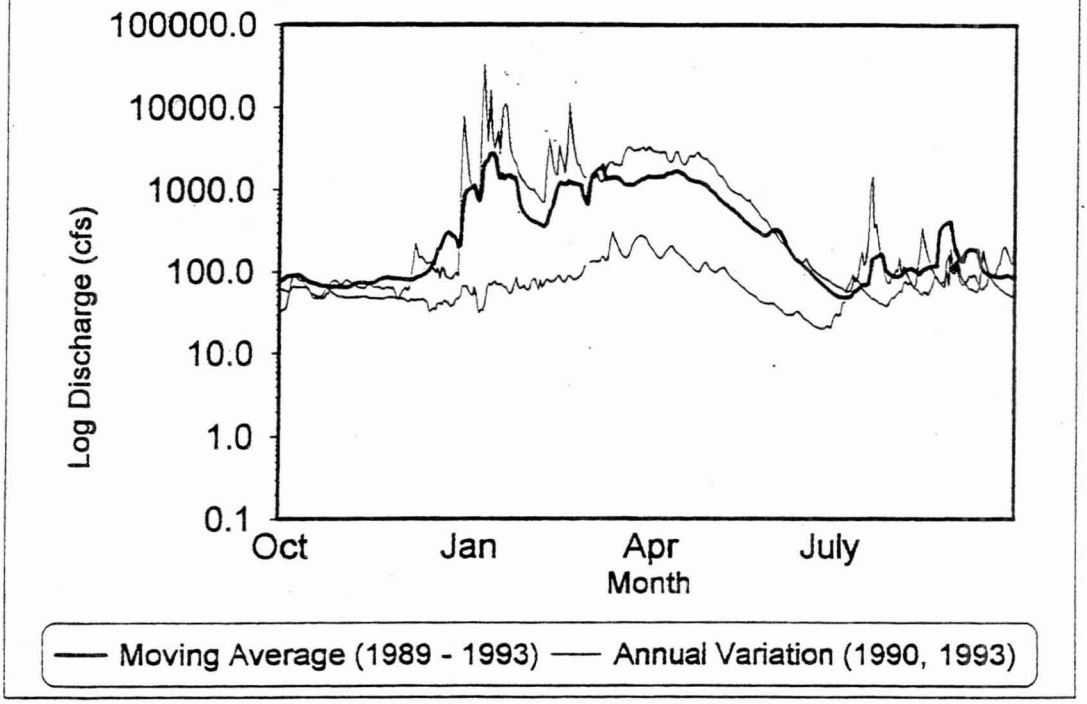


Figure B. Moenkopi Wash

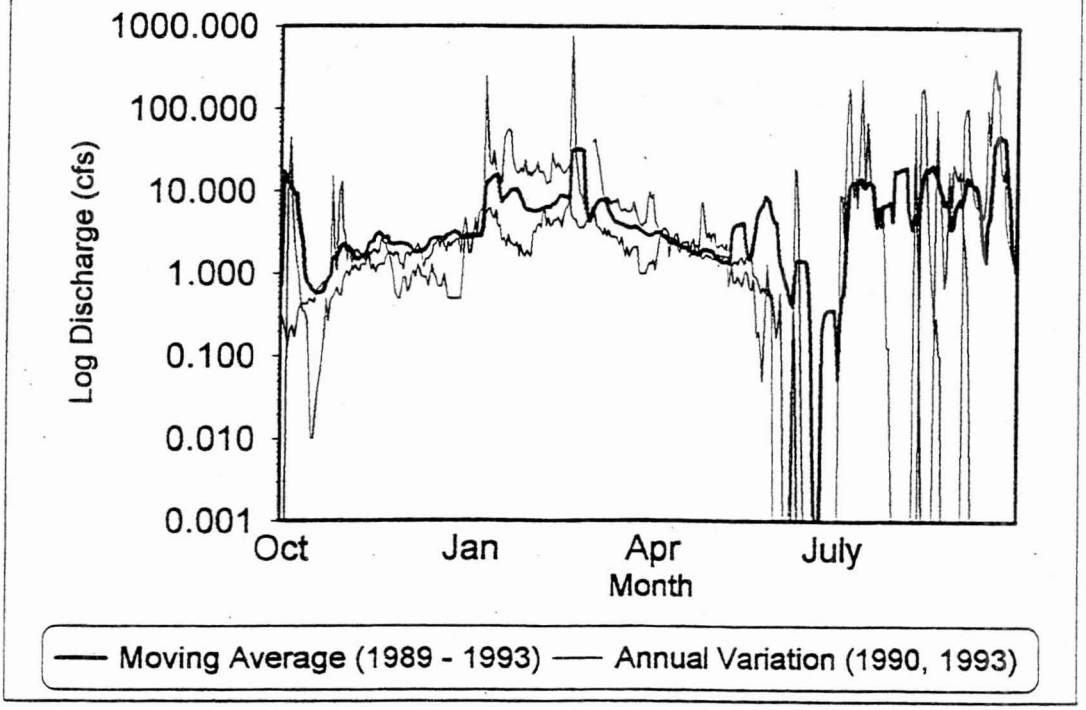


Figure C. Santa Maria River

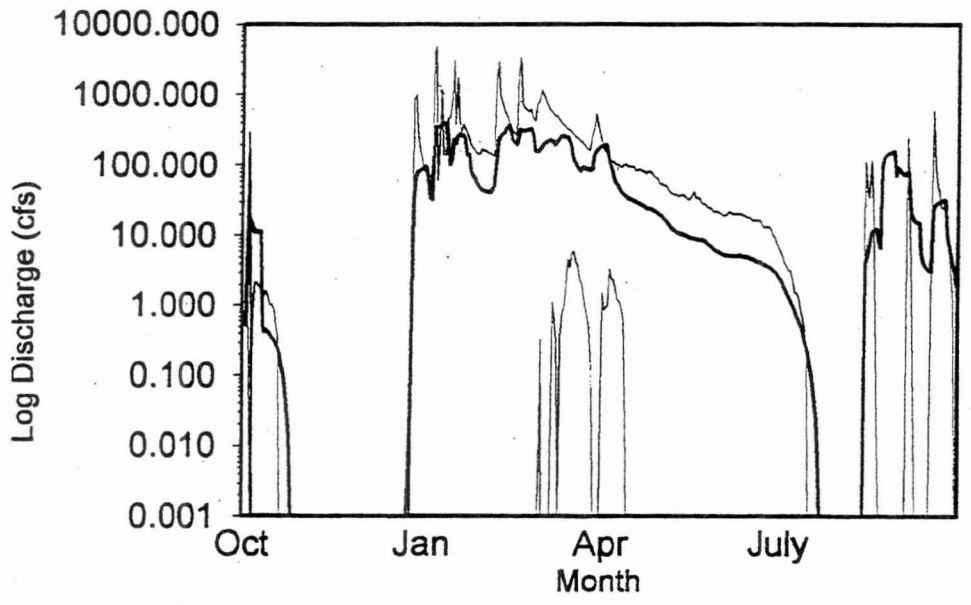
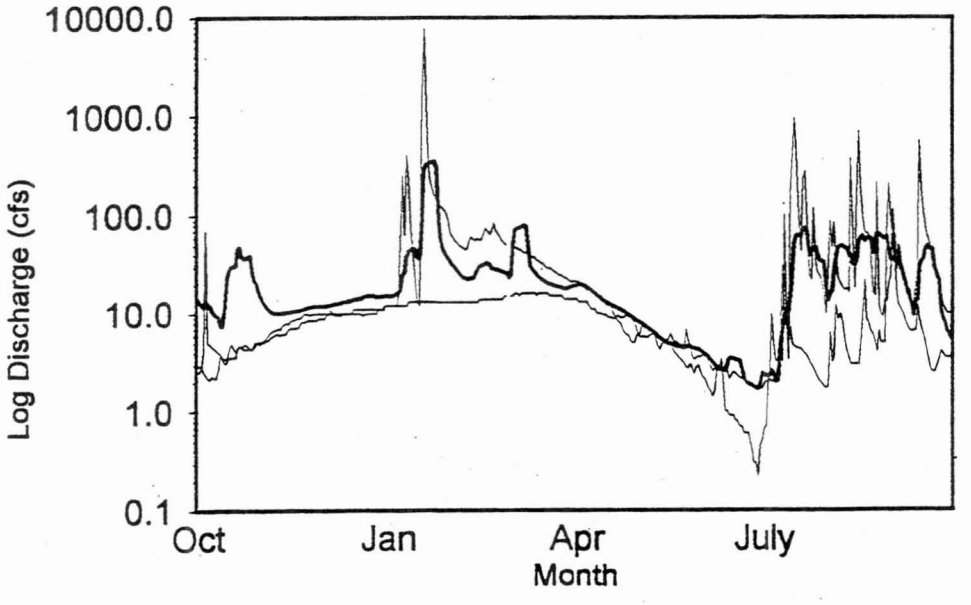


Figure D. San Pedro River (Charleston)



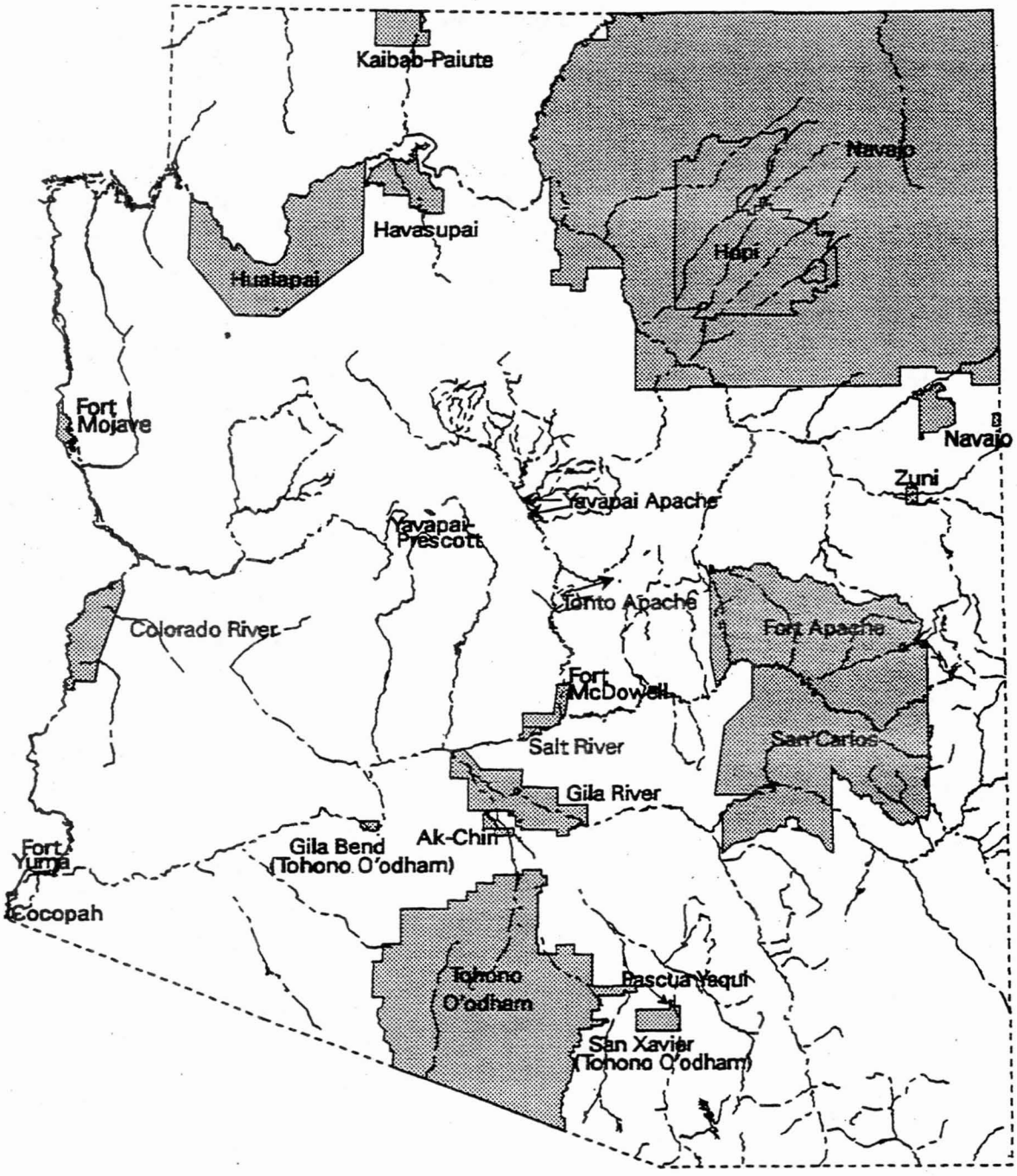
Water Quality Management Jurisdiction--A majority of Arizona land (83%) is owned or managed by the federal government, state government, or is on Indian lands **(see Table 1)**. Along with the Arizona Department of Environmental Quality (ADEQ), the following agencies have jurisdiction in water quality protection and conservation in Arizona:

Arizona Department of Water Resources (ADWR),
Arizona Game and Fish Department (AGFD),
Arizona State Land Department (ASLD),
Arizona State Parks Department,
Army Corps of Engineers (COE),
Bureau of Indian Affairs (BIA),
Bureau of Land Management (BLM),
Bureau of Reclamation (BOR),
County health departments and county environmental departments,
Designated Planning Agencies (e.g., Councils of Government),
Indian tribes,
International Boundary and Water Commission (IBWC),
National Park Service (NPS),
Natural Resources Conservation Service (NRCS),
Salt River Project (SRP),
U.S. Environmental Protection Agency (EPA),
U.S. Forest Service (USFS),
U.S. Fish and Wildlife Service (USFWS),
U.S. Geological Survey (USGS),

Many inter-agency working agreements have been developed to coordinate shared jurisdiction in water quality protection and conservation in Arizona. The newest partnering agreement was signed in May 1996 between ADEQ, NRCS, EPA and the Arizona Association of Conservation Districts.

ADEQ is developing a "watershed protection approach" to coordinate the efforts of multiple agencies, other interested parties, neighboring states, and Mexico to identify water quality issues of mutual concern and resolve these problems at a local level. The watershed approach is highlighted in Chapter 2 of this report.

The 21 tribal governments in Arizona **(Map 6)** have jurisdiction for 28% of the land base. Tribal lands are not subject to Arizona's water quality laws. ADEQ seeks to work cooperatively with tribal governments in protecting the environment. Waterbodies located on Indian lands were not assessed for this report. Several of the tribes are instituting water quality monitoring and assessment programs and will be issuing their own water quality assessment reports.



Map 6. Indian Reservations in Arizona

PART II - WATER QUALITY STANDARDS AND ASSESSMENT CRITERIA

Surface Water Standards and Assessment Criteria–The assessments in this report are based on the surface water quality standards certified in 1992, the aquifer water quality standards, and water quality criteria chosen to evaluate the protection of designated uses and potability (e.g., tissue criteria, sediment criteria, and secondary maximum contaminant levels). Violations of adopted standards may result in enforcement actions to mitigate the problem. For assessment purposes, natural conditions may cause standards to be exceeded although this would not be a violation. Such findings should initiate a process to determine site-specific surface water standards or a reclassification of the aquifer to reflect natural conditions.

Surface Water Standards and Designated Uses–Arizona's surface water quality rules (Arizona Administrative Code R18-11-101 through R-11-205) apply only to "waters of the United States", as defined in R18-11-101(45). "Waters of the United States" include many types of waterbodies such as streams, lakes, ephemeral washes, playas, reservoirs, and wetlands. Waters generally not considered as "waters of the United States" are groundwater, manmade lakes (other than impoundments of natural drainages), and canals outside of the floodplain of a natural waterway or lake. The surface water quality rules provide a list of designated uses for many of Arizona's streams and lakes, the numeric and narrative water quality criteria to protect those designated uses, and antidegradation rules. In addition, there are rules that are specifically applied to permits including nutrient waivers, mixing zones, schedules of compliance, and enforcement (ADEQ 1992c).

At a minimum, the Clean Water Act requires the establishment of designated uses for all waterbodies to protect the aquatic life and wildlife that inhabit these waters and recreation in or on the water. In accordance with this requirement, Arizona has established designated uses to protect these uses as well as established other uses to protect waters for use by agriculture and municipal water treatment plants.

Arizona's Surface Water Designated Uses

- Fish Consumption (FC);
- Domestic Water Source (DWS);
- Full Body Contact (FBC);
- Partial Body Contact (PBC);
- Aquatic and Wildlife (A&W)
  - Coldwater fishery (A&Wc),
  - Warmwater fishery (A&Ww),
  - Ephemeral stream (A&We),
  - Effluent Dependent Water (A&Wedw);
- Agricultural Irrigation (AgI); and
- Agricultural Livestock Watering (AgL).

Designated uses are specified for stream segments and lakes in the surface water rules. Under the 1992 Tributary Rule (Arizona Administrative Code R18-11-104 (D)) waterbodies not listed in the rules obtain the designated uses of the nearest downstream listed segment, excluding waters designated as effluent-dependent or ephemeral. When a tributary flows into an effluent-dependent water, the designated uses of the tributary are those of the stream segment immediately downstream of the effluent-dependent designated portion. When the Tributary Rule is applied to an ephemeral water, the ephemeral water's designated uses, typically A&We and PBC, apply only to that portion of the tributary that is likewise ephemeral, while A&Ww and FBC designated uses are applied to the rest of the tributary.

The Clean Water Act goal for all waterbodies to be "fishable and swimmable" is generally met when the designated uses are assessed in full support. In Arizona, all "waters of the United States" are protected for appropriate Aquatic and Wildlife uses and recreational uses, either Full Body Contact (swimming) or Partial Body Contact (incidental water contact) uses. In addition, the Fish Consumption designated use is typically applied to all perennial streams

and lakes, and the Domestic Water Source use is applied to waterbodies that serve as sources for municipal water treatment facilities. While support of these designated uses usually means that the goals of the Clean Water Act are being met, the water quality rules generally do not address other important issues that also impact water quality, such as:

- There is limited attention given to hydro/habitat modification in the surface water rules, although the destruction of riparian area, changes in water quantity, and streambank destabilization have direct impacts on water quality and aquatic communities.
- Although the USFWS reviews the State's water quality standard rules to determine whether or not the rules may affect threatened and endangered species, the water quality rules do not recognize the introduction of exotic species as a water quality concern, although it has been documented that exotic species are frequently the primary stressors for most threatened and endangered species in Arizona (USFWS 1979a, 1979b, 1982, 1990a, 1990b, 1990c, 1990d, 1990e, 1991a, 1991b, 1993).

Surface Water Rule Revisions--Although this assessment is based on the 1992 rules, new surface water quality standard rules became effective in Arizona April 24, 1996. The next assessment will use the 1996 rules as their basis. Several rule changes that occurred in 1996 will directly affect future assessments. Examples include:

- An *Escherichia coli* (*E. coli*) standard was adopted to replace the fecal coliform standard on all waters with the full body contact designated use.

- A new Tributary Rule (Arizona Administrative Code R-18-11-105) was established that prescribes the default designated uses for any waterbody not specifically listed in Appendix B with designated uses. Default uses are based on whether the stream would be classified as ephemeral, effluent-dependent, coldwater, or warmwater.

- The numeric water quality criteria to protect human health uses (FBC, PBC, DWS, FC) were updated according to the latest scientific information. This update included modifying the arsenic FC standard from 3.1 μg/l to 1450 μg/l. Many waterbodies that are not in full support as a result of the 1992 arsenic FC standard will be in support in future assessments because of this new standard.

- Fish consumption was added as a designated use to approximately 100 waterbodies listed in the standards.

In addition to the adoption of new rules, a tissue monitoring program to evaluated the impacts of mercury on wildlife has been established by the State, in coordination with the USFWS, EPA, and AGFD. The study was initiated by the finding by the USFWS that the State's mercury water quality criteria may not be protective of wildlife that prey on fish. In the spring of 1996, sampling of the prey base of bald eagles and brown pelicans was begun in a number of waterbodies around the State where these threatened and endangered bird species are known to nest. If a pattern of elevated mercury levels in tissue can be established, then the source(s) of mercury will be determined and appropriate actions will be initiated to reduce mercury discharges into the watershed. This study should provide the basic data needed to determine whether existing water quality standards provide adequate protection of indigenous wildlife.

Aquifer Water Quality Standards--Arizona's Aquifer Water Quality Standards are the cornerstones of the State's groundwater protection program. All aquifers were initially classified and protected for drinking water use, and none have been reclassified (Arizona Revised Statute § 49-224.B). Numeric aquifer water quality standards are consistent with federal Primary Drinking Water Standards. Maximum Contaminant Levels (MCLs) are developed and adopted by EPA as enforceable standards for public water systems, and may be adopted in Arizona by rule

(see Arizona Administrative Code Title 18, Chapter 4, Article 4) as aquifer water quality standards pursuant to Arizona Revised Statutes 49-223.A.

ADEQ has also adopted narrative aquifer water quality standards which allow regulation of pollutant discharges for which no numeric standards have been adopted. The narrative standards state that:

- A discharge shall not cause a pollutant to be present in an aquifer in a concentration which endangers human health;
- A discharge shall not cause a violation of the surface water quality standard established for navigable waters of the state; and
- A discharge shall not cause a pollutant to be present in an aquifer which impairs existing or reasonably foreseeable uses of water in an aquifer.

A major accomplishment for the Aquifer Protection Program has been the development of Health-Based Guidance Levels (HBGLs) for 268 chemicals (e.g., pesticides, organics, and inorganics including trace metals) for drinking water and soils, based on health risks due to ingestion (ADHS 1992). However, the published edition is already outdated and has since been replaced by a computer bulletin board system which is updated monthly using EPA data. Contact the Arizona Department of Health Services at (602) 542-7314 to obtain access to this system and obtain the current effective HBGLs.

Biocriteria Development--Biological criteria are being developed by ADEQ, which will recognize normal regional differences in biological community structure and allow for an assessment of the biological integrity of our streams. ADEQ has developed biological monitoring protocols (ADEQ 1994b) and is focusing on macroinvertebrates and algae (diatoms) as indicator communities.

Biological data have been collected to address the following program objectives:

- Develop an inventory of Arizona's macroinvertebrates and algae,
- Test field and laboratory methods to determine cost-effectiveness of available methods in Arizona,
- Determine relationships among various habitats or chemical parameters and their associated biological communities,
- Identify regional differences in biological community structure,
- Develop metrics which will accurately differentiate between macroinvertebrate communities at reference sites and impacted sites,
- Identify best attainable community assemblages at reference sites,
- Develop narrative biocriteria for inclusion in the State's surface water quality rules and associated implementation guidance documents,
- Perform biological assessments to determine the effect of land use activities on water quality in the Verde River watershed, and
- Develop a list of macroinvertebrates for effluent dependent waters.

Initial efforts of the program focused on the macroinvertebrate and algae community structure of minimally-impacted sites (e.g., reference sites) within a region. Once the reference conditions have been characterized, assessments of biological integrity and associated water quality can be performed by comparing the biological community structure of potentially impacted sites with the appropriate regional reference conditions.

The first biocriteria report is entitled, *Using Ecoregions for Explaining Macroinvertebrate Community Distribution Among Reference Stream Sites in Arizona* (ADEQ 1996). This report critiques the use of ecoregions for assessing

community responses to watershed impacts, and offers an alternative classification for these reference communities. The alternative classification proposes three macroinvertebrate classes: a desert lowland community, a montane upland community and a mid-elevation transition community. These communities occur at sites distinguished by elevation, watershed area and stream gradient. This new classification will be tested with data from 1993 and 1994. Future reports will cover the testing of metrics for describing the reference biological community, and will present results from the Verde River watershed bioassessment project.

The goal of this program is to propose narrative biocriteria standards for the triennial review scheduled to begin in 1997. Once analysis is completed for the 1992-1994 data, ADEQ intends to formalize biocriteria monitoring and assessment methods into a guidance document. An interim "methods" document may be obtained from ADEQ (ADEQ 1994b).

Sediment Criteria--The sediment criteria used in this report were a combination of the Soil Remediation Standards (adopted as emergency rules by ADEQ in 1996) and normal background levels found in Arizona soils (Earth Technology 1991) (see **Appendix A**). The soil remediation standards were established to protect public health, based on soil ingestion. The Arizona background levels provided a comparative value to determine contaminated sediment. Neither criteria considered the risk to aquatic and wildlife nor other uses. Surface waters were assessed as threatened when a sediment criterion was exceeded.

Fish and Wildlife Tissue Criteria--Tissue criteria were used to assess two designated uses:

- Fish Consumption -- to protect human health, as established by Food and Drug Administration and EPA screening levels, and
- Aquatic and Wildlife -- to protect aquatic life and wildlife, as established by USFWS documents and other literature.

Assessments based on these criteria considered whether initial results had been confirmed and if the median measurement exceeded the criterion. (See **Appendix A** for criteria used and **Appendix C** for information about the assessment process.)

Wildlife protection screening values are based on best professional judgement from the interpretation of sparse data. Values are often derived from research conducted using a single species. Therefore, extreme care must be taken when using the derived values to extrapolate effects that may occur in other species, especially species that are taxonomically dissimilar (Ronald Eisler, personal communication). For example, some wildlife protection screening values are established for prey species to protect their predators from the toxicants that may accumulate in the prey. These tissue concentrations cannot be applied to predator tissue levels.

Trophic interactions determine the proclivity to biomagnify, the extent of biomagnification, and the probability of transmission of toxicants. All of these factors must be considered when assessing the effect(s) of a toxicant. The trophic status for an individual may change due to physical, geographical, behavioral, size and life cycle factors. For example, prey species (i.e., threadfin shad, small bass, or ducks) accumulate toxicants from lower trophic positions and transmit these toxicants to their predators. Prey species may be asymptomatic, not exhibiting physical or reproductive signs of toxicity, even though they may have accrued high body burdens of a toxicant. Conversely, physical signs of toxicity, such as the loss of equilibrium and sluggishness associated with mercury intoxication (Armstrong 1979), may actually make that prey item a preferred target. High level predators (e.g., large bass, eagles, and cormorants) that accumulate toxicants from lower trophic positions, do not present a significant hazard of further biomagnification because they do not constitute a significant portion of the diet of higher level predators. (See further discussion of screening values in Aquatic Life and Public Health Impacts section of this chapter.)

Antidegradation Policy--The Antidegradation policy is found in the surface water rules (R18-11-107), and provides three tiers of protection:

- Tier I -- No further degradation of existing water quality is permitted in a "water of the United States" where applicable water quality standards are not being met.

- Tier II -- Limited water quality degradation can be allowed in these waters only after it has been demonstrated that the water quality will continue to support all existing uses. This requires a public participation process.

- Tier III -- provides special protection for waters classified by Arizona as "Unique Waters". The purpose of this special protection is to maintain the quality of waters that have exceptional ecological or recreational significance, or provide important habitat for species listed as Threatened or Endangered by the state or federal government. For waters designated as Unique, water quality must be maintained and protected.

PART III - DATA SOURCES AND MONITORING PROGRAMS

General Description

Data and information used in this report came from many state, federal, and local agencies in Arizona with water resource management programs (e.g., ADEQ, U.S. Geological Survey, U.S. Bureau of Land Management, U.S. Forest Service, Arizona Game and Fish Department, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, National Park Service, Salt River Project, and research projects associated with state universities). This data exchange has been encouraged by national efforts to coordinate monitoring, provide more consistent monitoring protocols, and provide mechanisms to share data (ITFM 1992, 1995).

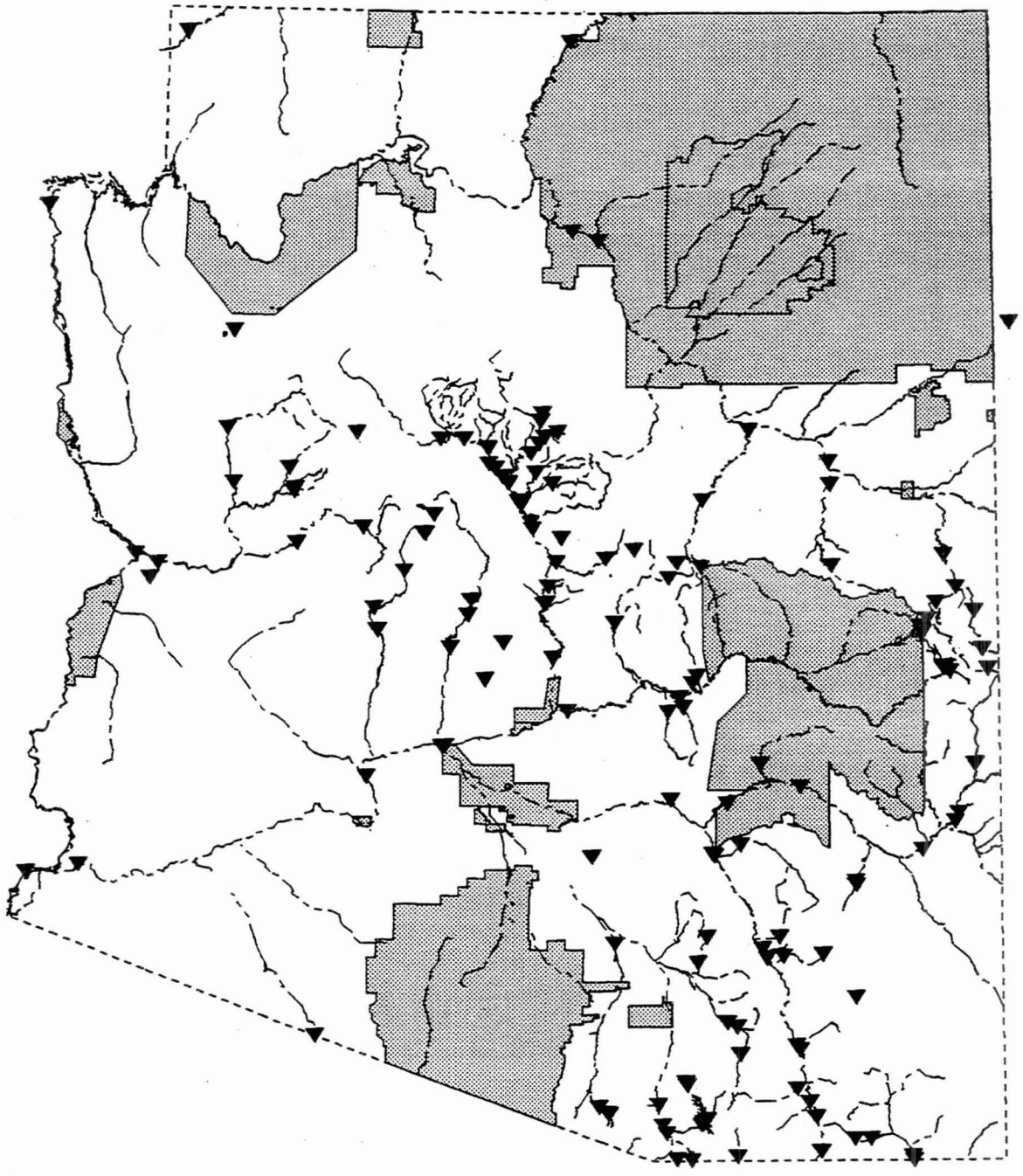
Water Quality Monitoring and Tracking

Monitoring Sites--ADEQ's water quality monitoring programs are outlined in **Table 3**, and a series of maps illustrate where monitoring has been focused (**Maps 7, 8, 9, 10, 11, 12, 13, and 14**). Surface water monitoring sites used by the Arizona Game and Fish Department, the U.S. Bureau of Land Management, and the National Park Service, and U.S. Geological Survey monitoring sites not included in ADEQ's "fixed station network" are illustrated on **Map 15**. The maps illustrating special studies (**Maps 10, 11, and 14**) include monitoring sites and special studies conducted by agencies other than ADEQ used in this assessment.

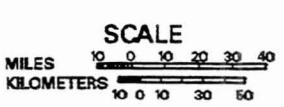
ADEQ's monitoring programs follow written protocols for all aspects of the program including sample collection, sample handling, field and data analysis, quality assurance/quality control (QA/QC) tests, data management, and reporting. Fixed Station Network, Clean Lakes Program, and Biocriteria Development Program data are maintained in individual site files and on computer spreadsheets. Most of these surface water data are transferred to EPA's Storage and Retrieval database (STORET) for public access.

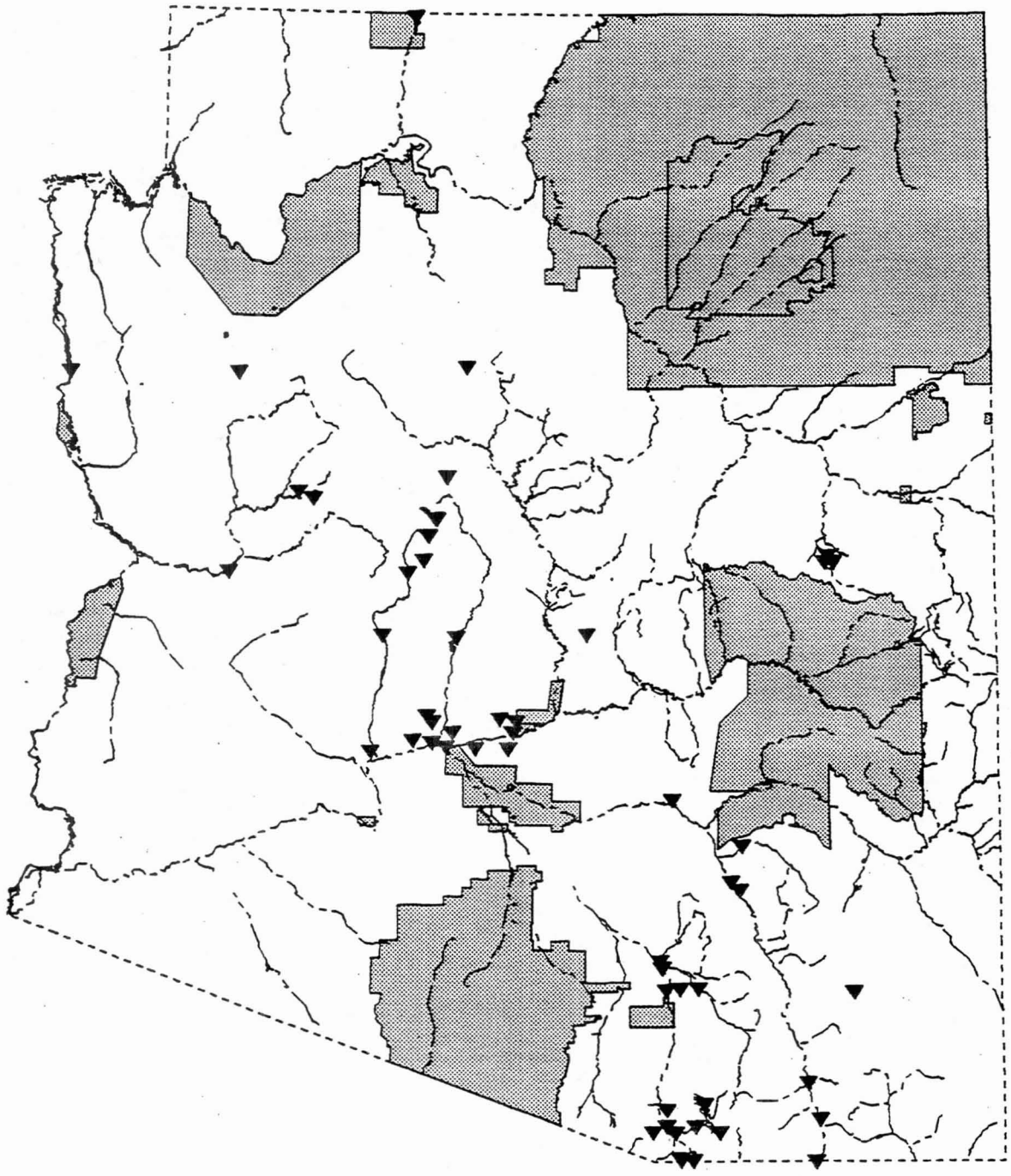
Surface water monitoring data used for this assessment are summarized in **Appendix B**. As indicated in **Appendix C**, waterbody assessments result from combining these data with other site and watershed information. The standards and criteria applied to these data for assessments are provided in **Appendix A**.

Groundwater data and information used in this assessment primarily originated from ADEQ, ADWR, and USGS monitoring projects. These data have been collected for many purposes, from characterizing regional groundwater quality conditions to the investigation of site-specific problems. A large portion of the monitoring data collected by public drinking water systems was not used for the general assessment because this compliance monitoring normally occurs at the point-of-entry into the system. This point-of-entry is after treatment and may reflect several sources because many systems in Arizona use multiple wells or surface water sources.

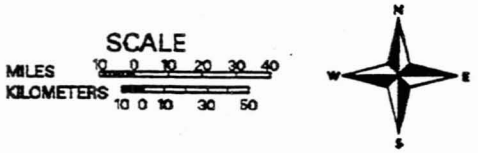


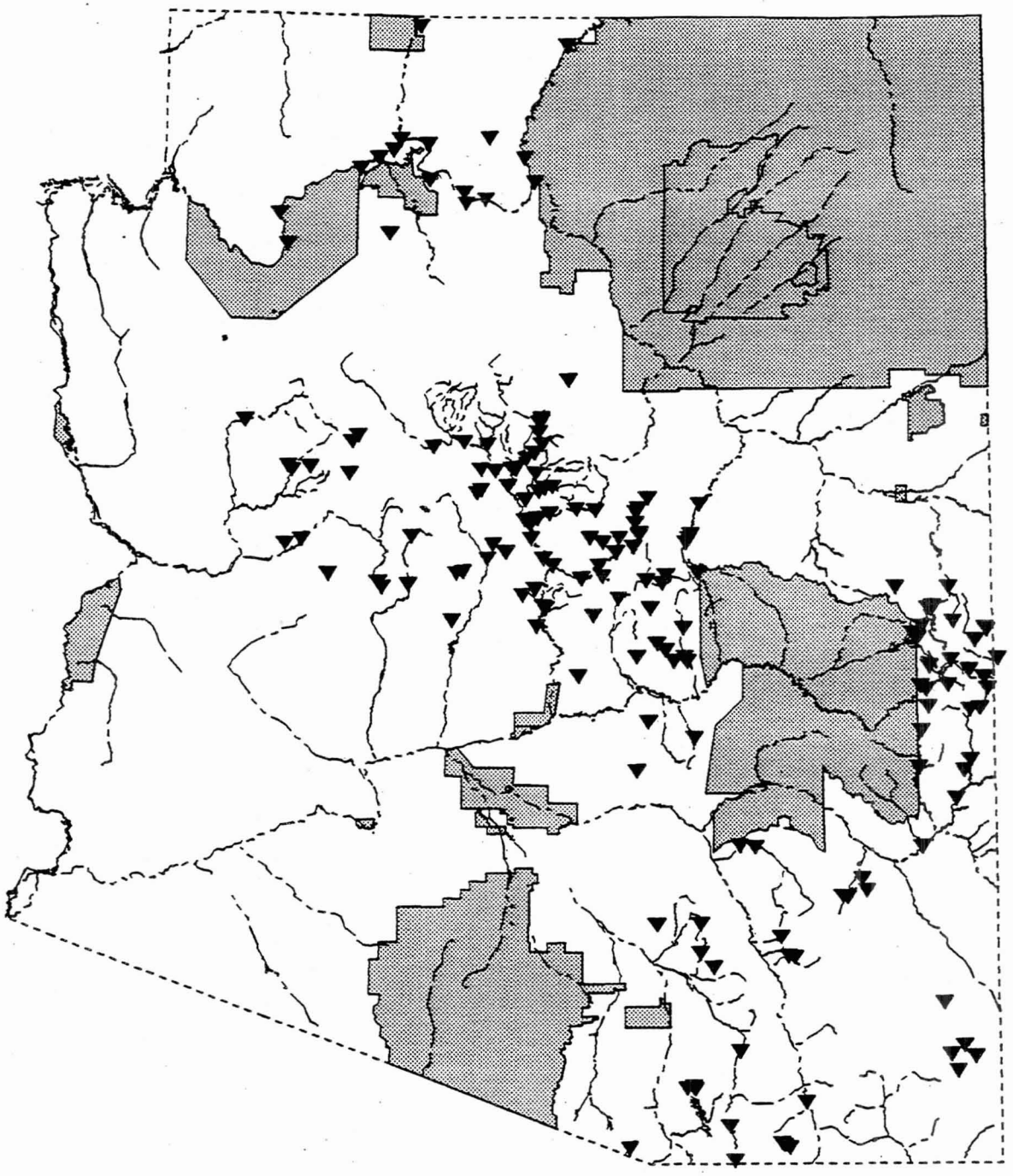
Map 7. Fixed Station Network Sites - 1991 - 1995



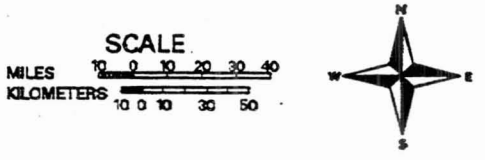


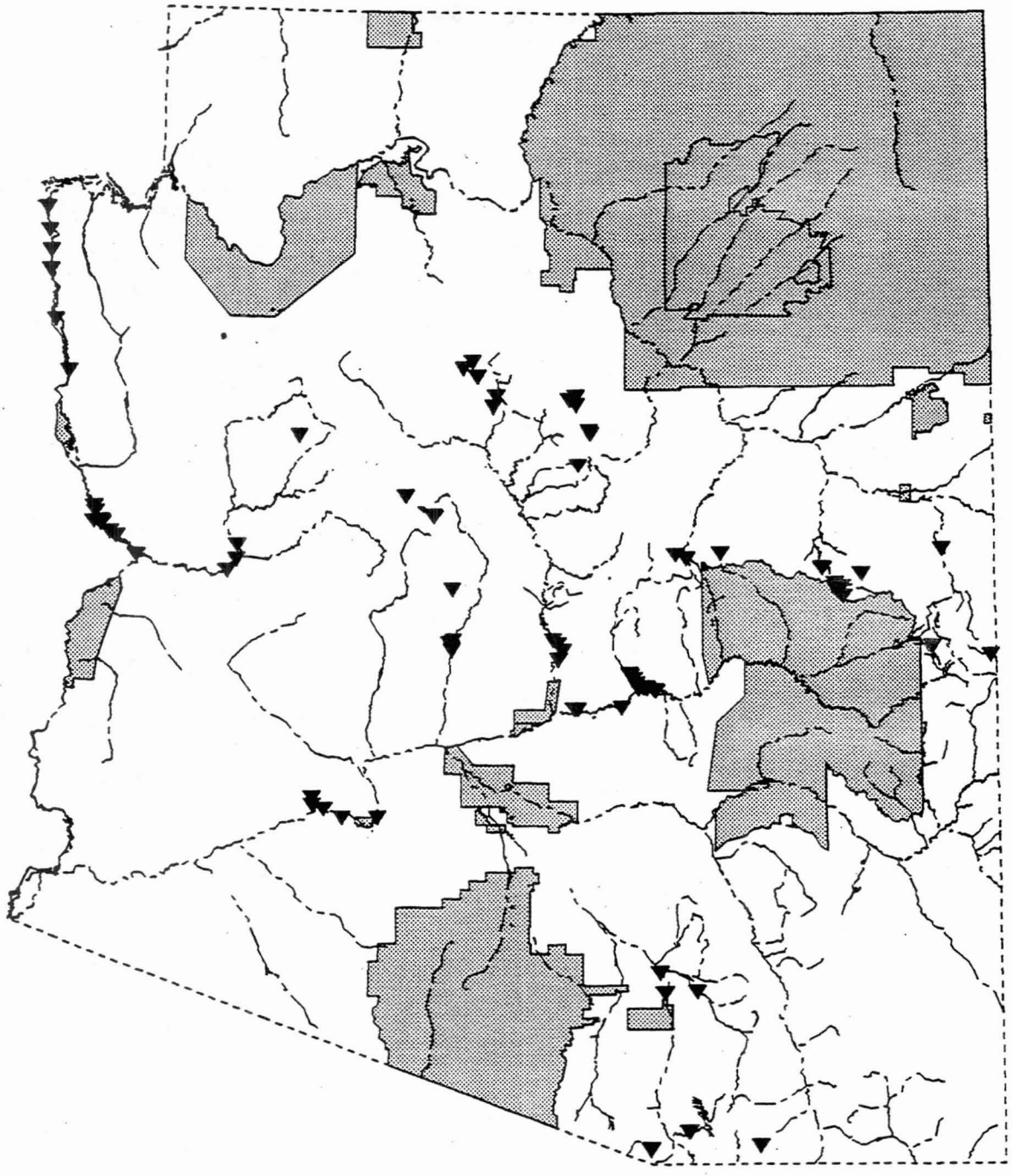
Map 8. Priority Pollutant Sites - 1991 - 1995



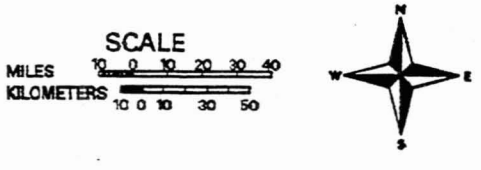


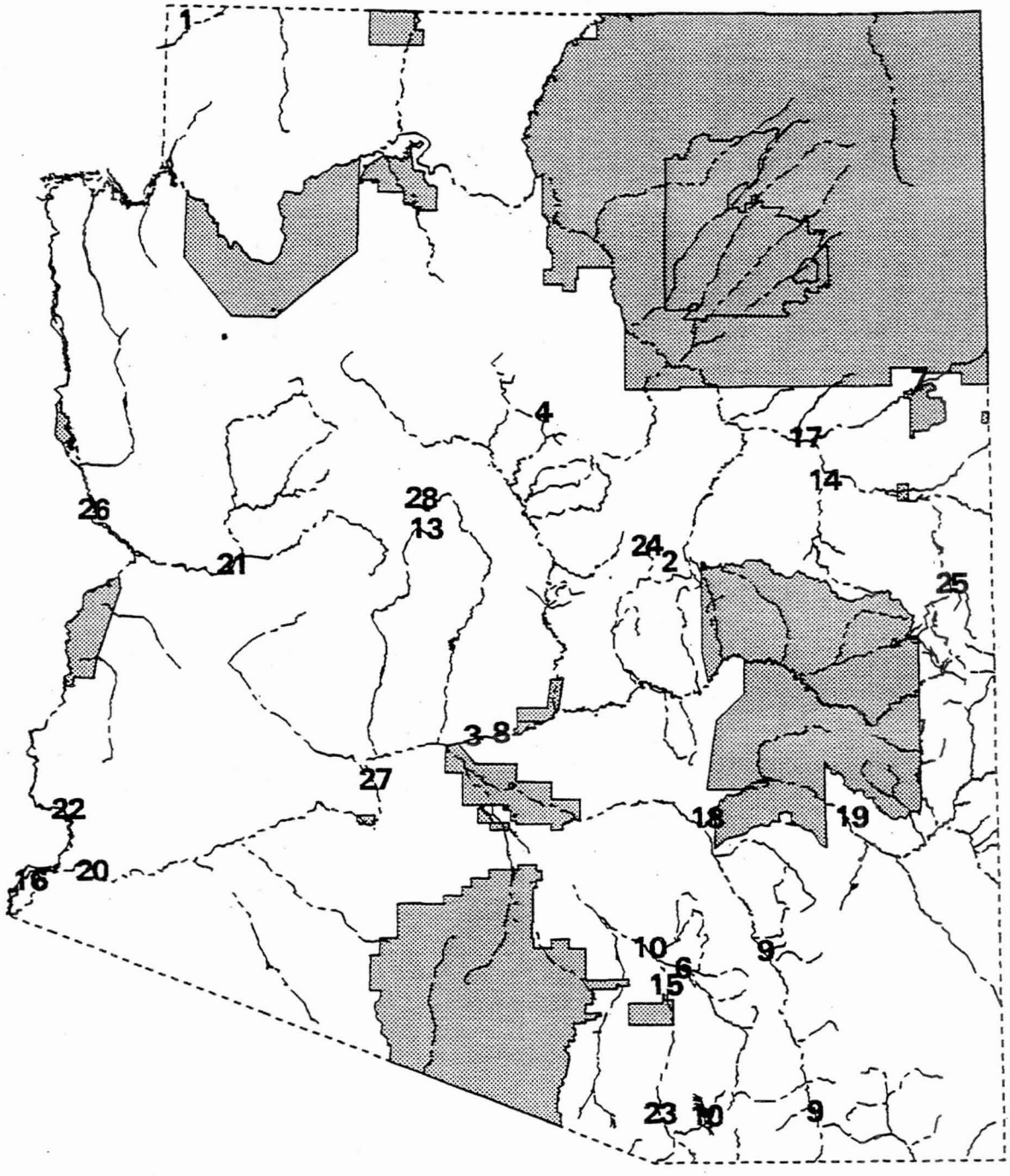
Map 9. Biocriteria Sites - 1991 - 1995





Map 10. Lake Monitoring Sites (State & Federal Agencies) - 1991 - 1995





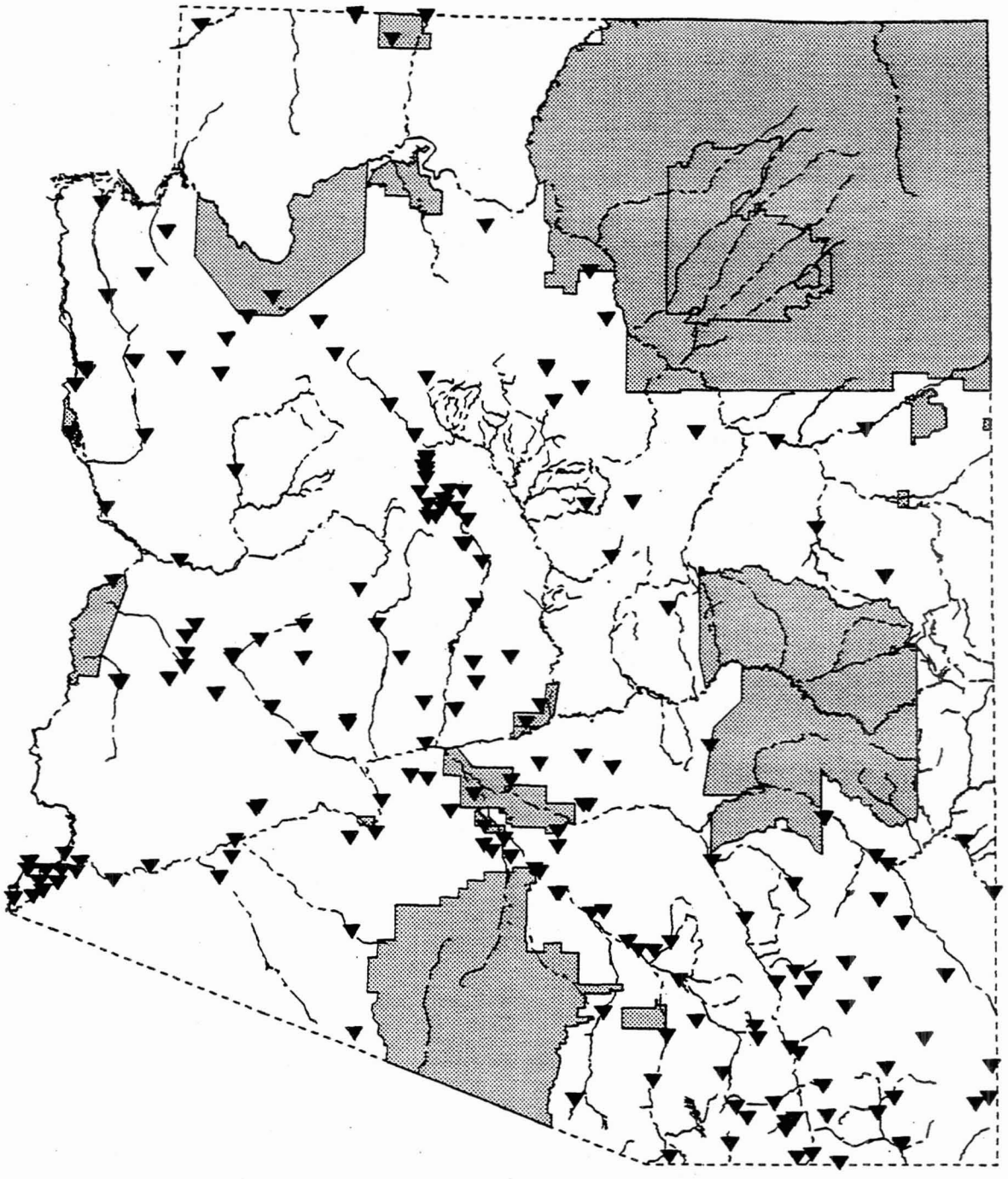
Map 11. Surface Water Special Studies - 1991 - 1995

SCALE
MILES 10 0 10 20 30 40
KILOMETERS 10 0 10 30 50

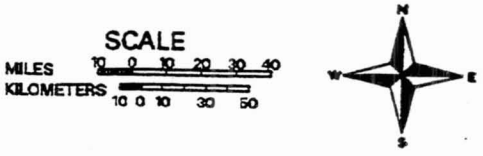
N
W E
S

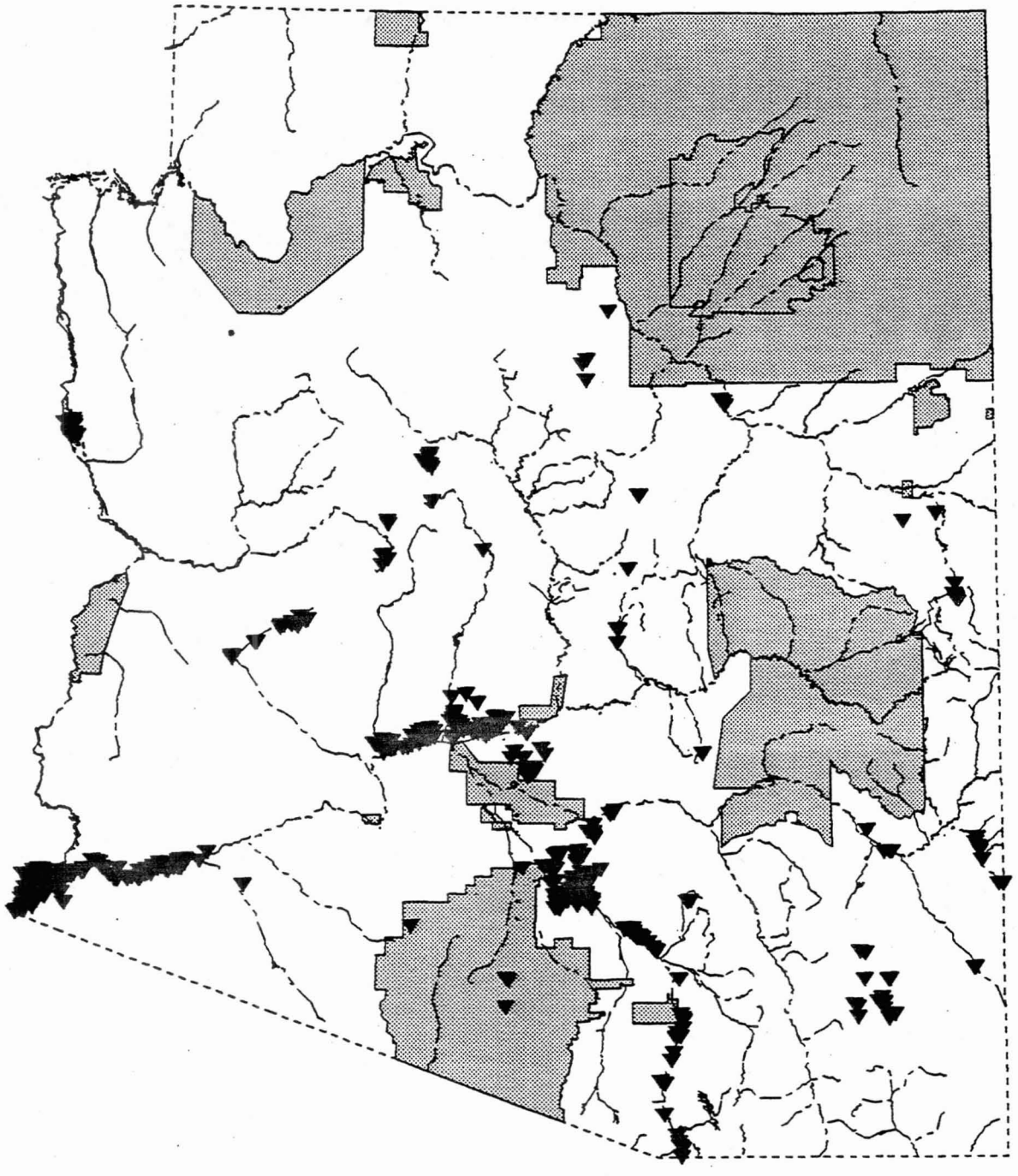
Surface Water Special Studies (Map 11)

MAP NUMBER	NAME OF STUDY	AGENCY
1	Beaver Dam Wash Study	ADEQ
2	Christopher Creek Study	ADEQ
3	Maricopa County Stormwater Study	USGS and Maricopa County Flood Control
4	Oak Creek Study	EPA and ADEQ Nonpoint Source Program
6	Pima County Stormwater Study	Pima County
7	Puerco River Study	USGS
8	Salt River Floods	ADEQ
9	San Pedro River Pathogens Study (4 other sites in area not shown)	ADEQ
10	Santa Cruz River Pathogens Study (4 other sites in area not shown)	ADEQ
13	Senator and Cash Mines	ADEQ
14	Silver Creek Study	ADEQ
15	Tucson Stormwater	City of Tucson
16	Colorado River Wildlife Refuges Study	USFWS
17	Little Colorado River Fish and Wildlife Study	USFWS
18	Middle Gila River Biota, Water, and Sediment Study	USFWS
19	Upper Gila River Biota, Water, and Sediment Study	USFWS
20	Yuma Valley Biota, Water, and Sediment Study	USFWS
21	Bill Williams River Biota, Water, and Sediment Study	Univ. of Az. and USFWS
22	Colorado River Backwater Studies	Univ. of Az. and USFWS
23	Upper Santa Cruz River Study	Friends of Santa Cruz and ADEQ
24	Upper Tonto Creek Study	ADEQ
25	White Mountain Virus Study	ADEQ
26	Lake Havasu Study	ADEQ, Mohave County & Lake Havasu City
27	Painted Rocks Area Study	ADEQ
28	Prescott Mining Study	ADEQ and Bureau of Mines

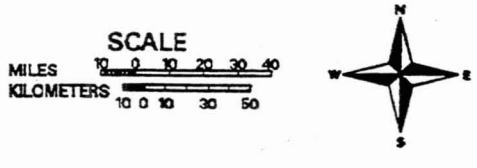


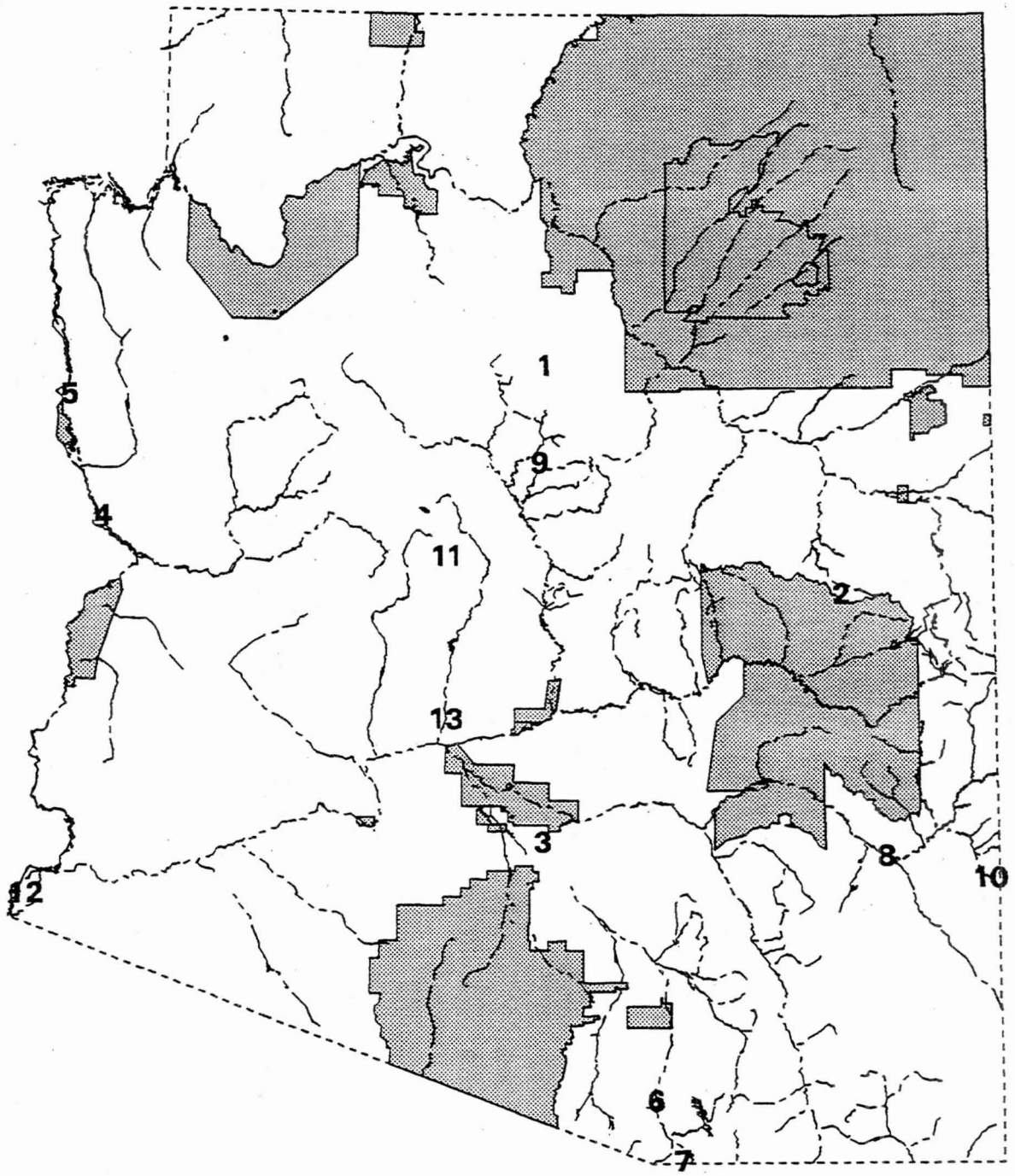
Map 12. Water Quality Index Wells - 1995





Map 13. Pesticides Groundwater Monitoring - 1991 - 1995

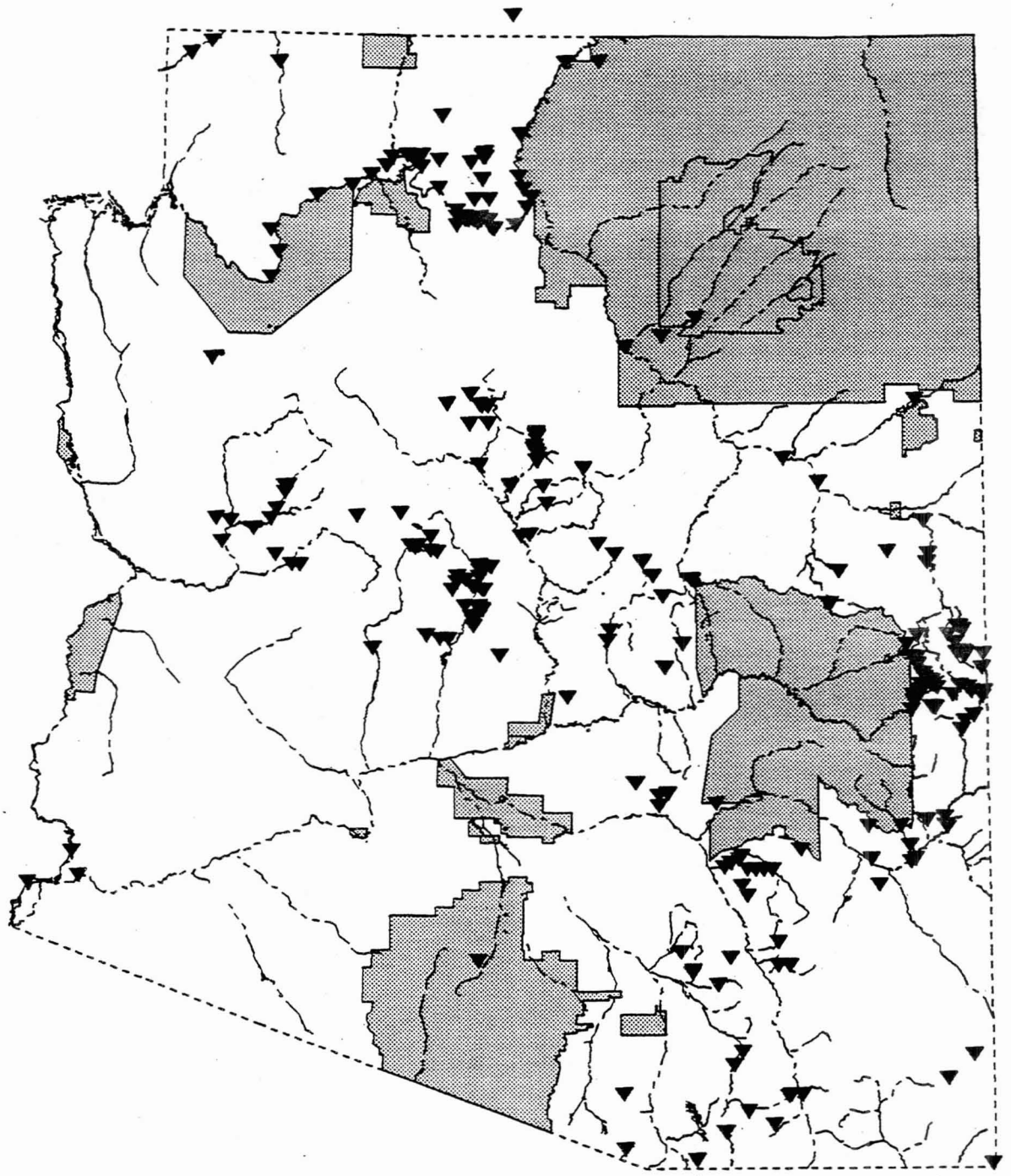




Map 14. Groundwater Special Studies - 1991 - 1995

Groundwater Special Studies (Map 14)

Map Number	Name of Study	Agency
1	Fort Valley	ADEQ
2	Pinetop-Lakeside Seep	ADEQ
3	Casa Grande	ADEQ
4	Lake Havasu	ADEQ
5	Bullhead City and Northern Mohave Valley	ADEQ
6	Tubac	ADEQ
7	Nogales Wash	ADEQ/EPA/IWBC/ equivalent agencies in Mexico
9	Oak Creek Watershed	ADEQ
8 & 10	San Carlos-Safford-Duncan Watershed	ADEQ
11	Prescott Mining	ADEQ/U.S. Bureau of Mines
12	Yuma Pesticides	ADEQ
13	Litchfield Pesticides	ADEQ



Map 15. Other Agencies Surface Water Sites - 1991 - 1995

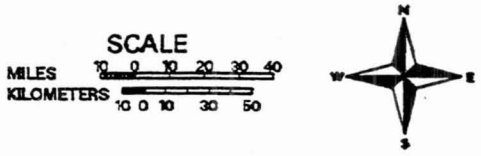


Table 3. ADEQ Water Quality Monitoring Programs

PROGRAM	PURPOSE OF MONITORING	TYPE(S) OF DATA	NUMBER OF SITES AND FREQUENCY	COMMENTS
SURFACE WATER MONITORING PROGRAMS				
Fixed Station Network (Map 7)	Long-term conditions and trends at critical points in a watershed.	Field, general water chemistry, nutrients, total and dissolved metals, and bacteria.	6 times per year. 186 sites in the past 5 years; 26 monitored all 5 years.	USGS has a contract to sample an additional 12 sites.
Priority Pollutant Program (Map 8)	Screen water, sediment, and fish & wildlife tissues for the presence of toxicants.	126 priority pollutants -- generally testing sediment and fish.	Generally waterbody sampled once.	Cooperative effort among ADEQ, AGFD, USFWS, and EPA.
Biocriteria Development Program (Map 9)	Develop baseline data for evaluating biological health of macroinvertebrate and algal communities. To be used to develop biological criteria.	Diversity and abundance of macroinvertebrates, algae. Water chemistry, stream morphology, and habitat data also collected.	1992-1994, about 100 reference sites once a year and another 20 sites twice a year. 1995 48 sites (twice a year) in Verde Watershed.	ADEQ plans to propose narrative biocriteria for the surface water "triennial review" beginning in 1997.
Verde Watershed Watch Program	To evaluate effectiveness of implementing Best Management Practices in the watershed.	Field, general water chemistry, macroinvertebrates.	Initiated in 1996. 7 schools in Verde Watershed, each monitoring an upstream-downstream paired site.	A federally funded Nonpoint Source Program to teach high school students water quality monitoring techniques.
Clean Lakes Program (Map 10)	Determines ambient conditions, sources of pollution, and potential for remediation of lake water quality.	Field, general water chemistry, total metals, and nutrients at various depths and locations in lake.	6 lakes monitored and 3 lakes received diagnostic feasibility surveys in 1995.	New program in 1989.
Special Investigations and Intensive Surveys (Map 11)	Targeted surface water quality investigations.	Media and types of parameters vary. Source and land use information normally documented. Stream morphology and habitat data collection initiated in 1996.	Varies widely. Shorter term, more intensive, and more targeted than Fixed Station Network monitoring.	Includes complaint investigations, enforcement case development, and the surface water portion of the pesticides program.
GROUNDWATER MONITORING PROGRAMS				
Water Quality Index Wells (Map 12)	Determine regional groundwater quality status and trends based on an index well monitoring network.	Field, general water chemistry, nutrients, and dissolved metals at all sites. VOCs, radiochemicals, bacteria, and pesticides (State Groundwater Protection List and banned) at selected sites.	A little more than 200 index wells, which are monitored every 3-5 years.	
Pesticides Monitoring (Map 13)	Develop baseline data on pesticide levels in groundwater.	Analyze for 85 pesticides on Arizona's Groundwater Protection List (currently registered for agricultural use in Arizona). Water and soils monitored	75-100 sites per year; generally sampled once, unless a pesticide is detected which initiates follow-up sampling.	
Groundwater Special Investigations (Map 14)	Targeted water quality investigations.	Media (water and soil) and types of parameters vary.	Varies widely. Three basin-wide studies per year; approximately 50 samples per basin.	Includes complaint investigations, enforcement case development, and emergency response program support.

Monitoring and Data Management Needs

There are several basic monitoring needs not yet addressed in Arizona, and although some steps are being made to fill these needs, more resources are necessary. A report to the Office of Management and Budget by the Intergovernmental Task Force on Monitoring Water Quality (ITFM 1995) indicated that many of these problems are a national concern. A list of the most significant monitoring improvements to consider for Arizona's water quality monitoring programs includes:

- Better environmental indicators (physical, chemical, and biological/habitat) need to be developed to determine the effectiveness of our water quality programs and identify chronic water quality problems that are currently undetected. For example, water quality indicators might include the abundance, richness, and diversity of aquatic populations, the functional condition of riparian areas, or long term trends in surface and groundwater. Obviously, supporting information about land use changes, discharge changes, and the implementation of strategies to improve water quality also need to be tracked to determine the causal relationships of water quality improvements or declines. Staff at ADEQ has been investigating the applicability of nationally recommended environmental indicators in Arizona. (See a further discussion of this initiative in Chapter 2.)

- A database management system for surface water and groundwater analysis is needed. Such a database would facilitate the storage and retrieval of data collected by multiple agencies, quick comparisons to standards or criteria, links to spatial information and other databases, and be capable of routine uploading of information to EPA's STORET database for national use. ADEQ has developed a groundwater database, and currently has plans to revise it to facilitate surface water data.

- An integrated monitoring strategy needs to be developed for surface and groundwater within ADEQ, as well as among other resource management agencies now involved in such monitoring. Issues concerning field and laboratory protocols, and mechanisms for collaboration and data exchange need to be resolved. The newly developing watershed protection approach should facilitate this coordination (see discussion in Chapter 2).

- Probability-based sampling is needed to properly describe ambient water quality and natural conditions rather than basing assessments on the results of monitoring targeted at answering site-specific questions. This need for assessment information continues to compete for limited monitoring resources with a second mandate to mitigate water quality problems. Currently assessments rely on data generated for non-assessment purposes by multiple agencies. The interpretation of this water quality data must allow for a high degree of error and reduced confidence because of:

  - Unknown or insufficient quality control procedures for monitoring by other agencies,
  - Inconsistencies in sampling, preservation, and laboratory analytical techniques,
  - Clustering of sampling sites around known or suspected areas of contamination which does impose a bias on water quality assessments,
  - Sample bias if sites were chosen to establish reference conditions in more pristine areas,
  - Water quality problems actually caused by improper construction of wells rather than aquifer contamination, and
  - Insufficient supporting information about sampling locations, probable sources of contaminants, stream flow, well depths, well construction, and aquifer characteristics.

Although such limitations are common to diverse environmental data sets, such considerations must be included in the interpretation of the data in this report.

- Volunteer monitoring programs need to be instituted, to allow the public to be active participants in water quality management programs. Volunteers could provide basic information on pollutant sources, land uses, habitat conditions, stream bank stabilization, and management practices, as well as collect basic water quality data. Initial voluntary monitoring programs (e.g., Upper Santa Cruz Study) have been carefully structured and have provided valuable information. Additional resources (e.g., full time coordinator, equipment, supplies, and laboratory analysis) are necessary to fully establish and operate a volunteer program that will produce reliable data and information.

- Biocriteria, sediment criteria, and tissue criteria need to be further to protect aquatic and wildlife, agricultural, and human health uses. This is a national issue that requires more basic research on the effect of toxicants and exposure risks.

- In-stream monitoring requirements need to be added to permits discharging to Arizona's streams so that cumulative impacts of discharges to waterbodies can be assessed.

PART IV - STATEWIDE SURFACE WATER ASSESSMENTS

This section describes the status of surface water quality in Arizona. Groundwater quality is described in Part VI of this chapter. Statewide statistics are provided in these sections. A regional perspective on water quality is provided in the watershed section of this chapter (Part VII) because of the size and diversity of Arizona.

The Assessment Process

Assessments are primarily based on monitoring data and information collected in a 5-year period, from October 1, 1990 through September 30, 1995 (Water Years 1991-1995). There are two categories of assessed waters based on the amount of monitoring data available: monitored assessments and evaluated assessments (EPA 1995b).

Type of Assessment

Monitored assessments--These assessments are based on current (within the past 5 years) monitoring data of two types:

- Chemical/physical monitoring collected at least once per quarter for perennial waters, or at least 4 times in 2 years for non-perennial waters; or
- Samples collected over a shorter period of time as part of an intensive survey using multiple sites and/or multiple media samples (i.e. fish tissue, sediment, water).

Evaluated Assessment--There is insufficient data for a monitored assessment, but sufficient information or data for an assessment based on:

- Nominal monitoring data or data older than 5-years;
- Sediment, animal tissue, or wildlife tissue sample results compared to applicable criteria (**Appendix A**), such as:
  - Health Based Guidance Levels (HBGLs) for soil,
  - Secondary Maximum Contamination Levels (SMCLs), if water protected for Domestic Water Source,
  - EPA's total dissolved solids criteria, if water is protected for Agriculture Irrigation,
  - Fish tissue or wildlife tissue criteria;
- Reliable information concerning non-compliance with narrative surface water standards (e.g. debris, films, toxicants in toxic amounts, accumulation of bottom deposits);
- Reliable information concerning conditions judged to cause impairment (i.e. lack of fish reproduction, algae blooms, weed harvesting, fish kills);
- Reliable information concerning how impending changes within a watershed may impact protected uses (normally used to determine if threatened when in full support);
- Extrapolation of data from upstream or downstream monitoring sites.

Designated Use Support–There are four categories of designated use support used in this assessment: full support, threatened, partial support, and non-support. "Threatened" is actually a subcategory of full support, and uses in partial support and non-support are frequently combined and referred to as "impaired." Therefore, waters could be classified simply as supporting their uses or impaired.

Designated Use Support Definitions

Full Support - No uses are impaired. No narrative violations. No conditions which could be judged as impaired. Numeric standards are met.

Threatened - No uses are impaired (full support); however, occasional exceedances suggest intermittent impairment, or there are pending changes within the watershed which may impair water quality. Sediment samples indicate transport of toxicants in streambed during runoff events.

Partial Support - One or more uses are impaired, but no uses are in non-support. Narrative violations occur seasonally (e.g. algal blooms, weed harvesting). Toxic spill or discharge with nominal or short term effects. The median of test results for non-toxicants exceeds the standard, but substantial impairment of the use has not been documented.

Non-Support - There is substantial impairment of one or more uses (e.g. fish kills, bathing area closures, cattle deaths). Toxicants are present in toxic amounts. Non-toxicants are present at a frequency that would severly impair their use (more than 25% of the time.

The decision criteria used for surface water assessments are provided in **Appendix C.** The assessment process consists of comparing water quality data and information to numeric and narrative standards or criteria. As simple as this sounds, the decision matrix is complex because each "designated use" has a separate set of standards and criteria.

There are also many subjective decisions involved in the interpretation of data or information. For example, if a lake's pH exceeds the standard (9.0), but the lake is monitored only in the summer when the pH is seasonally high, is the impairment assessed as partial or non-support of uses? Or if a stream dries down to a stagnant pool due to natural conditions, test results will show insufficient dissolved oxygen. Should the test results be used to indicate impaired uses? Such subjective decisions have been based on the potential outcome of listing. In the example above, the lake would be listed as in partial support unless there was further information of severe impacts to aquatic communities or other uses (e.g., repeated fish kills). In the drying stream example, the waterbody normally would be listed as in full support because this is a natural condition in an arid climate and site-specific standards or further investigations are not necessary. However, impairment could be shown if unapproved hydrologic modifications had caused the drying conditions.

Assessment Qualifications

The methods used in preparing this assessment of surface waters are primarily the same as those used in the 1994 assessment; however, three changes should be noted:

- Compliance with NPDES permit limits was no longer used to directly determine use support, except that non-compliance is considered a threat to waters receiving the discharge and is used in conjunction with other data or information for assessments.

- EPA provided new assessment criteria for the Aquatic and Wildlife use. If more than 10 data points are available, a toxicant standard can be exceeded in one test result and be considered in full support, rather than (as previously assessed) in non-support.

- Chronic toxicity standards adopted in 1992 were used for the first time. The standard requires at least four consecutive days of sample collection for enforcement action. However, for assessment purposes (a non-enforcement action), the median sample value was compared to the chronic standard. At least three data points were used to calculate a median value.

Changes in analysis methods occur from year to year, making it inappropriate to compare assessment reports. Fewer miles assessed as impaired cannot be concluded to mean improved water quality, but instead is often related to changes in assessment criteria or monitoring approaches. Trends in specific indicator constituents or riparian area conditions at specific sites are a more direct and better measures of water quality improvements than assessments. Such trends (Baldys 1990, Baldys et al. 1995) need to be linked to specific activities in the watershed, program actions, discharge changes, or changes in land use to establish a cause and effect relationship. ADEQ is currently investigating ways to track such supporting data so that trend studies can be used to evaluate progress in the future.

Several aspects of the overall assessment and monitoring process need to be considered to avoid inaccurate conclusions from this report. Monitoring and assessment programs are being modified to reduce impacts from some of these aspects in future assessment reports:

- ADEQ used surface water standards adopted in 1992 as the basis of this assessment rather than standards adopted in 1996 because the assessments were completed in January before new standards were adopted in April. The current assessment process is time consuming to allow for all of the data to be reanalyzed in time for this assessment.

- Violations of standards are different from use support assessments. Use support assessments can be based on non-enforceable criteria, such as the use of chronic toxicity standards discussed above or the use of secondary maximum contaminant level criteria. For this reason, many surface water assessments are not used for listing a waterbody on the Clean Water Act 303(d) Water Quality Limited Waters list (see discussion of this list in Chapter 3).

- ADEQ's monitoring is frequently stimulated by perceived problems in stream quality or known pollution sources; therefore, more exceedances would be found then if waters were randomly sampled or if sites were chosen for their ability to represent the watershed.

- Normally the entire reach or lake is assessed as impaired although the extent of contamination is frequently unknown. This simplification allows for assessments to be made with limited information.

- Monitoring during rain events has been emphasized on some waterbodies, distorting ambient conditions.

- Laboratory detection limits for several key chemicals are above the standard; therefore, future testing with lower detection limits may discover more exceedances.

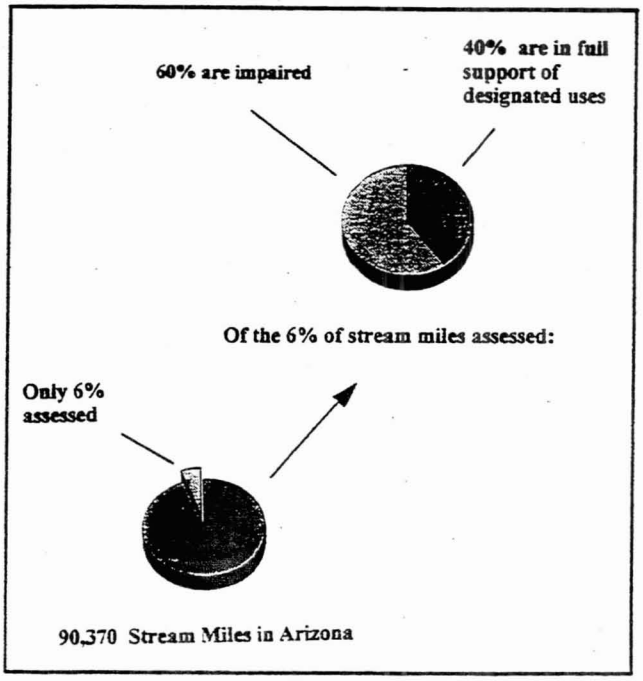
- Additional data and information are needed support or refute assessments. Current assessments are primarily based on chemical analysis. In its assessment guidance, EPA recommends "aquatic life use" support assessments be based on a composite of four types of information: biological integrity (biotic communities), habitat condition (stream morphology and vegetation), toxicity testing, and chemical analysis (water, sediment, and animal tissue as appropriate).

- Part of the assessment process includes identifying pollutant source(s); however, source information is normally not attached to the sampling data and is difficult to track for a watershed. For example, the location of grazing permits and abandoned mines, the condition of riparian areas, and the location of new septic systems are normally not available for watersheds. The current availability of source information makes it difficult to decide whether the water quality problem is caused by natural or anthropogenic conditions.

Designated Use Support of Streams and Lakes

Use attainment in streams and lakes in Arizona is illustrated on **Map 1 (in the Executive Summary)**, and statewide statistics are summarized in **Tables 4, 5, 6, and 7**. Lakes and streams on Indian Lands were not subject to this assessment.

Figure E. Assessed Streams

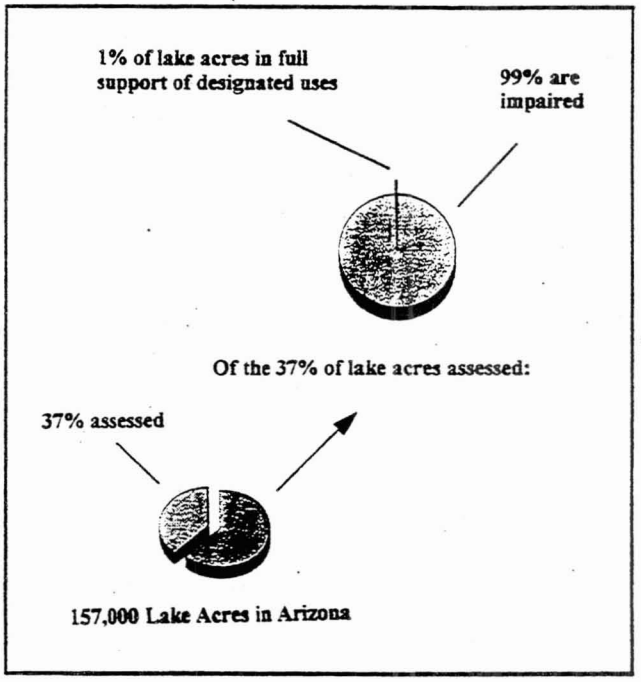


Of the 90,300 stream miles in Arizona, 5,410 stream miles (6%) were assessed **(Figure E)**. Of the 5,410 stream miles assessed, 40% were in "full support" of all uses (including "threatened") and 60% were impaired (partial and non-support). **These assessment statistics cannot be expanded to reflect the general water quality conditions of the whole State** because the samples were not collected under an unbiased probability-based monitoring program. Instead, the samples were targeted to answer specific questions.

The USGS hydrography estimates 3,528 miles of perennial stream in Arizona **(Table 2)**. Approximately 2,674 miles were assessed (75%). (However, these numbers should be viewed with discretion because within the assessment database the hydraulic characterization of the stream was an approximation. The assessment database did not use the USGS hydrography information.) **Table 2** shows that use support on perennial streams was assessed as:

- 31% full support (including threatened)
- 51% partial support
- 18% non-support.

Figure F. Assessed Lakes



As indicated in Table 4, the number of "evaluated" assessments far outnumbered the number of "monitored" assessments. Evaluated assessments are less reliable than monitored assessment; however, more monitoring resources are needed to provide a monitored assessment. A comparison of perennial and non-perennial assessments shows that more perennial miles had monitored assessments. The evaluated sites are less likely to be impaired than monitored sites. This data bias is probably due to targeting monitoring at perceived problems.

A higher percentage of lake acres were assessed than stream miles **(Table 5)**. Of approximately 157,000 lake acres inventoried as public-owned lakes, 58,860 acres were assessed (37%) **(Figure F)**. Monitoring data focused on large reservoirs (up to 10,000 acres); therefore, few lakes were assessed -- 76 of 364 public-owned lakes (21%).

Table 4. Arizona's Stream Use Support Summary - 1996

DEGREE OF USE SUPPORT	ASSESSMENT BASIS		
	Evaluated	Monitored	TOTAL
	Number of Reaches Assessed		
	333	136	469
Full Support (miles)	1,220	476	1,696
Threatened (miles)	319	170	489
Partial Support (miles)	1,277	789	2,066
Non-Support (miles)	570	589	1,159
Total Assessed (miles)	3,386	2,024	5,410

RATE OF IMPAIRMENT*	ASSESSMENT BASIS		
	Evaluated	Monitored	TOTAL
Total Assessed (miles)	3,386	2,024	5,410
Impaired * (miles)	1,847	1,378	3,225
Percent Impaired	55%	68%	60%

TYPE OF STREAM ASSESSED	ASSESSMENT BASIS		
	Evaluated*	Monitored*	TOTAL
Perennial (miles)	1,538	1,136	2,674
Non-perennial (miles)	1,777	754	2,531
Canals (miles)	71	134	205
Total Assessed (miles)	3,386	2,024	5,410

"Stream" includes perennial and non-perennial (ephemeral and intermittent) streams and canals not on Indian lands.

Rate of Impairment = (partial support + non-support) / total assessed.
Impaired = partial support + non-support.

Table 5. Arizona's Lake Use Support Summary - 1996

DEGREE OF USE SUPPORT	ASSESSMENT BASIS		
	Evaluated	Monitored	TOTAL
	Number of Lakes Assessed		
	59	17	76
Full Support (acres)	272	0	272
Threatened (acres)	274	0	274
Partial Support (acres)	21,477	35,275	56,752
Non-Support (acres)	1,137	425	1,562
Total Assessed (acres)	23,160	35,700	58,860

RATE OF IMPAIRMENT*	ASSESSMENT BASIS		
	Evaluated	Monitored	TOTAL
Total Assessed (acres)	23,160	35,700	58,860
Impaired * (acres)	22,614	35,700	58,314
Rate	98%	100%	99%

Lakes = publicly owned lakes and reservoirs not on Indian Lands.

Rate of Impairment = (partial support + non-support) / total assessed.
Impaired = partial support + non-support.

Table 6. Arizona's Stream Use Support Matrix - 1996 (miles)

DESIGNATED USE	FULL SUPPORT	THREATENED	PARTIAL SUPPORT	NON-SUPPORT	TOTAL ASSESSED
Aquatic and Wildlife					
Warmwater	936	365	1,140	677	3,118
Coldwater	936	188	449	223	1,796
Ephemeral	41	13	21	74	149
Effluent Dependent	19	38	38	47	142
Total	1,932	604	1,648	1,021	5,205
Fish Consumption	2,517	248	1,187	98	4,150
Body Contact					
Full (swimming)	2,482	356	1,228	497	4,563
Partial (wading)	212	129	261	40	642
Total	2,694	48 5	1,489	537	5,205
Domestic Water Source	516	191	651	128	1,486
Agriculture Livestock Watering	3,624	440	434	279	4,777
Agriculture Irrigation	2,680	282	444	276	3,682
Overall Use Support	1,696	489	2,066	1,159	5,410

Table 7. Arizona's Lake Use Support Matrix - 1996 (acres)

DESIGNATED USE	FULL SUPPORT	THREATENED	PARTIAL SUPPORT	NON-SUPPORT	TOTAL ASSESSED
Aquatic & Wildlife					
Warmwater	2,126	13,130	22,342	692	38,290
Coldwater	2,009	14,155	3,567	815	20,546
Ephemeral	0	0	0	0	0
Effluent Dependent	0	0	24	0	24
Total	4,135	27,285	25,933	1,507	58,860
Fish Consumption	36,028	18,095	4,160	200	58,483
Body Contact					
Full (swimming)	36,948	5,195	16,420	20 5	58,768
Partial (wading)	56	0	36	0	92
Total	37,004	5,195	16,456	205	58,860
Domestic Water Source	6,495	88	39,812	2	46,397
Agriculture Livestock Watering	51,141	45	2,125	0	53,311
Agriculture Irrigation	50,260	45	1,315	200	51,820
Overall Use Support	272	274	56,752	1,562	58,860

"Stream" includes perennial and non-perennial (ephemeral and intermittent) streams and canals not on Indian Lands. Stream statistics include 205 miles of canals.

Of the 58,860 lake acres assessed, only 347 acres were in full support (1%). Much of the "impairment" is caused by creating impoundments and diverting surface water, resulting in shallow lakes with low flows and high productivity. Under these conditions, algal blooms result in high pH values, low dissolved oxygen, and occasional fish kills. These impoundments act as sinks for contaminated (and uncontaminated) sediments, and evaporation further increases naturally high total dissolved solids. (See further discussion of stressors in this section.)

The status of designated use support on streams and lakes is presented in **Tables 6 and 7**. The most impaired status of any use on the waterbody is used to determine the "overall use support." For example, if a waterbody partially supports the Aquatic and Wildlife Coldwater Fishery standard for turbidity while meeting all other standards, the overall use support would be partial support. These tables show the following:

- Aquatic and Wildlife uses were fully supported in half of the assessed streams and lakes.
- Fish Consumption use was fully supported in 70% of streams and 93% of the assessed lakes.
- Swimming was fully supported in two-thirds of the assessed streams and lakes.
- Drinking water use was fully supported in half of the streams assessed but only 14% of the assessed lakes.

On their own, these statistics raise more questions than they answer. For example: Is the water safe to drink? Should the public refrain from swimming in a third of Arizona's lakes and streams? It is important to provide more context for these statistics by looking at specific stressors or causes identified as contaminants of concern and their probable sources. Then we will look at specific reported impacts on aquatic life and human health. Only then, it may be possible to judge the relative risks associated with impairment.

Stressors and Potential Source

Ranking Stressors and Sources--Categories of stressors and their relative impact on waterbodies in Arizona are listed in **Table 8**. Metals, salinity, turbidity, pathogens, and pH are the top stressor categories.

Source categories refer to activities, types of facilities, or natural conditions that contribute to the impairment or identified stressor. The top sources were natural, agriculture, hydromodification, and resource extraction. Probable sources of contamination identified in this assessment are listed in **Table 9**. Multiple sources were identified for many waterbodies. The reliability of source identification varies greatly, depending on the purpose of the monitoring. Complaint investigations frequently identify sources of contamination; however, ambient monitoring seldom provides such information. Land uses are assumed to be the sources of contamination where sources have not been identified by the study.

Background information about several of these causes and sources is provided here to help interpret these statistics.

- **Natural**--This was the top source category because often natural conditions contribute to water quality problems. For example, Arizona's soils are highly erodible and typically waters carry a heavy load of suspended solids. ADEQ hopes to learn the contribution of natural conditions by modeling "loadings" and completing Total Maximum Daily Load analysis (assimilation capacity analysis) in impaired watersheds.

- **Salinity**--Public Water Supply secondary maximum contaminant levels (SMCLs) were used as assessment criteria for waterbodies with Domestic Water Source designated use. These criteria suggest that the public might find Arizona's drinking water has an "off" flavor due to high salts (i.e., total dissolved solids, chloride, and sulfate), iron, and manganese. This hypothesis is supported by the popularity of in-home treatment devices and bottled water in Arizona.

Table 8. Stressors Impacting Designated Uses in Arizona - 1996

STREAMS		LAKES	
Stressor Category	**Miles***	**Stressor Category**	**Acres***
Metals *	1,963	Salinity *	38,193
Turbidity	1,948	Metals *	34,626
Salinity *	1,104	Other inorganics *	5,000
Pathogens (fecal coliform)	428	Turbidity	3,442
pH	385	pH (high pH)	2,336
Low dissolved oxygen	333	Noxious aquatic plants	2,014
Radiation (gross alpha)	161	Low dissolved oxygen	1,021
Nutrients	114	Suspended solids	455
Pesticides	110	Pesticides	370
Debris, bottom deposits	106	Nutrients	260
Other inorganics *	50	Debris, bottom deposits	200
Suspended solids	25		

* Miles and acres were rounded to the nearest whole number.
"Metals" include metalloids (i.e., arsenic, beryllium, and selenium)
Salinity includes: total dissolved solids (TDS), sulfate, and chloride.
Other inorganics include: sulfide, barium, cyanide, fluoride, phenols, etc.

Other minor stressors not listed impaired less than 25 stream miles or 200 lake acres.
Subcategories will not add up to the total miles or acres assessed because several stressors may impair the same waterbody.

Table 9. Probable Sources Impacting Designated Uses in Arizona - 1996

STREAMS		LAKES	
PROBABLE SOURCE CATEGORY	**Miles***	**PROBABLE SOURCE CATEGORY**	**Acres***
Point Sources (rank order):		**Point Sources (rank order):**	
Urban stormwater sewers	164	Urban stormwater sewers	780
Municipal point sources	145	Municipal point sources	461
Industrial point sources	80	Industrial point sources	520
Package plants	60		
Nonpoint Sources **(rank order):		**Nonpoint Sources **(rank order):**	
Natural	2,753	Natural	56,659
Agriculture (Rangeland) (Crop production)	2,205 (1,753)* (551)*	Agriculture (Crop production) (Rangeland)	50,385 (42,418)* (8,167)*
Hydromodification	1,116	Hydromodification	37,783
Resource Extraction (Inactive operation) (Active operations)	1,004 (771)* (422)*	Resource Extraction (Inactive operation) (Active operations)	14,926 (14,849)* (13,058)*
Recreation	430	Urban and rural runoff	9,920
Silviculture	413	Recreation	1,901
Construction	264	Septic systems	900
Solid waste disposal	139	Solid waste disposal	200
Outside Arizona Jurisdiction	481	**Outside Arizona Jurisdiction**	19,070

*Subcategories will not add up to the total miles or acres assessed because several sources may affect the same waterbody. Unlisted sources impaired less than 50 stream miles or less than 150 lake acres.

**Categories:

- Agriculture = irrigation, rangeland, animal holding and management practices, and manure lagoons.
- Hydromodification = removal of riparian vegetation, stream bank modification or destabilization, flow modification or impoundments impairing water quality.
- Recreation = off-road vehicles, hiking, camping, boating, swimming, etc.
- Resource Extraction = mining, sand and gravel operations, mill and mine tailings, acid mine drainage from active and inactive mining operations. Both active and inactive operations may impair some waters.
- Silviculture = forestry management.

EPA has also provided salinity criteria at levels where crop production may be impaired within arid and semi-arid areas (EPA 1986). Using these levels, streams or lakes with Agricultural Irrigation as a designated use were assessed as "partially supporting" if the mean value of total dissolved solids was more than 1000 mg/l.

Arizona's surface waters have naturally high levels of total dissolved solids (TDS); however, a review of the monitoring data reveals noticeably higher TDS levels downstream of some irrigation canal return flows, near mining operations, and within effluent dependent waters.

The federal Salinity Control Act was authorized because salinity was recognized as a major concern in both the United States and Mexico. Salinity impacts crop production, as well as municipal and industrial uses. Damage in the Colorado Basin below Lees Ferry, Arizona is currently estimated by The U.S. Department of Interior (Bureau of Reclamation 1995a) has estimated that high salinity levels have an annual cost of $311 million (primarily crop damage). If salinity levels approach the Colorado River salinity standards, then the estimated user costs increase to more than $1 billion per year.

The USGS indicated that irrigated agriculture is the largest anthropogenic source of dissolved solids in the upper Colorado River watershed (above Lees Ferry, Arizona) (Mueller and Osen 1988). Irrigation increases salinity by consuming water, thereby concentrating stream water, and by dissolving salts found in the underlying saline soils and geologic formations. The salt laden irrigation tail-waters then may drain back into the stream (Bureau of Reclamation 1995a). Irrigated land is probably the primary manmade source of salinity within the upper Colorado River Basin. In comparison to irrigation, trans-basin diversions, and reservoir storage, other types of water resource development have had only a minor effect on dissolved solids concentration and discharge (Mueller and Osen 1988).

The federal Colorado River Basin Salinity Control Program has focused its efforts on reducing impacts from agriculture irrigation along the Colorado River. According to the latest Bureau of Reclamation progress report (1995a), six projects in the Wellton-Mohawk Irrigation and Drainage District have been established to improving irrigation efficiencies. The Colorado River Indian Reservation Unit has also been the site of an intensive investigation of irrigation practices to reduce salt loading into the Colorado River.

- **Metals and Mining--**"Metals," which includes metalloids (i.e., arsenic, beryllium, and selenium), is among the top stressors in both streams and lakes **(Table 8)**. The types of metals impairing Arizona's lakes and streams are shown in **Table 10**. "Resource extraction" (i.e., active, inactive, and abandoned mines) and natural mineralization are the primary sources of metals. The occurrence of both low pH and high levels of metals in some streams is a more conclusive indicator of impact from historic and widespread mining. Many mines have been abandoned, leaving tailing piles and other spoils along streams. This allows the transport of toxic metals into surface water that often attach to sediments. These contaminated sediments move downstream during storm events and settle in Arizona's reservoirs.

  Chemicals used in mining processes (largely historic uses), such as cyanide and mercury, have also contaminated surface and groundwater. ADEQ continues to focus special investigations around mining activities because of the toxicity of the substances discharged; however, this focus would over emphasize the extent of impairment if the statistics are incorrectly extrapolated. Metals may also leach from the soil in areas where they are exposed by road cuts, sand and gravel operations, land development, or land is inundated by water with the creation of a reservoir. Several specific mining investigations are included in the watershed discussions section later in this chapter.

Table 10. Metals Impairing Streams and Lakes in Arizona - 1996

STREAMS		LAKES	
Metals*	**Miles**	**Metals***	**Acres**
Arsenic	1,206	Selenium	15,740
Copper	528	Beryllium	13,208
Beryllium	299	Arsenic	4,324
Zinc	244	Mercury	2,047
Lead	241	Iron	1,204
Mercury	240	Manganese	1,039
Selenium	194	Lead	57
Cadmium	169		
Boron	157		
Manganese	153		
Total Impaired**	1,962	Total Impaired**	34,454

* Metals impairing less than 100 stream miles or 50 acres are not shown.
** The "total impaired" is not the sum of individual metals because waterbodies can be impaired by more than one metal.

There are five toxic metals that deserve further discussion: arsenic, beryllium, mercury, selenium, and copper.

- **Arsenic and Beryllium**--Elevated levels of arsenic are normal in mineralized zones containing gold, silver, and sulfides of lead and zinc (Eisler 1988a). Such conditions are common in Arizona. Arsenic can also be contributed by copper smelters, coal-fired power plants, industrial and manufacturing processes, and (historically) pesticides. Arsenic in soils is constantly being resolubilized and made available by organisms for plant uptake and reduction. Arsenic is constantly being oxidized, reduced, or otherwise metabolized in living tissue (Eisler 1988a). Arsenic has a low bioconcentration factor, a short half-life in fish tissue, and there is no maximum permissible fish tissue concentration established by the U.S. Food and Drug Administration (EPA 1984a).

  In Arizona, high levels in groundwater and surface water have been linked to a particular stratum of the Verde Formation (Mohapatra 1991). A recent study of the sources and fate of arsenic in the Verde and Salt rivers (Baker 1994) concluded the following:

  - The Verde Formation, a natural alluvial deposit in the Verde River, is a major source of arsenic to this river. Anthropogenic activities (i.e., mining) might play an indirect role in increasing arsenic concentrations by increasing the hydrologic interaction between the river and the Verde Formation.
  - Streams in mining districts do not appear to have elevated arsenic levels.
  - At the confluence of the Verde River and Salt River, the Verde contributes 30% of the water and 58% of the arsenic.
  - Reservoirs on the Verde River trap around 16% of the arsenic.

  Beryllium is used as a structural metal in the aerospace industry, a neutron reflector in nuclear reactors, an additive in solid rocket motors, and in the manufacture of electronics. Beryllium is sometimes elevated near mining operations. Beryllium occurs naturally at high levels in Arizona's soils, with normal background levels as high as 5 mg/kg (Earth Technology Corporation 1991). Arizona's Interim Soil Remediation Rules (Arizona Administrative Code R18-7-203 through R18-7-209, adopted in 1995) established a cleanup level of 1.34 to protect human health in non-residential areas.

  This assessment used the 1992 standards for arsenic and beryllium; however, after completion of this assessment, the State adopted new standards in 1996 as shown below:

DESIGNATED USES*	Arsenic (µg/l)		Beryllium (µg/l)	
	Old (1992)	New (1996)	Old (1994)	New (1996)
Domestic Water Source	50	50	0.008	4
Fish Consumption	3.1	1400	0.21	0.21
Full Body Contact	50	50	0.33	4

The change in the arsenic standard for fish consumption should bring almost all waters into compliance for arsenic in future assessments. Of the 1,962 stream miles impaired by metals, 1,205 miles were impaired by arsenic. Arsenic was the only stressor impairing 207.5 miles of stream. Arsenic impaired 4,247 lake acres; however, only one lake should come back into compliance with

these standards changes (2,015 acres of Bartlett Lake). A review of the 1996 data (**Appendix B**) suggests that no assessments would be changed based on the new beryllium standards.

- **Mercury**--Mercury was used historically by mining operations to leach gold. Mercury or mercurial compounds were also used in dental amalgams, mercury vapor lamps, electronics, and as a fungicide and disinfectant. In some areas, elevated mercury has also been associated with effluent discharges from wastewater treatment plants. Mercuric sulfide occurs within natural deposits of cinnabar, and seven of Arizona's fourteen counties contain significant deposits of cinnabar.

  There is also evidence that mercury can be contributed by atmospheric deposition (Adamson 1990). Elemental mercury is volatile. Once mercury enters the atmosphere, winds and air currents can carry it worldwide, and rains and snow can deposit it far from its origins. In freshwater lakes, particularly those with low alkalinity, mercury can be converted into an organic compound, methylmercury, which bioaccumulates in fish and other aquatic organisms. The contribution of mercury from atmospheric deposition in Arizona's lakes has not been explored; however, elevated levels of mercury have been found in fish where other sources have not been established.

  Mercury is toxic, interfering with growth and photosynthesis in plants, and exhibits neurotoxic effects in higher organisms. This toxicity and the propensity for mercury to bioaccumulate and biomagnify are major factors in mercury having one of the most stringent EPA water quality criteria among the heavy metals. Numerous factors, such as hardness and pH, affect the bioavailability of inorganic mercury. However, once methylated (i.e., methylmercury), mercury is readily transferred through, and accumulated in, the food chain. Methylmercury compounds have no known normal metabolic function; their presence in the tissues of living organisms represents contamination from environmental sources. Once introduced into the aquatic system, mercury cycles between these different forms with little being removed from the system; therefore, it becomes difficult to identify sources or mitigation strategies.

  A fish tissue monitoring program has been initiated by ADEQ (in cooperation with AGFD, USFWS, and EPA) in 1996 to evaluate the threat posed by mercury to bald eagles nesting along watercourses in Arizona. Fish tissues collected will be compared to the 0.1 mg/kg of mercury in tissue suggested by a U.S. Fish and Wildlife Service (Eisler 1987) to protect sensitive species that regularly consume fish and aquatic organisms. This concentration is also the mean value found for mercury in fish tissue by the National Biomonitoring Program (Schmitt and Brumbaugh 1990).

- **Selenium**--Recent selenium studies by the University of Arizona (in cooperation with the U.S. Fish and Wildlife Service) suggest that selenium approaches critical levels in tissue of fish, birds, and other biota along the lower Colorado River. The tissue sample results suggest potential impairment of reproduction in birds and fish within the Colorado River backwater lakes, as well as part of the Colorado River and the Bill Williams River (Rusk 1991, Lusk 1993, Martinez 1994, McCaulou et al. 1994, Ruiz 1994, Villegas and Maughan 1994, Welsh and Maughan 1994). This work supported findings of earlier studies by USFWS and other agencies (Bussey et al. 1976, Radtke et al. 1988, Baker et al. 1992, King et al. 1993).

  The sources of selenium have not been clearly identified. Current thinking is that rising Colorado River water saturates high selenium content soils; then when the water recedes, selenium laden waters are released to the river. The relative contribution of selenium from irrigation return flows, natural sources, or other sources has not been determined.

Selenium levels found in Arizona are minor compared to the levels reached in the Kesterson National Wildlife Refuge and other areas in California where high selenium levels have resulted in the death of thousands of birds and fish in the 1980s (Ohlendorf 1986). However, because of the levels of selenium in some backwaters along the Colorado River, U.S. Fish and Wildlife personnel have recommended that a fish consumption advisory be considered for at-risk human populations where contamination is highest, and that further studies be conducted (King et al. 1993).

- **Copper**--Arizona has some of the largest open pit copper mines in the world, with accompanying massive tailings piles and azure tailings ponds. Most mines have been working with ADEQ and EPA to mitigate the surface water, groundwater, and air pollution caused by historic mining and smelting practices. Although untold dollars have been spent on berms, dams, groundwater pumping and reuse, pond liners, and other technology-based remediation, some surface water impairment remains.

  Copper is a minor nutrient for both plants and animals at low concentrations, but is toxic to aquatic life at only slightly higher levels. The toxicity of copper decreases as water hardness increases, which is reflected in Arizona's surface water standards to protect Aquatic and Wildlife uses (i.e., the standard varies with water hardness).

  Copper has limited ability to bioconcentrate in edible portions of freshwater aquatic species (EPA 1984b); however, elevated levels of copper have been noted in fish tissue within several watersheds (see the Aquatic Life Impacts discussion in the next section of this chapter). This would seem to indicate a long-term exposure to high levels of copper.

- **Turbidity, Suspended Solids, and Siltation**--The combination of turbidity, suspended solids, and siltation remains the principal cause of stream impairment and an important cause of lake impairment. These stressors are closely related, yet distinctly different. Turbidity is a measurement of the clarity of water due to the presence of suspended solids and organic matter. Suspended solids are particulates carried by the stream. Siltation/sedimentation occurs as these solids settle out of solution as stream velocity slows.

  Turbidity standards were established in Arizona to protect Aquatic and Wildlife uses. Generally, high turbidity may be evidence of accelerated erosion associated with bank de-stabilization, channel cutting, topsoil removal, and associated sediment transport (including contaminated sediments). In a watershed with accelerated erosion, such as the Little Colorado River watershed, surface water may become so muddy that it is unfit for livestock consumption (U.S. Department of Agriculture 1981, Appendix II). Streams in arid regions have higher suspended solid loads than other regions due to sparse vegetation and erodible soils; however, anthropogenic activities within the Little Colorado River watershed appear to have accentuated this turbidity.

  High levels of suspended solids may also have negative effects on crop irrigation (e.g., inhibition of water infiltration, soil aeration and plant emergence, formations of films on plant leaves that block sunlight and impede photosynthesis, and the adverse effects on irrigation delivery canals and equipment) (EPA 1986). In some watersheds in Arizona, suspended solids are the primary cause of turbidity problems. Because suspended solids are a more direct measure of water quality problems (i.e., erosion and stream bank stabilization, siltation, metals transport), Arizona is considering establishing a standard for suspended solids.

Siltation has socioeconomic costs that need to be considered. In Arizona, reservoirs fill with sediment due to erodible soils, sparse vegetation, and the removal or disruption of riparian vegetation (U.S. Department of Agriculture, 1981, Appendix II). The reduced viability of these reservoirs means a reduction in recreational potential, hydroelectric capacity, and water storage capacity.

- **Eutrophication and Nutrients**--Eutrophication is a process of aging in lakes and reservoirs caused by the introduction of sediments and nutrients from the surrounding watershed. The process in natural lakes (there are only a handful in Arizona) occurs slowly, but the process is accelerated by human activities. Manmade lakes and reservoirs generally become eutrophic more rapidly because they are often very efficient in capturing sediment and nutrient loadings. It is possible that some reservoirs in Arizona had eutrophic characteristics shortly after they were filled. Some of the more notable problems with eutrophication in Arizona include:

  - High densities of submerged and emergent aquatic vegetation that restrict recreational activities and may have adverse impacts on fisheries' habitat,
  - High pH which stresses aquatic organisms and can contribute to fish kills, and
  - Low dissolved oxygen concentrations, at relatively high water temperatures, that decrease the area and volume of potential fish habitats in a reservoir,

- **Pesticides**--The pesticides most often identified as impairing lakes and streams in Arizona are DDT metabolites, toxaphene, and dieldrin. Fish advisories have been posted in several waterbodies due to these chemicals (see the Public Health and Aquatic Life Concerns section of this chapter).

  The source of pesticide contamination is thought to be historical agricultural practices, although the use of DDT has been banned in Arizona since 1969, and the use of toxaphene was banned in 1982. These pesticides were banned because of their persistence in the environment and ability to bioaccumulate. DDT metabolites and toxaphene are normally below detection limits in water, but can be detected in sediment and fish tissues because they quickly adhere to sediment and fat and they bioaccumulate in predatory species.

- **Hydromodification**--Hydromodification is widespread in Arizona; however, its impact on surface water quality has seldom been studied. This category includes: channelization, dredging, flow regulation (releases from dams), diversions, inundation of soils due to impoundments, groundwater pumping, dam construction, bridge construction, removal of riparian vegetation, stream bank modification, stream bank destabilization, or the drainage/filling of wetlands. Hydromodification frequently occurs as a secondary result of another source. For example, mining and rangeland management may result in riparian destruction or stream bank modification.

  Riparian vegetation is important in reducing flood damage as a result of the relationship among stream velocity, resistance to flow, and stream gradient. There is an inverse relationship between stream velocity and resistance to flow provided by riparian vegetation. In streams, when resistance to flow is doubled, stream velocity is cut in half. The erosive force of water is directly proportional to stream velocity. That is, if water velocity is reduced by a factor of five, the erosive power of water is reduced by 125. During normal flood events, well-vegetated floodplains (i.e., shrubs, trees, and grasses) would receive irrigation water for alluvial recharge, a heavy nutrient and sediment load, and little, if any, scouring damage. The flood height would be less, with longer duration, and lower intensity than poorly vegetated floodplains (i.e., grasses and rocks) (Ohmart 1996).

ADEQ is currently looking at methods to document impacts on riparian areas. The Bureau of Reclamation has developed a method to inventory and describe the "functional condition" of riparian areas. ADEQ intends to begin using these field methods to assess the biological integrity of streams (including washes) in 1997. These assessments may provide a more accurate assessment of the impact of hydromodification from all sources.

- **Agriculture**--Agriculture (i.e., rangeland grazing, irrigated crop production, and animal holding/management areas) remains a predominant source of contamination in streams because it is the principal land use in Arizona in terms of area. Historic over-utilization of rangeland and agriculture clearing practices have resulted in the removal or loss of protective vegetation from valley bottoms and desert rangelands, which significantly contributes to accelerated erosion and increased turbidity. Agricultural practices have also been a source of pesticides, boron, nutrients, fecal coliform and total dissolved solids.

  Unmanaged grazing and over-utilization of riparian systems continue to occur even though most grazing allotments have management plans that should protect these areas. "Unmanaged grazing" refers to the practice of releasing livestock into an area without implementing measures to protect the health of the vegetation along the stream or its floodplain (e.g., removing livestock from the riparian area during vegetation growing seasons). Lush vegetation, water, and shade attract cattle, which congregate in the floodplain during the hotter, drier, summer growing season. Excessive utilization of riparian areas can impair plant species vigor and result in physical damage to the channel and banks (Ohmart 1996).

- **Point Sources**--Industrial and municipal wastewater treatment systems discharging to surface waters are required to obtain a National Pollutant Discharge Elimination System (NPDES) permit. Compliance records, between October 1991 and September 1995 (four years), indicate that 75 facilities of the 137 with NPDES permits (55%) did not meet some of their permit discharge limitations in at least one reporting quarter (ADEQ's Water Quality Compliance Section). Theoretically, these facilities contributed to impairment of surface waters in this assessment. However, there was nominal in-stream monitoring above and below these point sources during this time period to measure the impacts of these discharges. This lack of information may be reflected in **Table 9** statistics.

  Municipalities with more than 100,000 population are now required to obtain NPDES permits for urban stormwater discharges. This requirement affects Phoenix, Mesa, Tempe, Scottsdale, Glendale, Tucson, and unincorporated parts of Pima County. Stormwater and stream flow were monitored in 1993 and 1994 to describe or estimate the following:

  - The physical, chemical and microbial characteristics of stormwater from areas having different land uses,
  - The characteristics of stream flow in a river that receives urban stormwater, and
  - The constituent loads in stormwater from monitored areas, and estimated loads from areas not monitored.

  Stormwater permits have not been finalized yet. These permits will not contain discharge limitations, but will instead contain Best Management Practices for different land use categories to control pollutant loads.

  In the Phoenix metropolitan area, the USGS recently completed a special study of stormwater quality (Lopes et al. 1995). The following conclusions were made in this study:

- The concentration of suspended solids decreased with an increased percentage of impervious area. Commercial and industrial areas have a higher percentage of impervious area than residential areas.
- Localized areas in the cities of Chandler, Mesa, Paradise Valley, and Peoria seemed to contribute a large proportion of the constituent loads (other than suspended solids). These localized areas typically have more than 40% impervious area and are associated with industrial, commercial, and high-density residential land use.
- Concentrations of cadmium, lead, and zinc were greatest in sediments from basins classified as heavy industrial.
- The concentration of dissolved solids in urban stormwater was less than in the Salt River at 24th Street and at Priest Drive (i.e., stormwater could dilute the concentration of dissolved solids in the Salt River).
- Urban stormwater had larger concentrations of chemical oxygen demand, biological oxygen demand, oil and grease, and fecal bacteria than Salt River water.
- Pesticides, semi-volatile organic compounds, and volatile organic compounds were detected in some of the urban stormwater samples, but were not in samples from the Salt River or runoff from undeveloped areas. Volatile and semi-volatile organic compounds were detected in seven out of 30 samples, in light industrial and commercial drainage areas. Degradation by-products of DDT were measured in concentrations of 0.04 to 1.1 μg/l.
- Initial runoff from several sites typically was black in color because of oil and grease, particulates from tires, and other sources.

PART V - PUBLIC HEALTH AND AQUATIC LIFE CONCERNS

Impairment Caused by Toxicants

Waters Impaired by Toxicants--For this assessment, toxicants included: pesticides, organic compounds, metals (including arsenic and selenium), ammonia, chlorine, and other inorganics (including sulfide). **Table 11** summarizes the extent these toxicants cause surface water impairment in Arizona. **Table 11** also shows the miles of stream or acres of lakes monitored for these toxicants. Routine surface water monitoring by ADEQ and USGS includes testing for the following chemicals: ammonia, arsenic, silver, beryllium, cadmium, chromium, copper, mercury, nickel, lead, selenium, antimony, and thallium. ADEQ's Priority Pollutant Program tests for the 126 EPA listed priority pollutant toxicants, primarily in sediment and fish.

Table 11. Toxicants in Arizona's Waterbodies - 1996

RIVERS	ASSESSED	MONITORED FOR TOXICANTS	TOXICANTS EXCEEDED STANDARDS
	(miles)		
Perennial	2,660	1,522	923
Non-perennial	2,545	1,136	650
Canals	205	134	0
Total	5,410	2,792	1,573
% of Assessed	--	51%	29%

LAKES	ASSESSED	MONITORED FOR TOXICANTS	TOXICANTS EXCEEDED STANDARDS
	(acres)		
Total	58,860	41,003	9,886
% of Assessed	--	70%	17%

By comparing these statistics to those presented in **Tables 4 & 5**, several conclusions can be made:

- Among the assessed waters, half of the streams and more than two-thirds of the lakes were monitored for toxicants.
- All of the waterbodies with "monitored" assessments were monitored for toxicants, along with 23% of the "evaluated" stream miles (768 miles) and 23% of the "evaluated" lake acres (5,303 acres).
- Of the streams and lakes assessed, almost a third of the stream miles and a sixth of the lake acres were impaired by toxicants.

Public Health and Aquatic Life Impacts

Reported Incidence--Public health and aquatic life impacts in Arizona during the past two years are listed in **Appendix E**. The following incident categories of public health and aquatic life impacts were considered:

- Waterborne disease incident,
- Fish advisory, ban, or restriction,
- Fish kills or abnormalities caused by pollutants,
- Sediment contamination,
- Surface drinking water supply closure or advisory,
- Swimming area closure, and
- Fish or wildlife tissue contamination above Arizona's "screening level" (see **Appendix A**).

The list in **Appendix E** is not comprehensive because Arizona does not have a central reporting system for compiling these data from numerous agencies (i.e., county and state health departments, county and state environmental departments, Arizona Game and Fish Department, USFWS, BLM, USFS, National Parks Service, and more). To clarify the risks represented by the contamination problems listed, a discussion of the use of "screening values," beach closures, fish advisories, and related issues follows.

Screening Values--The screening values in **Appendix A** were used by ADEQ as "warning flags" which indicate potential health or environmental problems. These values were derived conservatively, and should be viewed as alert levels warranting further investigation rather than an imminent risk to human or aquatic health. These criteria were based on:

- U.S. Environmental Protection Agency screening values. These values are based on average consumption of 45.5 grams/week (1.6 ounces/week) of fish tissue and 70 kilograms human body weight (154 pounds) (EPA 1995a);
- U.S. Food and Drug Administration action levels. These actions levels were developed to protect humans from the chronic effects of toxic substances consumed in foods (FDA 1982);
- National Academy of Sciences and National Academy of Engineering aquatic life protection guidelines. These criteria were developed to protect aquatic resources (i.e. fish and wildlife) and were published in EPA's 1972 water quality criteria document (i.e. The Blue Book) (NAS 1973);
- Threshold values for chronic effects on aquatic life, as cited in peer-reviewed journals; and
- USFWS National Contaminant Biomonitoring Program results. A national survey of fish tissue analyzed for concentrations of metals and pesticides (Schmitt and Brumbaugh 1990, Schmitt et al. 1990). The 85th or 90th percentiles of these data were used to indicate variation from the norm.

Fish Advisories--Fish advisories to the general public are currently in effect at four sites: Painted Rocks Lake and watershed (including portions of the Gila, Salt, and Hassayampa rivers), Peña Blanca Lake, Arivaca Lake, and Dysart Drain. A public health risk assessment for recreational usage of the Painted Rocks Lake was completed after monitoring established that organochlorine pesticides (i.e., DDE, toxaphene, dieldrin, and chlordane) and mercury were contaminating fish and other aquatic life (ADHS 1991). The following conclusions were made utilizing Arizona's health-based guidance levels for drinking water and soil:

- Human health risk associated with exposure to lake water or sediment was deemed insignificant, as neither organic chemicals nor trace metals were present at human health hreatening concentrations in lake water or lake sediment.

- Elevated and potentially human health-threatening levels of organochlorine pesticide and methylmercury were found in the edible portion of various fish species. Both lifetime cancer risk and systemic toxic effects could result from long-term consumption of these fish. Maximum recommended consumption rates were determined for fish caught in this lake, and the fishing advisory was reissued to the public.

- Toxic levels in the sediment should gradually diminish due to natural biodegradation; therefore, fish contamination should continue to diminish. Disturbance of the sediment by dredging or other activities could cause a rise in fish contamination. Periodic monitoring was recommended to adjust consumption guidelines.

- Soft-shelled turtles may be the most contaminated animal species existing at the lake site, based on whole body samples. A ban on the consumption of soft-shelled turtles was recommended.

- Elevated levels of organochlorine insecticide residues have been documented in sediment and wildlife collected along the Gila River below Buckeye and Goodyear, Arizona, to Painted Rocks Borrow Pit Lake, and in various lateral return flow canals. A fishing advisory was recommended for these streams. In general, the closer to the Buckeye/Goodyear region, the higher the level of contamination.

Further testing by the Clean Lakes Program (The Earth Technology Corporation 1993) and ADEQ's Priority Pollutant Program (1994c) indicated that pesticide levels may be declining in the Painted Rocks study area.

Mercury is the contaminant of concern at both Peña Blanca Lake and Arivaca Lake. In each case, historic mining practices are believed to have contributed mercury into the lake's ecosystem. A holistic watershed approach to resolve this problem is needed because of the size and number of abandoned mines within these watersheds. Remediation of abandoned mines and related facilities in these watersheds (and many others in Arizona) will be a lengthy and expensive process, and one which cannot be undertaken without proper planning and commitment.

The Dysart Drain has been posted due to extremely high levels of DDT metabolites in fish tissue (up to 24 mg/kg). Fish consumption is not a recommended use for this drain, and it is therefore not protected for this use. However, nets and other equipment found at the site indicated that fishing has occurred. The water discharged into this canal is runoff from Luke Air Force Base and agricultural fields that had historically high rates of DDT application. The drain eventually discharges to the Agua Fria River. Sediment samples from the drain showed that the concentration of DDT metabolites was related to stream flow, with highest levels where the return flows begin, and lowest levels near its discharge to the Agua Fria River.

Drinking Water Advisory--The National Parks Service has posted Pumpkin Springs and Horn Creek as not potable to discourage such use by the Colorado River rafters in the Grand Canyon National Park. Pumpkin Springs has a high concentration of arsenic (as high as 1180 μg/l), and Horn Creek has elevated uranium (up to 92 μg/l) and gross alpha (as high as 61 pCi/l). Fortunately, the poor taste of water discharged at Pumpkin Springs has discouraged drinking this water in the past.

Fish Kills--Only two fish kills were reported by Arizona Game and Fish Department in the past two years, and both occurred at the same urban lake: Maricopa Lake in Youngstown, Arizona. The fish kills were due to eutrophic conditions (i.e., excess nutrients, resulting in algal blooms, lack of oxygen, and high pH) caused by a large duck population, that was encouraged by the sale and use of duck food at this 4.5-acre publicly owned lake.

Swimming Area Closures--In the past two years, two swimming areas in Arizona were closed: beaches in Lake Havasu's Thompson Bay on the Colorado River and Slide Rock State Park on Oak Creek. Some beaches were also closed on Lake Powell due to high fecal coliform counts; however, these beaches were in the Utah portion of this reservoir.

An extensive investigation of the source(s) of fecal coliform in Lake Havasu was initiated after repeated beach closures in the Lake Havasu City area by the Mohave County Health Department. Groundwater feeding into the bay was found to be heavily loaded with nutrients due to a variety of wastewater disposal practices. The shallow, nutrient rich, bay water does not circulate during sunny summer days (frequently over 120° F these two years), and the fecal coliform "bloom." See a more thorough discussion of this investigation on page 191.

The natural rock water-slide at Slide Rock State Park attracts many tourists during the summer months. As a result, of this heavy use this swimming area was closed by the Coconino County Health Department for two weeks in 1994 and one day in 1995 due to high fecal coliform counts. Weekly summer monitoring was initiated in 1994 as part of the EPA funded National Monitoring Program. The sources of fecal coliform are still be investigated but are believed to be caused by heavy use, low summer flow. Other potential sources within the park and the watershed are still being investigated, especially septic systems.

Other Aquatic Life Impacts--There are several other endemic waterborne diseases which occur in Arizona that were not included in **Appendix E**. Outbreaks of most of these are initiated or enhanced by the productivity of our shallow, low-flow, manmade, nutrient rich lakes. The rapid growth of algae and pathogens in Arizona's sunny climate may be encouraged by bread crumbs, fertilizer, or even treated wastewater discharges. These diseases include:

- Avian botulism - a disease caused by *Clostridium botulinum* which kills waterfowl.
- "Swimmers itch" - larval trematode (i.e., schistosome worms) of birds and mammals, which causes itchy skin welts on swimmers or waders who venture near weeds harboring this parasite
- *Giardia* - a parasite that causes diarrhea and other symptoms in people, is frequently transmitted by drinking untreated surface water.
- Trichomoniasis - a parasite, which kills pigeons and doves, is spread by guano contamination of water or food used by birds.

Threatened, endangered, and extirpated native fish species in Arizona comprise another category of impacts that was not reported in Appendix E. Five of the 32 native fishes found in Arizona at the turn of the century no longer inhabit Arizona waters, and 21 of the remaining 27 are listed by the State as endangered or threatened, or are under study for listing (Governors Executive Order Number 91-6). As documented in the recovery plans issued by the USFWS, these fish declined because of intense hydro-habitat modification (dams, diversions, groundwater pumping, and the physical removal of suitable habitats), and the introduction of exotic game species (USFWS, 1979a, 1979b, 1982, 1988, 1990a, 1990b, 1991a, 1991b, 1991c, 1991d). These once prodigious native fish now only exist in isolated pockets, and most streams in Arizona have been affected. The negative effects of hydro-habitat modification also extend to other native aquatic-dependent species.

PART V - GROUNDWATER QUALITY ASSESSMENTS

Groundwater Assessment Process

Statewide groundwater contamination was considered from three perspectives:

- Groundwater monitoring -- the number of wells exceeding Arizona's Aquifer Water Quality Standards **(Table 12)**,
- Groundwater remediation -- the number of sites **(Table 13)**, and
- Probable sources of groundwater contamination **(Table 14)**.

More site-specific and regional information is provided in the Watershed Assessment (Part VI of this chapter).

Groundwater Monitoring

The last five years (October 1990 through September 1995) of groundwater monitoring results were compared to Arizona's Aquifer Water Quality Standards (standards in **Appendix A**). The number of wells exceeding a standard is shown in **Table 12**. There are no standards for some manmade organic compounds and pesticides; however, the mere detection of these products in the groundwater is a "warning flag" signaling contamination. Therefore, the number of detections is shown for two categories: volatile organic compounds (VOCs) and pesticides.

Groundwater monitoring has also been separated into two categories: water quality index wells, and other groundwater monitoring.

- Water quality index wells provide an ambient monitoring network of more than 200 wells which have been chosen by ADEQ or the Arizona Department of Water Resources to provide long-term data and characterize regional water quality within watersheds **(Map 12)**.

- "Other groundwater monitoring" includes groundwater data collected by various programs in ADEQ, as well as data from other agencies (i.e., ADWR, USGS, the Salt River Project, etc.). These data include a limited amount of site investigation data collected for superfund sites, leaking underground storage tank sites, pesticide prevention program, and other special investigations **(Maps 13 and 14)**.

Another potential source of groundwater data is the required monitoring by Public Water Supplies which is tracked in a database by ADEQ. However, these supplies are required to monitor at the "point of entry" into the distribution system rather than at the source (i.e., at the well) because the focus of this program is providing safe drinking water to consumers at the tap. Unfortunately for assessment purposes, this monitoring point is after treatment and blending of multiple sources and cannot be used to determine the quality of source water. There are more than 300 systems with only one well, where blending would not be a consideration; however, other database problems exist which made the data unreliable until errors can be methodically eliminated from the system. For these reasons, the Public Water Supply data was not used in this assessment, but may be in the future.

Regional Groundwater Quality

A summary of groundwater quality monitoring results from 1991 to 1995 for watersheds throughout the State is provided in **Table 12**. Along with the number of wells sampled and the number of wells with exceedances of an Arizona Aquifer Water Quality Standard, the number of wells detecting a volatile organic compound or pesticide is included in the table. Many of these manmade chemicals lack water quality standards but are not natural components of groundwater, and therefore, their presence indicates contamination of the water.

Table 12. Arizona Groundwater Monitoring Data Summary -- 1991-1995

MONITORING DATA TYPE*	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS			PERCENT OF WELLS EXCEEDING STANDARDS
		SAMPLED	PARAMETER DETECTED**	PARAMETER EXCEEDED*** STANDARD(S)	
WATER QUALITY INDEX WELLS	Radiochemicals	17		11	65%
	Fluoride	181		21	12%
	Metals	193		14	7%
	Nitrate	172		1	0.6%
	Volatile Organic Compounds	36	2	0	0%
	Pesticides	36	0	0	0%
OTHER GROUNDWATER MONITORING	Radiochemicals	66		26	39%
	Volatile Organic Compounds	529	127	72	14%
	Nitrate	583		45	8%
	Fluoride	828		60	7%
	Metals	1373		77	6%
	Pesticides	516	21	9	2%
TOTAL NUMBER OF WELLS ****		2,200		288	13%

* Water Quality Index Wells -- data collected at more than 200 wells, which are routinely monitored to provide long-term and regional characterizations of groundwater quality.

* Other Groundwater Monitoring -- data from private domestic wells, irrigation wells, stock watering wells, industrial wells, monitoring wells, and wells in areas suspected of contamination.

** "Detected" = A quantified level of the parameter was detected. Detections were shown for categories of manmade chemicals that include chemicals that do not have established standards. These manmade chemicals are contaminants of groundwater even though a standard may not be exceeded. Nitrate, fluoride, metals, and radiochemicals may be natural and are commonly detected; therefore, detections were not indicated for these parameter groups. Laboratory reports of "less than" a laboratory detection limit were treated as non-detections.

*** "Exceeded" = Results above the Maximum Contamination Levels (MCLs) established in the Aquifer Water Quality Standards (**Appendix A**).

**** "Total Number of Wells" indicates the number of wells for that column. Because wells are monitored for different parameters, the total number of wells cannot be calculated from the information provided in that column.

Of the 2,200 wells sampled, 13% exceeded Arizona's Aquifer Water Quality Standards. A well may be sampled more than once and analyzed for a number of chemicals. A well exceeding one or more standards within a parameter group is only shown once. That is, if one well exceeds standards for silver, chromium, and zinc, only one well is indicated as exceeding in the metals parameter group. However, one well can be exceeding in more than one parameter or parameter group. For example, a well can exceed both the nitrate and pesticides parameter groups.

In **Table 12** data collected through the State's ambient groundwater monitoring program to assess regional water quality conditions is presented separately from data collected as part of other monitoring projects, most of which are targeted at areas of suspected or known contamination. Very few volatile organic compounds and no pesticides were detected among the 36 wells tested under the ambient monitoring program. Nitrate rarely exceeded an Aquifer Water Quality Standard, metals exceeded standards in 7% of the wells sampled, and fluoride exceeded standards in 12% of the wells sampled. However, among the 17 wells tested for radiochemicals 11 wells (65%) exceeded at least one standard. Radionuclides in groundwater are a result of the State's uranium-rich rocks, coupled with the widespread occurrence of geological environments favorable for uranium transport, accumulation, and deposition.

Results from the other groundwater monitoring programs (i.e., targeted monitoring) show that volatile organic compounds were detected in 24% of the wells and exceeded an Aquifer Water Quality Standard in 14% of the wells. Pesticides were detected in only 4% of the wells tested, and exceeded a standard in less than 2% of the wells. Less than 10% of the wells tested for nitrate, fluoride, and metals exceeded a standard. Radiochemical standards were exceeded in 39% of the 66 wells tested.

Groundwater Remediation

The Arizona Department of Environmental Quality has several programs that identify and remediate groundwater contamination **(Table 13)**. The number of remediation sites within the State provides a rough measurement of the stress that contamination is putting on Arizona's groundwater resources. Remediation occurs under the following programs (more information is provided about these programs in the next chapter of this report):

- The Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980 provides federal funds for investigation and remediation of soil and groundwater contamination due to hazardous substance releases (i.e., Superfund sites).
  - Projects targeted for remediation are put on the "National Priorities List."
  - The Department of Defense works with the State to evaluate and remediate sites on military bases.
  - The Department of Energy remediates sites contaminated by mining and use of radiochemicals (in Arizona these sites have been on Indian Lands).
- The Water Quality Assurance Revolving Fund (WQARF) is a state-funded remediation (Superfund) program, directed primarily at contaminated sites that are not placed on the National Priority List.
- ADEQ's Underground Storage Tank Program was developed to identify and remediate leaking underground storage tanks (LUST sites).
- Resource Conservation and Recovery Act (RCRA) Program was established to track the use, storage, transportation, and disposal of hazardous waste. Contamination problems are primarily addressed under RCRA but more serious problems may be elevated to the CERCLA or WQARF programs.

Table 13. Arizona Groundwater Remediation Site Summary

SITE TYPE	NUMBER OF SITES WITH CONFIRMED CONTAMINATION				Other Sites Closed Out 1991-1995
	Groundwater Contamination	Surface Water Contamination	Soil Contamination	Total Sites in Programs	
SUPERFUND SITES					
National Priority List (NPL)	12	1	12	12	4
Department of Defense	7	0	7	7	6
Department of Energy	0	0	0	0	0
WQARF	31	2	39	39	14
Total	50	3	58	58	24
LUST Sites	654	0	2209	2863	1108
RCRA Corrective Action Sites	12	3	35	38	

Appendix G provides site-specific information about these projects. The listed sites were active as of October 1995. Note that several past sites have been combined in the Phoenix metropolitan area, and another 7 sites were undergoing remediation though a voluntary program that does not require enforcement actions by ADEQ. More current and site specific information can be obtained through ADEQ's Remedial Projects Section or through the department's annual report.

Sources of Groundwater Contamination

Groundwater pollution can be closely related to land use; however, groundwater contamination can also be the result of naturally occurring elements. Contamination may occur as relatively well defined plumes emanating from sources such as landfills, waste lagoons and industrial sites. Contamination may also occur as a general deterioration of water quality over a wide area due to diffuse nonpoint sources such as agricultural fertilizer and pesticide applications, septic systems, leaking sewer networks, and mining activities. Groundwater quality degradation from diffuse nonpoint sources affects large areas, making it difficult to specify sources of contamination. Studies are being conducted throughout the State to relate widespread human activities to regional groundwater quality.

Major categories of potential sources of groundwater contamination in Arizona are shown in **Table 14**. The top ten sources of contamination are indicated, along with the pollutants of concern. The top ten sources in Arizona tend to be located in or near urban centers, where large populations depend heavily on high-quality groundwater from drinking water supplies. These sources are widespread, or the substances released pose more of a risk to the environment or human health. The most widely documented sources of contamination in Arizona include agricultural activities, wastes from industries, leaking underground storage tanks, septic tanks, landfills, mining activities, and wastewater treatment plant effluent.

Low priority sources are not numerous, primarily occur in less populated areas, and generally receive less regulatory attention. A few nationally acknowledged water quality problems (i.e., the storage and use of road salt, salt water intrusion) are only rarely a problem in Arizona.

It should be stressed that the quality of water delivered by public water supplies is strictly regulated and monitored to meet federal and state standards set to protect public health.

Table 14. Major Sources of Groundwater Contamination

Probable Sources of Groundwater Contamination	Ten Highest Priority	Factors* Considered	Contaminants of Concern*
Manufacture			
Hazardous Waste Generators	-	1	VOC, SOC
Nonhazardous Waste Generators	-	-	-
Agriculture Chemical Manufacture and Formulation	-	1	NO3, Pest
Application/Operation			
Concentrated Animal Feeding Operations	-	7	NO3, TDS
Fertilizer Application	Yes	1,2,3,4,5,6	NO3, TDS
Pesticide Application	-	3,6	Pest, SOC
Irrigation Practices (except for chemical irrigation)	Yes	1,2,3,4,5,6	TDS, NO3
Historic Use of Chemicals/Solvents	Yes	1,2,3,4,5,6	VOC, NO3, PH
Mining Operations (see Mine Waste & Tailings Piles)	Yes	3,5,7	Met, Rad, TDS, SO4, PP
Road Salting	-	-	TDS
Transportation			
Transportation of Materials	-	1	VOC, SOC
Material Transfer Operations	-	1	VOC, SOC
Storage Activities			
Material Stockpiles	-	-	--
Storage Tanks (above and under ground)	Yes	1,2,3,4,5,6	PH, VOC
Agriculture Chemical Storage	-	-	-
Hazardous Materials Storage	-	-	-
Disposal			
Drywells	-	7	VOC, Met, TDS
Septic Systems	Yes	1,2,3,4,5,6	Bact, NO3, TDS, VOC
Leaking Sewer Line	-	-	Bact, NO3, TDS, VOC
Sewage Disposal to Surface Waters (NPDES permit)	-	-	NO3, TDS
Deep Injection Wells (for waste, see Recharge Wells)	-	-	-
Land Application	-	-	Bact, NO3
Landfills	Yes	1,2,3,4,5,6	VOC,Met,Rad,TDS,SOC
Historic Dumps	Yes	1,2,3,4,5,6	VOC, Met, Rad, TDS
Surface Impoundments (lagoons)	-	-	VOC, Met
Mine Waste and Tailings Piles	Yes	1,3,5,7	Met, SO4, PP
Hazardous Waste Disposal Sites	-	1,7	SOC, SOC
Urban Runoff/Retention Basins	-	-	VOC, Met, NO3, TDS, Bact, Pest
Other			
Recharge Wells	-	-	-
Spills/Fires	-	-	VOC
Inadequate Construction or Maintenance of a Well	-	-	Bact, TDS, NO3, Pest
Salt Water Intrusion	-	-	-
Natural Deposit	Yes	3,4,7	F, Met, Rad, NO3, TDS
Unknown	-	-	TDS

"Factors Considered" in establishing category priority in Arizona:

1. Toxicity - human health or environmental risk.
2. Size of population (human) at risk.
3. Number or size of sources.
4. Risk to drinking water sources.
5. Hydro-geologic sensitivity
6. Arizona Comparative Risk Assessment Project (ACERP)
7. Priority in localized areas but not statewide

Contaminants of Concern for category:

Bact = bacteria, F = fluoride, Met = metals, NO3 = nitrate, Pest = pesticides, PH = petroleum hydrocarbons, PP = physical parameters, Rad = radionuclides, SOC = semi-volatile organic compounds, SO4 = sulfate, TDS = total dissolved solids, VOC = volatile organic compound.

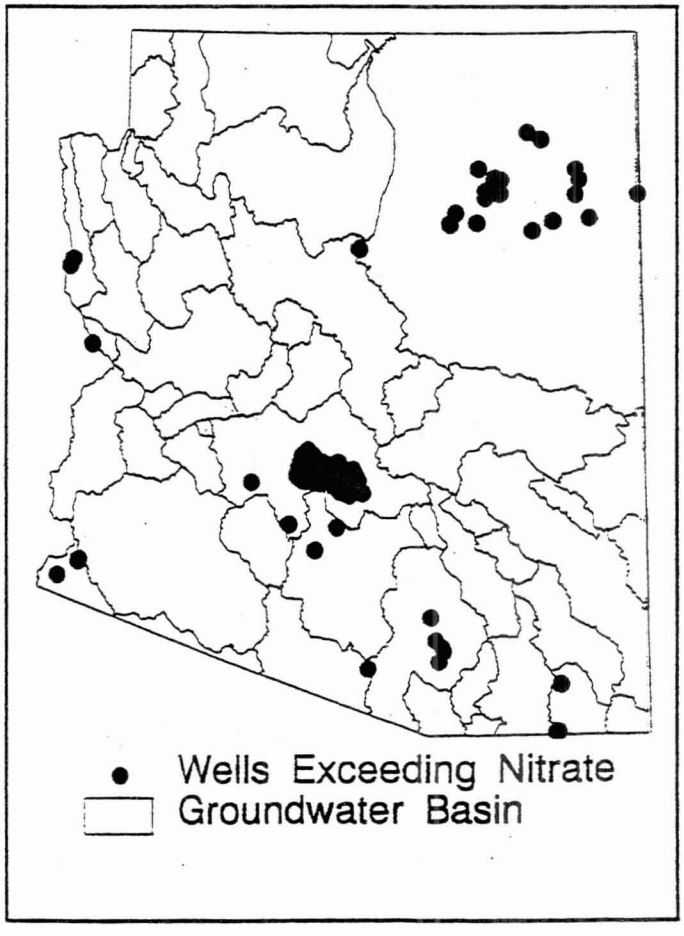
Groundwater Quality Parameters of Concern

As shown in **Table 12 and 14**, the constituents of concern in Arizona's groundwater are: volatile organic compounds (VOCs), nitrate, cations and anions (TDS, sulfate, fluoride), metals, pesticides, petroleum hydrocarbons, radiochemicals, and bacteria. Although some characteristics of these parameters have already been discussed in the surface water portion of this chapter, a groundwater perspective can provide further insight.

- **Volatile Organic Compounds**--Disposal of solvents has been documented from the early 1950s and probably originated much earlier. Aside from gasoline leaks reaching groundwater, disposal of solvents has resulted in most of the State's documented cases of VOC contaminated groundwater. Public drinking water wells in Phoenix, Tucson, and in Payson have been closed in past years because of VOC contamination. **Appendix G** provides several examples of VOC contamination of soil and groundwater in the Middle Gila, Santa Cruz, and Verde watersheds. High technology manufacturing facilities (e.g., electronics, aerospace, and military facilities), generally located in urban areas, use these solvents for degreasing. Industrial waste disposal practices (e.g., injection into drywells and disposal into surface impoundments, leach fields, dry washes, and unregulated landfills) lead to groundwater contamination by VOCs (Graf 1986). Many VOC contamination sites can be traced to disposal or leaks at dry-cleaning facilities. Because of the volatile nature of these chemicals, surface spills seldom contaminate groundwater or surface water.

- **Nitrate**--Nitrate is one of the most common pollutants in Arizona's groundwater and is usually associated with human activities (**Map 16**). Nitrate levels in groundwater have decreased in some areas where agriculture activities and septic systems have been eliminated as a result of urbanization (e.g., Phoenix metropolitan area), but have increased in other areas where wastewater disposal practices have contaminated groundwater (e.g., Bullhead City, Lakeside, Pinetop, Lake Havasu City). Percolation of nitrate-laden water from irrigation, septic tanks, wastewater treatment plants, and concentrated animal feedlots are likely sources of elevated nitrate levels (more than 3 mg/l) (Brown and Caldwell 1979, PAG 1983). Nitrate is not significantly attenuated by the soil, and therefore, is transported by groundwater with little or no change.

Map 16. Nitrate in Arizona Groundwater



- **Pesticides**--Detections of dicamba and 2,4-D have been confirmed in some test wells in the Yuma area. Thirteen other pesticides have been detected once in Yuma groundwater, but not during confirmation sampling. All detections are below Health-based Guidance Levels. Sources are still being investigated.

Prior contamination by ethylene dibromide and dibromochloropropane (Daniel et al. 1988) appears to have dissipated in the Yuma area. Sample results were at or below detection levels.

- **Petroleum Hydrocarbons**--Leaking underground storage tank sites, primarily those containing petroleum fuels, are a significant source of groundwater contamination in Arizona. These sites are located throughout the State, but are concentrated in urban areas. As of August 1996, ADEQ is tracking approximately 8,960 facilities with 30,000 underground storage tanks, 5,935 have reported leaks and cleanups have been completed at 1,937 of these. Of these leaks, 917 have or may have contaminated groundwater.

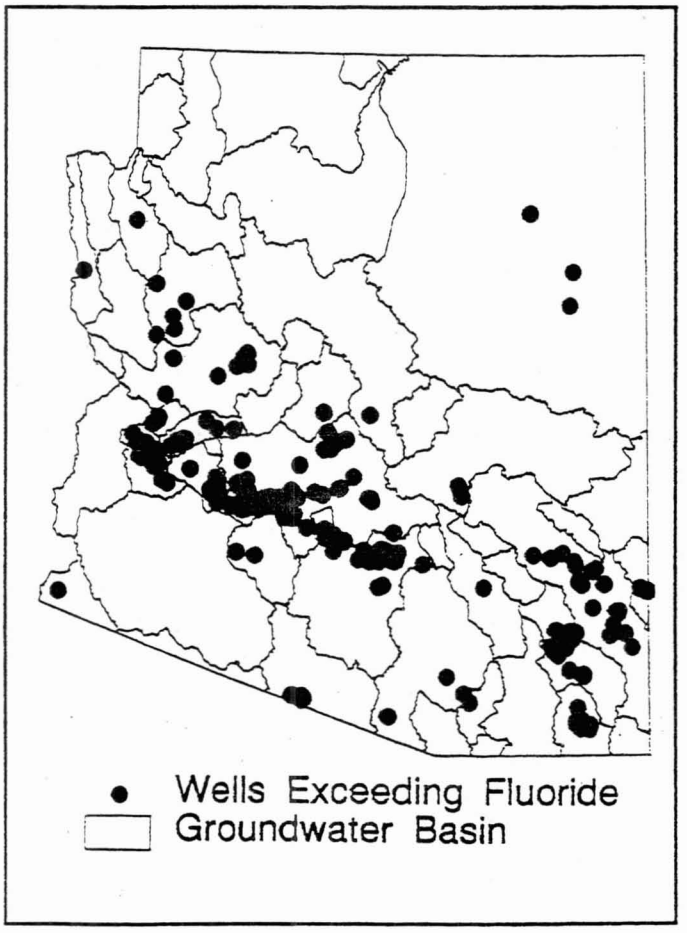
  Over half of the reported leaking underground storage tank sites were located at service stations. Other locations included utility, transportation and shipping companies; municipal facilities; pipelines; mining, food, lodging, high technology, and paint companies. Benzene, toluene, ethylbenzene, and xylene (BTEX), which are components of petroleum fuels, are the most commonly detected chemicals in groundwater at these sites. Total petroleum hydrocarbons (TPH) and ethylene dibromide have also been detected.

- **Major Cations and Anions (dissolved mineral content)**--Ambient groundwater quality can vary widely between basins. Dissolved mineral content is one measure of ambient water quality and potability, and is expressed as the total dissolved solids (TDS) content. In Arizona, the TDS content generally falls within the range of suitability for human consumption (less than 500 mg/l), although higher concentrations are relatively common. Some areas in the state, particularly in alluvial basins and along the Gila River, exhibit higher TDS concentrations (greater than 3,000 mg/l), rendering the groundwater unsuitable for drinking and other uses.

  Mining activities, irrigated agriculture, and wastewater effluent have been sources of high levels of dissolved mineral content. Sulfate, TDS, and hardness are frequently elevated in the groundwater down gradient from mining operations. Excessive amounts of sulfate and TDS in groundwater may also result from discharges of treated wastewater effluent and deep percolation of salts leached by irrigated agriculture.

  In certain basins, groundwater naturally contains moderate to high concentrations of trace metals and fluoride (**Map 17**). Volcanic rocks may be a major source of fluoride in Arizona (Robertson 1991).

Map 17. Fluoride in Arizona Groundwater



- **Radionuclides**--Radioactive elements such as uranium, radon, and radium occur naturally in the soil and water at locations throughout Arizona. In certain locations concentrations are elevated enough to cause concern. Recent studies by ADEQ, Arizona Geological Survey, and Arizona State University found that

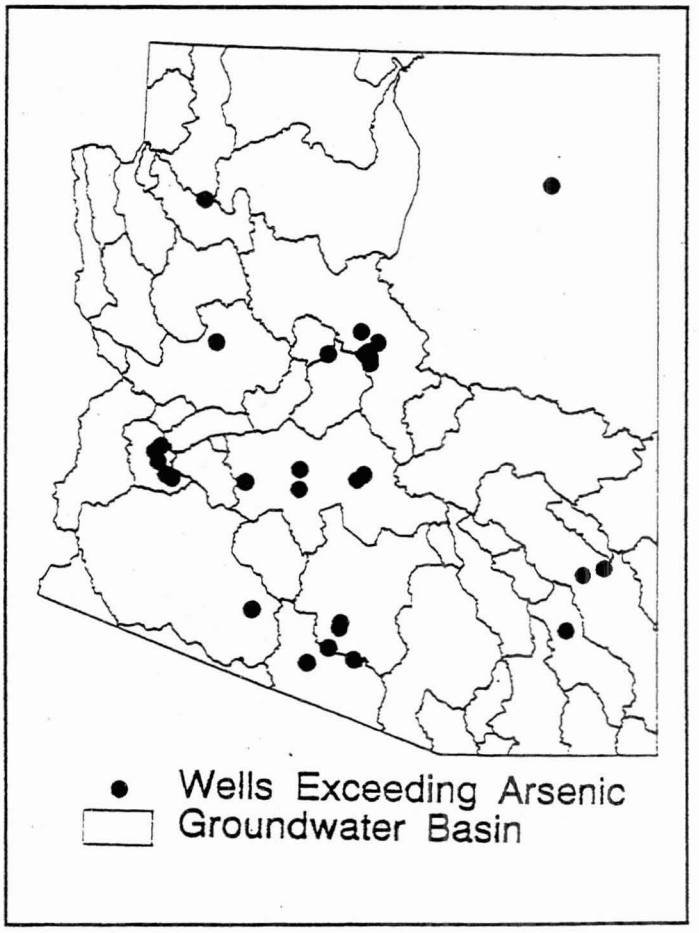
radon concentrations greater than 300 picocuries per liter (pCi/l) (the federally proposed maximum contaminant level) are normal for groundwater in several areas across the State. Contamination of groundwater has also resulted from uranium mining activities (waste dumps and mine tailings) and mine de-watering. These uranium mining activities have mainly occurred in the Plateau Uplands Province.

- **Bacteria**--Effluent from septic tanks may contaminate groundwater with bacteria and nitrate. The 1990 census estimated that approximately 283,000 homes in Arizona use septic tank systems (17% of the homes). Contamination of groundwater by microorganisms may result when the tanks are installed in areas with inadequate soils or shallow depth to groundwater, especially where limestone or fractured bedrock aquifers are present. Bacterial contamination of groundwater has been noted near Sedona, Dewey, Pinetop-Lakeside, Casa Grande, Fort Valley, Lake Havasu City, and Bullhead City. Poor well construction and well seals can also lead to the entrance of microorganisms into groundwater. However, most microorganisms are removed from the effluent after passing through a few feet of soil.

- **Metals**--Elevated metals can occur naturally in groundwater and are often associated with mineralized areas. Natural processes can contribute trace metals, such as evapotranspiration along flood plains, sulfate reduction, carbonate precipitation, and mineral dissolution and precipitation. For example, hexavalent chromium is found in groundwater at elevated levels in Paradise Valley and Kingman (Robertson 1975; Robertson 1986).

  Arsenic also occurs naturally in several areas at elevated levels **(Map 18)** because it leaches out of the arsenate laden geologic formations. Metals may also reach groundwater because of anthropogenic (i.e., human caused) sources. For example, chromium has been found in groundwater in several locations in the Phoenix and Tucson metropolitan areas due to industrial discharges from electronics, aviation, and plating firms. Metals such as manganese, copper, iron, and chromium have been found in groundwater down gradient from mining operations, particularly where acid drainage has developed. Also, groundwater down gradient from landfills commonly contains elevated concentrations of iron, manganese, and barium.

Map 18. Arsenic in Arizona Groundwater



Selected Groundwater Studies

Highlights of a few regional or statewide groundwater quality special studies are discussed in this section. Other studies are described within the watershed discussions later in this chapter or within the special initiatives section of the next chapter. ADEQ does not have a complete listing of all reports prepared by private consultants.

Nitrate Map Project--ADEQ has completed a map of nitrate concentrations in groundwater in the Phoenix Active Management Area (AMA). This map provides information about existing nitrate monitoring data for proposed Aquifer Protection Permits that can minimize further nitrate testing. Where the map indicates that nitrates are elevated or above the Aquifer Water Quality Standards, additional discharges (e.g., septic systems) may not be allowed.

Study of Radiation in Arizona's Aquifers--ADEQ and the Arizona Geological Survey conducted a cooperative study to generate baseline data on radon in Arizona groundwater (Duncan et al. 1993). The purpose of the study is to investigate whether radon concentrations in groundwater can be predicted on the basis of the geologic or geochemical characteristics of aquifer rocks and surrounding bedrock. Eight populated areas of Arizona were selected for groundwater sampling on the basis of geographical distribution and local geology. The areas sampled are in or near Kingman, New River, Paulden, Payson, Sierra Vista, Safford, Verde Valley, and Yuma.

This study indicated that radon concentrations greater than 300 pCi/l are normal for groundwater from a variety of rocks in geographically different parts of Arizona. The high radon concentrations in samples from the granite aquifer in Payson suggest that granites, regardless of uranium content in surface exposures, are likely to be associated with high radon concentrations in groundwater. Data from Sierra Vista, obtained from the main aquifer within or immediately above granitic bedrock, also support the association between granite and radon.

Underground Storage and Recovery Projects--ADEQ coordinates with ADWR in the permit process for artificial recharge and underground storage and recovery projects. There are approximately 25 projects in Arizona. A list and description of these projects are available through ADWR. The Granite Reef Underground Storage and Recovery Project is the biggest facility, and it has been designed to store up to 200,000 acre-feet per year of water from the Central Arizona Project, the Salt River, or the Verde River.

The City of Tucson Water is in the process of obtaining a permit for a pilot project to store Central Arizona Project in Avra Valley. The pilot will recharge 500 acre-feet in approximately six months to test the efficiency and water quality of different test sites.

Southeastern Alluvial Basin Groundwater Characterization--An evaluation of groundwater quality in 72 southwest alluvial basins in Arizona was completed as part of the Regional Aquifer Systems Analysis Program (RASA) by the USGS. Isotopic data and other chemical analyses were used to characterize and model the geochemistry for six of these basins (Robertson 1991).

PART VI - WATERSHED ASSESSMENTS

Overview

This section is a status report on surface water and groundwater conditions in each of the 10 "watershed zones" or "watersheds." These watersheds were delineated along USGS Hydrologic Unit boundaries, and correspond to the 13 surface water basins. A few surface water basins have been combined and one has been split to form the 10 watersheds. As discussed in Part I of this chapter, surface water basins and groundwater basin boundaries follow similar contours because they are both defined by the State's hydrology. (See the Watershed Protection Approach discussed in the next chapter.)

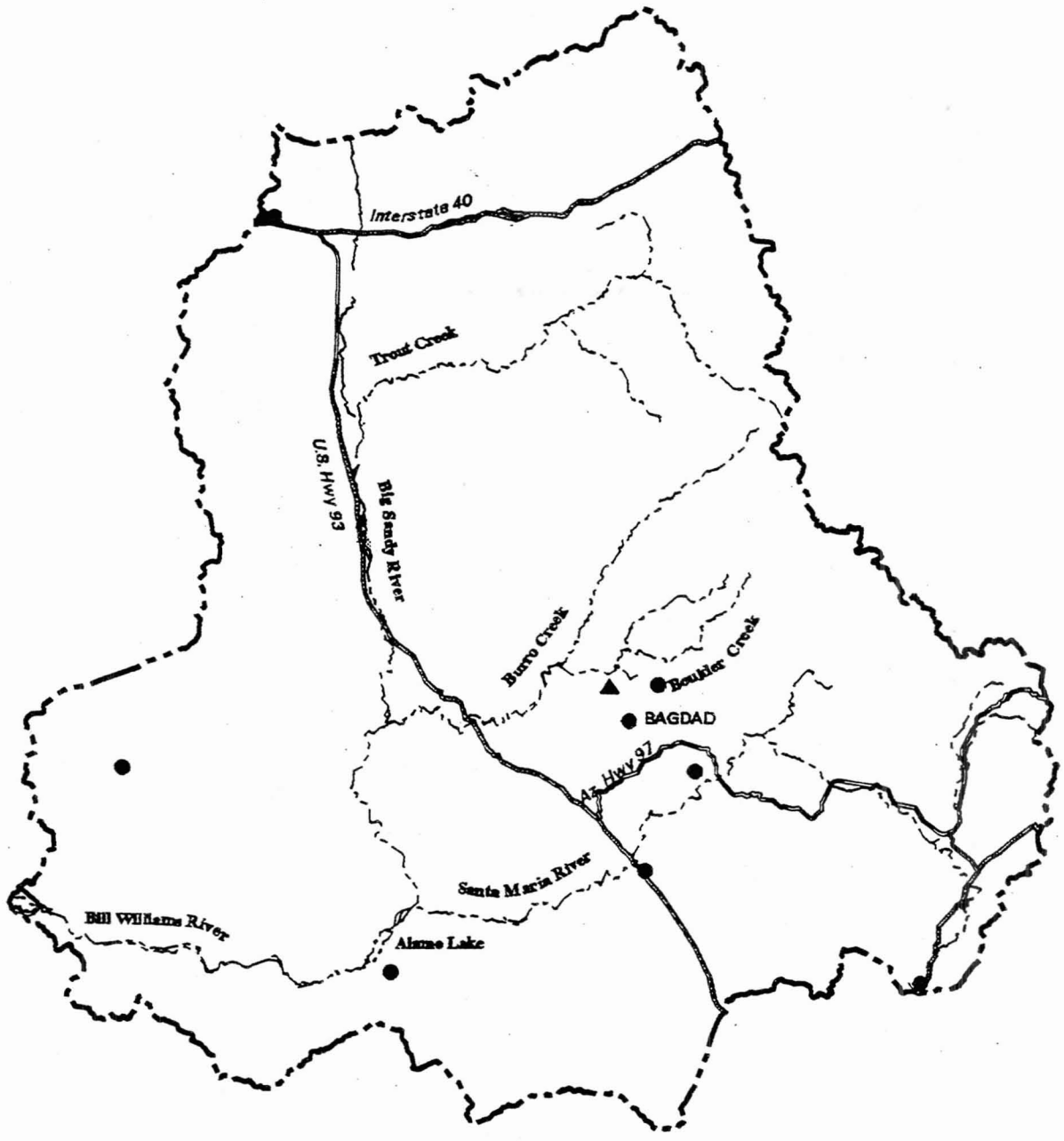
In this section, water quality information for each watershed zone and groundwater basin or active management area (AMA) is presented in the following order:

- Bill Williams Watershed (pages 67-74): Big Sandy, Bill Williams, and Sacramento Valley* groundwater basins.
- Colorado - Grand Canyon Watershed (pages 75-83): Big Sandy*, Coconino Plateau, Detrital Valley, Grand Wash, Hualapai Valley, Kanab Plateau, Little Colorado River*, Meadview, Paria, Peach Springs, Shivwits Plateau, and Virgin River groundwater basins.
- Colorado - Lower Gila Watershed (pages 84-94): Butler Valley, Lower Gila, Lake Havasu, Lake Mohave, Parker, Ranegras Plain, Sacramento Valley, and Yuma groundwater basins.
- Little Colorado - San Juan Watershed (pages 95-103): Coconino Plateau* and Little Colorado River groundwater basins.
- Middle Gila Watershed (pages 104-115): Agua Fria, Bill Williams*, Donnelly Wash, Dripping Springs, Gila Bend, Harquahala Valley, Lower San Pedro*, McMullen Valley, Phoenix AMA, Pinal AMA*, Prescott AMA (southeastern half)*, Tiger Wash, Tucson AMA*, and Upper Hassayampa groundwater basins.
- Salt Watershed (pages 116-124): Phoenix AMA*, Salt River, and Tonto Creek groundwater basins.
- San Carlos - Safford - Duncan Watershed (pages 125-132): Bonita Creek, Duncan Valley, Morenci, and Safford groundwater basins.
- San Pedro - Rio Yaqui - Willcox Playa Watershed (pages 133-140): Aravaipa Canyon, Cienega Creek*, Douglas, Lower San Pedro, Upper San Pedro, San Bernardino Valley, and Willcox Playa groundwater basins.
- Santa Cruz - Rio Magdalena - Rio Sonoyta Watershed (pages 141-150): Cienega Creek, Pinal AMA, San Rafael, San Simon Wash, Santa Cruz AMA, Tucson AMA, and West Mexican Drainage groundwater basins.
- Verde Watershed (pages 151-158): Phoenix AMA*, Peach Springs*, Prescott AMA (northwest half), and Verde River groundwater basins.

* Denotes that only a minor portion of this groundwater basin is in this watershed, the major portion being in another watershed.

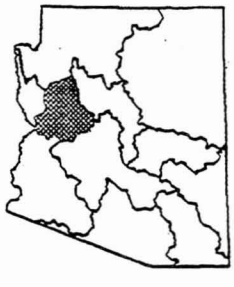
Characterization of the Bill Williams Watershed

SIZE	5,373 square miles (5% of the State's land area).
POPULATION BASE	6,400 people (less than 0.2% of the State's population). The area is sparsely populated with no significant population centers (**Map 19**).
LAND OWNERSHIP	Bureau of Land Management 37% Other state and federal 4% State Lands 27% U.S. Forest Service 5% Private 27%
LAND USES AND PERMITS	• Open range grazing is the principal land use. • A large mining operation occurs in the Bagdad area, with scattered historic mines in the Big Sandy and Bill Williams sub-watersheds. • Six wilderness areas are designated in this watershed. These areas are withdrawn from mineral entry and leasing and motorized travel is prohibited; however, grazing still occurs. • **Map 19** illustrates the location of facilities with NPDES and aquifer protection permits.
HYDROLOGIC PROVINCE(S)	Basin and Range Province in the west; Central Highlands Province in the east.
ECOREGIONS	Colorado Plateau in the north, Arizona-New Mexico Mountains in the west, and the remaining area is Southern Basin and Range. The biota varies from lowland deserts to upland pine forests.
GROUNDWATER BASINS	Bill Williams, Big Sandy, and a portion of Sacramento Valley.
HYDROLOGY AND GEOLOGY	• Elevations in the watershed range from 8,417 feet at Hualapai Peak to 1,000 feet above sea level at Mohave Wash. • Surface water flow is primarily intermittent or ephemeral. Perennial flow is frequently interrupted (short segments) (Brown et al. 1978). • At Planet Ranch, the Bill Williams River flow varies from no flow (for many days most years) to 6,800 cfs (in 1993) (USGS 1996). • Groundwater occurs in alluvial deposits, basin-fill, and fractured or porus volcanic rocks. The main water-bearing unit is basin-fill. Alluvial deposits (consisting of gravel, sand, and silt) are found along the Bill Williams River and its tributaries, and have high water-yielding potential. Fractured or decomposed formations of schist, gneiss, and granite also have water-bearing potential. Volcanic rock formations have little water-yielding potential (ADWR 1994).
UNIQUE WATERS	Burro Creek, Francis Creek, and Peeples Creek.
OTHER STATES, NATIONS, OR TRIBES	None.



Map 19. Bill Williams Watershed
Water Protection Permits

- Indian Reservation
- NPDES
- APP & GWPP
- Reuse
- Watershed Boundary
- Stream
- Primary Highway
- Secondary Highway
- WS/GW Boundary



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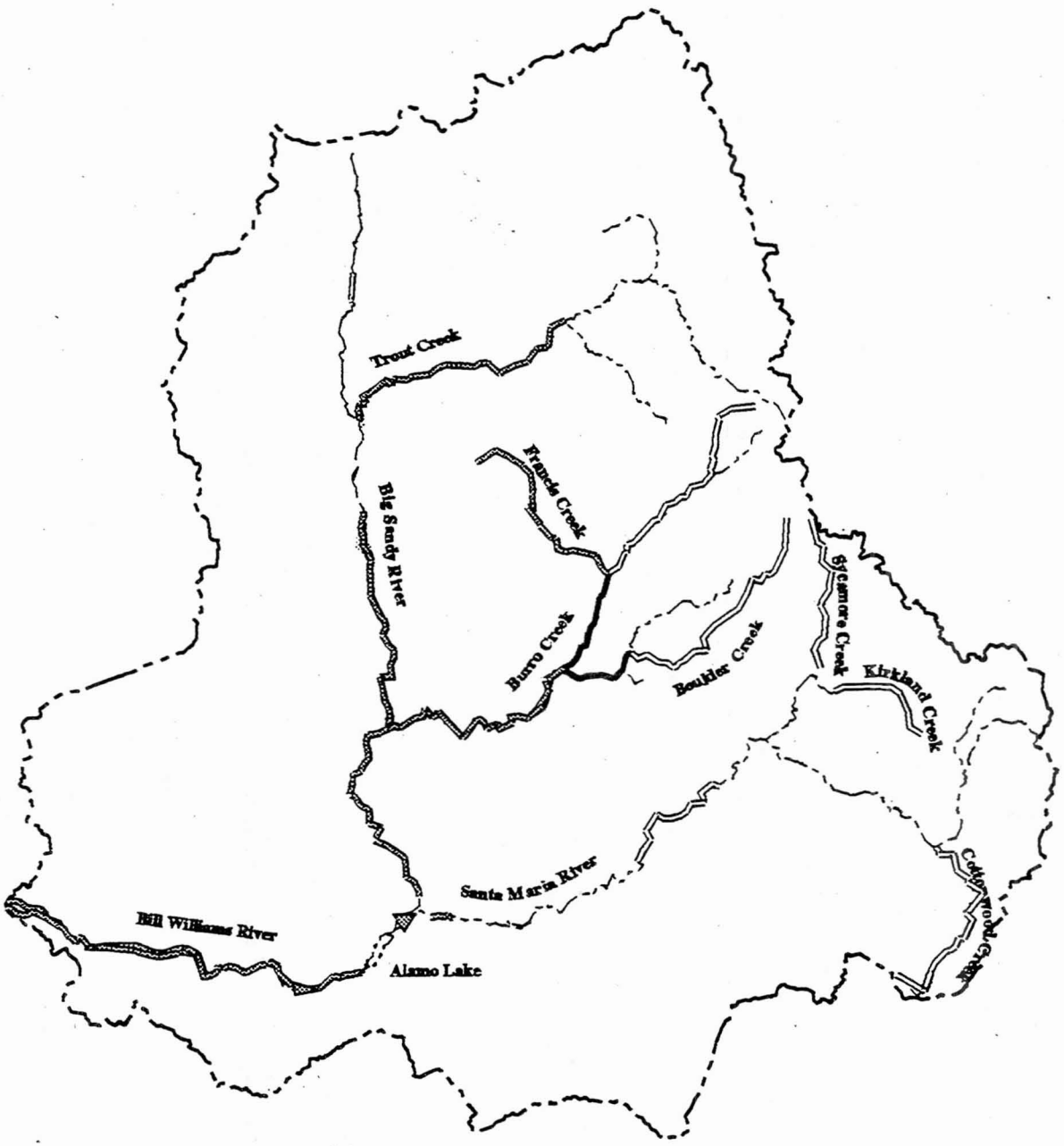
N W E S

Surface Water Assessments–Water quality assessments and surface water monitoring sites are illustrated on **Map 20** and assessments are summarized below. Major stressors and probable sources are listed in rank order; minor stressors and sources are not shown. Individual waterbody assessments are provided in **Appendix F**. Additional information concerning stressors which cause impairment and associated sources was presented in Part IV of this chapter.

BILL WILLIAMS WATERSHED ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	27 reaches (9 monitored, 18 evaluated)	Full support - 126 miles Impaired - 180 miles	Turbidity, arsenic, and fecal coliform.	Natural, rangeland practices, loss of riparian vegetation.
LAKES	2 lakes (1 monitored, 1 evaluated)	Full support - 0 acres Impaired - 5,015 acres	Sulfide and noxious weeds.	Natural, hydrologic modification.

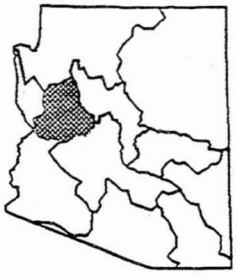
Groundwater Assessments–Groundwater quality monitoring data collected during 1991 to 1995 are summarized by groundwater basin in **Table 15** and illustrated on **Map 21**. No Aquifer Water Quality Standards were exceeded; however, there were insufficient data to characterize regional groundwater quality.

Investigations of potential groundwater contamination have lead to site remediation efforts through the state and federal Superfund Program (WQARF and CERCLA, respectively), the Underground Storage Tank Program, and the Resource Conservation and Recovery Act Program (RCRA). In other areas, groundwater is naturally contaminated with metals, halogens, and other inorganics. The status of these known contamination sites is provided in **Appendix G**, along with a map illustrating where these sites are located.



Map 20. Bill Williams Watershed Surface Water Assessments

- Indian Reservations
- Fully Supported/ Threatened Lake
- Partially Supported Lake
- Not Supported Lake
- Watershed Boundary
- Streams
- Fully Supported or Threatened
- Partially Supported
- Not Supported



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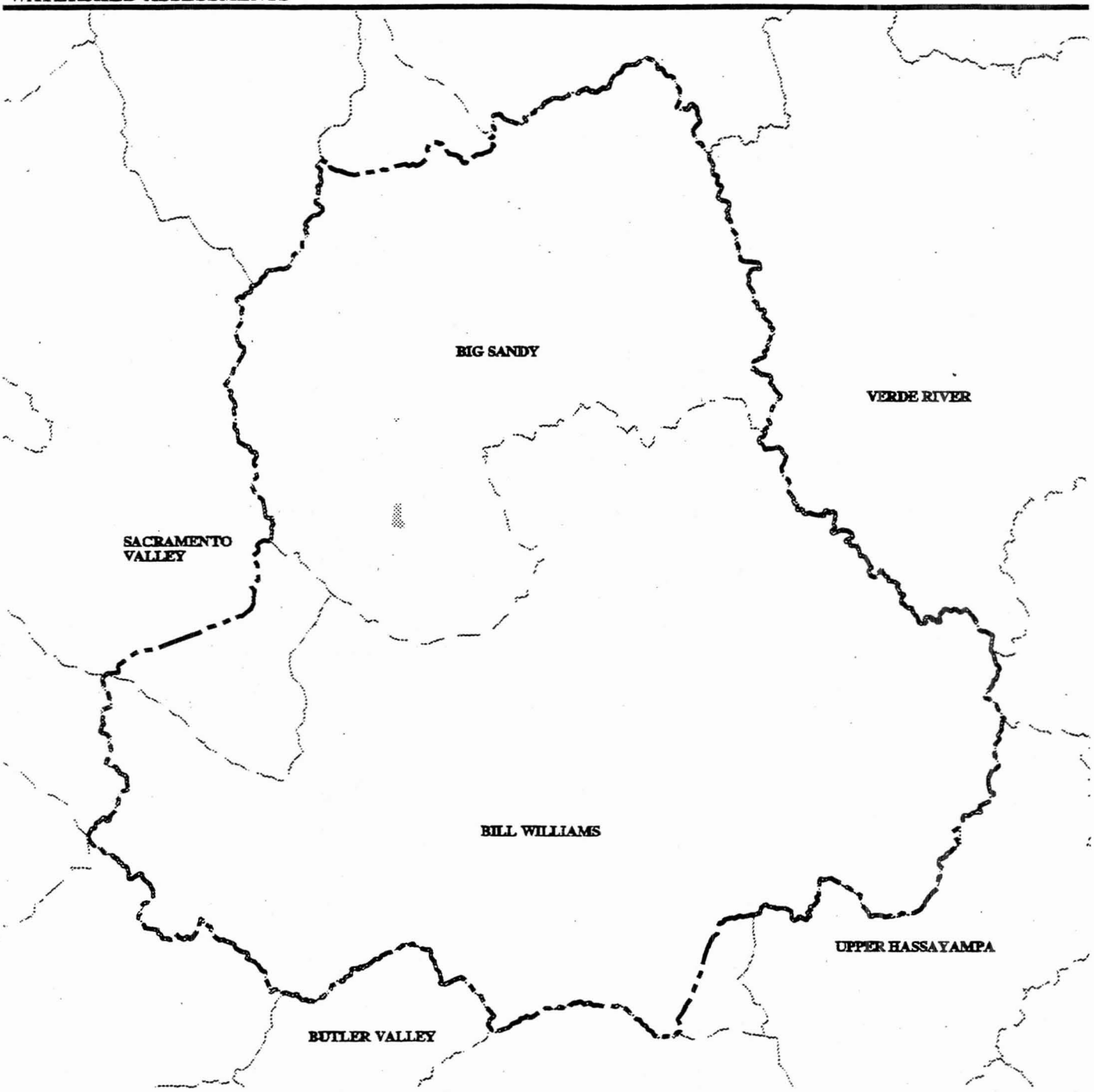
N W E S

Table 15. Bill Williams Watershed - Groundwater Monitoring Summary (1991-1995)

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS					
		SAMPLED			EXCEEDED AQUIFER WATER QUALITY STANDARD		
GROUNDWATER BASINS		Bill Williams	Sacramento Valley*	Big Sandy	Bill Williams	Sacramento Valley*	Big Sandy
WATER QUALITY INDEX WELLS	Nitrate	1	0	3	0	0	0
	Fluoride	2	1	1	0	0	0
	Metals	0	0	0	0	0	0
	Radiochemicals	0	0	0	0	0	0
	Volatile Organics	0	0	0	0	0	0
	Pesticides	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Nitrate	1	0	0	0	0	0
	Fluoride	5	2	5	0	0	0
	Metals	5	2	5	0	0	0
	Radiochemicals	0	0	0	0	0	0
	Volatile Organics	1	0	0	0	0	0
	Pesticides	7	0	0	0	0	0

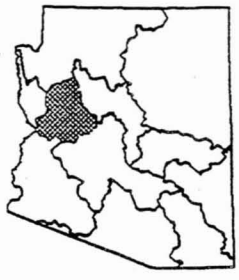
MONITORING DATA TYPE	PARAMETER GROUP	NUMBER OF WELLS		
		PARAMETER DETECTED		
GROUNDWATER BASINS		Bill Williams	Sacramento Valley*	Big Sandy
WATER QUALITY INDEX WELLS	Volatile Organics	0	0	0
	Pesticides	0	0	0
OTHER GROUNDWATER MONITORING	Volatile Organics	0	0	0
	Pesticides	0	0	0

* Only a small portion of Sacramento Valley groundwater basin is in this watershed; the major portion is in the Colorado-Lower Gila Watershed.



Map 21. Bill Williams Watershed
Wells Exceeding an Aquifer Water Quality Standard

Indian Reservation
Flouride
Radiation
Metal
Nitrate
Volatile Organic Compound
Pesticide
Watershed Boundary
Groundwater Basin
WS/GW Boundary



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N W E S

Special Studies in the Bill Williams Watershed--

- The US Fish and Wildlife Service funded a master's thesis study of contaminants in water, sediment, and biota from the Bill Williams River, through the University of Arizona's School of Renewable Natural Resources (Ruiz 1994). The conclusions from this investigation were:

  - Elevated concentrations of elements in water at some sites may be the result of contaminated groundwater becoming surface flow.
  - The data do not substantiate a relationship between concentrations of metals in water and runoff from washes with inactive copper mines and exposed tailings.
  - Samples collected three months after historic flood flows (1993) indicated a general decrease in arsenic, cadmium, selenium, and zinc, as compared to prior concentrations. This finding would be consistent with flushing associated with high flows. In contrast, copper and mercury generally increased (possibly a deposition of these materials which eroded from the watershed).
  - Selenium was elevated in biotic tissue samples in the lower reaches of the Bill Williams. This may be caused by biota moving upstream from the Colorado River (selenium is elevated Colorado River biota).

- The Cyprus Bagdad Copper Mine is a large, modern, active mine. Mining activities consist of open pit mining, flotation concentrating, leaching, and solvent extraction/electrowinning. In May 1991, the company discovered subsurface seepage into Boulder Creek from the Copper Creek leaching facility. A complete surface water and groundwater monitoring program and full scale remediation efforts were initiated at once. Violations of surface water standards were limited to a single pool in Boulder Creek for a duration of six months. The remediation consisted of major reconstruction of the containment ponds, the construction of a cutoff wall with interceptor wells across the entire Copper Creek floodplain, and the installation of monitoring wells next to the creek. The remediation was successful. EPA and ADEQ have been negotiating with the company on monetary fines and possible supplementary environmental improvement projects as a result of the releases.

- The abandoned Hillside Mine is less than two miles upstream from Cyprus Bagdad Copper Mine, and continues to discharge groundwater contaminated with lead, zinc, and gold into Boulder Creek. ADEQ investigations into the nature of these discharges and their effects on Boulder Creek have been conducted in 1981, 1982, 1983, 1991, and 1992. Two Fixed Station Network sites were established upstream and downstream of the upper tailings in 1991-92. One perennial discharge from a mine adit at the middle tailings causes intermittent violations of arsenic and other metals standards. Runoff from the tailings produces water quality violations during rainstorms and increases the metal content of the streambed sediments. Remediation is needed, but the inaccessibility of the site and its tripartite ownership (Bureau of Land Management, State of Arizona, and private sectors) presents serious obstacles.

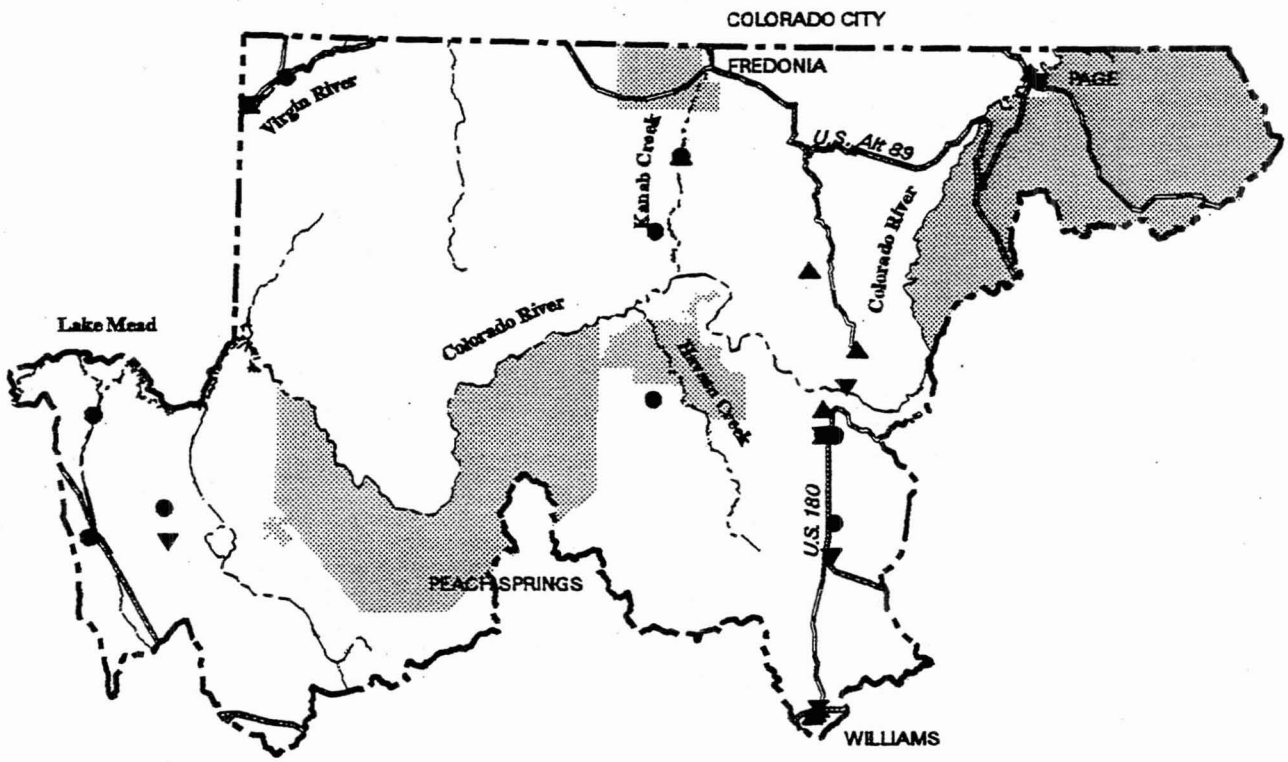
- The Blue Beacon and Petro Stopping Center wastewater treatment facilities were investigated in 1995 after ADEQ received a report that raw sewage was discharging from the Petro facility to an unnamed wash in the Big Sandy sub-watershed. Narrative and numeric surface water quality standard violations were noted in the streambed below the Petro discharge. High coliform counts in the water and sediment also indicate inadequate operation of the nearby Blue Beacon wastewater facility. Regulatory action is underway through the Aquifer Protection Permit Program.

- Alamo Lake water quality has been monitored by USFWS, AGFD, and the Corps of Engineers during the past five years. The lake is assessed as impaired due to sulfide exceedances and threatened by low dissolved oxygen and high amounts of suspended solids in the watershed. A potentially greater threat is the elevated levels of heavy metals found in fish (King et al. 1991 and ADEQ's Priority Pollutant

Program). Further monitoring and evaluation are needed to determine if there are risks to human health or aquatic life associated with these elevated metals, and whether further burdens from historic mining could be reduced.

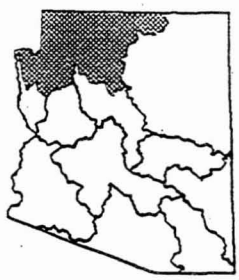
Characterization of the Colorado-Grand Canyon Watershed

SIZE	16,437 square miles (14% of the State's land area).
POPULATION BASE	47,500 people (1% of the State's population). Major communities are shown on **Map 22**.
LAND OWNERSHIP	Bureau of Land Management 32% Private 13% Tribal 22% U.S. Forest Service 10% National parks and monuments 15% State 8%
LAND USES AND PERMITS	• Primarily a mixture of open grazing, recreation, and silviculture, with scattered mineral districts. • This watershed contains the Grand Canyon National Park, Kaibab National Forest, and Lake Mead and Glen Canyon national recreational areas. • **Map 22** shows the location of facilities with wastewater discharge permits.
HYDROLOGIC PROVINCE(S)	The Plateau Uplands Province, with a portion of the Basin and Range Province.
ECOREGIONS	Primarily the Arizona-New Mexico Plateau, with Arizona-New Mexico Mountains on the eastern edge and Southern Basin and Range on the western edge.
GROUNDWATER BASINS	The Coconino Plateau, Detrital Valley, Grand Wash, Hualapai Valley, Kanab Plateau, Meadview, Paria, Peach Springs, Shivwits Plateau, and Virgin River basins. Minor portions of: Big Sandy, Lake Mohave, and the Little Colorado River basins.
HYDROLOGY AND GEOLOGY	• Incised canyons formed by erosion of sedimentary formations, volcanically formed mountains, high plateaus, valleys, and mountain canyons. Aquifers with low water-yields are contained in fractured limestones, sandstones, shales, and igneous rocks. High water-yield aquifers are typically found in alluvium and basin fill deposits in valleys and along rivers. (ADWR 1994) • Elevations range from 1,000 feet above sea level along the Colorado River to 12,600 feet at the San Francisco Peaks. • The Colorado River and many of its tributaries (near their confluence with the Colorado River) are perennial. However, most of the streams in the watershed are ephemeral or intermittent (Brown et al. 1978). • The Colorado River at Lee Ferry flow has an average discharge of 17,850 cfs, with a maximum discharge of 97,300 cfs (in 1983). Prior to completion of Glen Canyon Dam in 1963 the maximum flow was about 300,000 cfs (since 1868) (USGS 1996).
UNIQUE WATERS	None
OTHER STATES, NATIONS, OR TRIBES	Utah and Nevada to the north and west. Hualapai, Havasupai, Kaibab-Paiute, and Navajo tribes.



Map 22. Colorado-Grand Canyon Watershed Water Protection Permits

- Indian Reservation
- NPDES
- APP & GWPP
- Reuse
- Watershed Boundary
- Stream
- Primary Highway
- Secondary Highway
- WS/GW Boundary



SCALE
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KILOMETERS 10 0 10 20 30 40 50

N W E S

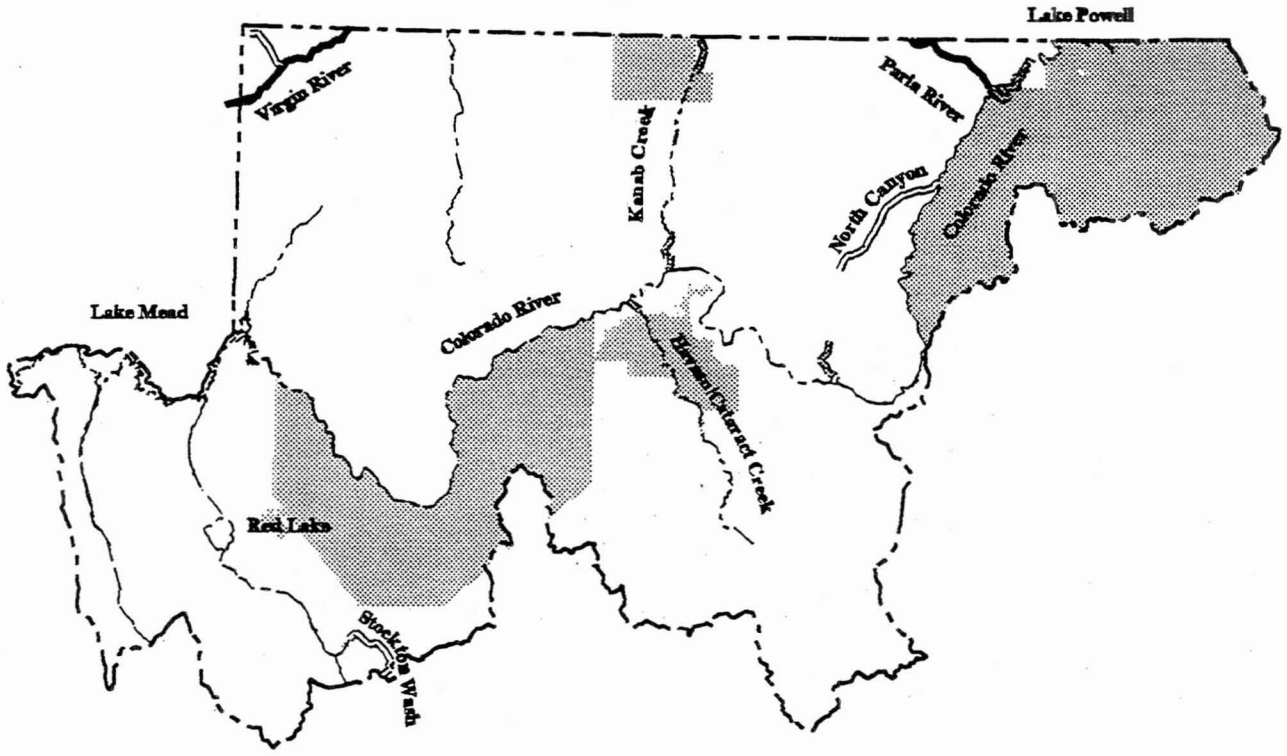
Surface Water Assessments--Water quality assessments and surface water monitoring sites are illustrated on **Map 23** and assessments are summarized below. Major stressors and probable sources are listed in rank order; minor stressors and sources are not shown. Individual waterbody assessments are provided in **Appendix F**. Additional information concerning stressors which cause impairment and associated sources was presented in Part IV of this chapter.

COLORADO - GRAND CANYON WATERSHED ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	45 reaches (16 monitored, 29 evaluated)	Full support - 98 miles Impaired - 300 miles	Total dissolved solids, turbidity, sulfate, arsenic, high pH, and radiochemcials.	Natural, grazing practices, loss of riparian vegetation.
LAKES	4 lakes (all evaluated)	Full support - 0 acres Impaired - 154 acres	Iron and manganese.	Natural and hydrologic modification.

Groundwater Assessments--Groundwater monitoring data collected during 1991-1995 are summarized by groundwater basins in **Table 16** and illustrated on **Map 24**. The following assessment is based on these limited monitoring data:

- Without treatment, natural contaminants (i.e., radiochemicals and fluoride) may make some groundwater unsuitable for drinking water purposes.
- No monitoring data was available for manmade contaminants such as pesticides and volatile organic chemicals.

Investigations of potential groundwater contamination have lead to site remediation efforts through the state and federal Superfund Program (WQARF and CERCLA, respectively), the Underground Storage Tank Program, and the Resource Conservation and Recovery Act Program. Some groundwater is naturally contaminated with metals, halogens, and other inorganics. The status of these known contamination sites is provided in **Appendix G**, along with a map illustrating where these sites are located.



Map 23. Colorado-Grand Canyon Watershed Surface Water Assessments

- Indian Reservations
- Fully Supported/ Threatened Lake
- Partially Supported Lake
- Not Supported Lake
- Watershed Boundary
- Streams
- Fully Supported or Threatened
- Partially Supported
- Not Supported

SCALE
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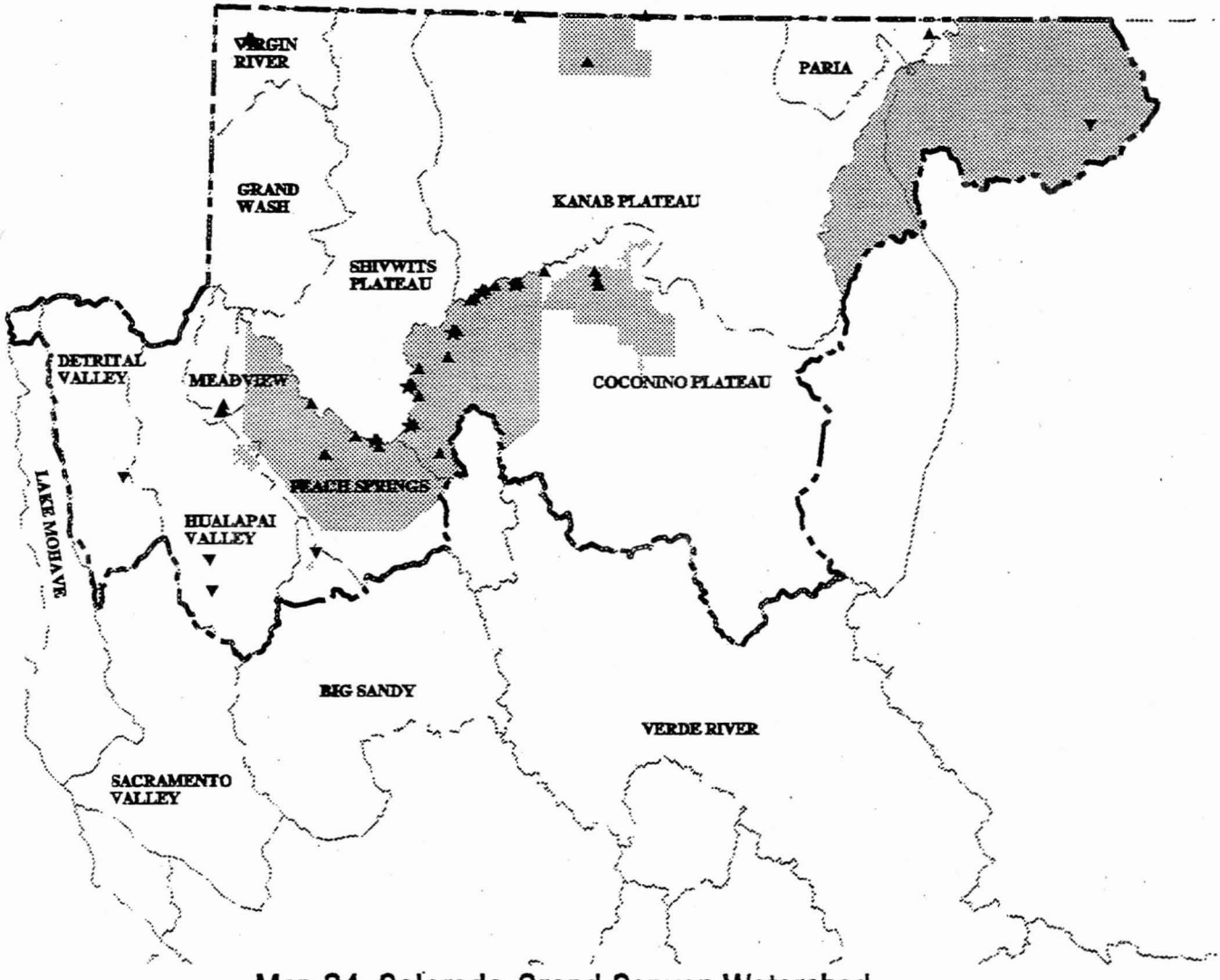
N W E S

Table 16. Colorado-Grand Canyon Watershed - Groundwater Monitoring Summary (1991-1995)

MONITORING DATA TYPE	PARAMETER OR PARAMENTER GROUP	NUMBER OF WELLS SAMPLED										NUMBER OF WELLS EXCEEDED STANDARD									
GROUNDWATER BASINS		BS	CP	DV	HV	KP	LC	MD	PA	PS	VR	BS	CP	DV	HV	KP	LC	MD	PA	PS	VR
WATER QUALITY INDEX WELLS	Nitrate	1	1	0	2	4	0	1	1	2	1	0	0	0	0	0	0	0	0	0	0
	Fluoride	3	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Metals	1	0	1	1	1	1	0	1	2	4	0	0	0	0	0	0	0	0	0	0
	Radiochemicals	0	1	0	0	4	0	0	1	0	1	0	0	0	0	4	0	0	1	0	1
	Volatile Organics	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pesticides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Nitrate	0	18	0	3	0	0	5	0	11	0	0	0	0	0	0	0	0	0	0	0
	Fluoride	3	15	14	21	3	2	9	2	25	0	1	0	0	2	0	1	0	0	1	0
	Metals	0	78	11	13	3	0	20	3	65	11	0	3	0	0	0	0	0	0	1	1
	Radiochemicals	0	18	0	1	0	0	5	0	11	0	0	16	0	0	0	0	3	0	6	0
	Volatile Organics	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pesticides	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

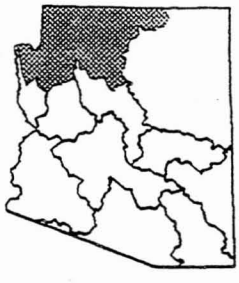
MONITORING DATA TYPE	PARAMETER GROUP OF CONCERN	NUMBER OF WELLS PARAMETER DETECTED									
GROUNDWATER BASINS		BS	CP	DV	HV	KP	LC	MD	PA	PS	VR
WATER QUALITY INDEX WELLS	Volatile Organics	0	0	0	0	0	0	0	0	0	0
	Pesticides	0	0	0	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Volatile Organics	0	0	0	0	0	0	0	0	0	0
	Pesticides	0	0	0	0	0	0	0	0	0	0

Groundwater Basins: BS = Big Sandy; CP = Coconino Plateau; DV = Detrital Valley; HV = Hualapai; KP = Kanab Plateau; LC = Little Colorado River; MD = Meadview; PA = Paria; PS = Peach Springs; VR = Virgin River.
Only minor portions of Big Sandy and the Little Colorado River basins are in this watershed.
No samples were collected in Grand Wash, Lake Mohave, or Shivwits Plateau groundwater basins (not shown due to size of table).



Map 24. Colorado-Grand Canyon Watershed
Wells Exceeding an Aquifer Water Quality Standard

- Indian Reservation
- Flouride
- Radiation
- Metal
- Nitrate
- Volatile Organic Compound
- Pesticide
- Watershed Boundary
- Groundwater Basin
- WS/GW Boundary



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KILOMETERS 10 0 10 20 30 40 50

N W E S

Special Studies in the Colorado-Grand Canyon Watershed--

- Beaver Dam Wash was surveyed in 1993 by ADEQ to determine whether septic systems used by mobile homes in the area or runoff from Beaver Dam Resort Golf Course were impacting the wash (ADEQ 1995c). Findings and conclusions of the survey included:

  - No Arizona surface water standards were exceeded throughout the survey period.
  - Housing and recreational facilities adjacent to the wash did not appear to have a significant impact on the wash's water quality.
  - A change in water quality occurs between the farthest upstream control site and the site nearest the wash's confluence with the Virgin River (i.e., total dissolved solids, nitrate-nitrite, and chloride increases).

- An investigation in the Cerbat Mountains in the Truxton Wash sub-watersheds in 1994 by ADEQ's Aquifer Protection Program was completed to determine whether acid mine drainage in the headwaters had contaminated the aquifer at the foot of the mountains (as previously suggested in a 1992 investigation). The investigators reported the following findings and conclusions:

  - The red-flowing adit near the American Legion Mine continues to violate surface water quality standards (as noted in the 1992 investigation), although the acidity and metals content had decreased. This source of pollutants, as well as De La Fontaine mine tailings, needs remediation. The owner of De La Fontaine tailings has applied for an Aquifer Protection Permit to construct an impoundment to contain the tailings.
  - Cattle should be prevented from further use of the spring flowing into the wash below American Legion Mine and the mine adit.
  - Drinking water standards for radiochemicals were exceeded at all points sampled in the American Legion watercourse, but were not exceeded in any down gradient wells. These wells also met all standards for metals.
  - Sediment transport from this historic mining area does not seem to be contaminating downstream surface water, groundwater, or streambed sediments.
  - Several wells along the eastern foot of the Cerbats were found to be suitable for supplying drinking water; however, fluoride was above the standard in one private well.

- Surface water and groundwater quality investigations of the Chloride Mining District and adjacent areas in the Cerbat Mountains were conducted in 1995 by Ulrike Roesner, Professor of Geography, University of Erlangen-Nurnberg, West Germany. This project was completed in cooperation with ADEQ staff. The purpose was to determine the extent and degree of surface and groundwater contamination from the historic mines along the western slope of the mountains. Professor Roesner concluded that:

  - Wells in Chloride should not be used for drinking water even when water shortages occur.
  - Livestock should be prevented from drinking water from streams which drain tailings of active or historic mines, adits, or tunnel discharges at mines.
  - Remediation of at least the largest tailings should be initiated to prevent water infiltration (e.g., at the Tennessee Mine), and tailings should be removed from streambeds (e.g., at Payroll, New Jersey, Jupiter mines).
  - Two of the active mines near the southern edge of the study area have Aquifer Protection Permits which entail considerable pollution prevention and remediation activities. Cyprus Mineral Park has recently improved the integrity of its principal tailingsimpoundment as well as the surface water drainage around it.

- The National Parks Service monitored 36 sites on tributaries to the Colorado River which are frequented by recreational rafters in the Grand Canyon National Park. Four years of monitoring ambient conditions in these generally pristine waters has resulted in the National Parks Service posting a drinking water and swimming advisory at the Grand Canyon rafting and backpacking headquarters for three tributaries: Lava Chuar and Pumpkin Spring due to arsenic and Horn Creek due to high levels of radiochemicals (gross alpha).

- The Glen Canyon National Recreation Area has been monitoring bacteria levels in Lake Powell since 1988 to assess potential impacts from recreational bathing and boating. Due to high bacteria levels, advisory notices were posted at several beaches during the last few years in Utah. No advisories have been posted in Arizona. Additional data are needed to determine whether the high bacteria contamination correlates to visitor use patterns or lake levels (Long and Smith 1995).

- The physical and chemical characteristics of Lake Powell, near the forebay of Glen Canyon Dam and outflows, are described in a recent report of the USGS (Hart and Sherman 1996). The study focused on the deep forebay area of the dam during 1990-91 to determine the characteristics of the lake water being discharged to the Colorado River below the dam. Some of the findings during the study included:

  - A strong chemocline persisted in the study area that fluctuated seasonally.
  - Thermal stratification existed during late spring through mid fall with a thick hypolimnetic zone
  - Metalimnetic (mid-depths) oxygen maxima and minima occurred during the photosynthetic period of the study.
  - Concentrations of chemical constituents generally increased with depth. Concentrations of organic carbon were greatest in the epilimnetic zone (upper layer) of the forebay.
  - Outflows from Glen Canyon Dam generally had the same physical and chemical characteristics as waters in the forebay at penstock depth (approximately 200 feet below the lake surface).

- An Environmental Impact Statement (EIS) of alternative Glen Canyon Dam operations was finalized by the Bureau of Reclamation in 1995. The Glen Canyon Dam has reduced sediment transport and supply, and controlled the volume of cold, clear water being discharged into the Colorado River in Arizona. Native and nonnative fish that cannot tolerate these conditions have declined or disappeared from the Grand Canyon. The EIS considered nine alternative ways to operate the dam to reduce further adverse impacts on the ecosystem or enhance components of that system. The findings and conclusions of this study included:

  - None of the alternatives presented in the EIS can return the system to pre-dam conditions.
  - The team recommended the "modified low fluctuating flow alternative" that would substantially reduce daily fluctuations since the dam began operation. Habitat maintenance flows are included in this alternative to re-form backwaters and maintain sandbars, which are important for camping beaches. A test beach-habitat flow was conducted in 1996; however, an "assessment impact" is expected in 1997.

- A series of eight geohydrologic reconnaissance studies has been completed in the Lake Mead National Recreation Area by the USGS, in cooperation with the National Park Service (the most recent by Laney and Bales 1996). The studies were done to evaluate water resources in the recreation area and to identify areas having potential for the development of water supplies adequate for marinas and campgrounds. Findings and conclusions of these studies included:

  - None of the groundwater that was sampled in this part of the recreation area (Las Vegas Wash to the Virgin River, Nevada) was suitable for drinking purposes because of large concentrations of

sulfate and chloride.

- The most suitable areas for developing potable groundwater supplies are in the permeable rocks near the shores of Lake Mead where lake water has infiltrated.
- Four areas identified for groundwater exploration are near Overton Beach, west of Callville Bay, near Middle Point, and the lower Moapa Valley. Water may be degraded by soluable minerals in the rocks; therefore, drilling in any of these areas should be considered exploratory.

- The Pratt Tank Demonstration Project was funded by EPA/ADEQ in 1995 to demonstrate the use of high intensity animal impact (hoof action) to reduce soil crusting common to drainage areas in this watershed. Hoof action should also be able to incorporate carbon into soils to improve microbial activity and soil structure, increase herbaceous ground cover, and decrease runoff and soil erosion.

- The Hualapai Tribe and the USGS conducted a water quality assessment of waters on the Reservation in 1992-1994. The assessment was part of a comprehensive project to provide the tribe with water resources data to for their development and management plans. The results of the assessment were provided to the tribe and EPA in a 305(b) report submitted in 1995. Some of the findings of the study were:

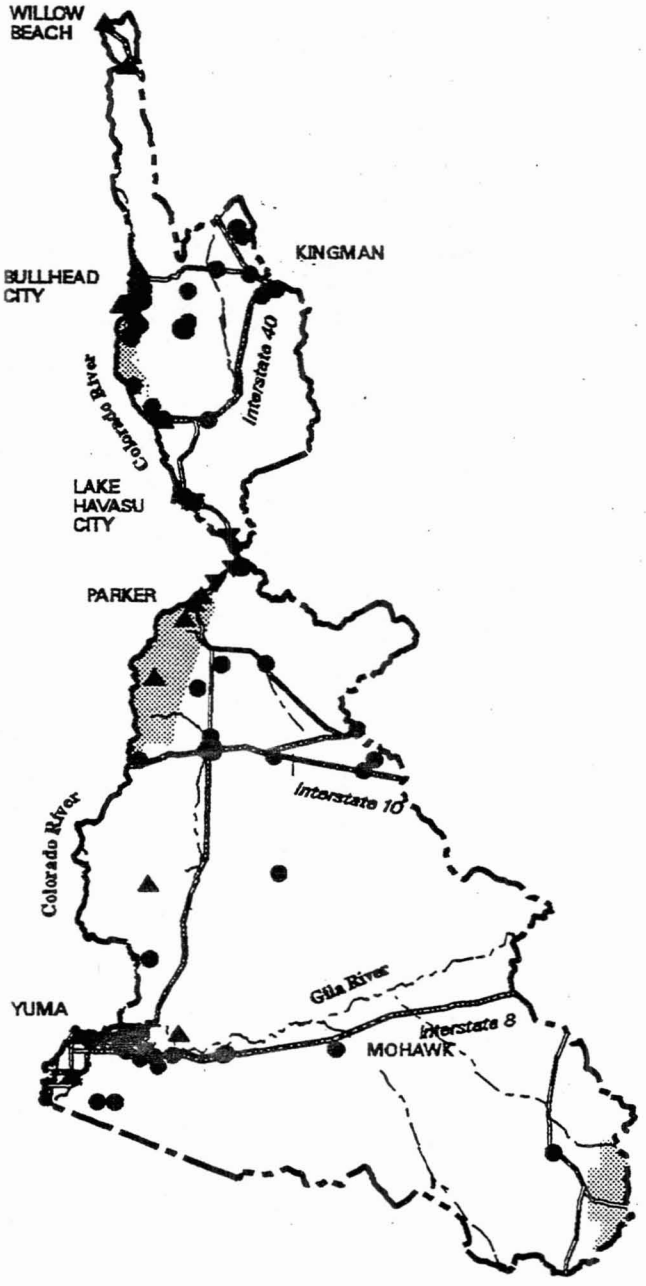
  - Most of the observed and potential contamination of the Reservation is natural in origin. Radionuclide activity and concentrations of selected major ions and metals are greatest in groundwater and surface water near secondary ore deposits.
  - Community development and livestock activity in local areas may be contributing nutrients and other organics to surface water and groundwater.
  - Surface water flows contain large concentrations of sediment, and thus, have high turbidity.
  - Operation of the Glen Canyon Dam on the Colorado River has affected the riparian corridor along the river to the detriment of native species on the Reservation.
  - Concentrations of dissolved solids along the Colorado River were greater than EPA's secondary maximum contaminant level, and typically were much greater at selected sites on the Reservation.
  - Concentrations of arsenic, mercury, lead, sulfate, chloride, and activities of radon in groundwater have exceeded established or proposed drinking water standards in some instances, but these concentrations generally occur in areas where the water is not used for human consumption.
  - Activities of gross alpha, gross beta, and uranium have exceeded established or proposed drinking water standards in some remote areas.

- The Havasupai Tribe and the USGS are assessing the water resources of the Reservation to support the Tribe's development and management plans. This assessment includes an evaluation of the water quality on the Reservation. Some findings to date include:

  - The quality of most waters sampled is suitable for human consumption.
  - Although analyses have not been completed, bacteria counts in Havasu Creek appear to meet standards established by ADEQ for Full Body Contact.
  - Some springs used as a source of drinking water have occasionally tested positive for pathogenic bacteria.

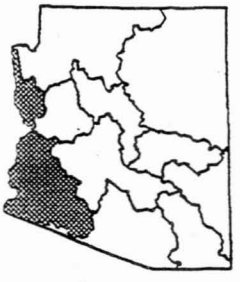
Characterization of the Colorado-Lower Gila Watershed

SIZE	14,459 square miles (13% of the State's land area).
POPULATION BASE	187,659 people (5% of the State's population). Major communities are shown on **Map 25** and many of these communities are growing quickly.
LAND OWNERSHIP	Bureau of Land Management 33% State 6% Military 25% Tribal 4% National Wildlife Refuge 14% Private <1% Other state and federal 17%
LAND USES AND PERMITS	• Private land along the Colorado River and Gila River is intensively cultivated. • This watershed contains a major air force base with bombing ranges, six wildlife refuges, three wilderness areas, and four Indian reservations. • Land use within designated national wilderness areas has been restricted (i.e., mineral lease and mineral entry withdrawn and motorized travel prohibited); however, grazing still occurs on most of these lands. • **Map 25** shows the location of facilities with wastewater discharge permits.
HYDROLOGIC PROVINCE(S)	Basin and Range Province, characterized by fault-block desert mountains with broad valleys and basins.
ECOREGIONS	Southern Basin and Range.
GROUNDWATER BASINS	Butler Valley, Hualapai Valley, Lower Gila, Lake Havasu, Lake Mohave, Parker, Ranegras Plain, Sacramento Valley and Yuma basins, with a small portion of the Harquahala basin.
HYDROLOGY AND GEOLOGY	• Groundwater in valleys is typically found in unconfined high yield aquifers consisting of basin-fill sediments, alluvial sands, and gravel. Confined aquifers are often found in Bouse formations and fanglomerate units (ADWR 1994). • Elevations in the watershed range from 80 feet above sea level where the Colorado River enters Mexico to 5456 feet above sea level in the Black Mountains near Lake Mohave. • Perennial water is primarily limited to the mainstem of the Colorado River, with irrigation return flow providing perennial flow in the Gila River near its confluence with the Colorado River (Brown et al. 1978). • Above Imperial Dam diversions, the flow on the Colorado River has varied between a minimum of 1,450 cfs to a maximum of 40,800 cfs since Hoover Dam was constructed in 1935 (USGS 1996).
UNIQUE WATERS	None
OTHER STATES, NATIONS, OR TRIBES	Nevada and California to the west and Mexico to the south. Fort Mohave, Fort Yuma, Cocopah and Colorado River Indian Tribes.



Map 25. Colorado-Lower Gila Watershed Water Protection Permits

- Indian Reservation
- NPDES
- APP & GWPP
- Reuse
- Watershed Boundary
- Stream
- Primary Highway
- Secondary Highway
- WS/GW Boundary



SCALE
MILES 10 0 10 20 30 40
KILOMETERS 10 0 10 20 30 40 50

N W E S

Surface Water Assessments--Water quality assessments and surface water monitoring sites are illustrated on **Map 26** and assessments are summarized below by surface water basin. (The basins are shown separately because the problems are different.) Major stressors and probable sources are listed in rank order; minor stressors and sources are not shown. Individual waterbody assessments are provided in **Appendix F**. Additional information concerning stressors which cause impairment and associated sources was presented in Part IV of this chapter.

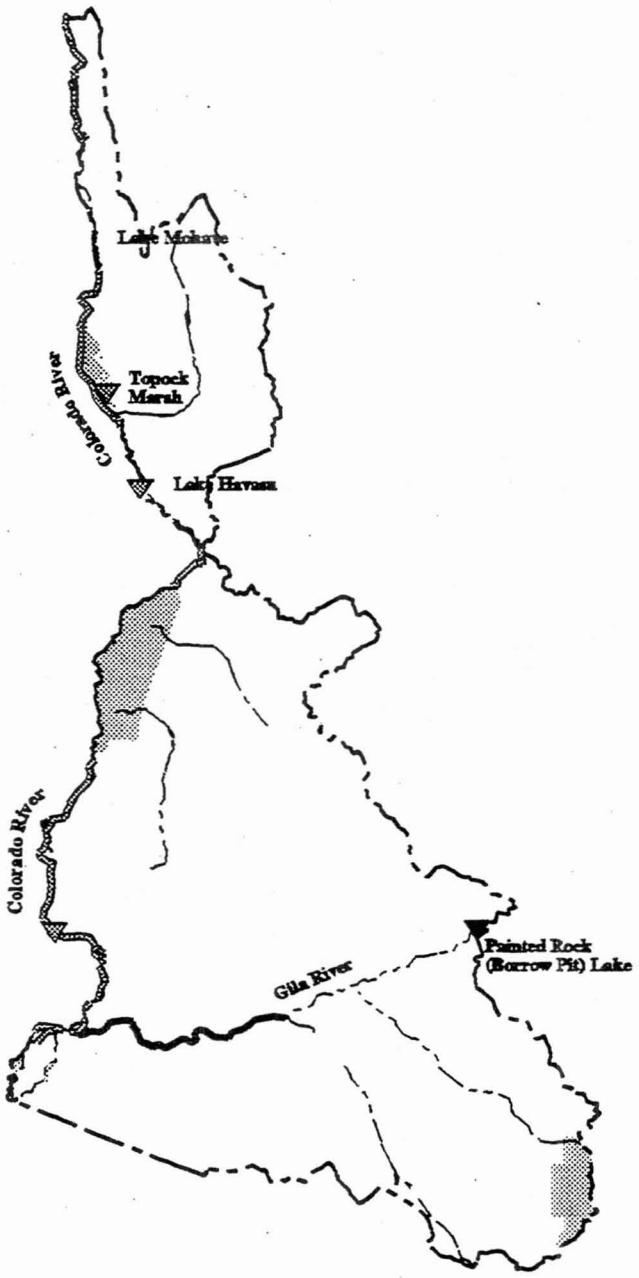
COLORADO BASIN ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	21 reaches (8 monitored, 13 evaluated)	Full support - 10 miles Impaired - 242 miles	Total dissolved solids, sulfate, and selenium.	Natural, irrigation return flows, hydrologic modification.
LAKES	12 lakes (10 monitored 2 evaluated)	Full support - 0 acres Impaired - 28,990 acres	Total dissolved solids, sulfate, and selenium.	Natural, wastewater disposal, other nutrient enhancement, irrigation return flows.

LOWER GILA BASIN ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	4 reaches (1 monitored, 3 evaluated)	Full support - 0 miles Impaired - 71 miles	Boron, total dissolved solids, and turbidity.	Irrigated crop production and natural.
LAKES	1 lake (1 monitored)	Full support - 0 acres Impaired - 170 acres	Pesticides, mercury, pH, low dissolved oxygen, total dissolved solids, and turbidity.	Historic irrigated crop production, hydro-modification, and natural.

Groundwater Assessments--Groundwater monitoring data collected during 1991-1995 are summarized by groundwater basins in **Table 17** and illustrated on **Map 27**. The limited groundwater samples collected in this watershed suggest the following assessment:

- Pesticides (e.g., Dicamba, 2,4-D, methomyl) have been detected in groundwater in the Yuma Groundwater Basin; however, they were generally at detection levels and none have exceeded an Aquifer Water Quality Standard.
- Manmade volatile organic chemicals are not a serious problem in this watershed. They were detected at one well in the Yuma Groundwater Basin and did not exceed an Aquifer Water Quality Standard.
- Older water quality monitoring data, collected between 1975-1990 by state and federal agencies, show that the median concentration of total dissolved solids in the Yuma Groundwater Basin exceeded the secondary maximum contaminant level for public drinking water of 500 mg/l.

Investigations of potential groundwater contamination have lead to site remediation efforts through the state and federal Superfund Program (WQARF and CERCLA, respectively), the Underground Storage Tank Program, and the Resource Conservation and Recovery Act Program. Some groundwater is naturally contaminated with metals, halogens, and other inorganics. The status of these known contamination sites is provided in **Appendix G**, along with a map illustrating where these sites are located.



Map 26. Colorado-Lower Gila Watershed Surface Water Assessments

Indian Reservations
Fully Supported/ Threatened Lake
Partially Supported Lake
Not Supported Lake
Watershed Boundary
Streams
Fully Supported or Threatened
Partially Supported
Not Supported

SCALE
MILES 10 0 10 20 40
KILOMETERS 10 0 10 20 30 40 50

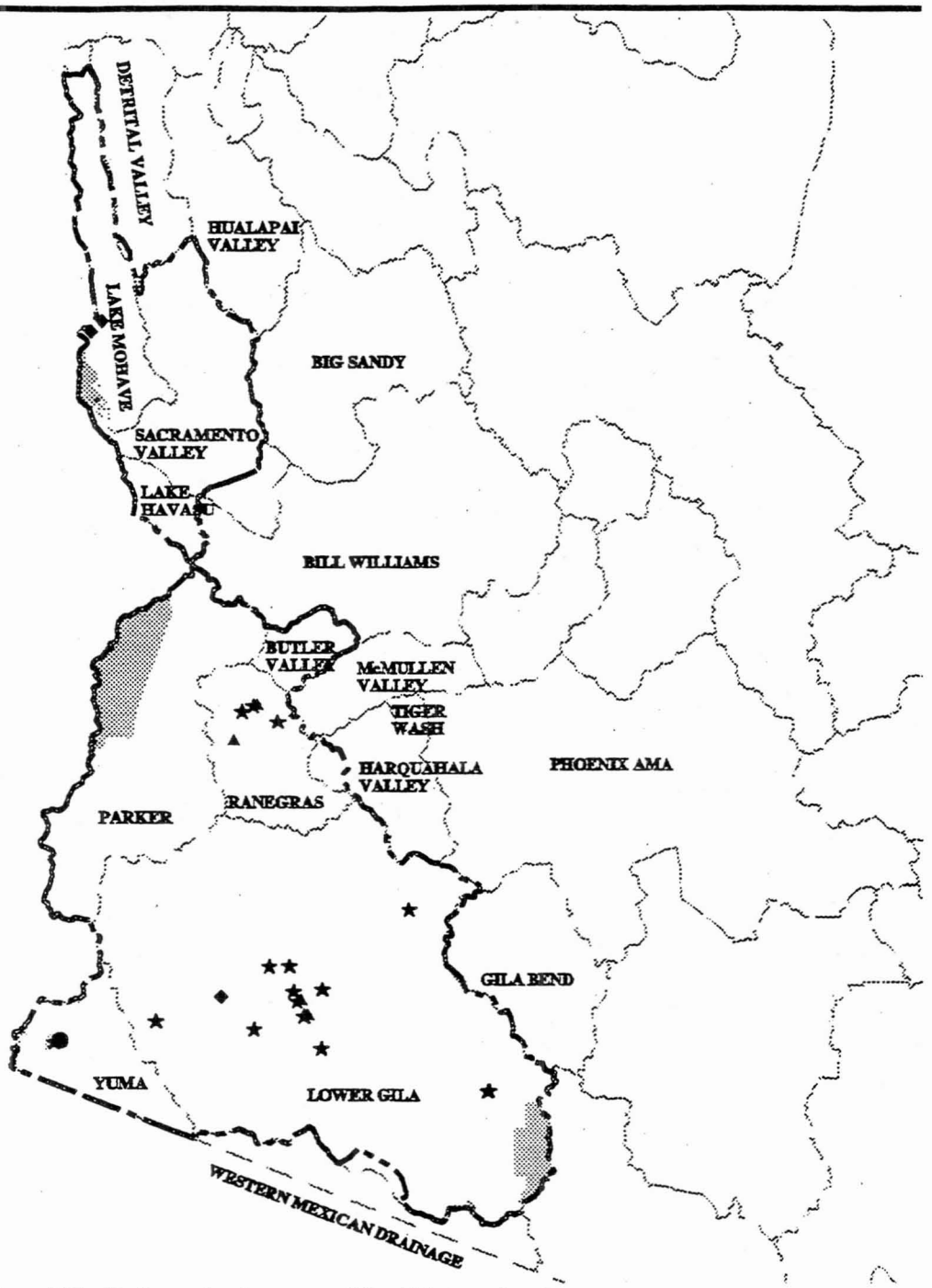
N W E S

Table 17. Colorado-Lower Gila Watershed - Groundwater Monitoring Summary (1991-1995)

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS SAMPLED									NUMBER OF WELLS EXCEEDED AQUIFER WATER QUALITY STANDARD								
GROUNDWATER BASINS		BV	HV	Gila	LH	LM	PK	RP	SV	YU	BV	HV	Gila	LH	LM	PK	RP	SV	YU
WATER QUALITY INDEX WELLS	Nitrate	1	0	6	1	2	3	4	3	2	0	0	0	0	0	0	0	0	0
	Fluoride	0	0	1	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0
	Metals	1	0	7	0	11	1	0	2	2	0	0	5	0	0	0	0	0	0
	Radiochemicals	0	0	1	0	0	0	2	0	0	0	0	1	0	0	0	0	2	0
	Volatile Organics	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
	Pesticides	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Nitrate	0	0	15	6	33	2	1	2	2	0	0	1	0	2	0	0	0	0
	Fluoride	0	1	0	0	8	1	3	8	0	0	0	0	0	0	0	0	0	0
	Metals	2	0	7	3	85	15	11	29	2	0	0	7	0	0	0	4	0	1
	Radiochemicals	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Volatile Organics	0	0	32	0	14	2	0	0	23	0	0	0	0	0	0	0	0	0
	Pesticides	0	0	43	0	22	1	0	0	37	0	0	0	0	0	0	0	0	1

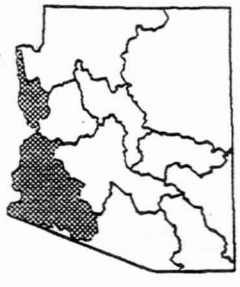
MONITORING DATA TYPE	PARAMETER GROUP	NUMBER OF WELLS PARAMETER DETECTED								
GROUNDWATER BASINS		BV	HV	Gila	LH	LM	PK	RP	SV	YU
WATER QUALITY INDEX WELLS	Volatile Organics	0	0	0	0	0	0	0	0	0
	Pesticides	0	0	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Volatile Organics	0	0	1	0	0	0	0	0	1
	Pesticides	0	0	0	0	0	0	0	0	9

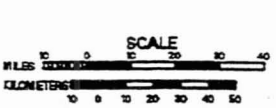
Groundwater Basins: BV = Butler Valley, HU = Hualapai Valley, Gila = Lower Gila, LH = Lake Havasu, LM = Lake Mohave, PK = Parker, RP = Ranegras Plain, SV = Sacramento Valley, and YU = Yuma.
No samples were taken in Harquahala Valley groundwater basin (not shown).



Map 27. Colorado-Lower Gila Watershed
Wells Exceeding an Aquifer Water Quality Standard

- Indian Reservation
- Flouride
- Radiation
- Metal
- Nitrate
- Volatile Organic Compound
- Pesticide
- Watershed Boundary
- Groundwater Basin
- WS/GW Boundary





Special Studies in the Colorado-Lower Gila Watershed--

- Selenium studies by the University of Arizona's School of Renewable Natural Resources were funded by the US Fish and Wildlife Service along the lower Colorado River. Each of these studies focused on a different aspect of the elevated selenium levels in the biota of the Colorado River drainage: the extent of contamination, contribution of selenium by irrigation practices, better methods for measuring selenium, and the effectiveness of mechanically increasing flow in backwater lakes to decrease selenium in the biota. These reports provided the following conclusions:

  - With the exception of selenium, trace elements in birds are not elevated above background (Rusk 1991).
  - Selenium levels were higher in backwater lakes receiving water from the Colorado River than lakes receiving water from other sources, including those receiving irrigation return flow waters (Rusk 1991, Martinez 1994, Lusk 1993).
  - Local irrigation practices do not appear to be responsible for elevated selenium concentrations, suggesting that the source(s) of selenium is upriver (Welsh & Maughan 1994).
  - Bird species, which feed primarily on fish or insects, had higher selenium concentrations in their tissues than herbivores (Martinez 1994). Invertebrates that consume detrital materials have the highest selenium concentrations (Lusk 1993). Bioaccumulation is greater in omnivorous fish than predatory fish (Lusk 1993).
  - Immature birds had higher selenium concentrations in their tissues than adults, but there were no seasonal nor gender differences in selenium levels (Martinez 1994).
  - Based on the liver selenium concentrations and the liver to kidney relationship of selenium, marsh birds are at a low risk of adult mortality but at high risk of teratogenicity (genetic defects in young) (Rusk 1991). Selenium levels in prey species of the Yuma clapper rail (an endangered species) are at or approaching levels known to be toxic to birds (Rusk 1991). However, there are no data to document the effects of high selenium levels on waterbird reproduction success or teratogenesis (Martinez 1994). Correlations between selenium contamination and indices of diversity and abundance were weak (Welsh & Maughan 1994).
  - The selenium level in clams can be used as a bioindicator of selenium levels in other species which are harder to collect (McCaulou et al. 1994).
  - A consumption advisory should be considered at some of the lakes, especially for pregnant women, nursing mothers, and children (Welsh & Maughan 1994).

- An investigation of Gila River water and sediment quality in the Wellton-Mohawk Irrigation District was conducted by ADEQ in 1994 to look at transport of sediments contaminated with heavy metals and pesticides from Painted Rocks Lake during the 1993 floods. Water and sediment samples were collected within the Wellton-Mohawk Irrigation District and at control sites nearby. The investigation found that the contaminated sediments had not concentrated along the watercourse. There was no evidence of these metals or pesticides leaching into the groundwater or surface water.

- Water, sediment, and aquatic plants were collected from five irrigation drainage canals in four study areas in the Yuma Valley by the USFWS in 1989 (Baker et al. 1992). The entire study area receives frequent applications of agricultural chemicals primarily for field and vegetable crops and citrus. Although agricultural insecticides are still actively used, non-persistent, acutely toxic organophosphate and carbamate pesticides are used in place of the former chlorinated hydrocarbon pesticides (e.g., DDT metabolites and toxaphene). The findings of this study were:

  - Selenium, toxaphene and DDT metabolite levels in some fish were above the criteria established to protect nonhuman predatory species.

- In one of three channel catfish collected copper was elevated above the 85th percentile of samples collected through the National Biomonitoring Program (Schmitt et al. 1990).
- DDT metabolites, dieldrin, and chlordane were above EPA screening values for human health protection.
- Irrigation drainage waters in Yuma Valley have the potential to cause significant harmful effects on fish and wildlife resources; therefore, the report recommended further study by the USFWS.

- In 1995, a study was conducted on the irrigation drainage waters in the Yuma Valley to determine potential for harmful impacts on human health, fish, and wildlife. The USGS monitored surface water and bottom sediments and the USFWS monitored biota from nine sites. This study was part of a larger study initiated in 1985 by the U.S. Department of Interior to identify the nature and extent of irrigation induced water quality problems in western states. Water samples were analyzed for major ions, nitrite plus nitrate, and selected trace elements along with water and air temperature, specific conductance, pH and alkalinity. To date, none of the constituents analyzed in water samples exceeded the EPA primary drinking water standards. However, the analyses and interpretation of the laboratory results have not been completed.

- A Yuma Groundwater Basin study was completed by ADEQ in 1995 to provide an overview of groundwater quality, as well as to identify areas of groundwater quality concern. Fifty-six groundwater samples were collected from the Yuma Basin for inorganic analyses, while fewer samples were analyzed for the following banned pesticides and radiochemicals: dibromochloropropane (DBCP) and ethylene dibromide (EDB) (37 samples), Groundwater Protection List Pesticides (21 samples), and radionuclides (7 samples). The study's conclusions were:

  - The majority of samples did not exceed any aquifer water quality standards. Most exceeded secondary maximum contaminant levels established for chemicals which affect taste and odor but do not threaten human health (e.g., total dissolved solids, sulfide, chloride, manganese, and iron).
  - No pesticides were detected in the groundwater samples.
  - A nitrate plume was identified in the eastern Gila Valley portion of the groundwater basin, with concentrations of nitrate as high as 122 mg/l (nitrate as N). A source of these nitrates has not yet been identified.

- A progress report on salinity in the Colorado River (Bureau of Reclamation 1995) indicates that natural diffuse sources and saline springs accounted for almost half (47%) of the total salt load in the river. Agricultural irrigation, reservoir evaporation, and municipal and industrial sources contribute to the remainder. The report estimates that 37% of the salinity is contributed by agricultural irrigation practices, which have been the target of most salinity control measures implemented in the last decade. The Department of Interior has constructed salinity control units along the Colorado River (in other states), implemented on-farm salinity programs, and conducted research on alternative salinity control methods. Since 1989, the average annual salinity level in the Colorado River has met standards because of increased flows and salinity control projects. Several new salinity control units must be constructed to meet salinity control objectives and keep pace with water resources development.

- The Bureau of Reclamation monitored agriculture canal return flows within the Colorado River Indian Tribe lands in 1991 through 1993 for levels of total dissolved solids and specific ions. These drains are located on tribal lands in California and Arizona, and therefore, these waterbodies were not assessed. Nevertheless, the data is summarized as follows:

  - TDS concentrations increase in the Colorado River water below the canal return flows.
  - The other 15 parameters measured did not exceed existing standards or criteria; however, the level of selenium (a parameter shown to be a concern in other studies) was not measured.

- ADEQ's Pesticide Program monitoring of groundwater in the Yuma and Lower Gila basins in the late 1980s and early 1990s did not detect any currently-registered pesticides in water samples collected from a cross-section of drainage, irrigation, municipal, and domestic production wells. Only the pesticides DBCP and EDB were detected, substances banned from use during the early 1980s. However, groundwater samples obtained from shallow monitoring wells (installed to monitor the depth of groundwater) detected fifteen different currently-registered pesticides. Generally, the pesticide detections were of very low concentrations. The accompanying table compares the detected levels of these pesticides with the lab minimum reporting levels (MRLs) as well as the Maximum Contaminant Levels (MCLs) and Health-Based Guidance Levels (HBGLs).

PESTICIDE LEVELS IN YUMA-AREA OBSERVATION WELLS

PESTICIDE	HIGHEST DETECTED LEVEL (µg/l)	LAB MRL (µg/l)	MCL (µg/l)	HBGL (µg/l)
Banvel (Dicamba)	7.4	0.5		210
2,4-D	6.0	0.5	70	70
Methomyl	50	2		180
Dacthal (DCPA)	2.41	5		3500
Dibromochloropropane (DBCP)	10.4	5	0.2	0.03
Diuron	52	20		14
Nebaron	3.4	1		N/A
Endosulfan, Sulfate	5.4	0.2		0.35
Linuron	3.5	0.1		1.4
Endosulfan, Alpha	1.6	0.1		0.35
Oxamyl	24	0.5	200	180
Endosulfan, Beta	2.8	0.2		0.35
Propoxur (Baygon)	150	5.0		2.8
Bromacil (Hyvar)	20	1.0		91
Chloropropham (CIPC)	7.4	1.0		N/A

- Comprehensive surface water and groundwater monitoring in Lake Havasu and Lake Havasu City were initiated in 1994 to locate the source(s) of high fecal coliform counts along the beaches in Thompson Bay. Initial monitoring focused on sampling beaches and offshore portions of the lake. This monitoring suggested diffused sources of nutrients and natural conditions were creating the high fecal coliform counts. It also suggested that groundwater may be a source of contaminants, which lead to monitoring nineteen wells. The majority of wells sampled were located on the island to monitor impacts from a municipal treatment facility and its use of treated wastewater for golf course irrigation on the island. The remaining wells were on the mainland, and were sampled to determine whether nutrients or fecal coliform were being contributed by septic systems, leaking sewer pipes or other mainland sources. The results of the sampling found the following (ADEQ 1996c):

- Nitrogen compounds are present in the aquifer and may be reaching Thompson Bay and Windsor Beach.
- Fecal coliform and *Escherichia coli* are not present in groundwater.
- Five factors may contribute nutrients to the lake and allow bacteria blooms during summer months:
  - Irrigation practices (using mainly treated wastewater),
  - Use of fertilizer on parks and golf courses,
  - The wastewater treatment plant on the island,
  - Fluctuating lake levels that influence groundwater movements, and
  - Private septic systems on the mainland.

A more comprehensive discussion of the Lake Havasu study is provided on page 191.

- The Painted Rocks Lake studies by USFWS, ADEQ, and AGFD resulted in a human health risk report (ADHS 1991) and a fish consumption advisory to not eat fish, turtles, crayfish or other aquatic organisms from portions of the Salt and Gila rivers, including Painted Rocks Lake. Camping, boating, fishing, other recreational uses and public access have been prohibited since the Painted Rocks Lake State Park was closed in 1989. Management of the area has since then reverted back to the U.S. Army Corps of Engineers and the Bureau of Land Management through actions by the State Parks Board.

  A diagnostic study of Painted Rocks Lake by the Clean Lakes Program (Earth Technology Corp., 1993) had the following conclusions (see further discussion in the Middle Gila Watershed):

  - Painted Rocks Lake is eutrophic, receives toxic pollutant loading, and has uncontrolled water losses. Symptoms of these problems include: aquatic organisms contaminated with DDT metabolites, toxaphene, and mercury; massive fish kills, algal blooms, hydrogen sulfide odors, and lack of aquatic plants.
  - Historic agricultural activities and pesticide disposal in the watershed are the assumed source of pesticides.
  - The potential sources of mercury contamination include: natural geology, mining activities (historic use of mercury to leach precious metals), landfills, and treated sewage effluent.
  - Nutrients are contributed by a wide range of agricultural and urban activities in the watershed.
  - Pesticide contamination of sediments is at approximately the same level in 1991 as in 1985, indicating that loading of toxic pollutants from the watershed continues, and that pesticides are degrading at a very slow rate.
  - The disparity between high biota contaminant concentrations and low sediment concentrations indicates that bioaccumulation is important in concentrating toxicants in aquatic species.
  - Several restoration techniques were proposed for Painted Rocks Lake to mitigate the eutrophic conditions at the lake; however, these proposals were costly and would not resolve the ongoing pesticide loading from the watershed.

- A Citrus Tree Fertilization Project was funded by EPA/ADEQ in 1996 to demonstrate Best Management Practices for fertilization of young citrus trees. The data gathered on controlled release fertilizers will be transferred to commercial citrus producers and home owners through the Cooperative Extension education outreach programs.

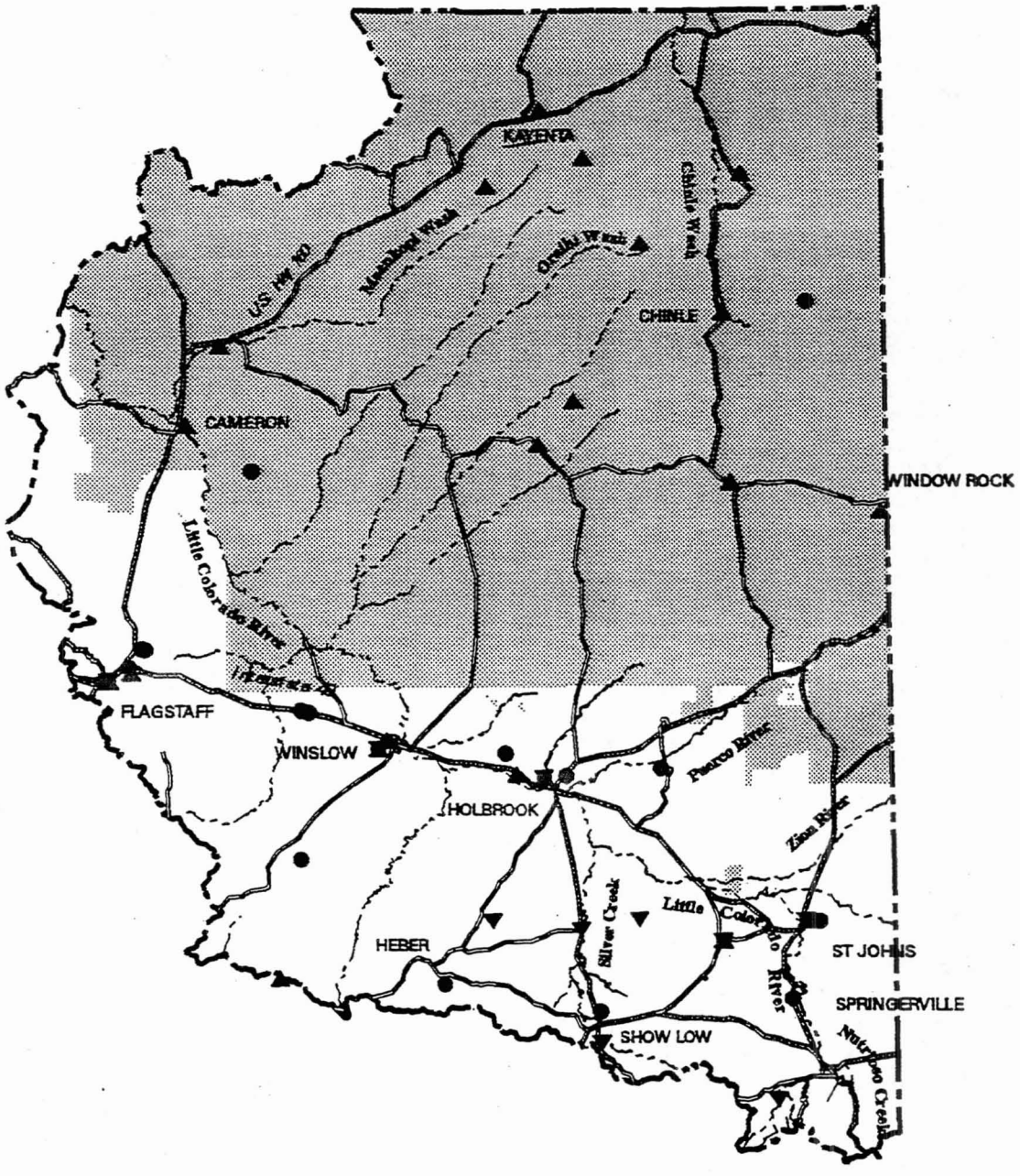
- A study of water quality trends using data collected from 1972 through 1987 was completed by USGS at two of their sites on the Gila River near its confluence with the Colorado River -- at Dome, Arizona and at the Colorado River confluence (Baldys et al. 1995). Flow at these sites is dominated by irrigation return flows. Findings at these two sites included:

- Median concentrations of dissolved solids were 2,000 and 2,270 mg/l, well above EPA criteria of 1000 mg/l for crop production.
- Sulfate, total ammonia plus organic nitrogen, and total lead concentrations were increasing. Some lead concentrations exceeded surface water standards.
- Total copper and manganese concentrations were decreasing.

- A study of the presence or absence of pesticides in soil, sediment, surface water and groundwater in the area around Fort Mohave Indian Reservation was initiated by ADEQ's Pesticide Protection Program after residents voiced their concern due to over spraying of pesticides by aerial applicators on the Reservation. Soil samples were collected from public and residential sites, whereas the groundwater samples were obtained from domestic and irrigation wells. Two samples of sediment and one surface water sample were collected at Topock Marsh, which receives surface water runoff from agricultural areas in Fort Mohave. Samples were analyzed for pesticides identified by local agricultural officials as used in the previous two growing seasons. The study did not detect pesticides in soil, sediment, surface water, or groundwater samples.

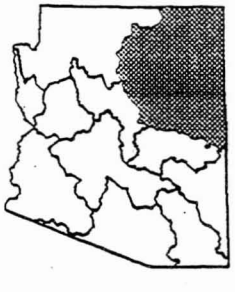
Characterization of the Little Colorado-San Juan Watershed

SIZE	26,794 square miles (24% of the State's land area).
POPULATION BASE	199,900 people (5% of the State's population). Major communities are shown on **Map 28**.
LAND OWNERSHIP	Tribal 58%; Private 16%; U.S. Forest Service 11%; State 8%; Bureau of Land Management 2%; National Parks and Monuments 1.5%; Other state and federal 3.5%
LAND USES AND PERMITS	• The Petrified National Monument and small portions of two national forests occur in this watershed, including four small designated wilderness areas. • Land use is primarily open grazing, forestry, recreation, and mining. • **Map 28** shows the location of facilities with wastewater discharge permits.
HYDROLOGIC PROVINCE(S)	Plateau Highlands Province
ECOREGIONS	Primarily Arizona-New Mexico Plateau, with western and southern edges in Arizona-New Mexico Mountains, and the northern fringe in Colorado Plateau.
GROUNDWATER BASINS	Little Colorado River Basin, with a portion of the Coconino Plateau Basin.
HYDROLOGY AND GEOLOGY	• Elevations range from 2,700 feet above sea level where the Little Colorado River flows out of the watershed to 12,600 feet at Humphrey's Peak. • Horizontally stratified sedimentary rocks have eroded to form canyons and plateaus. The San Francisco Mountains and White Mountains in the Mogollon Rim are igneous rocks deposited on sedimentary formations caused by recent volcanic activity. • This basin contains three stratified regional aquifers of poor water quality. The regional aquifers saturate the sedimentary formations of sandstones and limestones which are separated by shale and siltstone. Local aquifers are an important water source for domestic use and exist in alluvial deposits, sedimentary, and volcanic portions of the Bidahochi Formation, and various sandstones (ADWR 1994). • The flow on the Little Colorado River is interrupted (i.e., stretches of perennial, intermittent, and ephemeral flow) (Brown et al. 1978). • Above Lyman Lake on the Little Colorado River, flow varies from no flow to 16,000 cfs (in 1940), with an average annual mean of 23.5 cfs (USGS 1996).
UNIQUE WATERS	None
OTHER STATES, NATIONS, OR TRIBES	Utah, Colorado, and New Mexico. Navajo, Hopi, and Zuni Indian tribes within Arizona.



Map 28. Little Colorado-San Juan Watershed Water Protection Permits

- Indian Reservation
- NPDES
- APP & GWPP
- Reuse
- Watershed Boundary
- Stream
- Primary Highway
- Secondary Highway
- WS/GW Boundary



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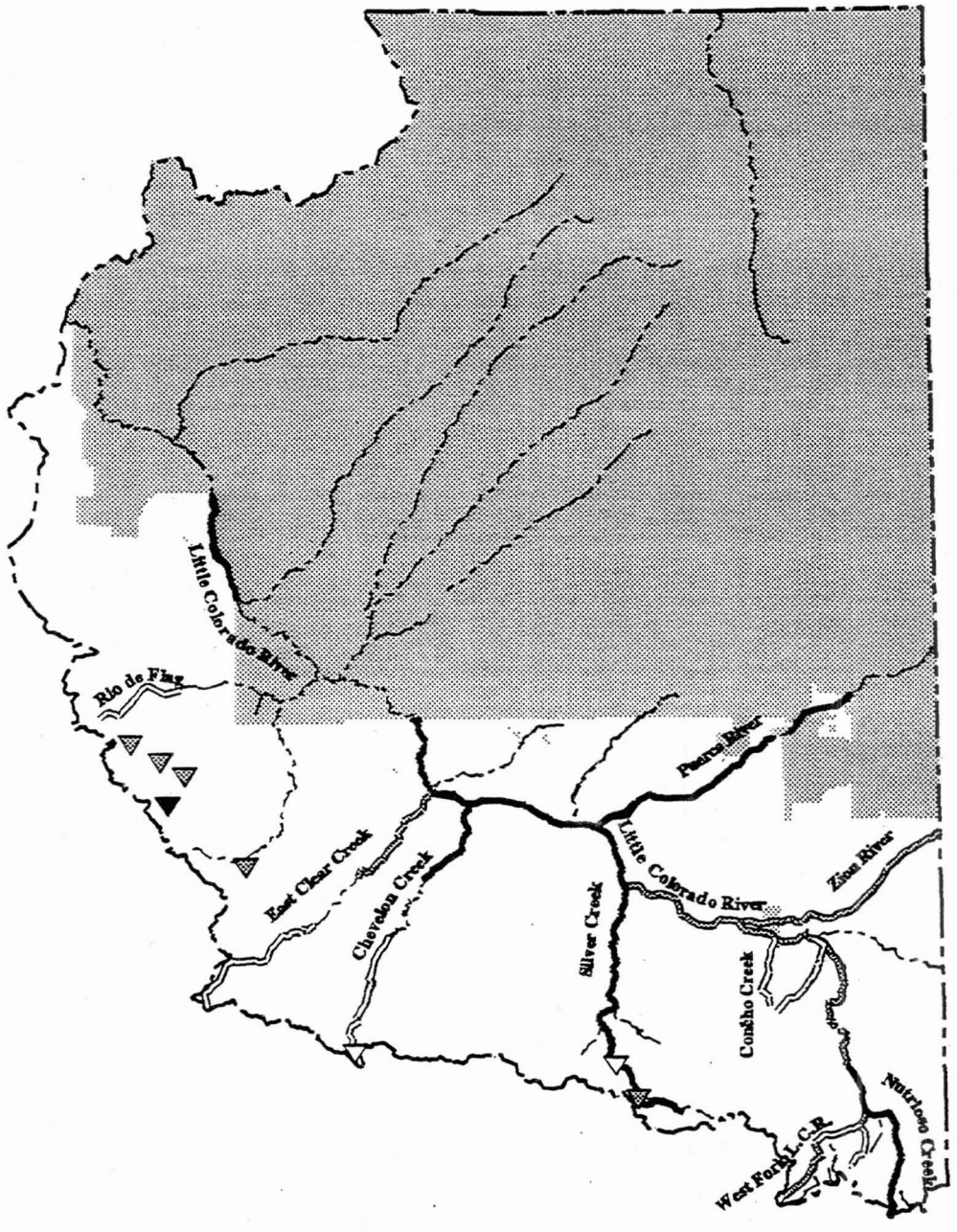
Surface Water Assessments--Water quality assessments and surface water monitoring sites are illustrated on **Map 29** and assessments are summarized below. (Note that no waterbodies were assessments in the San Juan Basin which is all on Native American lands.) Major stressors and probable sources are listed in rank order; minor stressors and sources are not shown. Individual waterbody assessments are provided in **Appendix F**. Additional information concerning stressors which cause impairment and associated sources was presented in Part IV of this chapter.

LITTLE COLORADO - SAN JUAN WATERSHED ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	77 reaches (12 monitored, 65 evaluated)	Full support - 210 miles Impaired - 560 miles	Turbidity, total dissolved solids, copper, radiochemicals, arsenic, beryllium, and lead.	Natural, rangeland practices, loss of riparian vegetation, and resource extraction.
LAKES	24 lakes (1 monitored, 23 evaluated)	Full support - 459 acres Impaired - 4,057 acres	Turbidity, high pH, noxious plants, iron, manganese, and low dissolved oxygen.	Natural and hydrologic modification.

Groundwater Assessments--Groundwater monitoring data collected in 1991-1995 are summarized by groundwater basins in **Table 18** and illustrated on **Map 30**. The following assessments were based on the limited groundwater quality data collected during this sampling period:

- Fluoride, a natural contaminant, exceeded Aquifer Water Quality Standards in the Little Colorado River Groundwater Basin.
- Metals also exceed standards, but no conclusions could be drawn as to whether this contamination is associated with mining activities or is naturally occurring.
- Manmade contaminants, such as volatile organic chemicals and pesticides, were not detected.
- Only one well was sampled for radiochemicals, and it exceeded Aquifer Water Quality Standards.

Investigations of potential groundwater contamination have lead to site remediation efforts through the state and federal Superfund Program (WQARF and CERCLA, respectively), the Underground Storage Tank Program, and the Resource Conservation and Recovery Act Program. Some groundwater is naturally contaminated with metals, halogens, and other inorganics. The status of these known contamination sites is provided in **Appendix G**, along with a map illustrating where these sites occur.



Map 29. Little Colorado-San Juan Watershed Surface Water Assessments

Indian Reservations

Fully Supported/ Threatened Lake

Partially Supported Lake

Not Supported Lake

Watershed Boundary

Streams

Fully Supported or Threatened

Partially Supported

Not Supported

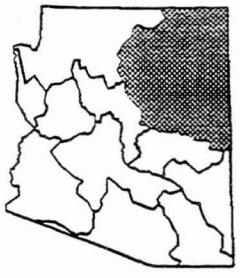


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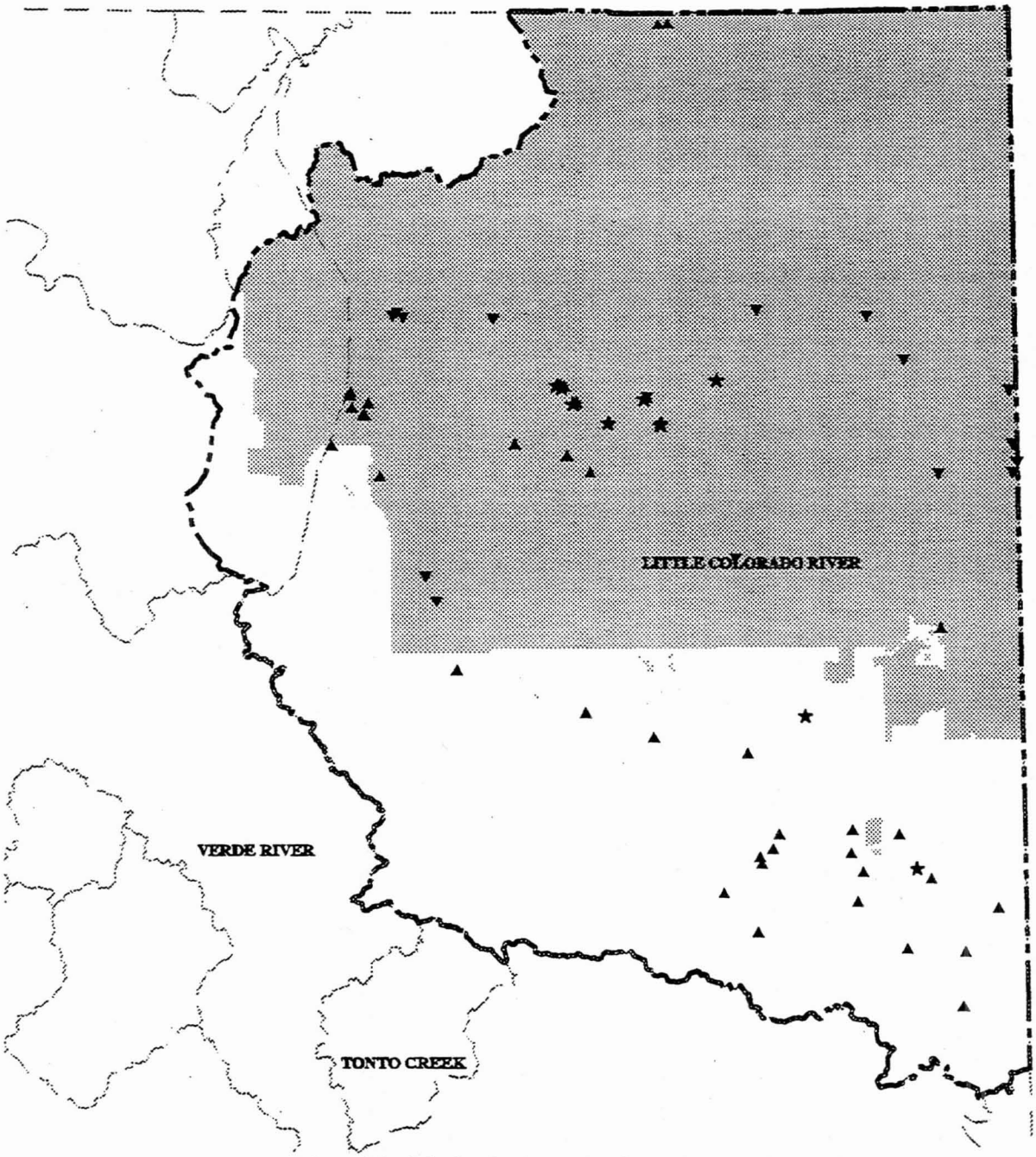
Table 18. Little Colorado-San Juan Watershed - Groundwater Monitoring Summary (1991-1995)

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS			
		SAMPLED		EXCEEDED STANDARD	
GROUNDWATER BASINS		Coconino Plateau*	Little Colorado	Coconino Plateau*	Little Colorado
WATER QUALITY INDEX WELLS	Nitrate	0	10	0	0
	Fluoride	2	22	0	2
	Metals	0	25	0	1
	Radiochemicals	0	1	0	1
	Volatile Organics	0	2	0	0
	Pesticides	0	2	0	0
OTHER GROUNDWATER MONITORING	Nitrate	0	180	0	0
	Fluoride	4	218	0	17
	Metals	0	312	0	7
	Radiochemicals	0	92	0	37
	Volatile Organics	0	10	0	0
	Pesticides	0	9	0	0

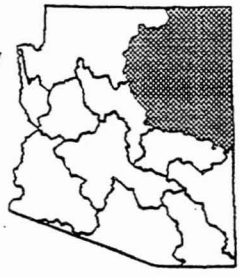
MONITORING DATA TYPE	PARAMETER GROUP	NUMBER OF WELLS PARAMETER DETECTED	
GROUNDWATER BASINS		Coconino Plateau	Little Colorado
WATER QUALITY INDEX WELLS	Volatile Organics	0	0
	Pesticides	0	0
OTHER GROUNDWATER MONITORING	Volatile Organics	0	0
	Pesticides	0	0

* Only the east edge of the Coconino Plateau Groundwater Basin is in this watershed, the major portion is in the Colorado-Grand Canyon Watershed.



Map 30. Little Colorado-San Juan Watershed
Wells Exceeding an Aquifer Water Quality Standard

Indian Reservation
Flouride
Radiation
Metal
Nitrate
Volatile Organic Compound
Pesticide
Watershed Boundary
Groundwater Basin
WS/GW Boundary



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Special Studies in the Little Colorado-San Juan Watershed--

- Two Uranium Mill Tailings Remedial Action Projects--at Monument Valley and Tuba City--are under the supervision of the U.S. Department of Energy and exist on tribal lands in this watershed (Jacobs Engineering Group Inc. and MK-Ferguson Co. 1995). The latest status report of these projects indicates the following:

  - Surface water remediation has been completed at both sites.
  - Surface water at Monument Valley has not been impacted by nitrates from the milling process. However, groundwater contamination exists, and a plume is moving approximately 100 feet per year to the northeast. To date, domestic wells are unaffected by groundwater contamination.
  - At Tuba City, chloride, sulfate, TDS and uranium were used as indicators of groundwater contamination from the processing activities and tailings piles. Groundwater contamination due to uranium processing continues to exist. Concentrations of molybdenum, selenium, and uranium exceeded maximum contaminant levels (for public drinking water systems); however, no risk to public health exists because this groundwater is not being used for drinking purposes.

  Previous monitoring indicated that nitrate levels were 275-1000 mg/l (measured as nitrate, with a standard of 45 mg/l). Nitrate levels were not mentioned in the current report.

- A preliminary Total Maximum Daily Load Analysis was completed on the Silver Creek watershed in 1993, which included Show Low Creek and Rainbow Lake. This TMDL was prepared by Limno-Tech (1993) as a case study for EPA and ADEQ to demonstrate the use of the TMDL in a watershed where there are no point source contributors (i.e., no NPDES permits). Water quality problems within the Silver Creek Watershed included: turbidity, erosion and sedimentation, hydrologic/habitat modification, eutrophication in impoundments, nutrient enrichment in the lower watershed, and high fecal coliform associated with specific activities. There were insufficient monitoring data and watershed characteristics (e.g., land use, topography, stream bank stability) available to support rigorous water quality modeling; therefore, a phased approach was selected. The conclusions and finding of this preliminary TMDL analysis were:

  - Model-estimated total suspended solids loads were 7,900,000 kg/year, while the objective was 1,000,000 (13% of existing). Control of erosion on open lands and stream banks must be increased for Silver Creek water quality objectives to be achieved.
  - Model-estimated nitrogen loads indicated that present nitrogen loads exceeded the water quality objectives. At Rainbow Lake the estimated load was 3,200 kg/year and the objective was 1,900, while at a site near the mouth of Silver Creek the estimated load was 15,000 kg/year and the objective was 11,000. Nutrients should also be reduced to the objective loads by implementing Best Management Practices to reduce suspended solids.
  - Subsequent TMDL development will require further data collection to verify or modify assumptions made in this model.

- ADEQ virus and parasite monitoring detected the presence of the parasites Giardia and Cryptosporidium in the Little Colorado River mainstem, its South Fork Tributary and the Silver Creek mainstem. These parasites are widespread in their distribution and occurrence and have been found in other Arizona watersheds to date. Human enteric viruses were detected once in the Little Colorado River, below its confluence with Nutrioso Creek, in the vicinity of the Springerville Wastewater Treatment Plant.

- The USGS has completed its investigation of residual radionuclide and trace element contamination of the Puerco River due to a tailings pond breach in New Mexico in July 1979. The findings and conclusions of this study were (Wirt 1994):

- Water containing little or no suspended sediment had low radioactivity and generally met water quality standards.
- Unfiltered samples containing large amounts of suspended sediment had high radioactive activity and large concentrations of heavy metals and dissolved solids. These samples did not meet Arizona surface water standards.
- The radioactivity in sediment varies only slightly among all monitoring sites, including control sites. Increased radioactivity was not associated with mining. Therefore, this minor variation in radioactivity is believed to be associated with differences in geology.
- Concentrations of uranium near the Arizona-New Mexico border tended to be greatest in water samples collected in the first few feet beneath the streambed. Further downstream, uranium concentrations were similar to natural concentrations, indicating little impact by mining releases.
- Water from a few shallow alluvial wells (less than 40 feet deep and 300-400 feet from the streambed) exceeded the proposed standard for uranium of 20 μg/l. However, the uranium probably did not migrate far from the streambed, and recent monitoring indicates that uranium concentrations appear to be declining in these shallow drinking water wells.
- Natural radioactivity exceeds standards in some alluvial and bedrock wells which were not affected by mining. For example, a well near Sanders had 15,000 picocuries per liter (pC/l) of radon (proposed standard is 300 pCi/l), and 280 μg/l of uranium (proposed standard is 20 μg/l).
- The levels of radioactivity found in sediment are not harmful for direct human contact and would not pose a health risk unless continually inhaled or ingested over a long period of time.
- The presence of radioactivity is a potential concern for residents who drink water from shallow private wells that are less than 400 feet from the river between Houck and Chambers, Arizona.
- Water from wells drilled into sedimentary rock near the Puerco River alluvial aquifer could potentially contain natural, although hazardous, levels of radioactivity.

- The USFWS investigated the level of metals and radiochemicals in the tissues of aquatic invertebrates, fish, and birds collected from several locations along the Puerco and Little Colorado rivers (Andrews et al. 1995). Findings and conclusions from this study were:

  - Aluminum, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc concentrations were elevated in the fish tissue.
  - Aluminum, cadmium, and mercury were detected in one or more fish tissue samples at concentrations that could cause secondary poisoning of avian predators that consume a large portion of fish in their diet.
  - One fathead minnow sample contained copper at four times the highest copper concentration detected during the National Contaminant Biomonitoring Program survey of fish across the United States.
  - Arsenic and lead were detected in fish at levels which could possibly limit their reproduction.
  - The radiochemical fish tissue data could not be interpreted because there was a lack of background data for comparison.

- A uranium mining study by the USGS was conducted to identify potential impacts on groundwater by uranium mine pit water, shallow groundwater near the mine pits, and mine-spoil materials (Longsworth 1994).

- A diagnostic feasibility study of management options to improve water quality in Rainbow Lake was completed by ADEQ's Clean Lakes Program in 1995 (ADEQ 1996d). Details and findings of this study are summarized in the Clean Lakes report in the next chapter of this report.

- The City of Flagstaff and USGS are investigating the occurrence and movement of groundwater in the regional aquifer. Historical and recently collected water quality, isotope, and geophysical data are being used to determine the evolution of water and to identify zones of greatest flow within the aquifer.

- Impacts of industrial aquifer withdrawals on domestic and municipal supplies in the Black Mesa area are being studied by USGS in cooperation with the Bureau of Indian Affairs and ADWR. Data collection and analysis are to determine if industrial pumping is inducing irreversible changes on the availability or quality of water in an aquifer. Ongoing data collection activities include continuous and periodic measurement of groundwater and surface water at more than 100 sites. Groundwater data include annual pumpage, water levels, and water chemistry. Surface water data include stream flow, spring discharge and water chemistry. A series of summary data reports, published by USGS, includes some data interpretation, trends analysis, and groundwater modeling (latest report by Littin and Monroe 1995)

- A study in which geochemical techniques were used as a means of detecting leakage between two aquifers in the Black Mesa area was recently completed by USGS, in cooperation with the Bureau of Indian Affairs and the Navajo Nation (report being finalized). Increased pumpage has raised concerns about the possibility of leakage between the aquifers. Water quality in one aquifer (D) is considered poor because of high concentrations of dissolved solids. The findings and conclusions of this study were:

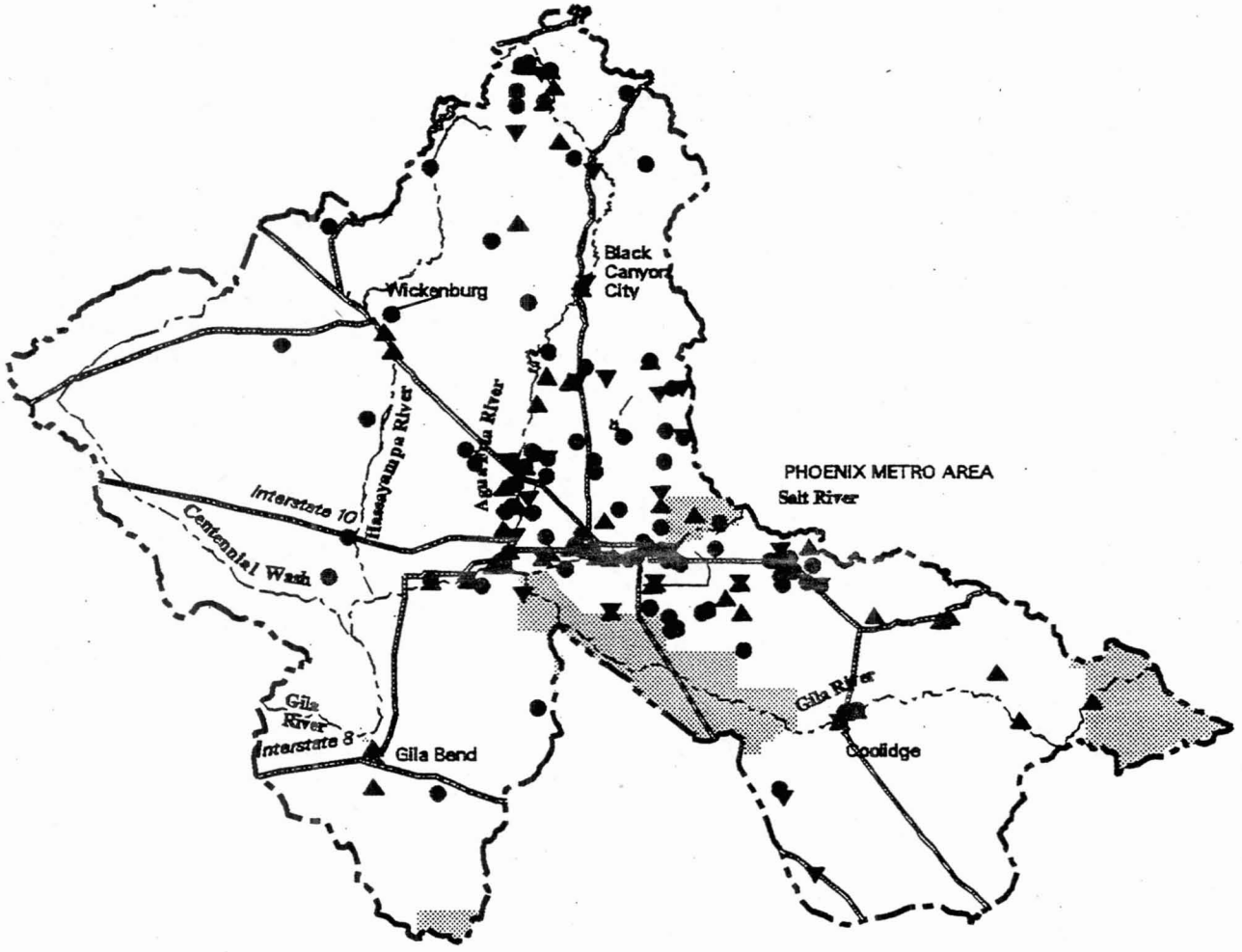
  - Concentrations of dissolved fluoride, chloride, boron, and dissolved gases, ratios of dissolved ions, and tritium, carbon-13, and chloride-36 data indicated that the overlying D aquifer may be leaking into the N aquifer in the southeastern part of Black Mesa.
  - The boundary between the leaking and nonleaking areas is estimated by a line from Rough Rock to Second Mesa that separates groundwater having significantly different chemistries.
  - The amount of water from the D aquifer leaking into the N aquifer is unknown.

- A Fort Valley groundwater study was conducted by ADEQ to determine potential impacts from septic system leaching fields. Located five miles northwest of Flagstaff, Fort Valley is an unincorporated community underlain by shallow perched aquifers variable in size and scattered in distribution. Private domestic wells provide Fort Valley's water supply, while septic systems handle sewage disposal. Over a three-year period, 23 groundwater samples were collected in the Fort Valley area. The findings and conclusions to this study were:

  - The majority of the groundwater samples met Aquifer Water Quality Standards and primary or secondary maximum contamination levels for drinking water, especially those samples collected from deeper portions of several perched aquifers where most domestic wells draw water.
  - Some shallow wells exhibited elevated levels of septage indicator inorganic constituents such as nitrate, chloride, and total dissolved solids, especially during wet springtime conditions.
  - Septic systems do affect groundwater quality in the Fort Valley area, as indicated by comparing the concentration of septage indicator parameters in samples collected at an up gradient control site to samples in the study area.
  - Groundwater depth proved to be related to groundwater quality. Concentrations of many groundwater quality parameters decreased at a high rate as groundwater depth increased up to a "threshold depth." Typically this threshold was around 15 feet below land surface. Below this depth a much lower rate of change in concentrations of groundwater quality parameters occurred.
  - Caution should be exercised in operating existing septic systems and in selecting appropriate locations and types of new wastewater disposal systems for future development in Fort Valley. When groundwater levels rise (i.e., precipitation events), septic tanks should be pumped. Leaching systems should be installed only where groundwater levels remain more than 15 feet below land surface.

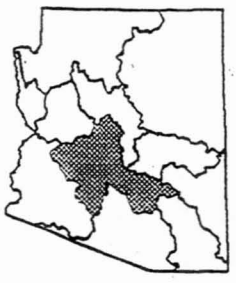
Characterization of the Middle Gila Watershed

SIZE	12,249 square miles (11% of the State's land area).
POPULATION BASE	2,202,745 people (60% of the State's population). Major communities are shown on **Map 31**.
LAND OWNERSHIP	Private 27% Tribal 6% Bureau of Land Management 26% Military 3.5% US Forest Service 10% Other state and federal 4.5%
LAND USES AND PERMITS	• The historical land use in the Middle Gila Basin was agricultural; however, in the Phoenix metropolitan area agriculture has been displaced by 30 years of rapid population growth. • **Map 31** shows the location of facilities with wastewater discharge permits.
HYDROLOGIC PROVINCE(S)	Primarily the Basin and Range Province, with only a relatively small portion extending into the Central Highlands Province.
ECOREGIONS	Primarily Southern Basin and Range, with the northeastern edge in the Arizona-New Mexico Mountains.
GROUNDWATER BASINS	Agua Fria, Donnelly Wash, Dripping Springs, Gila Bend, Harquahala Valley, McMullen Valley, Phoenix Active Management Area (AMA), Tiger Wash, and Upper Hassayampa basins, along with portions of the Bill Williams and Lower San Pedro basins, Prescott AMA, and Pinal AMA.
HYDROLOGY AND GEOLOGY	• Surface water diversions and groundwater pumping for agricultural and urban uses have left streambeds in the Phoenix area dry. The basin receives limited rainfall; therefore, surface water flow in this basin is primarily attributable to occasional releases from upstream impoundments, effluent from wastewater treatment plants, and agricultural return flows (Brown et al. 1978). • Gently-sloping alluvial plains are separated by mountain ranges that trend to the north and northwest. The main water-bearing unit is the basin-fill deposits which are found in valleys between the mountains. These deposits of gravel, sand, silt, and clay may yield several hundred gallons per minute to wells. In the mountains, small yields of groundwater are obtained from thin alluvial deposits and/or fractured bedrock. (ADWR 1994) • Several distinct surface water sub-basins can be identified in this watershed: Gila River, lower Salt River, Agua Fria River, and Hassayampa River. • The flow in the Gila River above Gillespie Dam varies from less than 5 cfs (in 1966) to an estimated 130,000 cfs (in 1993) during a major flood event (USGS 1996).
UNIQUE WATERS	None
OTHER STATES, NATIONS, OR TRIBES	Salt River, Fort McDowell, Gila Bend, and Gila River Indian communities.



Map 31. Middle Gila Watershed Water Protection Permits

Indian Reservation
NPDES
APP & GWPP
Reuse
Watershed Boundary
Stream
Primary Highway
Secondary Highway
WS/GW Boundary



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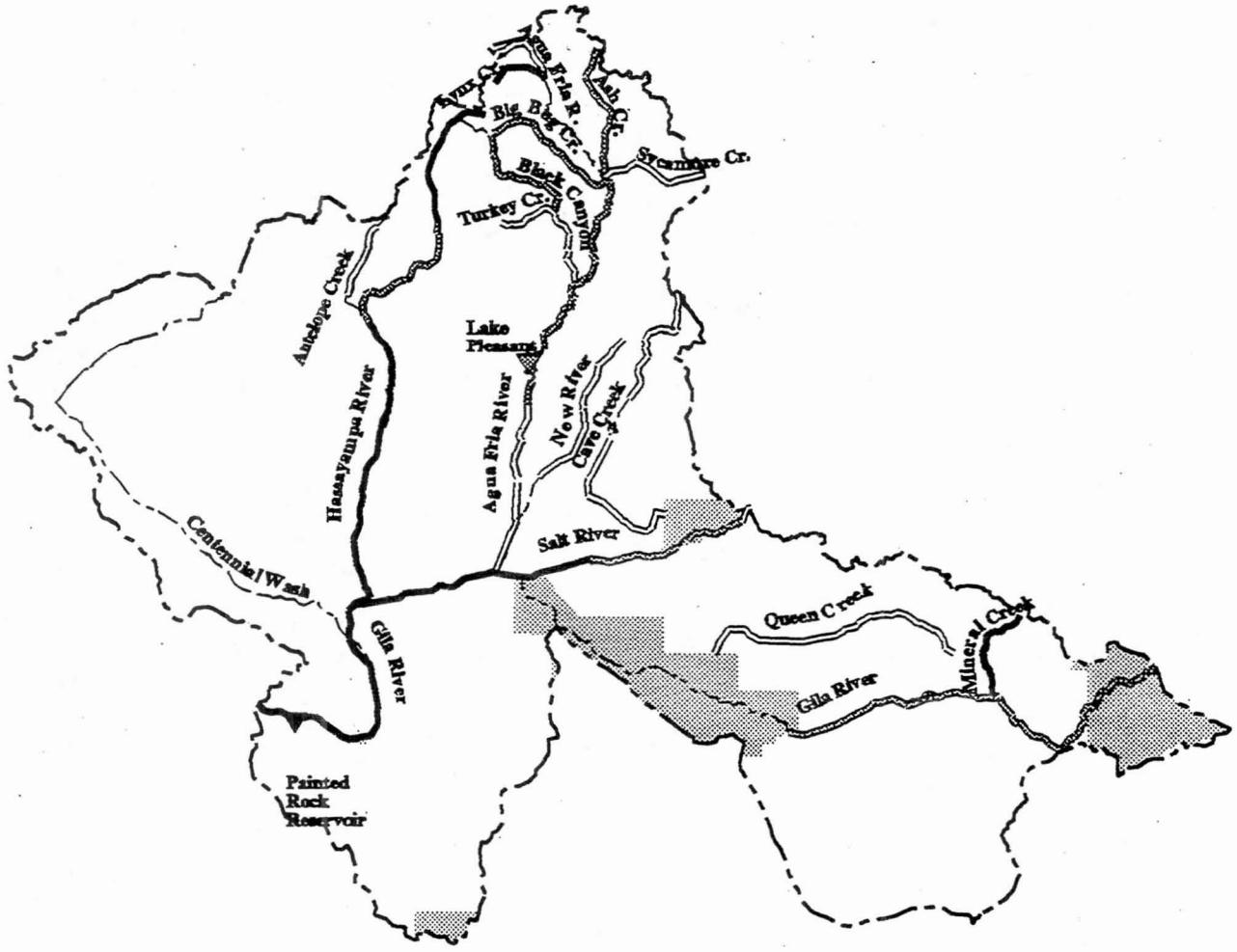
Surface Water Assessments--Water quality assessments and surface water monitoring sites are illustrated on **Map 32** and assessments are summarized below. Major stressors and probable sources are listed in rank order; minor stressors and sources are not shown. Individual waterbody assessments are provided in **Appendix F**. Additional information concerning stressors which cause impairment and associated sources was presented in Part IV of this chapter.

MIDDLE GILA WATERSHED ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	75 reaches (21 monitored, 54 evaluated)	Full support - 477 miles Impaired - 574 miles	Turbidity, arsenic, total dissolved solids, mercury, fecal coliform pesticides, and copper.	Natural, rangeland practices, loss of riparian vegetation, and resource extraction.
LAKES	9 lakes (1 monitored, 8 evaluated)	Full support - 57 acres Impaired - 1,797 acres	Mercury, arsenic, pesticides, turbidity, high pH.	Natural, rangeland practices, resource extraction, historic pesticide use.

Groundwater Assessments--Current groundwater monitoring data (1991-1995) are summarized by groundwater basins in **Table 19** and illustrated on **Map 33**. The limited amount of data collected suggests the following assessment:

- Fluoride, a natural contaminant, exceeds Aquifer Water Quality Standards and primary drinking water maximum contaminant levels in several groundwater basins.
- Human-caused contaminants (nitrate, volatile organic chemicals, and pesticides) exceed Aquifer Water Quality Standards and primary drinking water maximum contaminant levels at some wells in the Phoenix Active Management Area, but were generally not a problem outside of this area.
- Metals exceed standards in several groundwater basins. The contamination may be natural or created by mining and other activities.
- Nitrate levels frequently exceeded Aquifer Water Quality Standards in the Phoenix Active Management Area. Exceedances are frequently related to wastewater leaching facilities.
- Older groundwater quality monitoring data, collected between 1975-1990 by state and federal agencies, show that the median concentrations of selected indicators of potability (e.g., hardness, nitrate, TDS, and sulfate) are generally less than drinking water secondary maximum contaminant levels (SMCLs). An exception is that TDS levels in the Phoenix Active Management Area exceed the SMCL of 500 mg/l. This suggests regional groundwater quality conditions are very good.

Investigations of potential groundwater contamination have lead to site remediation efforts through the state and federal Superfund Program (WQARF and CERCLA, respectively), the Underground Storage Tank Program, and the Resource Conservation and Recovery Act Program. Some groundwater is naturally contaminated with metals, halogens, and other inorganics. The status of these known contamination sites is provided in **Appendix G**, along with a map illustrating where these sites occur.



Map 32. Middle Gila Watershed Surface Water Assessments

- Indian Reservations
- Fully Supported/ Threatened Lake
- Partially Supported Lake
- Not Supported Lake
- Watershed Boundary
- Streams
- Fully Supported or Threatened
- Partially Supported
- Not Supported

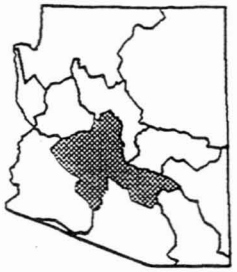


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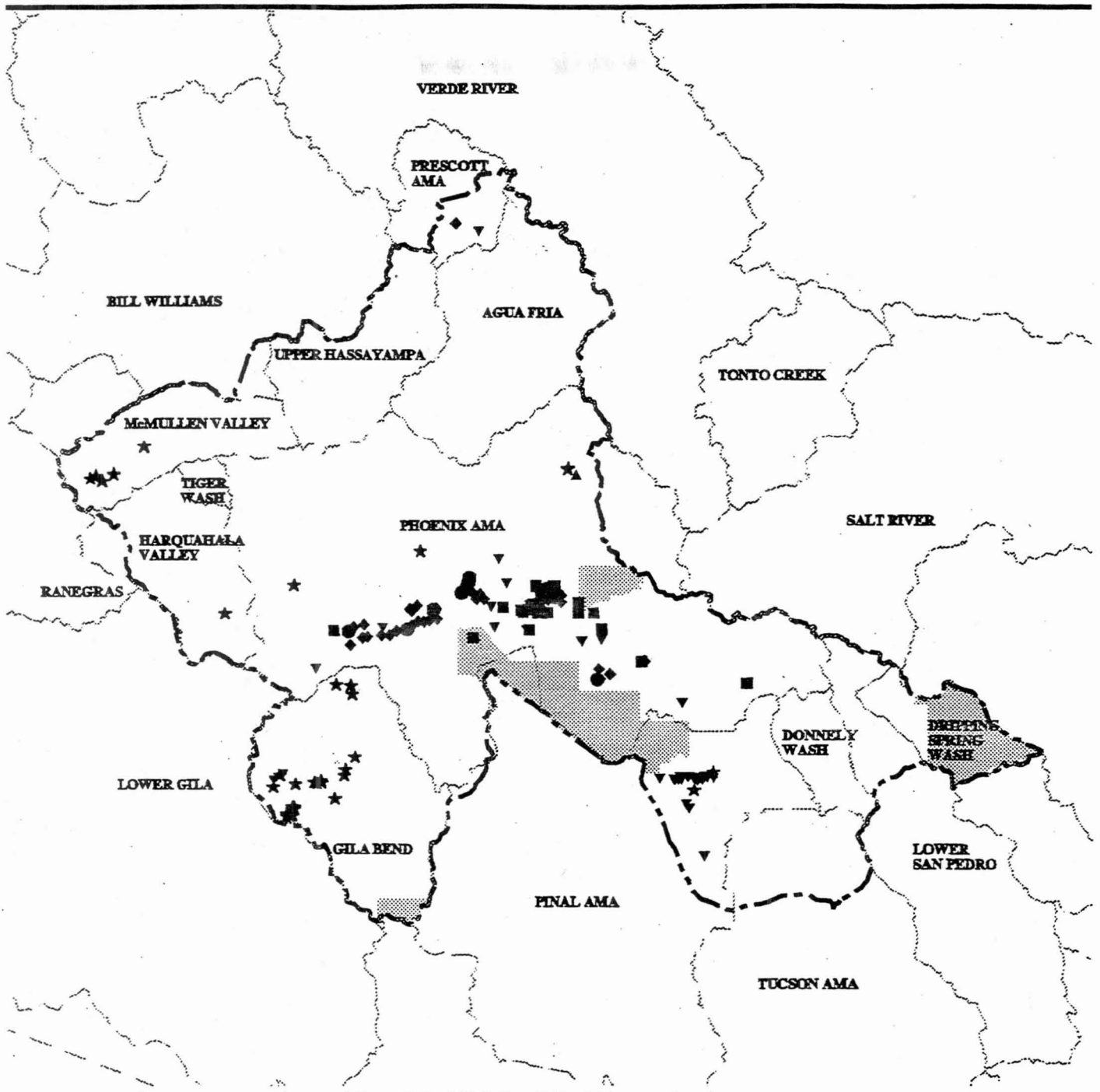
Table 19. Middle Gila Watershed - Groundwater Monitoring Summary (1991-1995)

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS																			
		SAMPLED										EXCEEDED STANDARD									
GROUNDWATER BASINS		AF	GB	HR	LS	MV	PHX	PI	PR	TI	UH	AF	GB	HR	LS	MV	PH	PI	PR	TI	UH
WATER QUALITY INDEX WELLS	Nitrate	4	2	3	0	4	14	2	7	1	2	0	0	0	0	0	0	0	1	0	0
	Fluoride	1	2	1	0	5	30	20	0	0	0	1	1	0	0	0	7	4	0	0	0
	Metals	0	2	0	0	6	9	2	3	0	0	0	1	0	0	0	1	1	0	0	0
	Radiochemicals	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	Volatile Organics	1	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
	Pesticides	1	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Nitrate	1	23	0	0	24	57	2	3	0	3	0	0	0	0	0	31	0	0	0	0
	Fluoride	0	6	7	1	1	104	53	3	0	0	0	1	0	0	0	5	16	1	0	0
	Metals	9	41	4	1	28	132	2	26	0	12	0	22	1	0	5	3	1	0	0	0
	Radiochemicals	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Volatile Organics	1	0	0	0	10	192	46	1	0	0	0	0	0	0	0	43	0	0	0	0
	Pesticides	2	0	0	0	14	142	46	1	0	0	0	0	0	0	0	7	0	0	0	0

MONITORING DATA TYPE	PARAMETER GROUP	NUMBER OF WELLS									
		PARAMETER DETECTED									
GROUNDWATER BASINS		AF	GB	HR	LS	MV	PHX	PI	PR	TI	UH
WATER QUALITY INDEX WELLS	Volatile Organics	0	0	0	0	0	0	0	0	0	0
	Pesticides	0	0	0	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Volatile Organics	0	0	0	0	0	77	0	0	0	0
	Pesticides	0	0	0	0	0	9	0	0	0	0

Groundwater Basins: AF = Agua Fria; GB = Gila Bend; HR = Harquahala Valley; LS = Lower San Pedro; MV = McMullen Valley; PHX = Phoenix Active Managaement Area; PI = Pinal AMA (north-eastern portion); PR = Prescott AMA (south-eastern half); TI = Tiger Wash; TU = Tuscon AMA UH = Upper Hassayampa.
Only minor portions of the Bill Williams, Tucson AMA, Prescott AMA, Pinal AMA, and Lower San Pedro Basin are included in this watershed.
No samples were collected in: Bill Williams, Donnelly Wash, Dripping Springs, and Tucson AMA (not shown).



Map 33. Middle Gila Watershed
Wells Exceeding an Aquifer Water Quality Standard

Indian Reservation
Flouride
Radiation
Metal
Nitrate
Volatile Organic Compound
Pesticide
Watershed Boundary
Groundwater Basin
WS/GW Boundary

SCALE
MILES 10 0 10 20 30 40
KILOMETERS 10 0 10 20 30 40 50

N W E S

Special Studies in the Middle Gila Watershed--

- ADEQ investigated the impact of the Arizona Welding fire in Phoenix to surface water and groundwater in 1995. The findings and recommendations of this investigation were:

  - Runoff from efforts to fight the fire, as measured at manholes on 40th and 43rd avenues, contained evidence of the fire as three volatile organic compounds and three semi-volatile compounds were detected in amounts exceeding the Health-based Guidance Levels. However, this water evaporated in the stormwater system before discharge into the Salt River.
  - Water contaminated by petroleum hydrocarbons, volatile organics, semi-volatile organics and metals accumulated in a ditch that drained a storage yard on railroad property. Soil cleanup was recommended in this area.
  - On neighboring residential property, very low levels of metals and total petroleum hydrocarbons were detected; however, one polycyclicaromatic compound was found near the Health-based Guidance Level (benzo(K) fluoranthene at 0.1 ppm, HBGL = 0.11 ppm).

- The effects of ASARCO - Hayden facility's accidental release of 200,000 cubic yards of tailings during the floods of 1993 was investigated in 1993 and 1994 by ADEQ. Concentrations of copper, soluble solids, and sulfate in 17 downstream samples were compared with concentrations in the tailings and at upstream control sites. The findings and conclusions of this investigation were:

  - Tailings were found in every sample; however, they were not concentrated enough to be visually recognized, nor did the concentrations exceed Health-based Guidance Levels. It was determined that recovery was not necessary because of the thorough dispersal of the tailings.
  - The release of tailings from the impoundments, even during flood conditions, violates State statutes. ASARCO has already enlarged and improved the containment dikes in Hayden to prevent this from recurring.

- The Gibson Mine discharges to Mineral Creek at five mine adits: Pasquale Adit, the *In situ* Adit (a discharge point for in situ leaching in 1988-1990), and three adits known as the 600 level adits. Most of the perennial flow to the creek emanates from the Pasquale Adit at 20-26 gallons per minute. ADEQ reviewed the monitoring data collected in 1990-1994 at these adits and concluded the following:

  - The water quality from the *In Situ* Adit is improving, with fewer acidic pH readings and lower copper levels since the leaching operation was discontinued in 1990; however, copper remains many times higher than allowed by water quality standards.
  - No improvement has been noted at the other adits.
  - Remedial actions are necessary at this site for Mineral Creek to meet surface water standards.

- Copper has been mined on a large scale from the ASARCO Ray Mine on Mineral Creek since the early twentieth century. ASARCO conducts open pit mining, flotation concentrating, leaching, and solvent extraction/electrowinning on the site. Mineral Creek flows through the mine in a tunnel which protects it from most of the mining activities. However, from the tunnel outlet to the downstream end of the property, Mineral Creek is subject to chronic subsurface seepage from various leaching and electrowinning facilities, along with occasional overflows during heavy rain storms. Investigations were conducted by ADEQ and EPA in 1990-93 and by the company in 1990 to the present. Numerous violations of water quality standards for copper and beryllium have been documented. Engineering remedies have already been put in place to stem the subsurface seepage of groundwater. Surface water and groundwater concerns will be further addressed during the process of developing an Aquifer Protection Permit for this facility.

- The McCleur Tailings are located in the Prescott National Forest near an unnamed wash draining the Cash Mine. These tailings originated from tunneling work at the Senator and Cash mines. Four investigations in the past five years have involved the McCleur Tailings. The findings and conclusions from these studies included:

  - The tailings contribute substantial loadings of toxic metals into the Hassayampa River when the river has surface flow (four to six months of the year).
  - Livestock should be prevented from drinking any water in the spoils pile, temporary pools of water, or in washes that drain to the river.
  - The site is small enough (approximately 50,000 cubic yards) that the tailings could be moved to a lined impoundment and covered.
  - Remediation is necessary at this site to mitigate further surface water contamination.

- The Painted Rocks Area studies by USFWS, ADEQ, and AGFD resulted in a human health risk report (ADHS 1991) and a fish consumption advisory to not eat fish, turtles, crayfish or other aquatic organisms from portions of the Salt, Gila, and Hassayampa rivers, including Painted Rock Reservoir and Painted Rocks Lake. (Note that Painted Rocks Lake is below the dam in the Lower Gila Surface Water Basin.)

  Sediment borings from the Gila River were tested for organochlorine pesticides and heavy metals as part of a Painted Rocks Lake diagnostic/feasibility study by the Clean Lakes Program (Earth Technology Corporation 1993). Results indicted that continued loading of DDT metabolites, toxaphene, and mercury can be expected from the watershed although the use of DDT and toxaphene has been banned for many years in Arizona. A disparity between high biota contaminant concentrations and low sediment concentrations suggests that the food web acts as a filtering mechanism for the removal and concentration of toxic lipidophilic contaminants (DDT metabolites, toxaphene, and mercury). Extensive agricultural area in the watershed is the assumed source for the DDT metabolites and toxaphene, while the potential sources of mercury contamination include the watershed's natural geology, mining activities (historic use of mercury to leach precious metals), landfills, and treated sewage effluent.

  Two projects provided information concerning the existing level of contamination by organochlorine pesticides in agricultural fields in the Painted Rocks Study Area.

  1) Samples were collected along the edge of cultivated fields (i.e., areas of over spray rather than direct application) (SCS Engineers 1991). Soil samples collected at approximately 6 inches below ground surface indicated extensive residual pesticide contamination in these areas.
  2) Soil samples were collected at two depths in fields which had been fallow for at least five years, and sediment samples were collected in drainage areas associated with these fields. DDT metabolites and toxaphene were detected (Brown 1993).

- A pesticide residue study was conducted in the Maryvale area of Phoenix (ADEQ 1992b). This study was initiated because of a childhood leukemia cluster in the Maryvale area of Phoenix, an area that had been previously used for agriculture crop production. Soil samples were collected from 10 sites (residential areas, parks, schools, and agricultural sites) in 1989-1990. Findings and conclusions of this study included:

  - DDT metabolites, toxaphene, heptachlor, and aldrin were detected at levels higher than the Health-based Guidance Level established by ADHS for human ingestion of soil.
  - Ziram, a fungicide and seed treatment, was also detected but no guidance level has been established.
  - Toxaphene was the only pesticide detected over the guidance level at an athletic field or public

area, the other exceedances were confined to samples collected around structural foundations. These results suggest that these pesticide residues resulted from application to the foundations for structural pest control rather than from agricultural activity.

- This study did not answer questions about any health risk these pesticide residuals may pose to the population.

- During the winter floods of 1992 and 1993, the Salt River inundated a portion of the Tri-City Landfill on the Salt River Indian Reservation. The landfill served several cities and institutions in the Phoenix metropolitan area. Although only a minor portion of the landfill was carried away, thousands of tons of debris were swept into the floodwater, to be deposited along the Salt and Gila rivers shorelines for more than 100 miles. EPA and the Army Corps of Engineers have been working with the tribal government to mitigate this problem (the State lacks jurisdiction). A portion of the landfill has been moved out of the floodplain, and the remaining section must be protected from future floods and natural shifts in the river channel.

- The Prescott Mining Project was an interagency study to assess impacts from abandoned and inactive mines on surface water and groundwater quality within a sub-watershed, and to develop a Compendium of Management Practices for controlling pollution from abandoned and inactive mines. ADEQ and the U.S. Bureau of Mines conducted the study within the lower Turkey Creek watershed for the Prescott National Forest. A total of 25 surface water and groundwater sites were sampled three times between the spring of 1994 and the spring of 1995. In addition, abandoned mines were surveyed and soil samples were collected from the largest mine waste sites within the watershed. The results of this study will be available in the later part of 1996. A Compendium of Management Practices for controlling pollution from abandoned and inactive mines has been prepared by the Arizona Geological Survey, and is being distributed to land management agencies by ADEQ and the Arizona Geological Survey.

- A study of urban stormwater in Maricopa County by the USGS and the Flood Control District of Maricopa County is ongoing to determine which factors contribute to the variability in stormwater chemistry and toxicity in drainage areas with various land uses. An additional objective is to determine if urban runoff is impairing Salt River water quality. A statistical summary of water quality characteristics and estimates of constituent loads were presented in Lopes et al. 1995. A second publication (Fossum and Davis 1996) will present data from the first four years of the study. The findings and conclusions of the Lopes et al. (1995) study were:

  - Urban stormwater chemistry was correlated to the percentage of impervious area in a drainage area.
  - Urban stormwater had large concentrations of chemical oxygen demand, biological oxygen demand, oil and grease, and high counts of fecal coliform.
  - Pesticides and other organic chemicals were seldom detected in urban stormwater and never detected in streamflow or stormwater from undeveloped areas.
  - DDT metabolites were the most commonly detected pesticide and may be residual from historic application.
  - Localized areas in the cities of Chandler, Mesa, Paradise Valley and Peoria seem to contribute a large proportion of the constituent loads. These areas typically had more than 40% impervious area and are associated with industrial, commercial, and high-density residential land use.

- Surficial sediments in stormwater detention basins in the Phoenix metropolitan area were sampled by the USGS and the Flood Control District of Maricopa County. Over a two-year period, 24 basins, draining areas of commercial, industrial, and residential land uses were sampled and analyzed to determine chemical characteristics and toxicity (Ingersoll et al 1995). Findings and conclusions of this study were:

- Although concentrations of various metals were above background levels (i.e., for cadmium, copper, lead, and zinc), values were still below EPA guidelines for soil remediation. Arsenic concentrations were above EPA guidelines. The relatively high concentrations are the result of regional geological factors, rather than human induced.
- Organochlorine compounds (i.e., chlordane, DDE, dieldrin, PCP, and toxaphene) were found in almost all of the basins sampled. Concentrations were low, except that a few sites had organochlorine concentrations well above median values, and one site showed polychlorinated biphenyls well above EPA guidelines for remediation.

- In 1992, the Maricopa County Flood Control District and Arizona State University collaborated on a demonstration artificial wetland for treatment of runoff from a vehicle maintenance area (Wass and Fox 1993). The treatment cell was separated so that one side was planted with cattail and the second side served as a non-vegetated control. Monitoring was conducted to assess the efficiency of oil and grease removal, and to confirm the presence of hydrocarbon degrading microorganisms. After eleven months of operation, the findings and conclusions were:

  - The system is efficiently removing oil and grease from the runoff. The non-vegetated control site removed 15%, while the vegetated site removed 87% of the oil and grease.
  - The vegetation appears to facilitate the removal of hydrocarbons by absorption followed by biodegradation.
  - The existence of microbial populations even after extended periods of drought indicate that sorbed hydrocarbons support microbial growth during extended periods without stormwater input.
  - Non-vegetated treatment systems, using a graded biological filter, would not be well suited for use in arid Southwest conditions.

- The USDA is coordinating two projects: one in the West Maricopa Hydrologic Unit Area; the other in the Casa Grande-Coolidge area. The purpose of these projects is to evaluate the impact of agricultural practices on groundwater quality and to assist local agricultural clientele with implementation of Best Management Practices to minimize the potential for groundwater degradation. These projects are a cooperative effort between the Natural Resources Conservation Service (NRCS), Consolidated Farm Services, Cooperative Extension Service, Arizona Department of Water Resources, Natural Resource Conservation Districts, and local producers.

- In the Queen Creek and Eloy areas (New Magma and Central Arizona Irrigation and Drainage Districts), the National Resources Conservation Service is providing accelerated technical and financial assistance to improve on-farm chemical handling facilities and irrigation systems which reduce deep percolation and runoff. The NRCS is cooperating on this project with Natural Resource Conservation Districts, local Irrigation and Drainage Districts, and ADWR in implementing land treatment projects to address water quality and quantity concerns. A similar land treatment project is in the planning stage for the Hohokam Irrigation District.

- Lake Pleasant fish have been monitored by the USFWS (King et al 1991) and ADEQ's Priority Pollutant Program (in 1992 and 1994). Mercury and selenium were elevated in the fish above screening levels in both studies, and copper and zinc were also elevated in the ADEQ study. ADEQ is coordinating with the Arizona Department of Game and Fish to determine the extent of contamination and risks posed.

- The Cave Creek Stormwater Recharge Demonstration Project was to develop stormwater recharge basins in the Cave Creek watershed for the purpose of enhancing groundwater supplies and decreasing concentrations of arsenic. Water quality data were collected and the source of arsenic was determined to be the geologic formation rather than area mines or urban impact. The project verified the feasibility of

aquifer recharge with stormwater runoff as a best management practice to mitigate arsenic concentrations and provide aquifer storage on a short term basis.

Designs for runoff detention and percolation enhancement facilities have been developed for several different washes in the Cave Creek area. One detention/recharge basin has been constructed at a road crossing of a wash. Both the elevated levels of arsenic in groundwater and the stormwater recharge projects have been discussed at numerous public forums.

- Sediment samples were collected by ADEQ's Pesticide Prevention Program on washes in and near the TerraVita Development in Cave Creek, Arizona, to determine possible impacts caused by golf courses. Three sampling sites were established along two arroyos down gradient from this Del Webb development, where surface water runoff from Terravita Golf Course should have accumulated. Findings of this study included:

  - Oryzalin, a selective pre-emergent herbicide, was detected in three sediment samples collected after an intense rainfall. No Oryazlin was detected in the sample from the control site.
  - Resample results indicated that the herbicide did degrade below the laboratory detection level in two out of three samples and to 5.6 mg/kg from 58 mg/kg within six months. This result was consistent with environmental degradation data provided by the manufacturer for Oryzalin.

- ADEQ coordinates with ADWR in the permit process for artificial recharge and underground storage and recovery projects. In the Middle Gila these projects include:

  - The City of Mesa Spook Hill Park groundwater recharge project. This project is to utilize Central Arizona Project (CAP) water for a recreational lake, and recharge excess water through drywells into the aquifer.
  - The City of Avondale is developing a project to treat and recharge CAP water for drinking water use. The city intends to develop a constructed wetland to provide cost-effective treatment of CAP water which contains a considerable amount of agricultural tailwater.

- An on-farm compost demonstration project at the Sunfresh Farms Education Center was funded in 1995 to demonstrate how urban organic wastes (trimmings) can be composted with livestock manure and crop residues to provide a useful product and reduce loads to landfills. This project is funded by EPA/ADEQ and is being implemented by the Agua Fria-New River Natural Resource Conservation District.

- The Salt River Project publishes an annual report of water quality monitoring results from numerous surface water sites and wells. The last published report was for data collected in 1994 (SRP 1995).

- Fish, lizards, and sediment samples were collected by the USFWS in 1991-1992 to determine the level of metals, metalloids, and organochlorides (King and Baker 1995). Samples were collected at 11 sites on the Gila River from below Dripping Spring Wash to the Ashurst Hayden Dam and on two tributaries near their confluence with the Gila (San Pedro River and Mineral Creek). Findings and recommendations of this study included:

  - Fish were found only at one of eleven sites. It is believed that the lack of fish is the result of poor fish habitat and high sediment loads which reduce photosynthesis and preclude the establishment of benthic organisms.
  - Copper was elevated in sediment, fish, and lizards below Mineral Creek.
  - Copper was present at 2,660 mg/kg in sediment in Mineral Creek, 89 times higher than the State mean level (Earth Technology Corp. 1991).

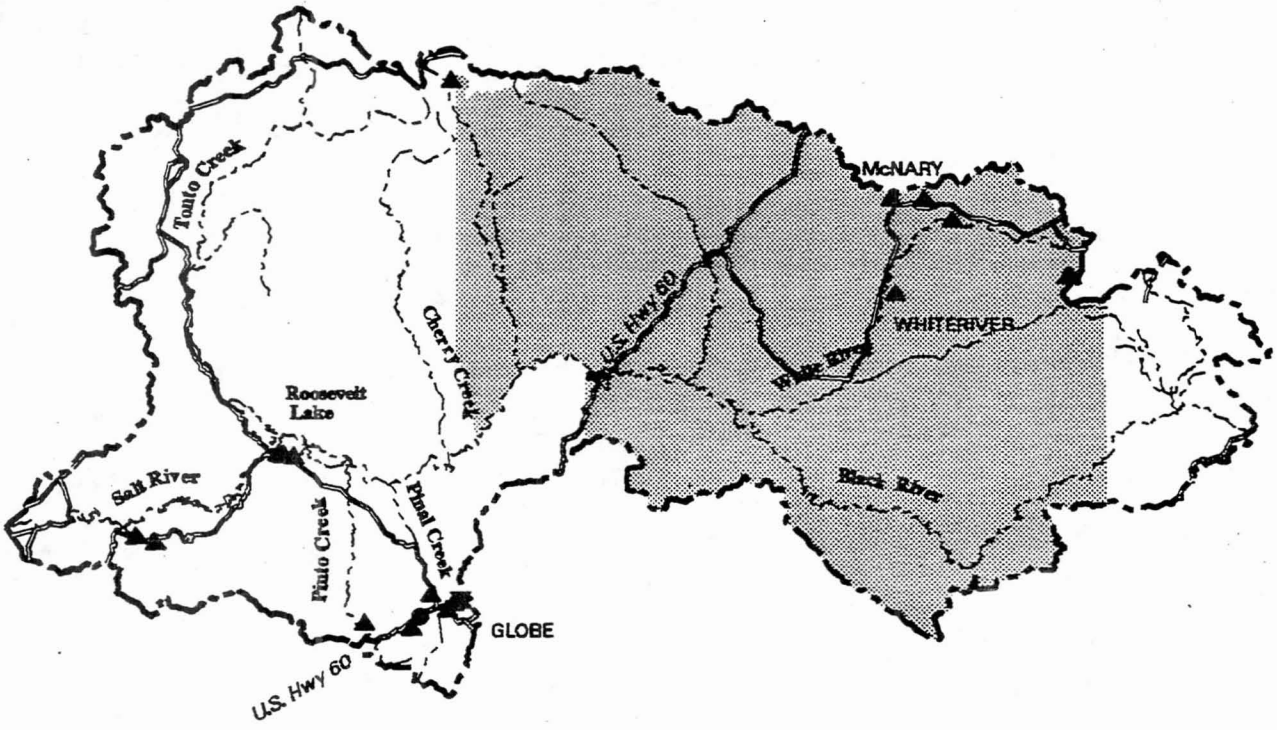
- Copper, mercury, and selenium were elevated in fish above Arizona's screening levels for fish and predator protection.

- A study of water quality trends using data collected from 1972 through 1987 was completed by USGS at two sites on the Gila River (at Winkelman, Arizona and Gillespie Dam) and two sites on the Agua Fria River (at Rock Springs, and at Waddell Dam) (Baldys et al. 1995). Changes in water quality could not be linked to changes in land uses or discharges in the watershed; therefore, this trend study has limited application for water quality management or assessment purposes. Findings and conclusions at these four sites included:

  - On the Agua Fria at Rock Springs (above Lake Pleasant) there was a decrease in hardness, dissolved solids, dissolved sodium, sulfate, chloride, and total boron. At Waddell Dam (below Lake Pleasant) there was a decrease in total copper and ammonia plus organic nitrogen.
  - At Rock Springs there was an increase in turbidity and total manganese. Turbidity varied from 0 to 17,000 nephelometric turbidity units. Neither of these constituents increased below Waddell Dam.
  - On the Gila River at Winkelman, hardness, dissolved solids, phosphorus, and total boron decreased, while pH increased.
  - On the Gila River at Gillespie Dam (predominantly wastewater effluent and irrigation return flows), hardness, dissolved solids, sodium, sulfate, chloride, barium, lead, and total manganese decreased, while pH and dissolved chromium increased.
  - The total organic carbon was at times much higher at Winkelman (up to 300 mg/l) than at Gillespie Dam (up to 37 mg/l). Total organic carbon is a measure of the concentration of organic material in an aqueous system.

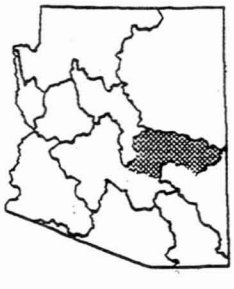
Characterization of the Salt River Watershed

SIZE	6,242 square miles (5% of the State's land area).
POPULATION BASE	34,400 people (1% of the State's population). Major communities are shown on **Map 34**.
LAND OWNERSHIP	Tribal 49% Private 2% U.S. Forest Service 47% Other state and federal 2%
LAND USES AND PERMITS	• Except for the Miami-Globe mining district, the basin is lightly populated • Principal land uses on National Forest lands are recreation, grazing, and silviculture. There are nine designated wilderness areas located in this basin with restricted land uses and activities. • **Map 34** indicates the location of wastewater discharge facilities with permits.
HYDROLOGIC PROVINCE(S)	Primarily in the Central Highlands Province.
ECOREGIONS	Arizona-New Mexico Mountains
GROUNDWATER BASINS	Tonto Creek Basin and the Salt River Basin, with a very small portion of the Phoenix Active Management Area.
HYDROLOGY AND GEOLOGY	• The western portion of this watershed consists of rugged mountains, composed of igneous, metamorphic, and sedimentary rocks along with unconsolidated sediments that accumulate in the larger valleys. Groundwater occurs to some extent in all of these formations, although the amount varies widely depending on composition and structure of the rocks. Unconsolidated sands and gravel, which occur within the floodplain of streams and washes, are generally the most productive aquifers (ADWR 1994). • The eastern portion of this watershed is dominated with volcanic materials such as basalt flows, cinder beds, tuffaceous agglomerates, and tuffs. Limited amounts of groundwater occur most predominately in cinder beds, fracture zones, and weathered zones (ADWR 1994). • Due to the high elevations, steep gradients, and a predominance of hardrock, the entire watershed has high runoff and minimal natural water storage capabilities. Therefore the area is very susceptible to both drought and heavy groundwater pumping (ADWR 1994). • The watershed contains four surface water sub-basins: White River, Black River, Tonto River, and the Salt River. • The perennial water in the White River and Black River sub-basins provides much of the water used in the Phoenix metropolitan area. • Flow in the Salt River above Roosevelt Lake varies between 59 cfs (in 1955) to 143,000 cfs (in 1993), with an average annual flow of 929 cfs (USGS 1996).
UNIQUE WATERS	None
OTHER STATES, NATIONS, OR TRIBES	White Mountain Apache, San Carlos Apache, and Salt River Indian tribes.



Map 34. Salt Watershed Water Protection Permits

- Indian Reservation
- NPDES
- APP & GWPP
- Reuse
- Watershed Boundary
- Stream
- Primary Highway
- Secondary Highway
- WS/GW Boundary



SCALE
MILES 10 0 10 20
KILOMETERS 10 0 10 20

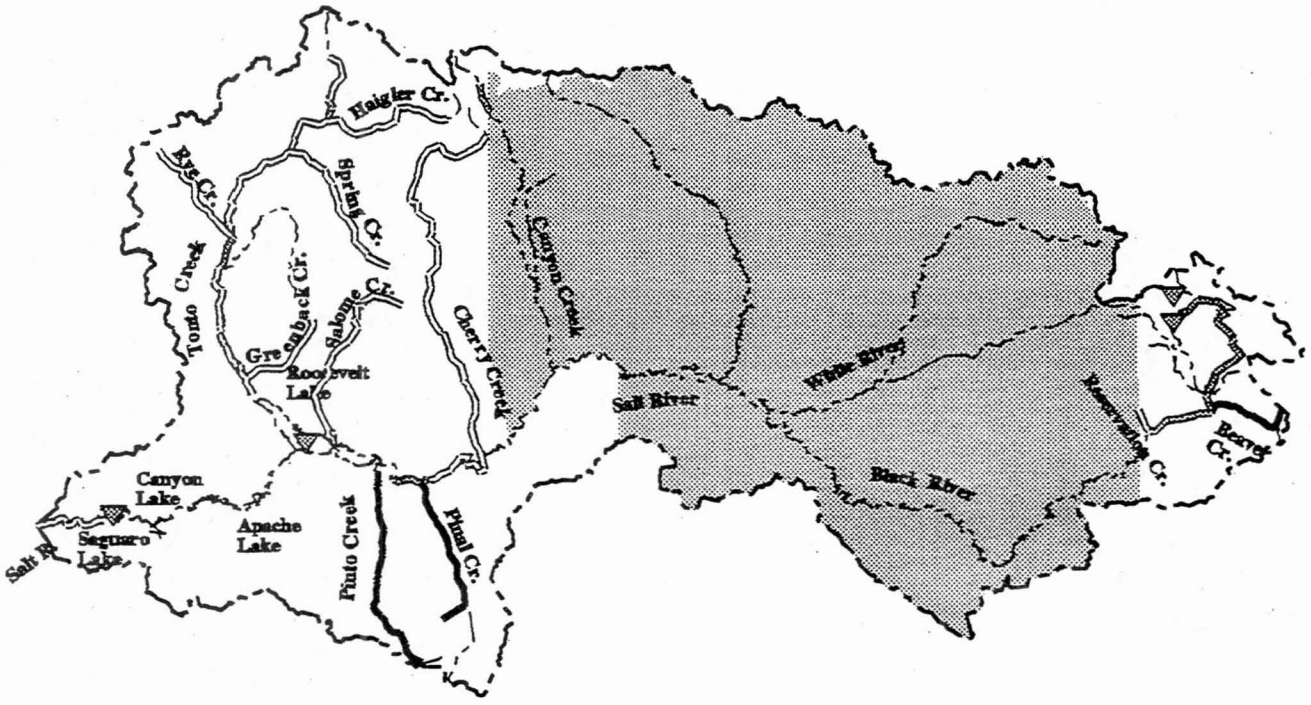
N W E S

Surface Water Assessments--Water quality assessments and surface water monitoring sites are illustrated on **Map 35** and assessments are summarized below. Major stressors and probable sources are listed in rank order; minor stressors and sources are not shown. Individual waterbody assessments are provided in **Appendix F**. Additional information concerning stressors which cause impairment and associated sources was presented in Part IV of this chapter.

SALT WATERSHED ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	42 reaches (13 monitored, 29 evaluated)	Full support - 332 miles Impaired - 167 miles	Turbidity, copper, and nutrients.	Natural, rangeland practices, loss of riparian vegetation, and resource extraction.
LAKES	4 lakes (1 monitored, 3 evaluated)	Full support - 0 acres Impaired - 14,803 acres	Total dissolved solids, chloride, beryllium, arsenic, and iron.	Natural, flow modification, resource extraction.

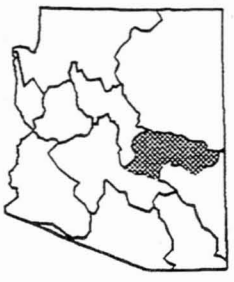
Groundwater Assessments--Groundwater monitoring data collected during 1991-1995 are summarized by groundwater basins in **Table 20** and illustrated on **Map 35**. As indicated in **Table 20,** the limited groundwater data available in this watershed show only two wells exceeding Aquifer Water Quality Standards. Both exceedances were for metals and occurred in the Miami-Globe Mining District, a designated WQARF Superfund site.

Investigations of potential groundwater contamination have lead to site remediation efforts through the state and federal Superfund Program (WQARF and CERCLA, respectively), the Underground Storage Tank Program, and the Resource Conservation and Recovery Act Program. Some groundwater is naturally contaminated with metals, halogens, and other inorganics. The status of these known contamination sites is provided in **Appendix G**, along with a map illustrating where these sites are located.



Map 35. Salt Watershed Surface Water Assessments

- Indian Reservations
- Fully Supported/ Threatened Lake
- Partially Supported Lake
- Not Supported Lake
- Watershed Boundary
- Streams
- Fully Supported or Threatened
- Partially Supported
- Not Supported



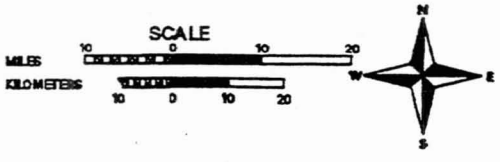
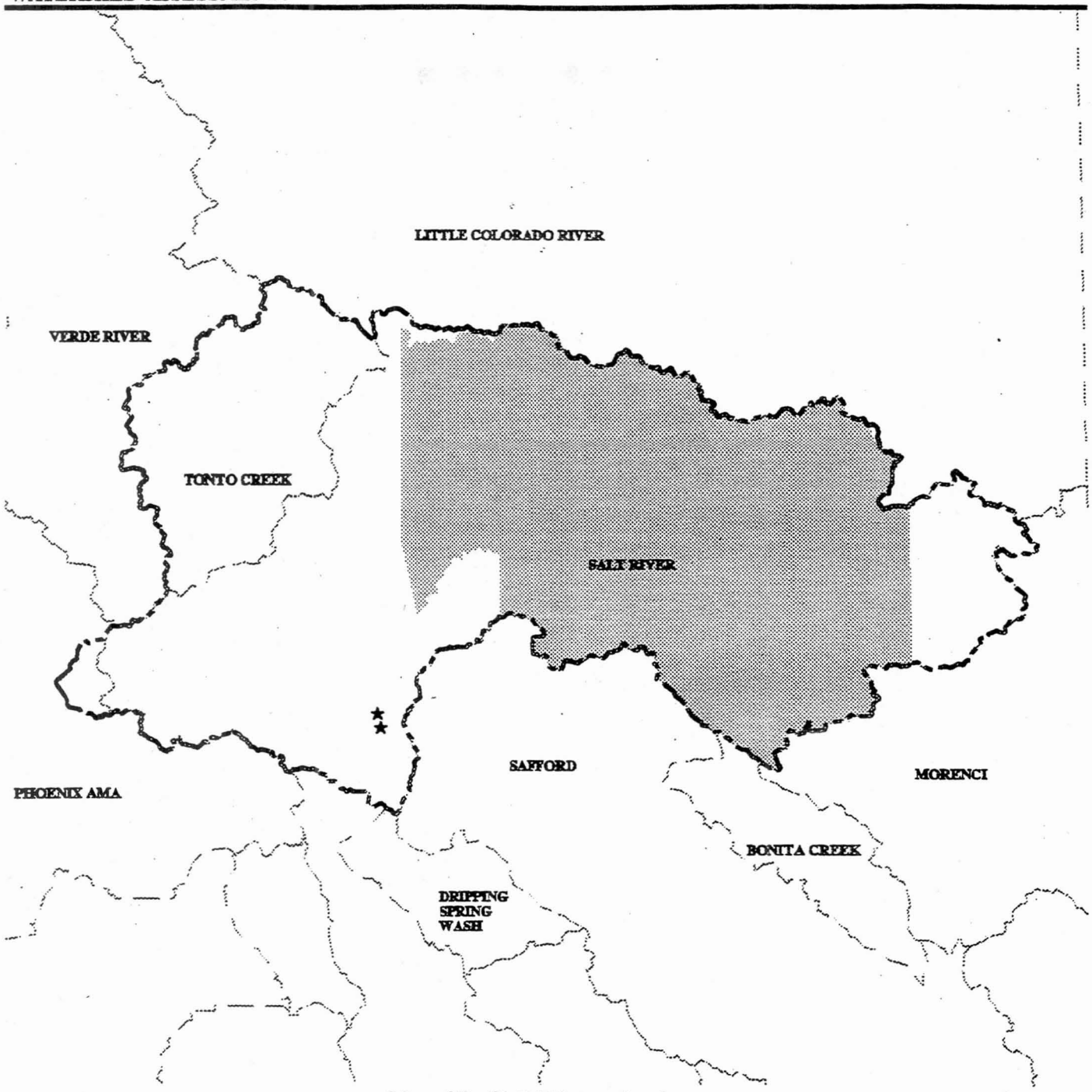


Table 20. Salt Waterhed - Groundwater Monitoring Summary (1991-1995)

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS					
		SAMPLED			EXCEEDED AQUIFER WATER QUALITY STANDARD		
GROUNDWATER BASINS		Phoenix AMA*	Salt River	Tonto Creek	Phoenix AMA*	Salt River	Tonto Creek
WATER QUALITY INDEX WELLS	Nitrate	0	1	0	0	0	0
	Fluoride	0	0	0	0	0	0
	Metals	0	3	0	0	0	0
	Radiochemicals	0	0	0	0	0	0
	Volatile Organics	0	0	0	0	0	0
	Pesticides	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Nitrate	0	2	0	0	0	0
	Fluoride	0	2	0	0	0	0
	Metals	0	55	0	0	2	0
	Radiochemicals	0	1	0	0	0	0
	Volatile Organics	0	1	0	0	0	0
	Pesticides	0	1	0	0	0	0

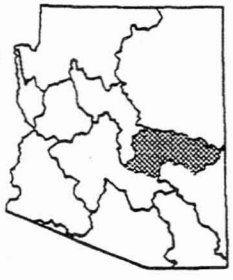
MONITORING DATA TYPE	PARAMETER GROUP	NUMBER OF WELLS		
		PARAMETER DETECTED		
GROUNDWATER BASINS		Phoenix AMA*	Salt River	Tonto Creek
WATER QUALITY INDEX WELLS	Volatile Organics	0	0	0
	Pesticides	0	0	0
OTHER GROUNDWATER MONITORING	Volatile Organics	0	0	0
	Pesticides	0	0	0

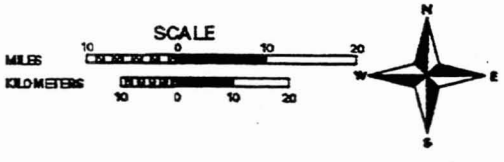
* Only a minor portion of the Phoenix Active Management Area (AMA) is in this watershed; the major portion is in the Middle Gila Watershed.



Map 36. Salt Watershed
Wells Exceeding an Aquifer Water Quality Standard

- Indian Reservation
- Flouride
- Radiation
- Metal
- Nitrate
- Volatile Organic Compound
- Pesticide
- Watershed Boundary
- Groundwater Basin
- WS/GW Boundary





Special Studies in the Salt Watershed--

- ADEQ has investigated the impact of Gibson Mine on Pinto Creek and its tributaries since 1990 (see also the Gibson Mine impact on Mineral Creek in the Middle Gila Watershed). An unnamed intermittent stream, referred to as the Gibson Mine Tributary in reports, has headwaters above the mine and flows (seasonally) 0.9 miles to Pinto Creek. Pooled water can often be found along the length of the stream. The findings and conclusions of these studies were:

  - Direct discharges from the mining area do not flow into the Pinto Creek watershed. However, in 1990 heavy rains caused the lower pregnant solution pond (about 10,000-20,000 gallons of leachate) to overflow into the tributary.
  - The shallow groundwater surfaces in the tributary, creating pools and short flowing reaches of chronically acidic, metal-laden (e.g., copper) water. Surface water contamination also occurs when rainfall runoff contacts reserve ore on the ground.
  - Remedial action is necessary at this site to meet surface water standards.

- In 1992 the USGS, in cooperation with ADEQ's Clean Lakes Program, initiated an investigation of basic limnological processes in Roosevelt Lake, with consideration of potential impacts of acid mine drainage from Pinal Creek (Ham 1995 and ADEQ 1993e). Conclusions of this lake reconnaissance study were:

  - Several samples from Roosevelt Lake exceeded surface water quality standards for arsenic and beryllium and EPA's secondary maximum contaminant levels in drinking water for chloride and total dissolved solids.
  - Mean concentrations of dissolved arsenic, iron, manganese, nickel, and strontium were lower in Roosevelt Lake than its source tributaries -- Salt River and Tonto Creek.
  - Concentrations of dissolved copper and zinc were greater in the lake than in tributary streams.
  - Mean concentrations of chromium, copper, nickel, and zinc in bottom sediment were greatest in sediment collected from the area of the lake receiving Tonto Creek drainage. Barium concentrations were greatest in sediment collected from the bay receiving Salt River water.
  - Major ion concentrations indicate that Roosevelt Lake is chemically influenced by the Salt River more than by Tonto Creek.
  - The forebay (the bay above the dam) had the greatest mean concentrations of dissolved arsenic, iron, manganese, and zinc, possibly the result of the large hypolimnetic zone in this area.
  - Most of the samples collected in Roosevelt Lake were taken at the surface rather than from varying depths; therefore, a thorough limnological evaluation of trends cannot be made using existing data.
  - Additional information is needed to evaluate effects of metals loading from Pinal Creek on Roosevelt Lake.

- USGS research on acidic metal contamination in the Pinal Creek drainage area has been ongoing since 1984. This research has significantly advanced understanding of the important physical processes and chemical reactions that control the chemistry of groundwater and surface water at the site (Brown and Favor 1996). Acid drainage related to decades of mining in the basin has generated a 15-kilometer-long plume of acidic groundwater in the regional alluvial aquifer. Research to date has found that:

  - The acidic plume becomes neutralized and pH increases to between 6-7 as it moves down-gradient, mainly through reaction with calcium carbonate, and as a result of silicate dissolution and partial equilibration with the atmosphere. These reactions slowed the rate of advance of the acidic front of the plume to a seventh of advective flow.
  - The oxidation and precipitation of iron (driven by the reductive dissolution of manganese oxides) have the net effect of further lowering the pH.

- The down-gradient decrease in dissolved concentrations of copper, cobalt, nickel, and zinc is caused by pH dependent adsorption to iron hydroxide in the aquifer.
- Analyses of streambed precipitates in the perennial reach of Pinal Creek indicate that the iron hydroxide minerals precipitate first, followed by manganese oxide. Manganese carbonate deposition occurs further downstream as pH increases.
- Carbon dioxide exsolution from the water table results from neutralization reactions involving carbonate minerals, while oxygen in-gassing is related to the oxidation of dissolved iron near the water table.
- Continual movement of perennial streamflow through streambed materials enhances manganese oxidation and co-precipitation of trace metals. Streambed reactions are enhanced by the presence of existing surfaces and possibly by biotic activity.

- Cyprus Miami Mining Corporation has been pumping contaminated groundwater in the Globe Mining Area since 1990 to prevent further downstream movement of the acid plume. The water is used in the mining operation. Annual performance reviews (Hydro Geo Chem. 1991, 1992a, 1992b), a human health risk assessment (Hydro Geo Chem. 1992c) and an ecological risk assessment (Hydro Geo Chem. 1993) have been published for this site.

- An intensive study of the upper Tonto Creek sub-basin was conducted to determine impacts to water quality from heavy summertime recreational use, discharge from a fish hatchery, and individual wastewater disposal systems in the watershed (ADEQ 1995b). The findings and conclusions were:

  - Generally the water quality in upper Tonto Creek met standards. An exception to this is immediately below the Arizona Game and Fish Department hatchery where the total nitrogen annual mean was exceeded. Shortly downstream the water meets standards again.
  - With higher flows nitrogen levels were 50% lower during winter months.
  - The hatchery impact on upper Tonto Creek appears to be minimal and short lived.

- Fish were collected in Roosevelt Lake, the Salt River (above Roosevelt Lake), and Tonto Creek by the USFWS as part of a statewide study of bald eagle prey (King et al. 1991). The findings and conclusions of the report were:

  - Fish tissue samples had elevated levels of copper and zinc in Roosevelt Lake and elevated mercury in Tonto Creek and the Salt River as compared to screening values (see Appendix A).
  - The trace elements most likely to cause reproductive problems in birds are: arsenic, cadmium, mercury, and selenium.
  - At these sites, mercury levels in fish were found to be the greatest pollutant threat to bald eagles.

- A study of water quality trends using data collected from 1972 through 1987 was completed by USGS at two sites on the Salt River (just above Roosevelt Lake and at Stewart Mountain Dam, below Saguaro Lake) and one site on Pinal Creek (near its confluence with the Salt River). These were three of the twelve sites where trends were calculated for the greater Gila River Basin (Baldys et al. 1995). Changes in water quality could not be linked to changes in land uses or discharges in the watershed; therefore, this trend study has limited use in water quality management or assessment purposes. Findings and conclusions at these three sites included:

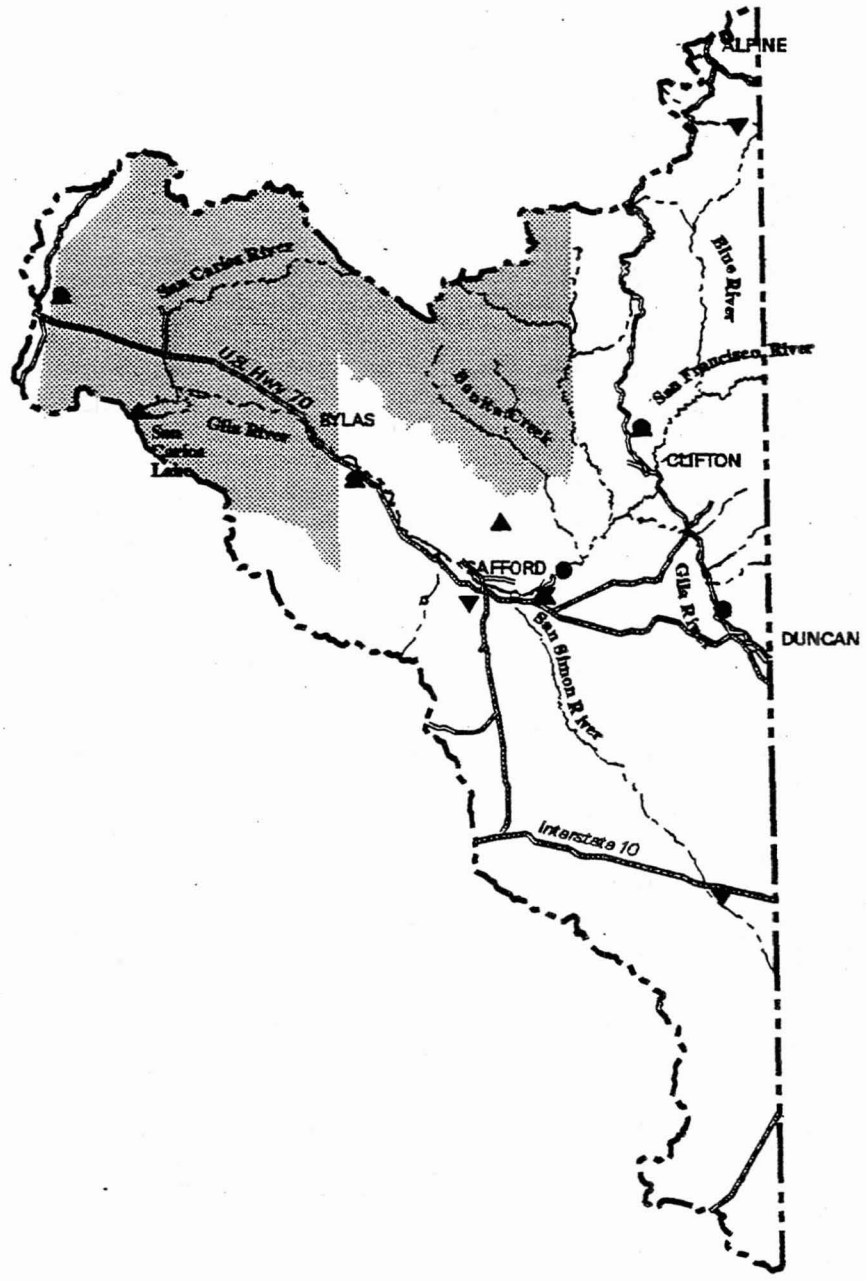
  - On Pinal Creek there was an increase in dissolved solids, dissolved sodium, sulfate, chloride, chromium, and total manganese, and a decrease in total copper and total lead.
  - At the Salt River site (above Roosevelt Lake and just below Pinal Creek), dissolved chloride and total manganese were increasing, while dissolved barium, total lead, and zinc were decreasing.

- At Stewart Mountain Dam (below a chain of reservoirs on the Salt River), pH, dissolved chromium, and total organic carbon were increasing, while turbidity, dissolved lead, and total manganese were decreasing.
- Median concentrations of hardness, dissolved solids, dissolved sulfate, total copper, and total manganese were higher at Pinal Creek than at any of the other 12 sites included in the trend study of the Gila Basin.

- ADEQ monitoring detected the presence of the parasites Giardia and Cryptosporidium in the East and West Forks of the Black River. These parasites are widespread in their distribution and occurrence and have been found in other Arizona watersheds.

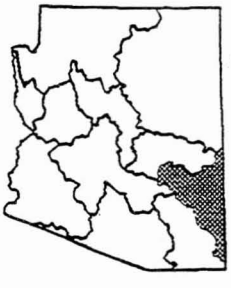
Characterization of the San Carlos-Safford-Duncan Watershed

SIZE	7,354 square miles (6% of the State's land area).
POPULATION BASE	39,000 people (1% of the State's population). Major communities are shown on **Map 37.**
LAND OWNERSHIP	Tribal 28%; Bureau of Land Management 22%; U.S. Forest Service 23%; State 14%; Private 9%; Other state and federal 4%
LAND USES AND PERMITS	• In 1990, Congress passed the Arizona Desert Wilderness Act which designated the Gila Box Riparian National Conservation Area, and directed the BLM to conserve, protect, and enhance the riparian and wetland areas within the conservation area. • The federal and state owned lands are used for grazing and recreation, with a minor amount of silviculture in the national forests. There are five designated wilderness areas and a wilderness study area on Mount Graham with restricted land uses. • Irrigated agriculture uses a high percentage of the Gila River flow. • Mining is concentrated near Morenci-Clifton on the San Francisco River. A new, large scale, open pit mine is proposed north of Safford near the Gila River (Sanchez Mine). • Existing wastewater discharge permits and populated areas are shown on **Map 37.**
HYDROLOGIC PROVINCE(S)	Primarily the Basin and Range Province, but the northern third falls within the Central Highlands Province.
ECOREGIONS	Primarily Southern Deserts. Northern edge in Arizona-New Mexico Mountains.
GROUNDWATER BASINS	Bonita Creek, Duncan Valley, Morenci, and Safford.
HYDROLOGY AND GEOLOGY	• This watershed is also referred to as the Upper Gila surface water basin. • Perennial flow is limited to the Gila River above Safford, the San Francisco sub-watershed, Eagle Creek, the lower portion of Bonita Creek, a portion of the San Carlos River, and short stretches of tributaries on Mount Graham and Chiricahua Mountains. (Brown et al. 1978). • The flow in the Gila River above the Safford Valley ranges from 11 cfs (in 1956) to 132,000 cfs (in 1983), with an annual mean of 477 cfs (USGS 1996). • The Safford and Duncan groundwater basins are large trough-like depressions formed by elongated mountain ranges composed of gneiss, schist, granite, volcanic material, and sedimentary rocks. These mountains rim a broad, alluvial-filled valley composed of the erosional remnants of these mountains. This alluvial fill constitutes the major aquifer in the Safford and Duncan Basins. Average discharge from wells is 1,000 gallons per minute. Groundwater levels and movement in these two basins are strongly influenced by the Gila River (ADWR 1994). • The Bonita Creek and Morenci groundwater basins, located within the Central Highlands Province, have limited groundwater resources. Most wells tap alluvial deposits along the major stream courses while the surrounding hardrock areas produce limited groundwater quantities (ADWR 1994).
UNIQUE WATERS	Bonita Creek, Cave Creek, and the South Fork of Cave Creek.
OTHER STATES, NATIONS, OR TRIBES	San Carlos Apache Indian Tribe. Another 5,000 square miles extend into New Mexico.



Map 37. San Carlos-Safford-Duncan Watershed Water Protection Permits

- Indian Reservation
- NPDES
- APP & GWPP
- Reuse
- Watershed Boundary
- Stream
- Primary Highway
- Secondary Highway
- WS/GW Boundary



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N W E S

Surface Water Assessments--Water quality assessments and surface water monitoring sites are illustrated on **Map 38** and assessments are summarized below. Major stressors and probable sources are listed in rank order; minor stressors and sources are not shown. Individual waterbody assessments are provided in **Appendix F**. Additional information concerning stressors which cause impairment and associated sources was presented in Part IV of this chapter.

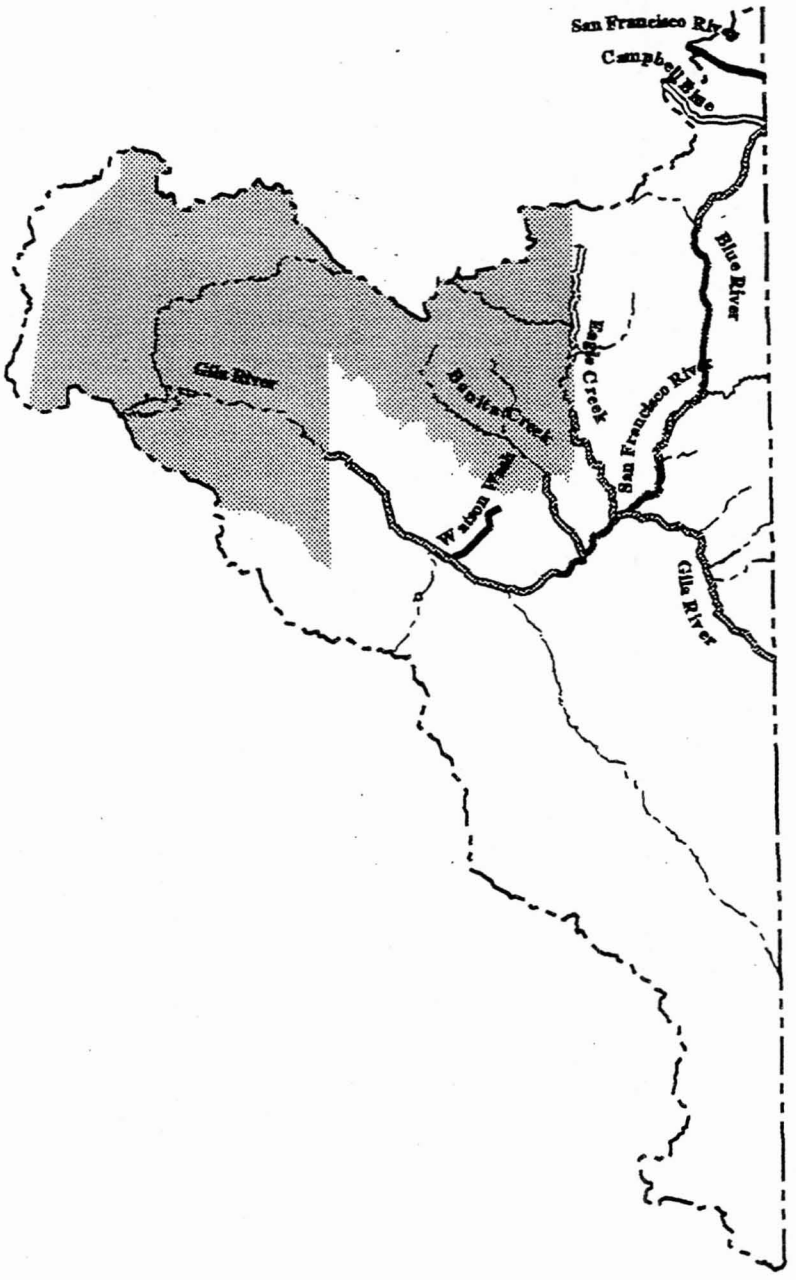
SAN CARLOS-SAFFORD-DUNCAN WATERSHED ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	**Use Support**	**Major Stressors**	**Probable Sources**
STREAMS	38 reaches (4 monitored, 34 evaluated)	Full support - 182 miles Impaired - 250 miles	Turbidity, arsenic, copper, and total dissolved solids.	Natural, rangeland practices, removal of riparian vegetation, and resource extraction.
LAKES	3 lakes (all evaluated)	Full support - 0 acres Impaired - 117 acres	High pH, noxious plants, low dissolved oxygen.	Flow modification and natural.

Groundwater Assessments--Groundwater monitoring data collected during 1991-1995 are summarized by groundwater basins in **Table 21** and illustrated on **Map 39**. The limited groundwater data available suggest the following assessment:

- Groundwater quality in general is suitable for drinking water use.
- Natural fluoride exceeds Aquifer Water Quality Standards in some wells.

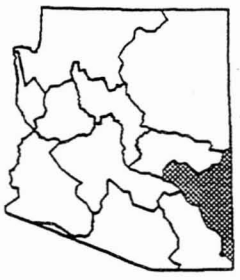
Older data collected by state and federal agencies since 1975 in the Safford Groundwater Basin indicate that the median concentrations of total dissolved solids exceeded the secondary maximum contaminant level for drinking water of 500 mg/l. In this basin, TDS levels (or salinity) are higher in the deeper regional aquifer than the shallow upper regional aquifer.

Investigations of potential groundwater contamination have lead to site remediation efforts through the state and federal Superfund Program (WQARF and CERCLA, respectively), the Underground Storage Tank Program, and the Resource Conservation and Recovery Act Program. Some groundwater is naturally contaminated with metals, halogens, and other inorganics. The status of these known contamination sites is provided in **Appendix G**, along with a map illustrating where these sites occur.



Map 38. San Carlos-Safford-Duncan Watershed Surface Water Assessments

Indian Reservations
Fully Supported/ Threatened Lake
Partially Supported Lake
Not Supported Lake
Watershed Boundary
Streams
Fully Supported or Threatened
Partially Supported
Not Supported



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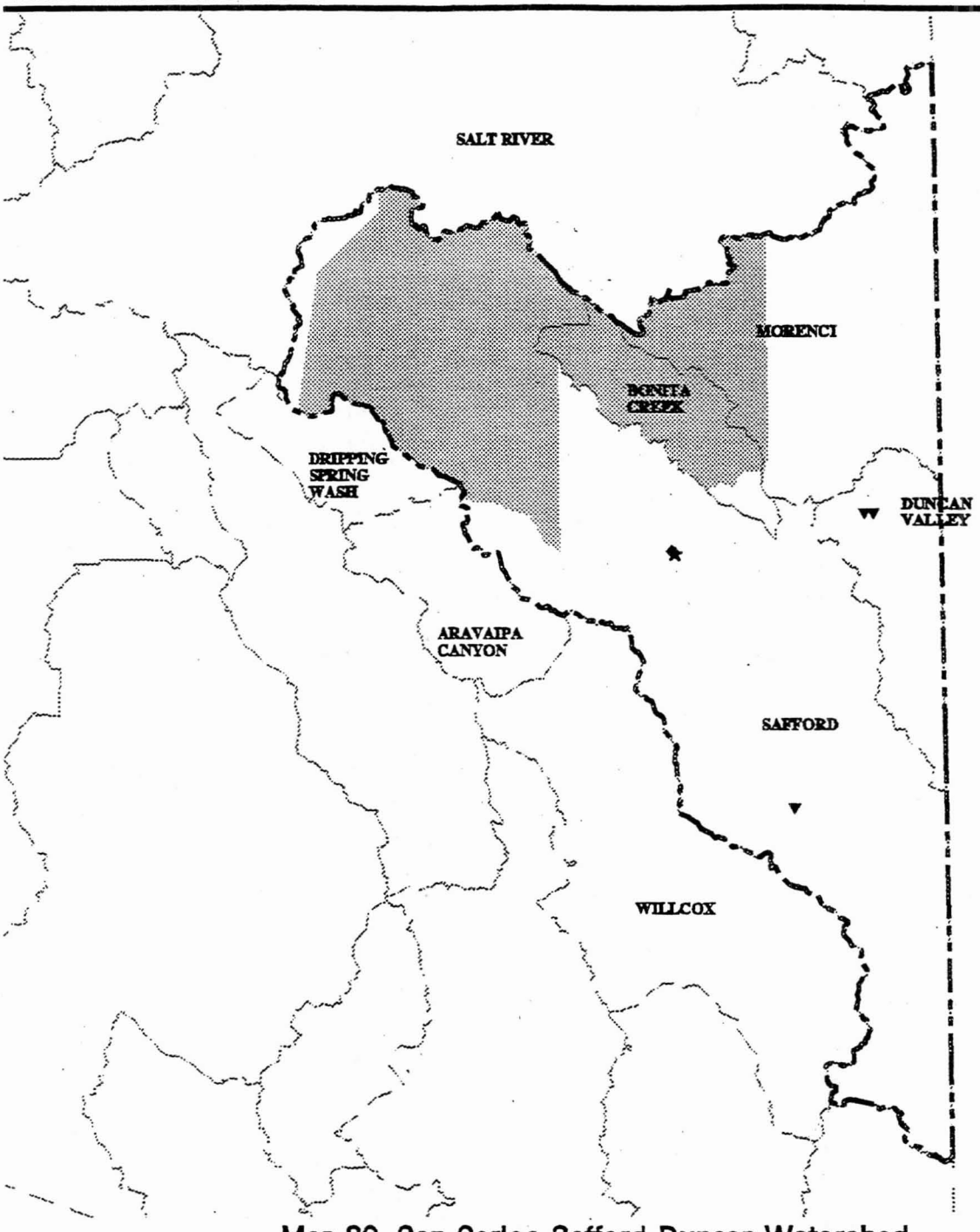
N W E S

Table 21. San Carlos-Safford-Duncan Watershed - Groundwater Monitoring Summary (1991-1995)

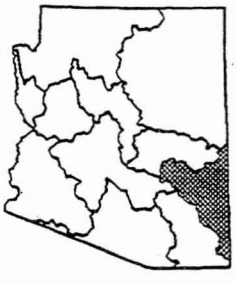
MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS							
		SAMPLED				EXCEEDED AQUIFER WATER QUALITY STANDARD			
GROUNDWATER BASINS		Bonita Creek	Duncan Valley	Morenci	Safford	Bonita Creek	Duncan Valley	Morenci	Safford
WATER QUALITY INDEX WELLS	Nitrate	0	1	0	10	0	0	0	0
	Fluoride	0	0	0	9	0	0	0	0
	Metals	0	1	0	9	0	0	0	1
	Radiochemicals	0	0	0	0	0	0	0	0
	Volatile Organics	0	0	0	0	0	0	0	0
	Pesticides	0	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Nitrate	0	4	0	3	0	0	0	1
	Fluoride	0	5	0	10	0	2	0	1
	Metals	0	1	0	6	0	0	0	0
	Radiochemicals	0	0	0	0	0	0	0	0
	Volatile Organics	0	3	0	4	0	0	0	0
	Pesticides	0	3	0	3	0	0	0	0

MONITORING DATA TYPE	PARAMETER GROUP	NUMBER OF WELLS			
		PARAMETER DETECTED			
GROUNDWATER BASINS		Bonita Creek	Duncan Valley	Morenci	Safford
WATER QUALITY INDEX WELLS	Volatile Organics	0	0	0	0
	Pesticides	0	0	0	0
OTHER GROUNDWATER MONITORING	Volatile Organics	0	0	0	0
	Pesticides	0	0	0	0



Map 39. San Carlos-Safford-Duncan Watershed Wells Exceeding an Aquifer Water Quality Standard

- Indian Reservation
- Flouride
- Radiation
- Metal
- Nitrate
- Volatile Organic Compound
- Pesticide
- Watershed Boundary
- Groundwater Basin
- WS/GW Boundary



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Special Studies in the San Carlos-Safford-Duncan Watershed--

- The San Carlos-Safford-Duncan Management Zone was established in 1993 to develop and implement nonpoint source management strategies in the upper Gila River drainage area (above San Carlos Reservoir dam) in Arizona. A Phase I report addresses information contained in the State's 1994 Water Quality Assessment Report, and provided recommendations concerning interpretation of water quality data. Phase II validates data within the 1994 assessment report through interviews with stakeholders and further water quality monitoring. There are four additional phases scheduled. It is anticipated that this management zone activity will be incorporated into The Watershed Protection Approach currently being developed (see Watershed Protection initiative in Chapter 2).

- An interstate watershed program, known as the Gila Monster, has been developed to manage nonpoint source pollution within the upper Gila River drainage area (above San Carlos Reservoir dam), an 8,500,000 acre area. ADEQ has been working with the New Mexico Environmental Department, EPA regions VI and IX, the U.S. Forest Service, the Bureau of Land Management, and more than 70 other interested parties to develop and implement strategies for management of nonpoint source loadings into this watershed. Four Advisory Groups have been established to facilitate local involvement, three in New Mexico and one in Arizona (i.e., the San Carlos-Safford-Duncan Management Zone Advisory Group).

- An investigation of groundwater quality was conducted by ADEQ, as requested by the Technical Advisory Group for the San Carlos-Safford-Duncan Nonpoint Source Management Zone. This advisory group has been identifying the nonpoint sources of water quality concern. The study involved characterizing groundwater quality and looking at impacts from nonpoint sources (e.g., agriculture practices and wastewater disposal). In 1995, 116 wells were sampled. Analytical results indicate the following:

  - Nitrates exceed background levels in some areas associated with agricultural activities, but elevated nitrates are not widespread.
  - Analytical results for both banned and currently used pesticides were below the laboratory detection level.
  - Salinity is the primary water quality issue in this watershed. In most places, a clay layer separates a shallow upper aquifer of good quality water from a lower aquifer of highly saline water. In areas where the clay layer is fractured or discontinuous, saline groundwater under artesian pressure enters the upper aquifer and creates local saline conditions. Seepage also contributes salinity to the Gila River, especially during periods of low flow.

- The copper mine in Clifton-Morenci, owned by Phelps Dodge, is the largest open pit copper mine in the United States. Currently, this operation has applied for an Aquifer Protection Permit. In the process of developing this permit all surface and groundwater concerns should be addressed for this site. In 1995, Phelps Dodge completed a characterization of groundwater using more than 100 monitoring wells, and will be submitting a detailed description of the mining processes used. Previous monitoring had located contaminated water on Gold Gulch as it seeped out of a development rock stockpile. This water is now being captured on site by dams and pumped back to the mining operation for process water.

- ADEQ monitoring detected the presence of the parasites Giardia and Cryptosporidium in the San Francisco River, near the headwaters in Alpine. These parasites are widespread in their distribution and occurrence and have been found in other Arizona watersheds. Human enteric viruses were detected once in the San Francisco River in the vicinity of the Alpine Wastewater Treatment Plant.

- A rangeland management and riparian protection project has been established in the Bonita Creek drainage area of the San Carlos Apache Nation. This project will be initiated soon, as a Memorandum of Understanding between the San Carlos Apache Tribe and ADEQ concerning implementation of this project was completed in 1996.

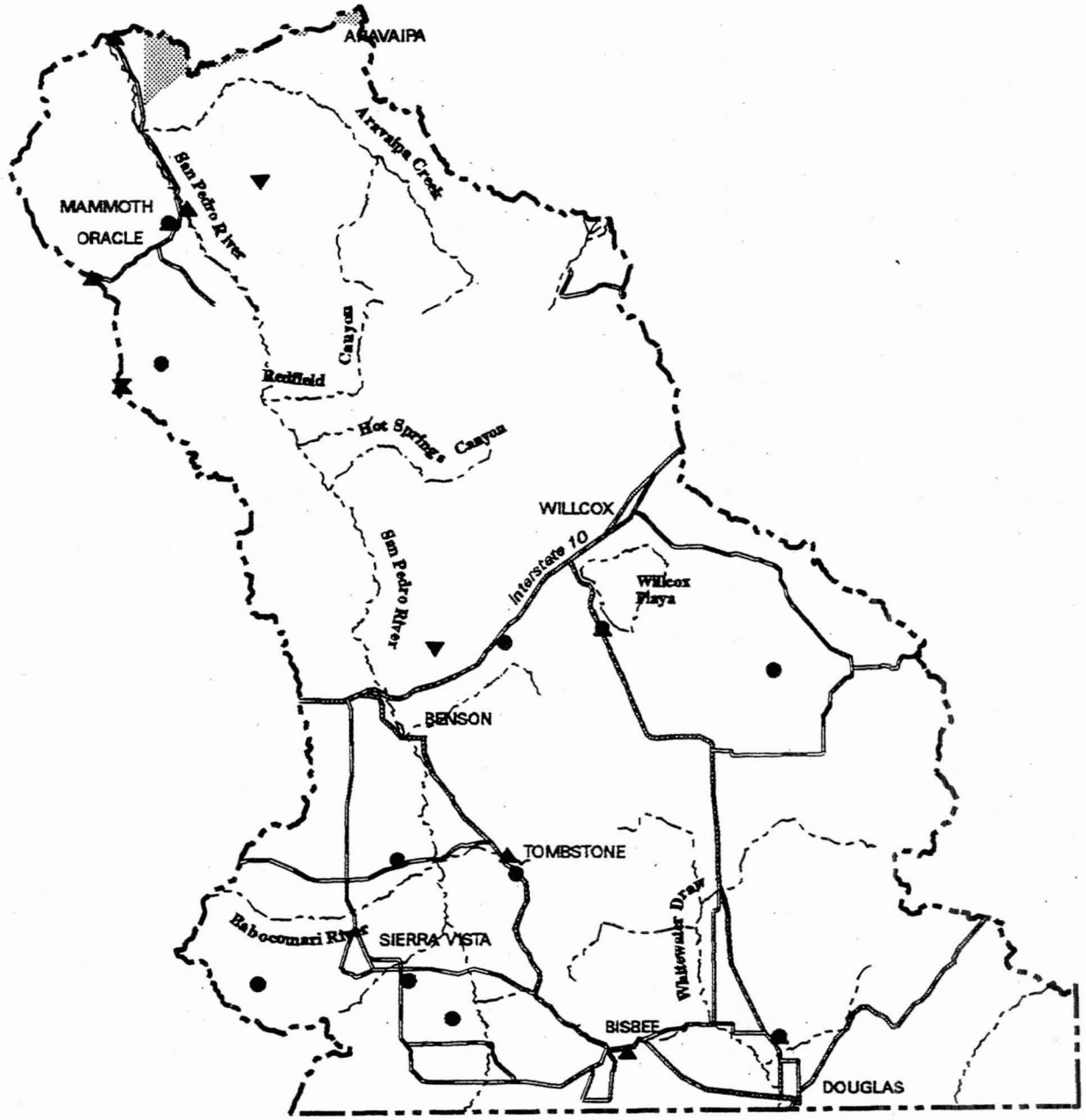
- The Arizona Geological Survey is analyzing geologic formations within this watershed to identify potential loadings from natural conditions. Water quality is known to be affected by geologic deposits of halite, anhydride and heavy metals.

- A study of water quality trends using data collected from 1972 through 1987 was completed by USGS at two sites on the Gila River (Calva, Arizona and Redrock, New Mexico) and one site on the San Francisco River (near Clifton) (Baldys et al. 1995). Changes in water quality could not be linked to changes in land uses or discharges in the watershed; therefore, such trends had limited use for water quality planning and assessment purposes. Findings and conclusions at these three sites included:

  - Total phosphorus, dissolved lead, total manganese, and dissolved zinc declined, while ammonia plus organic nitrogen increased near a major copper mine on the San Francisco River.
  - Dissolved solids, sodium, sulfate, and chloride were decreasing, while total lead was increasing at the Redrock, New Mexico site on the Gila River, just upstream of the Arizona border.
  - Hardness, dissolved solids, sodium, sulfate, chloride, total phosphate, dissolved lead, total manganese and dissolved zinc were decreasing, while pH was increasing at the Calva site downstream of the town of Safford.

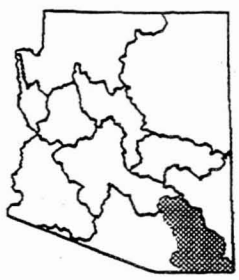
Characterization of the San Pedro-Willcox Playa-Rio Yaqui Watershed

SIZE	7,015 square miles (6% of the State's land area).
POPULATION BASE	106,100 people (3% of the State's population). See **Map 40**.
LAND OWNERSHIP	Private 38%; State 38%; U.S. Forest Service 14%; Bureau of Land Management 5%; Military 4%; Other state and federal 1%
LAND USES AND PERMITS	• Grazing is widespread. Irrigated agriculture is limited to isolated acres near the San Pedro River. There are only a few active mines (historic copper, silver, and gold mining), and mining activity reflects current market values. • **Map 40** indicates the locations of wastewater discharge permit facilities. • The nation's first Riparian National Conservation Area was designated in 1988, thereby protecting a 56,000 acre area along the upper San Pedro River.
HYDROLOGIC PROVINCE(S)	Basin and Range Province
ECOREGIONS	Southern Deserts, except for the northern edge which is in the Southern Basin and Range. Diverse vegetation ranges from desert grassland at low elevations (4,000 feet above sea level) to alpine forest in the Pinaleno Mountains, which rise to 10,700 feet above sea level at Mount Graham.
GROUNDWATER BASINS	Aravaipa Canyon, Douglas, San Bernadino Valley, Upper San Pedro, Willcox Playa, most of the Lower San Pedro, and a small portion of Cienega Creek.
HYDROLOGY AND GEOLOGY	• There are three hydrologically distinct surface water basins. 1) The San Pedro River flows north from Mexico almost 100 miles to the Gila River, and contains numerous riparian areas which support rich wildlife populations. 2) The Willcox Playa is a terminal basin, so that all surface water drainage within this basin is ultimately ponds in the playa. 3) The Rio Yaqui basin contains the Whitewater and Blackwater draws that flow south into Mexico. • Groundwater pumping has limited the perennial flow of the San Pedro River flows to approximately 25 miles near the Mexican border (Brown et al. 1978). Flow on the San Pedro River at Charleston varies between 0.22 cfs (in 1990) to 98,000 (in 1926) (USGS 1996). • The geology is characterized by mountain ranges that trend to the northwest, separated by broad alluvial valleys and three kinds of aquifers. The consolidated bedrock of the mountains that divide the groundwater basins has small localized aquifers (created by fault zones). They provide only enough water for low-use domestic and stock wells. The main groundwater source is provided by alluvial basin-fill sediments. Wells in these aquifers can produce more than 2,000 gallons per minute. Also, streambed alluvial aquifers produce well yields up to 1,800 gallons per minute (ADWR 1994).
UNIQUE WATERS	Aravaipa Canyon Creek and Buehman Canyon Creek.
OTHER STATES, NATIONS, OR TRIBES	Mexico



Map 40. San Pedro-Willcox Playa-Rio Yaqui Watershed Water Protection Permits

- Indian Reservation
- NPDES
- APP & GWPP
- Reuse
- Watershed Boundary
- Stream
- Primary Highway
- Secondary Highway
- WS/GW Boundary



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Surface Water Assessments--Water quality assessments and surface water monitoring sites are illustrated on **Map 41** and assessments are summarized below. Major stressors and probable sources are listed in rank order; minor stressors and sources are not shown. Individual waterbody assessments are provided in **Appendix F**. Additional information concerning stressors which cause impairment and associated sources was presented in Part IV of this chapter.

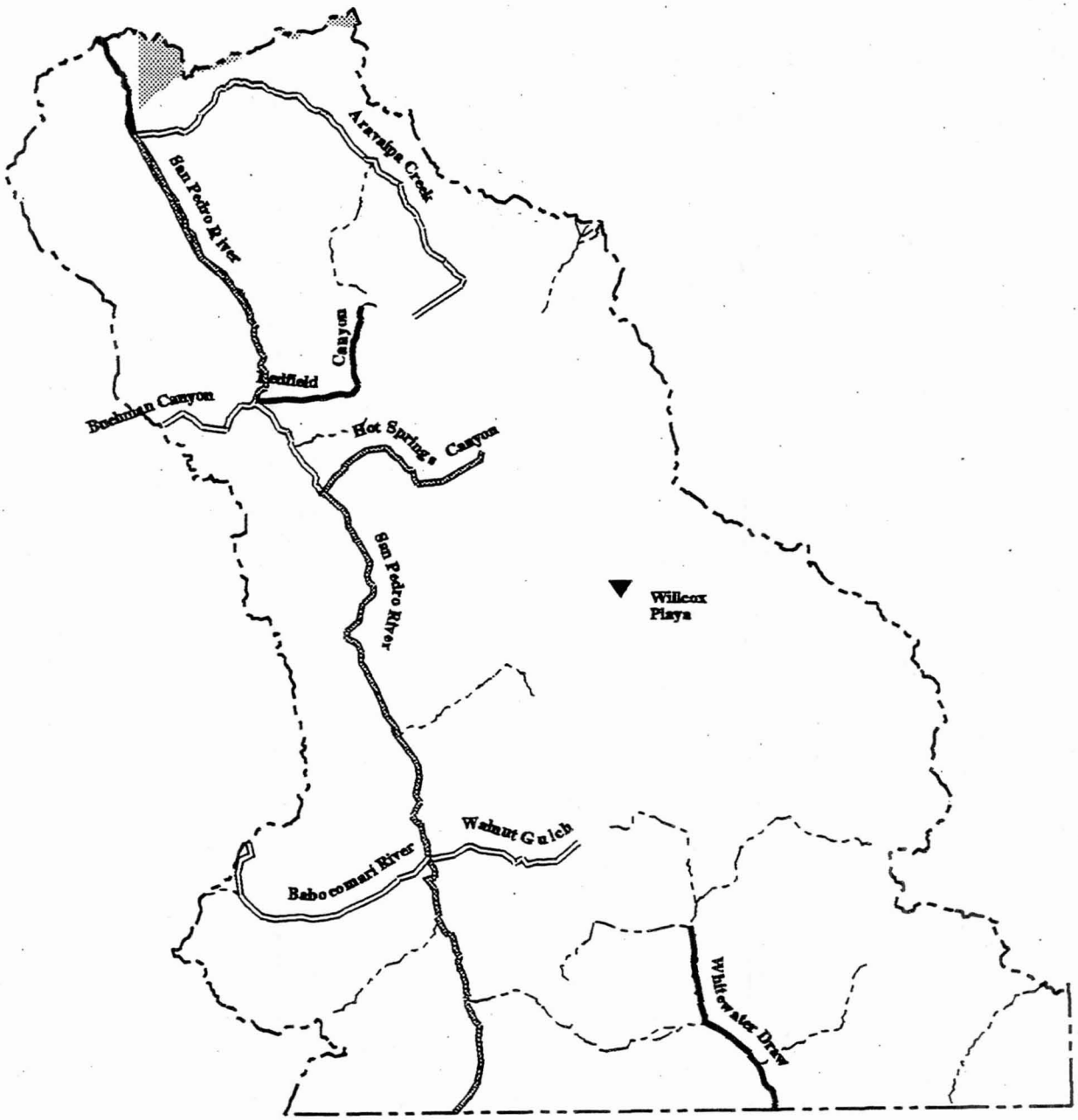
SAN PEDRO-WILLCOX PLAYA-RIO YAQUI WATERSHED ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	38 reaches (12 monitored, 26 evaluated)	Full support - 237 miles Impaired - 367 miles	Turbidity, fecal coliform, beryllium, low dissolved oxygen, arsenic, copper, chromium and zinc.	Natural, resource extraction, rangeland practices, and loss of riparian vegetation.
LAKES	1 lakes (evaluated)	Full support - 0 acres Impaired - 150 acres	Arsenic, beryllium, and turbidity.	Point source and natural.

Groundwater Assessments--Groundwater monitoring data collected during 1991-1995 are summarized by groundwater basins in **Table 22** and illustrated on **Map 42**. The limited available groundwater data in **Table 22** suggests the following assessment:

- Outside of the Willcox Playa, groundwater quality is generally suitable for drinking water use.
- Manmade and natural contaminants are a concern in the Willcox Playa (i.e., volatile organic chemicals, pesticides, nitrates, fluoride, and metals).
- Volatile organic chemicals (i.e., solvents) have been detected in two wells in the Upper San Pedro Groundwater Basin, although Aquifer Water Quality Standards are not exceeded.

Older groundwater quality data, collected by state and federal agencies from 1975 to 1990, show the median concentrations of selected indicators of potability (i.e., hardness, nitrate, TDS, and sulfate) in the Douglas Groundwater Basin are less than Aquifer Water Quality Standards or secondary maximum contaminant levels for drinking water. This suggests that the regional groundwater quality conditions support drinking water uses.

Investigations of potential groundwater contamination have lead to site remediation efforts through the state and federal Superfund Program (WQARF and CERCLA, respectively), the Underground Storage Tank Program, and the Resource Conservation and Recovery Act Program. Some groundwater is naturally contaminated with metals, halogens, and other inorganics. The status of these known contamination sites is provided in **Appendix G**, along with a map illustrating where these sites occur.



Map 41. San Pedro-Willcox Playa-Rio Yaqui Watershed Surface Water Assessments

- Indian Reservations
- Fully Supported/ Threatened Lake
- Partially Supported Lake
- Not Supported Lake
- Watershed Boundary
- Streams
- Fully Supported or Threatened
- Partially Supported
- Not Supported

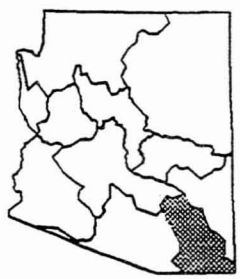


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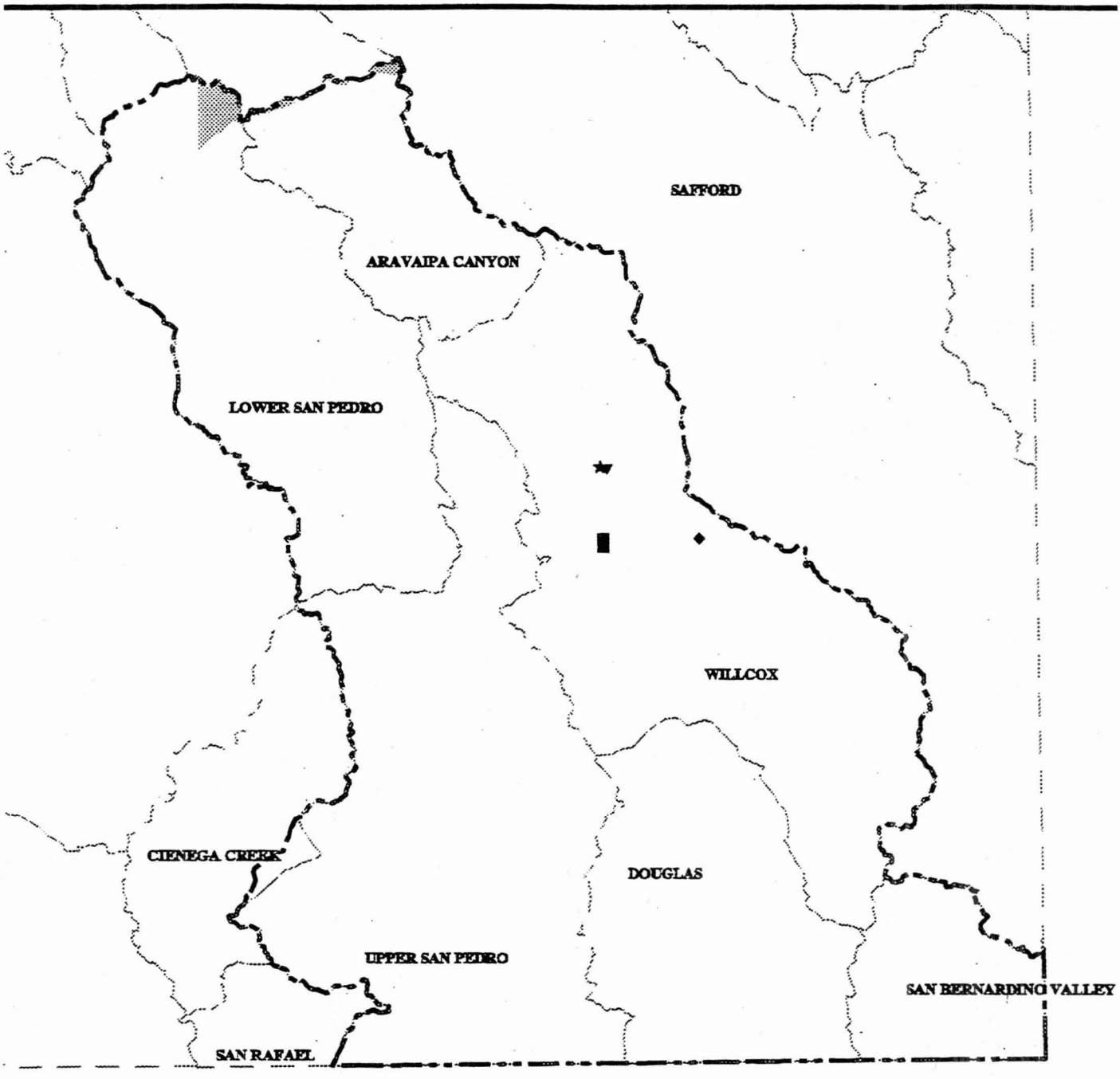
Table 22. San Pedro-Willcox Playa-Rio Yaqui Watershed - Groundwater Monitoring Summary (1991-1995)

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS													
		SAMPLED							EXCEEDED AQUIFER WATER QUALITY STANDARD						
GROUNDWATER BASINS		ARA	CC*	DG	L-SP	U-SP	SBV	WIL	ARA	CC*	DG	L-SP	U-SP	SBV	WIL
WATER QUALITY INDEX WELLS	Nitrate	1	0	3	3	15	1	4	0	0	0	0	0	0	0
	Fluoride	0	0	1	2	2	0	9	0	0	0	0	0	0	0
	Metals	1	0	4	3	18	1	4	0	0	0	0	0	0	1
	Radiochemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Volatile Organics	0	0	0	0	15	0	0	0	0	0	0	0	0	0
	Pesticides	0	0	0	0	15	0	0	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Nitrate	1	0	1	0	5	1	2	0	0	0	0	0	0	1
	Fluoride	0	1	28	1	3	29	33	0	0	0	0	0	0	1
	Metals	3	0	1	5	15	1	4	0	0	0	0	0	0	0
	Radiochemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Volatile Organics	0	0	0	0	2	0	14	0	0	0	0	0	0	2
	Pesticides	0	0	0	0	1	0	13	0	0	0	0	0	0	0

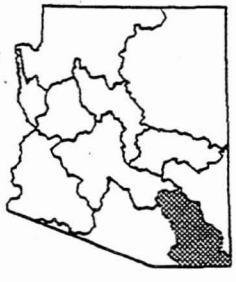
MONITORING DATA TYPE	PARAMETER GROUP	NUMBER OF WELLS						
		PARAMETER DETECTED						
GROUNDWATER BASINS		ARA	CC*	DG	L-SP	U-SP	SBV	WIL
WATER QUALITY INDEX WELLS	Volatile Organics	0	0	0	0	2	0	0
	Pesticides	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Volatile Organics	0	0	0	0	1	0	2
	Pesticides	0	0	0	0	0	0	1

* Only a small portion of Cienega Creek is in this basin; the majority is in the Santa Cruz Watershed.
Groundwater Basins: ARA = Aravaipa Canyon; CC = Cienega Creek; DG = Douglas; L-SP = Lower San Pedro; U-SP = Upper San Pedro; SBV = San Bernardino Valley; WIL = Willcox Playa.



Map 42. San Pedro-Willcox Playa-Rio Yaqui Watershed Wells Exceeding an Aquifer Water Quality Standard

Indian Reservation
Flouride
Radiation
Metal
Nitrate
Volatile Organic Compound
Pesticide
Watershed Boundary
Groundwater Basin
WS/GW Boundary



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KILOMETERS

N W E S

Special Studies in the San Pedro-Willcox Playa-Rio Yaqui Watershed--

- A baseline study of groundwater conditions in the Douglas Basin was initiated by ADEQ because of the dependence of the basin population on groundwater, as well as a history of groundwater quantity problems that culminated in 1980 with the designation of the Douglas Irrigation Non-expansion Area. The Douglas Groundwater Basin is located in the southeast portion of Arizona and includes the cities of Bisbee and Douglas, originally centers of mining and smelting, respectively. Also located within this groundwater basin are large tracts of irrigated agriculture and a rapidly growing population that is dispersed throughout the area. Test results from sampling 52 wells indicate the following:

  - Only two samples had parameters that exceeded a Primary Maximum Contaminant Level (for arsenic and nitrate).
  - Fifteen samples had parameters that exceeded a Secondary Maximum Contaminant Level: TDS (8 samples), fluoride (8), sulfate (2), iron (2), manganese (1), chloride (1), and pH (1).
  - There were no detections of pesticides on the Groundwater Protection List.
  - Only a single detection of volatile organic compounds has occurred in the ten well samples tested.
  - No radionuclide standards were exceeded in the six well samples tested.
  - Poor quality groundwater has only been encountered in an area north of the City of Douglas. Here water quality exceeded the following primary or secondary maximum contamination levels (MCLs and SMCLs).

PARAMETER	TEST RESULT	STANDARD
Arsenic	150 µg/l	(50 µg/l MCL)
Chloride	3,160 mg/l	(250 mg/l SMCL)
Sulfate	5,020 mg/l	(250 mg/l SMCL)
TDS	14,200 mg/l	(500 mg/l SMCL)
Iron	13,900 µg/l	(300 µg/l SMCL)
Manganese	1,520 µg/l	(50 µg/l SMCL)

  This poor quality groundwater is believed to be natural rather than from manmade sources. Further sampling is needed to determine the extent and source of this groundwater contamination.
  - Sulfate contamination of groundwater was also found east of Bisbee near Mule Gulch.

- ADEQ completed an investigation of water quality in Mule Gulch near the Copper Queen Mine in 1992. Mule Gulch begins in the Mule Mountains, flows through Tombstone Canyon of old Bisbee, continues in a concrete ditch along the edge of the Lavender Pit, and then passes the Lavender Mill and Warren Dump #7 area. Mule Gulch stops flowing on the surface before actually reaching Whitewater Draw. Phelps Dodge Corporation owns the property downstream of the outcrop and is conducting leaching operations on the Warren #7 dump. The findings and conclusions of this study included:

  - Water quality in Mule Gulch meets surface water standards until it leaves the Lavender Pit area. At this point (in the U.S. Highway 80 right of way) acidic drainage from a naturally mineralized outcrop seeps into the ditch.
  - The metals loading and acidity increase as the water passes by the Lavender Mill area.
  - Warren Dump #7 contributes metals to this stream through subsurface seepage.
  - Water quality standards are exceeded at every sampling point downstream of the mineralized outcrop.

Phelps Dodge has taken proactive measures to improve water quality, including the removal of mining related materials and improvements to stormwater containment in this area. In the impending application for an Aquifer Protection Permit for the Copper Queen Mine, ADEQ will further address water quality in Mule Gulch.

- ADEQ monitoring (ADEQ 1994a) detected the presence of the parasites Giardia and Cryptosporidium in the San Pedro River mainstem and the Babocomari River. Concentrations in the San Pedro River basin are relatively low. These parasites are widespread in their distribution and occurrence and have been found in other Arizona watersheds to date. However, the presence of Giardia and Cryptosporidium (which cause flu-like symptoms and diarrhea when ingested) indicates that drinking of untreated water should be avoided.

- Fifteen examples of erosion control structures have been constructed at the educational center in Sierra Vista, Arizona. This is a cooperative demonstration project through Nonpoint Source Program funding to provide examples of existing technologies for minimizing sediment discharges for urban and rural settings. This has been a cooperative effort between ADEQ, Cochise County, the Coronado Resource Conservation and Development Area, City of Sierra Vista, Herford Natural Resource Conservation District, the Natural Resource Conservation Service, the University of Arizona, and the U.S. Forest Service.

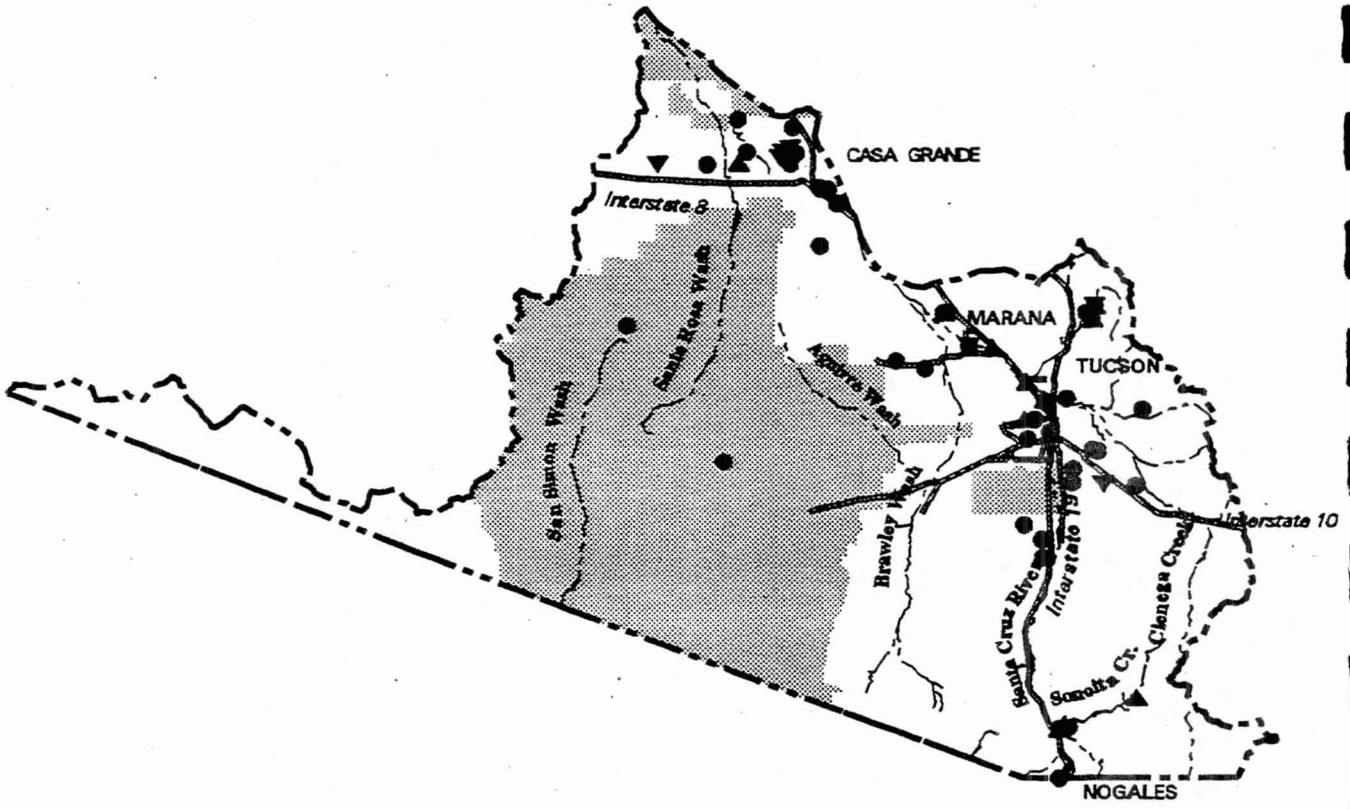
- In 1995, a study of stream-to-aquifer relations and water budget components in the upper San Pedro Basin was initiated by USGS, in cooperation with ADWR, BLM, and other federal and local organizations. The area being studied extends from Fairbank, Arizona to the United States-Mexico border. The study involves geochemical investigations, stream and aquifer monitoring, aquifer storage monitoring, geophysical investigations, and other aquifer tests. Although isotope and other chemical analyses have not been completed, stable isotope values in the deep and shallow wells at a well transect indicate at least two sources of water to the stream alluvium.

- A regional groundwater study within the Upper San Pedro Groundwater Basin was initiated during the summer of 1996 by ADEQ and the USGS. Sampling sites have been determined through a stratified random selection process. This project has four main objectives:

    - To obtain baseline data on the occurrence, concentrations, and ranges of a wide array of groundwater quality parameters,
    - To determine statistically significant groundwater quality differences between areas within the groundwater basin,
    - To assess the impact on groundwater quality from specific land uses or management practices (e.g., septic systems and mining activity), and
    - To statistically assess groundwater quality within the basin for significant temporal changes.

Characterization of the Santa Cruz-Rio Magdalena -Rio Sonoyta Watershed

SIZE	11,096 square miles (10% of the State's land area).
POPULATION BASE	730,500 people (20% of the State's population). Major communities are shown on **Map 43**. Most of the population is clustered around metropolitan Tucson, the State's second largest city.
LAND OWNERSHIP	Tribal 39%; Private 22%; State 15%; U.S. Forest Service 10%; Bureau of Land Management 6%; National Wildlife Refuge 4%; Other state and federal 3%; Military 1%
LAND USES AND PERMITS	• Grazing and irrigated crop production (near stream beds) are the dominant land uses. Some of the agricultural land has been converted to urban use or retired (where water rights have been purchased by mining or urban interests). • Active mining varies with the current market price. • The watershed includes eight designated wilderness areas. • The location of facilities with wastewater discharge permits is shown on **Map 43**.
HYDROLOGIC PROVINCE(S)	Basin and Range Province.
ECOREGIONS	Primarily Southern Basin and Range, with southeastern corner in Southern Deserts.
GROUNDWATER BASINS	Cienega Creek, San Rafael, San Simon Wash, Tucson AMA, Santa Cruz AMA, Pinal AMA, and West Mexican Drainage.
HYDROLOGY AND GEOLOGY	• This watershed is a composite of three surface water basins: the Santa Cruz which flows north, and the Rio Magdalena and Rio Sonoyta which flow south into Mexico. • Extensive groundwater pumping has eliminated natural perennial flow in the Santa Cruz River. Wastewater provides perennial flow below discharges from the cities of Nogales (Arizona and Sonora, Mexico) and Tucson (Brown et al. 1978). • The maximum discharge of the Santa Cruz River is 33,000 cfs (in 1983 near its confluence with the Gila River). In recent years, no flow has been measured during most of the year (USGS 1996). • Broad, gently-sloping alluvial basins are separated by fault block mountains that trend to the north to northwest. Generally, basin-fill sediments comprise the productive and widely used aquifers. Only minor amounts of groundwater are found in the surrounding hardrock mountains in thin alluvial valley deposits and fractured bedrock (ADWR 1994).
UNIQUE WATERS	Cienega Creek
OTHER STATES, NATIONS, OR TRIBES	Mexico. Tohono O'odham, San Xavier, Pascua Yaqui, Ak Chin, and Gila River Indian tribes.



Map 43. Santa Cruz-Rio Magdelana-Rio Sonoyta Watershed Water Protection Permits

- Indian Reservation
- NPDES
- APP & GWPP
- Reuse
- Watershed Boundary
- Stream
- Primary Highway
- Secondary Highway
- WS/GW Boundary

SCALE
MILES 10 0 10 20 30 40
KILOMETERS 10 0 10 20 30 40 50

Surface Water Assessments--Water quality assessments and surface water monitoring sites are illustrated on **Map 44** and assessments are summarized below. Major stressors and probable sources are listed in rank order; minor stressors and sources are not shown. Individual waterbody assessments are provided in **Appendix F**. Additional information concerning stressors which cause impairment and associated sources was presented in Part IV of this chapter.

SANTA CRUZ SURFACE WATER BASIN ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	33 reaches (14 monitored 19 evaluated)	Full support - 194 miles Impaired - 164 miles	Low pH, copper, turbidity, low dissolved oxygen, lead, and arsenic.	Natural, resource extraction, rangeland practices, and loss of riparian vegetation.
LAKES	7 lakes (all evaluated)	Full support - 0 acres Impaired - 727 acres	Manganese, noxious plants, mercury.	Flow modification, natural, inactive or abandoned mines.

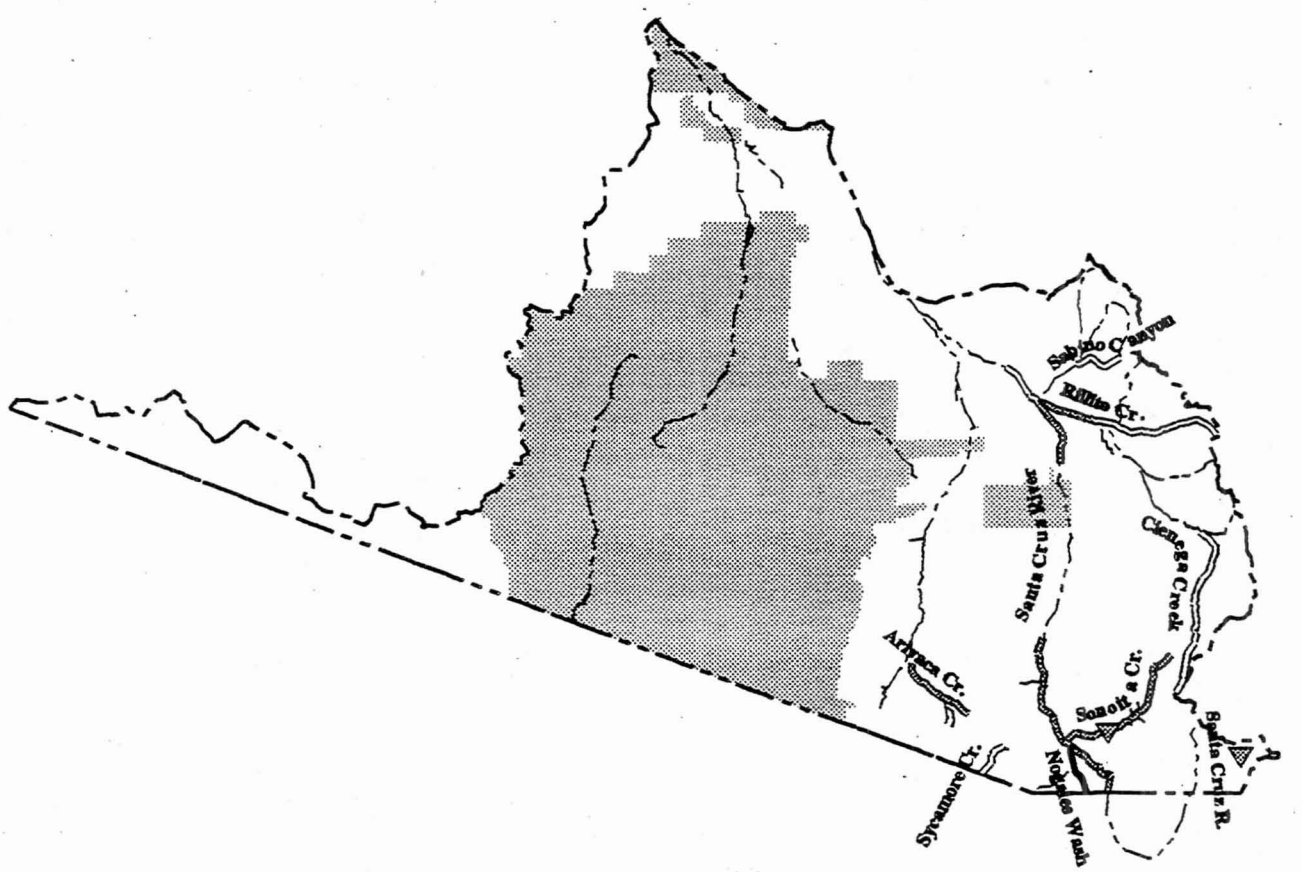
RIO MAGDALENA-RIO SONOYTA SURFACE WATER BASIN ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	2 reaches (1 monitored 1 evaluated)	Full support - 23 miles Impaired - 0 miles		
LAKES	0 lakes			

Groundwater Assessments--Groundwater monitoring data collected during 1991-1995 are summarized by groundwater basins in **Table 23** and illustrated on **Map 45**. The limited groundwater data available suggests the following assessments:

- Nitrate and fluoride exceed Aquifer Water Quality Standards in a few wells within several groundwater basins.
- Volatile organic chemicals are a concern within the Tucson and the Santa Cruz Active Management Areas.

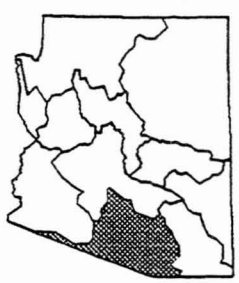
Older groundwater quality data, collected by state and federal agencies between 1975-1990, show the median concentrations of selected indicators of potability (i.e., hardness, nitrate, TDS, and sulfate) in the Tucson and Pinal Active Management Areas are less than the Aquifer Water Quality Standards or secondary maximum contaminant levels for drinking water. This suggests that regional groundwater quality conditions support drinking water uses in these areas.

Investigations of potential groundwater contamination have lead to site remediation efforts through the state and federal Superfund Program (WQARF and CERCLA, respectively), the Underground Storage Tank Program, and the Resource Conservation and Recovery Act Program. Some groundwater is naturally contaminated with metals, halogens, and other inorganics. The status of these known contamination sites is provided in **Appendix G**, along with a map illustrating where these sites occur.



Map 44. Santa Cruz-Rio Magdelana-Rio Sonoyta Watershed Surface Water Assessments

- Indian Reservations
- Fully Supported/ Threatened Lake
- Partially Supported Lake
- Not Supported Lake
- Watershed Boundary
- Streams
- Fully Supported or Threatened
- Partially Supported
- Not Supported



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KILOMETERS 10 0 10 20 30 40 50

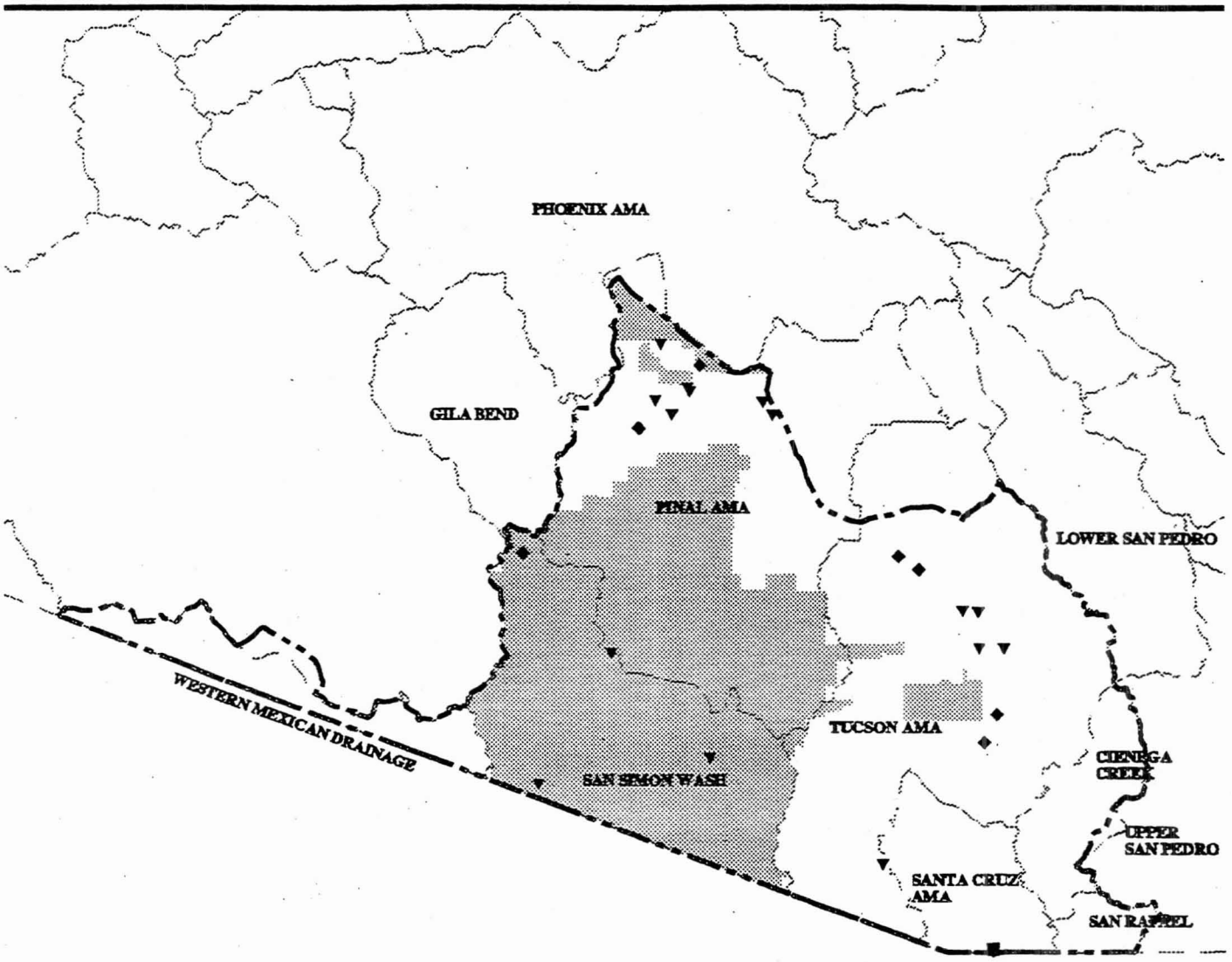
N W E S

Table 23. Santa Cruz-Rio Magdelena-Rio Sonoyta Watershed - Groundwater Monitoring Summary (1991-1995)

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS SAMPLED							NUMBER OF WELLS EXCEEDED AQUIFER WATER QUALITY STANDARD						
GROUNDWATER BASINS		CC	Pinal AMA	Santa Cruz AMA	SR	SS	Tuscon AMA	WM	CC	Pinal AMA	Santa Cruz AMA	SR	SS	Tucson AMA	WM
WATER QUALITY INDEX WELLS	Nitrate	1	12	3	1	0	9	1	0	0	0	0	0	0	0
	Fluoride	0	23	2	0	1	17	0	0	5	0	0	0	2	0
	Metals	1	12	3	1	0	9	1	0	0	0	0	0	0	0
	Radiochemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Volatile Organics	0	1	0	0	0	1	0	0	0	0	0	0	0	0
	Pesticides	0	1	0	0	0	1	0	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Nitrate	0	3	7	0	2	42	0	0	3	1	0	1	4	0
	Fluoride	20	32	11	2	20	73	0	0	2	0	0	3	3	0
	Metals	0	2	5	0	1	39	0	0	0	0	0	0	0	0
	Radiochemicals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Volatile Organics	0	65	8	0	2	44	0	0	0	1	0	0	0	0
	Pesticides	0	65	7	0	2	44	0	0	0	0	0	0	0	0

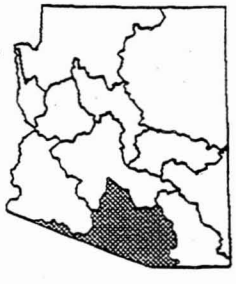
MONITORING DATA TYPE	PARAMETER GROUP	NUMBER OF WELLS PARAMETER DETECTED						
GROUNDWATER BASINS		CC	Pinal AMA	Santa Cruz AMA	SR	SS	Tucson AMA	WM
WATER QUALITY INDEX WELLS	Volatile Organics	0	0	0	0	0	0	0
	Pesticides	0	0	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Volatile Organics	0	0	2	0	0	5	0
	Pesticides	0	0	0	0	0	0	0

Groundwater Basins: CC = Cienega Creek; Pinal Active Management Area (AMA); SR = San Rafael; SS = San Simon Wash; Tucson AMA; and WM = West Mexican Drainage. Portions of Pinal and Tucson AMAs are also in the Middle Gila Watershed.



Map 45. Santa Cruz-Rio Magdelana-Rio Sonoyta Watershed Wells Exceeding an Aquifer Water Quality Standard

Indian Reservation
Flouride
Radiation
Metal
Nitrate
Volatile Organic Compound
Pesticide
Watershed Boundary
Groundwater Basin
WS/GW Boundary



SCALE
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KILOMETERS 10 0 10 20 30 40 50

N W E S

Special Studies in the Santa Cruz-Rio Magdalena-Rio Sonoyta Watershed–

- Water quality, fish, and macroinvertebrate communities were surveyed in the upper Santa Cruz River in 1993 (ADEQ 1995d). This was a cooperative effort between volunteers from the Friends of the Santa Cruz River and ADEQ. Equipment and other services were provided by the Arizona State Parks, Santa Cruz County Health Department, Arizona Game and Fish Department, and the International Boundary and Water Commission. The purpose was to document changes in water quality in the effluent dependent Santa Cruz River below the Nogales International Wastewater Treatment Plant because of concerns about the safety of the water for recreational use and potential threats to animals dependent on the water. Findings and conclusions of this study included:

  - Bacterial exceedances of water quality standards were minimal; however, it is strongly recommended that people restrict their contact with water to a minimum (i.e., swimming in this effluent dependent water is not recommended and not a designated use).
  - Metals do not appear to be a threat to aquatic life.
  - Nutrients from the treatment facility rapidly diminish downstream.
  - Un-ionized ammonia concentrations near the treatment plant are believed to have had severe impacts on fish populations.
  - The macroinvertebrate community was severely impaired near the treatment plant, but recovered slightly downstream.
  - Water clarity was generally good, except during high flow events.

- Surface water and groundwater contamination in Nogales, Arizona and Nogales, Sonora Mexico, has led to an international study and mitigation effort. A summary of this study is included in the next chapter, as one of the special initiatives in water quality in Arizona.

- Investigations of ASARCO's Trench Camp mine tailings and the Worlds Fair Mine were conducted in 1995 by ADEQ to determine the effectiveness of remediation efforts on surface water quality in Alum Gulch, Humboldt Canyon, and Harshaw Creek (all tributaries of Sonoita Creek). ASARCO built diversion channels and re-contoured, capped, and revegetated the Trench Camp tailings between 1990-1993. In 1994, ASARCO built a wetland treatment system for the acidic discharge coming from the January Mine which is also located in this drainage. The findings and conclusions of this study were:

  - Remediation has reduced the copper and acidity in the watershed; however, six other indicators of acid mine drainage have increased (total dissolved solids, sulfate, cadmium, lead, manganese, and zinc).
  - Water in Alum Gulch does not meet surface water standards for copper, cadmium, zinc, and pH.
  - Further remediation of the discharge from Trench Camp into Alum Gulch and the Worlds Fair Mine is advised. Removal of some tailings and spoil piles in Humboldt Canyon is desirable, although of lower priority than the other two mining sites.
  - The effectiveness of the constructed wetlands treatment system needs to be studied carefully, as the pH of the water at the dam is lower than the incoming water, and this suggests that treatment is not neutralizing the acidity of the mine drainage.

- Surface water monitoring in Three R Canyon by ADEQ in 1993 revealed acid mine contamination (high levels of arsenic, beryllium, cadmium, copper, and zinc, and low pH). Probable sources include the Three R Mine and the Worlds Fair Mine, but the contribution from each mine has not been determined. A series of newly installed groundwater wells will be monitored to develop information concerning groundwater quality for the Three R Mine as part of the pending Aquifer Protection Permit. Surface water and groundwater concerns will be addressed during the permitting process for this facility.

- There are three major mines along the Santa Cruz River in the Pima Mining Area south of Tucson: Cyprus Sierrita, Cyprus Twin Buttes, and ASARCO Mission. During the process of developing an Aquifer Protection Permit for Cyprus Sierrita, a plume of water heavily contaminated with total dissolved solids and sulfate has been defined. Cyprus Sierrita and Cyprus Twin Buttes have been determined as sources. The extent of contribution from the ASARCO Mission mining operation is unknown. A line of interceptor wells installed at the tailings impoundment in the 1970's did not keep this plume from forming (possibly because several of these wells were not working and had to be repaired or replaced recently). It is anticipated that the development of Aquifer Protection Permits for these three facilities and the implementation of actions called for under these permits should resolve all groundwater concerns.

- An overview investigation of groundwater contamination and remediation efforts at the Tucson International Airport Area Superfund Sites is nearing completion, based on a review of existing hydrologic and geologic data from many sources. A report is being prepared by the USGS, in cooperation with the U.S. Air Force. The report will summarize the progress of remediation efforts and will identify potential limitations to complete aquifer restoration. As a component of the investigation, a unified geographic information system database was created to store well and water quality data from many sources.

- The Nogales Wellhead Protection Program technical committee has completed delineating Wellhead Protection Areas for existing City of Nogales wells, and has begun the process of delineating Wellhead Protection Areas for potential future water supply sources. The committee will present project information to representatives from Mexico to seek their interest in establishing a similar program in Nogales, Sonora, since Wellhead Protection Areas in Nogales, Arizona extend hydrologically into Mexico.

- The Tucson Implementation Project technical subcommittee was established to provide coordination between ADEQ programs, local government agencies, and responsible parties. A technical subcommittee was to coordinate cleanup strategies and share data, and a newsletter was published to help share information on the status of projects within the study area. The project ended in 1996 without completing its purpose due to a lack of resources. ADEQ intends to address these tasks again when the Watershed Protection Approach is established in this area (see discussion of this initiative in Chapter 3).

- The Southern Pacific is cooperating with the Arizona Department of Transportation in the removal and thermal treatment of diesel contaminated soil. More than 180,000 tons of contaminated soil has been removed from the Broadway Traffic Interchange area in downtown Tucson. The Southern Pacific is continuing with free product recovery of diesel from the downtown Tucson area.

- An investigation of groundwater in the Casa Grande area was initiated by ADEQ because of potential impacts from septic systems on groundwater quality in an area north of Casa Grande. The agricultural use of fertilizers also could be a source of nutrients to the groundwater in this study area. The findings and conclusions from this study included:

    - The maximum contaminant level for nitrate was exceeded in two clusters within the study area: a subdivision in the northwest corner of the study area containing a high concentration of septic systems, and an area southeast of the Casa Grande wastewater treatment plant.
    - High fluoride and arsenic concentrations found in the northeast portion of the study area appear to be associated with natural sources.
    - Further groundwater contamination from septic systems can only be relieved through requiring the area to be sewered.

- In 1995 both Peña Blanca Lake and Arivaca Lake had fish advisories posted due to high mercury levels in game fish. In both cases, historic mining practices are believed to have contributed mercury into the

lake's ecosystem. A holistic watershed approach to resolve this problem is needed because of the size and number of abandoned mines within these watersheds. Remediation of abandoned mines and related facilities in these watersheds (and many others in Arizona) is expected to be a lengthy and expensive process, and one which cannot be undertaken without proper planning and commitment.

- The City of Tucson Water is conducting a pilot project to inject Central Arizona Project (CAP) canal water into the ground. The project, known as the Central Avra Valley Storage and Recovery Project, is utilizing 16 wells in a five square mile area of the central portion of the Tucson Basin. The project is designed to inject up to 10,000 acre feet of water over a two-year period. Tucson Water is taking progressive steps to utilize their CAP water resource. Plans include utilizing similar projects throughout the groundwater basin so that they may store the maximum amount of CAP water within their well-field.

- The Pima County Flood Control District is coordinating the investigation of several existing and proposed recharge projects. Investigations have focused on three potential recharge areas: along Rillito Creek, along Canada del Oro, and along Santa Cruz. Pima County Association of Governments is providing groundwater monitoring data from wells along the Santa Cruz, while the Metropolitan Domestic Water Improvement District is providing groundwater data along Canada del Oro. The USGS monitored surface water, groundwater, and bottom sediment in the Rillito Creek drainage area from 1986 through 1994 as part of a groundwater recharge study (Tadayon et al. 1994, Tadayon 1995a and 1995b). The USGS study concluded that pesticides and priority pollutants were detected in some surface water and sediment samples, but not in groundwater. The Rillito Creek area has been dropped from further study as a potential stormwater recharge area.

- The Arizona Geological Survey completed aquifer vulnerability analysis of Pinal County using a modified DRASTIC methodology. [DRASTIC = **D**epth to groundwater, net **R**echarge, **A**quifer media, **S**oil media, **T**opography, **I**mpact of the vadose zone, and hydraulic **C**onductivity.] The author of the study encountered problems applying the DRASTIC methodology to an arid region, and therefore, modified the DRASTIC methodology to produce maps that more accurately reflect assumptions about the vulnerability of groundwater to contamination in arid areas such as Pinal County. The Pinal County DRASTIC maps reflected the following problems and modifications:

  - The maximum depth to water recognized by the DRASTIC methodology is 100 ft. However, pollution potential is not negligible below this depth. In southern Arizona, the depth to water is usually greater than 100 ft. Perched water zones are common, but are discontinuous and often impossible to contour.
  - Recharge criteria were difficult to interpret. Recharge from precipitation is considered negligible in arid regions because evapotranspiration greatly exceeds precipitation. Most stream flow in the county is ephemeral, which is of short duration in direct response to rainfall. This type of flow is not conducive to aquifer recharge. One of the greatest sources of recharge is agricultural return flow, a large portion of which infiltrates to the aquifer below the irrigated area. The DRASTIC methodology does not address these conditions.
  - DRASTIC rates "thin or absent soil" as a high threat to aquifer contamination because such soil will provide no pollution attenuation. However, in Pinal County where soil is thin or absent (i.e., rock outcrops in the mountains), pollution attenuation is irrelevant during rainfall runoff.
  - Hundreds of earth fissures (up to 35 feet wide and 7 miles long) exist in the Pinal County area as a result of groundwater pumping for irrigation. Earth fissures form where horizontal stress exceeds sediment tensile strength due to compaction. Such fissures can substantially increase the potential for groundwater pollution. Since there is no rating for earth fissures in the DRASTIC methodology, the author of the study added a rating to areas that are known to have fissures.

- Conglomerate and caliche, two common soil types in the area are not rated in DRASTIC. Ratings for these were added by the author as well.
- The DRASTIC analysis indicated that groundwater pollution potential is greatest along streambeds and in irrigated areas. It is minimal in mountainous regions, as well as where the depth to water is a large distance.

- A study of the potential pollutants in soil along Ephraim Canyon Wash in Nogales, Arizona was conducted by ADEQ in 1995. The following four potential sources of pollutants have been identified:

  - A livestock holding facility, located in the town of Nogales, Sonora (Mexico), is situated on top of a small hill that drains into Ephraim Canyon Wash, which in turn flows through the town of Nogales, Arizona, and eventually enters the Santa Cruz River. This facility has a capacity of handling 2000 head per day, and about 1500 head are processed on an average day. The facility has not initiated any measures to restrict the migration of chemicals used for its cattle dipping operation, and it uses about 3,200 gallons of dipping solution per week (a mixture of coumaphos (43%) and plutonic (6%)). Manure, which is removed from the pens to an unknown storage site, is a source of nitrate contamination around the facility.
  - An automobile junk yard, situated on the banks of Ephraim Canyon Wash, may be generating contaminants, such as: heavy metals, polychlorinated biphenyl, benzene, toluene, ethylbenzene, and xylene.
  - An old ammunition bunker located in Camp Little (the camp was abandoned in the 1930s) has potentially contributed metals and nitrate.
  - A historic landfill situated in the western part of Nogales, Arizona. Potential contaminants from this site are unknown; however, metals, pesticides, total petroleum hydrocarbons, and petroleum derivatives are typical contaminants from landfills.

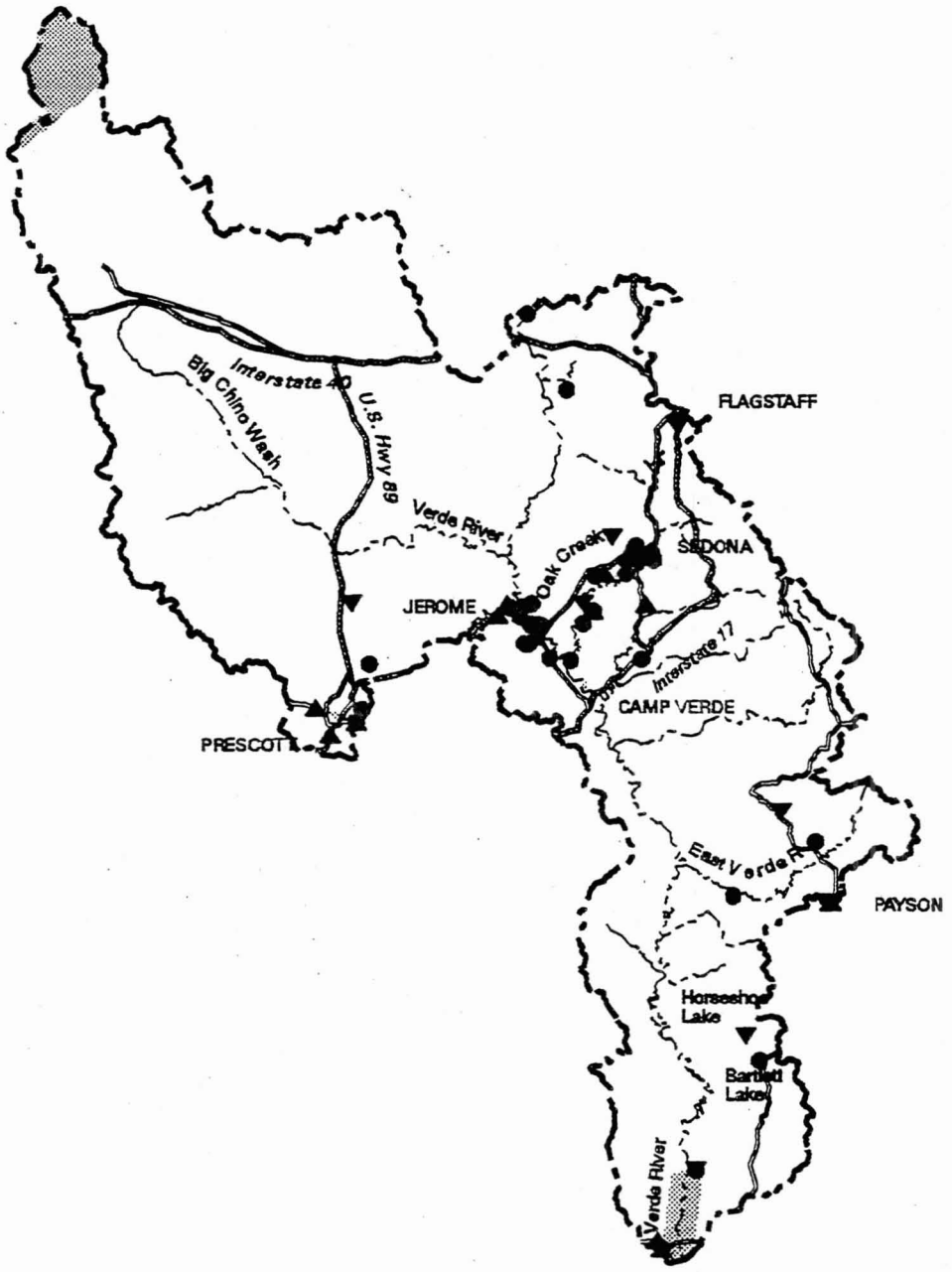
  Sediment sample results indicated that all chemicals were below established reference levels.

- A surveillance monitoring study of parasites and virus in the Santa Cruz River Basin was conducted by ADEQ and ADHS in 1990-91 (ADEQ 1993a). The findings and conclusions of this study included:

  - Giardia and Cryptosporidium parasites are widespread, found in the Santa Cruz River, its tributaries, and in other Arizona watersheds to date. The presence of Giardia and Cryptosporidium (which cause flu-like symptoms and diarrhea when ingested) indicates that the drinking of untreated water should be avoided.
  - Streams receiving treated or untreated wastewater discharges had a higher incidence of Giardia than those not receiving these discharges.
  - Streams with cattle grazing along the stream banks had higher incidences of Cryptosporidium than non-grazed streams.

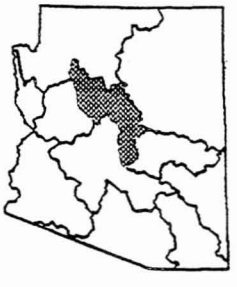
Characterization of the Verde River Watershed

SIZE	6,624 square miles (6% of the State's land area).
POPULATION BASE	111,000 people (3% of the State's population). Major communities are shown on **Map 46**.
LAND OWNERSHIP	U.S. Forest Service 64%; Private 23%; State 10%; Tribal 2%; Other state and federal 1%
LAND USES AND PERMITS	Primary land uses are silviculture, grazing, irrigated agriculture, recreation, and some mining. **Map 46** indicates the location of facilities with wastewater discharge permits.
HYDROLOGIC PROVINCE(S)	Central Highlands (southern half), Plateau Uplands (northern half).
ECOREGIONS	Arizona-New Mexico Mountains, except for the southern tip which is in the Southern Basin and Range.
GROUNDWATER BASINS	Verde River, Peach Springs, the northeast half of Prescott AMA, and a small portion of the Phoenix AMA.
HYDROLOGY AND GEOLOGY	• The Verde River and many of its tributaries are perennial (Brown et al. 1978). • Flows from the Verde River are regulated at two reservoirs -- Horseshoe Lake and Bartlett Lake. • Elevation ranges from more than 12,000 feet in the San Francisco Mountains to about 1,600 feet in the south. The Mogollon Rim escarpment forms a topographic relief of as much as 2,000 feet and trends northwest across the watershed. • Principal aquifers occur in: - Basin-fill sediment and alluvium (i.e., sands, gravels, clays, conglomerate) interbedded with basalt flows, - A shallow alluvial aquifer within the floodplain of the Verde River. - A sequence of limestones and sandstones, typical of the Verde Valley area (ADWR 1994). • Flow above Horseshoe Reservoir on the Verde River varies from 48 cfs (1956) to 145,000 cfs (1993), and the annual mean flow since 1946 has been 599 cfs (USGS 1996).
UNIQUE WATERS	Oak Creek and West Fork of Oak Creek
OTHER STATES, NATIONS, OR TRIBES	Camp Verde, Tonto Apache, Yavapai-Prescott, and Fort McDowell Indian tribes.



Map 46. Verde Watershed
Water Protection Permits

- Indian Reservation
- NPDES
- APP & GWPP
- Reuse
- Watershed Boundary
- Stream
- Primary Highway
- Secondary Highway
- WS/GW Boundary



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Surface Water Assessments--Water quality assessments and surface water monitoring sites are illustrated on **Map 47** and assessments are summarized below. Major stressors and probable sources are listed in rank order; minor stressors and sources are not shown. Individual waterbody assessments are provided in **Appendix F**. Additional information concerning stressors which cause impairment and associated sources was presented in Part IV of this chapter.

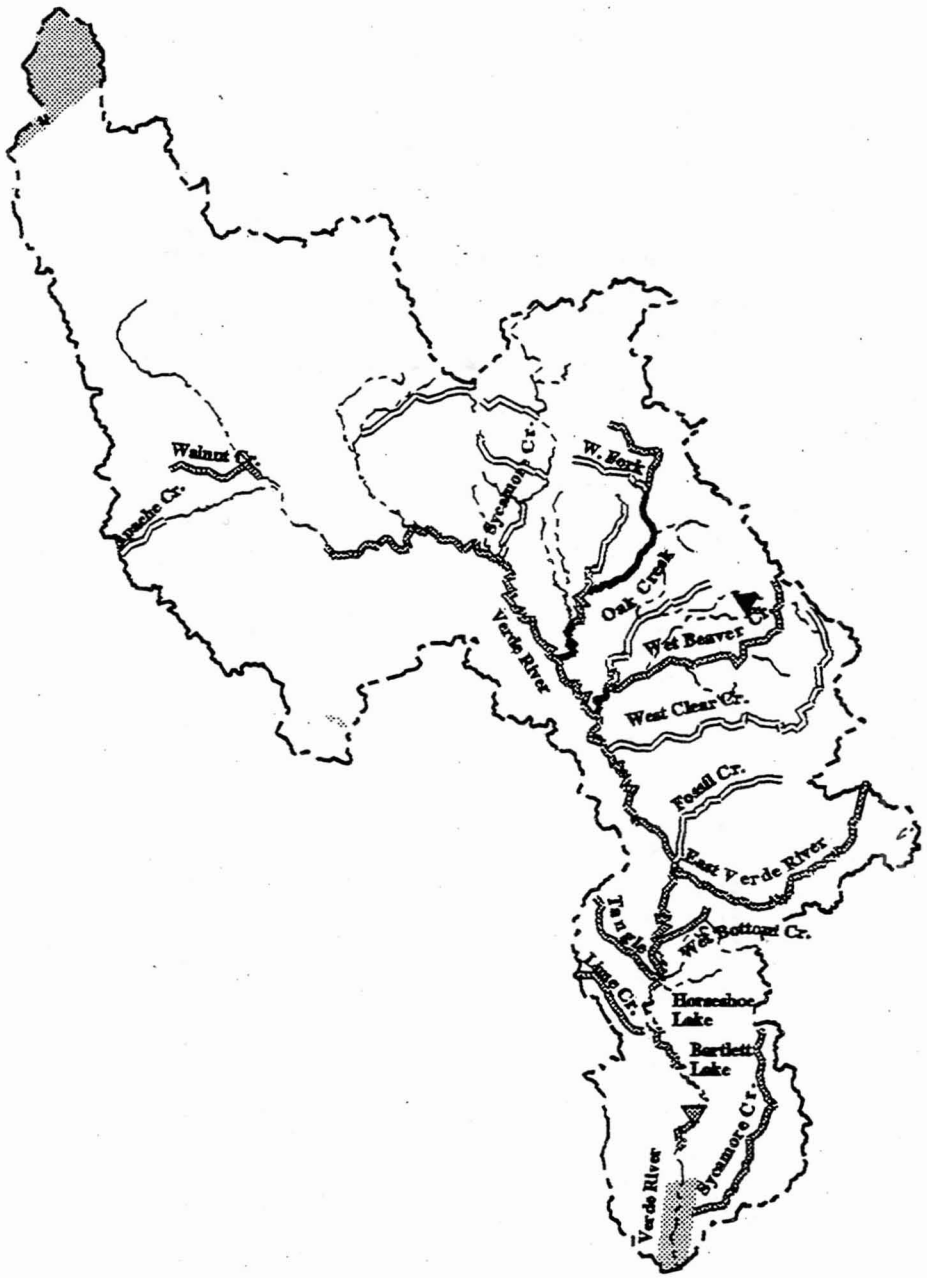
VERDE SURFACE WATER BASIN ASSESSMENT SUMMARY - 1996				
	Total Number Assessed	Use Support	Major Stressors	Probable Sources
STREAMS	66 reaches (25 monitored 41 evaluated)	Full support - 287 miles Impaired - 453 miles	Arsenic and turbidity	Natural, recreation, rangeland management, loss of riparian vegetation, silviculture, construction.
LAKES	9 lakes (2 monitored 7 evaluated)	Full support - 30 acres Impaired - 2334 acres	Arsenic, noxious plants, high pH, low dissolved oxygen	Natural and flow modification.

Groundwater Assessments--Groundwater monitoring data collected in 1991-1995 are summarized by groundwater basins in **Table 24** and illustrated on **Map 48**. The limited groundwater data available suggests the following assessments:

- Groundwater quality in the Prescott AMA and Peach Springs Basin is very good.
- Volatile organic chemicals are a concern in the Verde River Basin. All of the detections and exceedances occurred only in the Payson area.
- Arsenic is the groundwater "metal" of concern in the Verde River Basin.

Older groundwater data collected by state and federal agencies since 1975 show the median concentrations of selected indicators for potability (i.e., hardness, nitrate, TDS, and sulfate) for the Verde River Groundwater Basin are less than Aquifer Water Quality Standards and secondary maximum contaminant levels for drinking water. This suggests that regional groundwater quality conditions support drinking water uses.

Investigations of potential groundwater contamination have lead to site remediation efforts through the state and federal Superfund Program (WQARF and CERCLA, respectively), the Underground Storage Tank Program, and the Resource Conservation and Recovery Act Program. Some groundwater is naturally contaminated with metals, halogens, and other inorganics. The status of these known contamination sites is provided in **Appendix G**, along with a map illustrating where these sites occur.



Map 47. Verde Watershed Surface Water Assessments

- Indian Reservations
- Fully Supported/ Threatened Lake
- Partially Supported Lake
- Not Supported Lake
- Watershed Boundary
- Streams
- Fully Supported or Threatened
- Partially Supported
- Not Supported

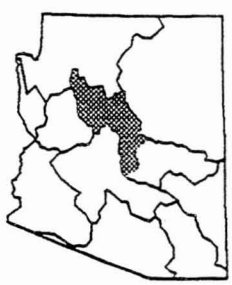


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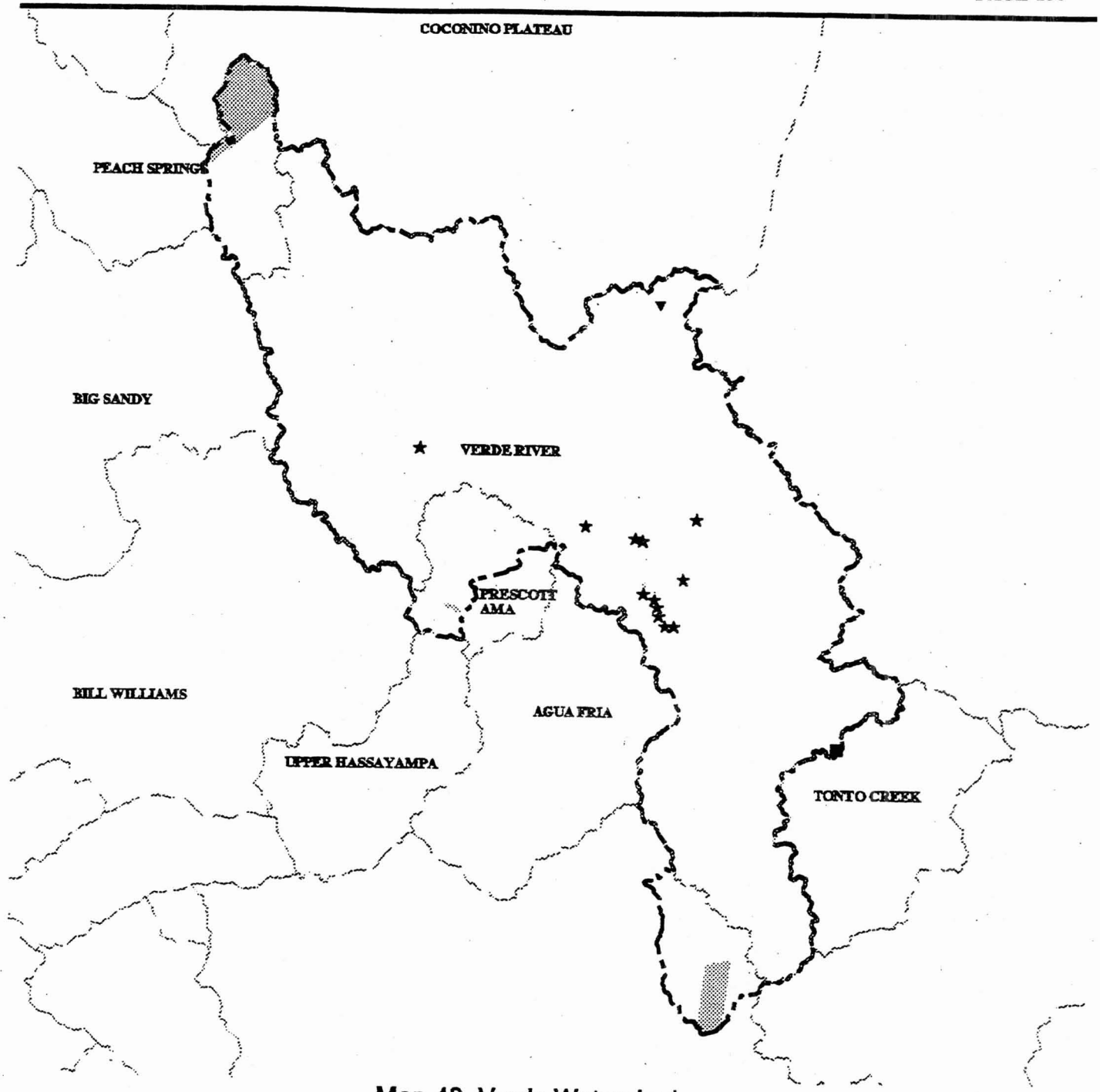
Table 24. Verde Waterhed - Groundwater Monitoring Summary (1991-1995)

MONITORING DATA TYPE	PARAMETER OR PARAMETER GROUP	NUMBER OF WELLS							
		SAMPLED				EXCEEDED AQUIFER WATER QUALITY STANDARD			
GROUNDWATER BASINS		Phoenix AMA*	Peach Springs	Prescott AMA*	Verde River	Phoenix AMA*	Peach Springs	Prescott AMA*	Verde River
WATER QUALITY INDEX WELLS	Nitrate	1	9	1	5	0	0	0	0
	Fluoride	1	1	9	3	0	0	0	0
	Metals	0	0	3	24	0	0	0	2
	Radiochemicals	0	0	0	3	0	0	0	0
	Volatile Organics	0	0	8	0	0	0	0	0
	Pesticides	0	0	8	0	0	0	0	0
OTHER GROUNDWATER MONITORING	Nitrate	0	2	0	115	0	0	0	0
	Fluoride	0	4	9	21	0	0	0	1
	Metals	2	2	30	260	0	0	0	7
	Radiochemicals	0	0	2	19	0	0	0	0
	Volatile Organics	0	0	2	48	0	0	0	25
	Pesticides	0	0	3	50	0	0	0	0

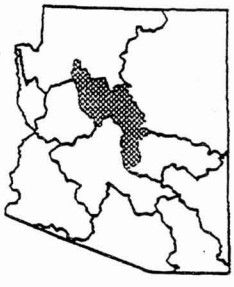
MONITORING DATA TYPE	PARAMETER GROUP	NUMBER OF WELLS			
		PARAMETER DETECTED			
GROUNDWATER BASINS		Phoenix AMA*	Peach Springs	Prescott AMA*	Verde River
WATER QUALITY INDEX WELLS	Volatile Organics	0	0	0	0
	Pesticides	0	0	0	0
OTHER GROUNDWATER MONITORING	Volatile Organics	0	0	1	42
	Pesticides	0	0	0	0

* Note: the southern half of the Prescott Active Management Area (AMA) and the majority of the Phoenix AMA is in the Middle Gila Watershed.



Map 48. Verde Watershed
Wells Exceeding an Aquifer Water Quality Standard

Indian Reservation
Flouride
Radiation
Metal
Nitrate
Volatile Organic Compound
Pesticide
Watershed Boundary
Groundwater Basin
WS/GW Boundary



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Special Studies in the Verde Watershed:

- The United Verde Mine in the Bitter Creek sub-watershed has been investigated by ADEQ in 1991, 1993, 1994, and 1995. Violations of surface water standards at both low and high flow conditions have been documented. All discharges on the property have been sampled (six sites); however, only two discharges are related to natural surface water drainage areas and subject to surface water standards: spring water at the toe of the 500 level dump and the Section House Springs drainage at Hopewell Tunnel. Both sites failed to meet surface water standards; however, the construction of a settling pond in 1993 may account for improved water quality in the stream course at the Hopewell Tunnel, which met all applicable surface water standards in 1995.

  Phelps Dodge has applied for an Aquifer Protection Permit and has proposed a plan for managing and containing acid mine runoff from the United Verde Mine. The system is to consist of a series of earthen dams and lined impoundments that will contain stormwater and allow evaporation of contaminated mine drainage on-site. Stormwater and spring water originating up gradient of the United Verde mine is to be captured and discharged off-site before contamination can occur. This should allow Phelps Dodge to close and remediate 22 unlined stormwater retention ponds constructed in the Section House Springs Wash.

- Investigation by Phelps Dodge, in cooperation with ADEQ and EPA, revealed that groundwater contamination is limited to a shallow aquifer and has not impacted the regional drinking water aquifer underlying the tailing pile. The shallow aquifer is impacted by high levels of sulfate, magnesium, total dissolved solids and low levels of metals (i.e., zinc, cadmium, copper, iron, manganese, and arsenic).

  Two Aquifer Protection Permits have been issued in conjunction with the reclamation of the Phelps Dodge's Clarkdale Tailings Impoundment, which is adjacent to Pecks Lake. The following actions are to be taken to fulfill requirements of the new Aquifer Protection Permits:

  - Cease discharging effluent from municipal Clarkdale Wastewater treatment Plant to the tailings pile and build a new treatment plant.
  - Cap and underdrain the tailings pile (cap will be a synthetic liner and a minimum three-feet of soil cover),
  - Construct a soil-bentonite slurry wall between Pecks Lake and the pile,
  - Operate a groundwater pumpback system to stop the seepage of contaminated groundwater currently discharging into the Verde River.

  Groundwater from the shallow aquifer beneath the tailings pile is to be mixed with treated effluent from the new treatment plant and fresh water for use on a proposed golf course for the Verde Valley Ranch development. A portion of the golf course will be constructed on top of the capped tailings pile. No homes will be built on top of the tailings pile.

- The sources and fate of arsenic in the Verde River were studied by Arizona State University (Baker 1994). A low-flow arsenic mass balance and a multi-year mass balance were developed for USGS stations in this watershed. The findings and conclusions of this study were:

  - Arsenic levels decreased with increasing flow, with highest concentrations around 25 μg/l at low flow.
  - The major source of arsenic was the Verde Formation, a soft, sedimentary deposit.
  - Streams with adjacent mine tailings piles had arsenic concentrations less than 10 μg/l, thereby indicating minimal contamination from mine tailings.
  - The reservoirs on the Verde River trap particulate arsenic (93% efficiency) and remove about 16%

of the total arsenic.

- A Verde River reclamation survey was conducted in 1991 by Arizona State University (Cook et al. 1991) to identify riparian areas in need of reclamation. The area of focus, between Tapco Substation to Beasley Flat, is known as the Verde River Corridor Project, and includes: Clarkdale, Cottonwood, Camp Verde, the Tuzigoot National Monument, Dead Horse Ranch State Park, and Pecks Lake. Findings and conclusions of the study included:

  - The major areas in need of reclamation included approximately 492.5 acres in 12 different sites. The 12 reclamation sites included: five recreation areas, four sand and gravel operations, one mill tailings pile, one tailings pond and one construction site.
  - The most urgent problem appeared to be the eroding riverbanks in 17 locations.

- Verde River fish were collected by the USFWS at two sites as part of a statewide study of bald eagle prey (King et al. 1991). The fish had elevated levels of heavy metals (i.e., copper, chromium, mercury, nickel, selenium, and zinc) as compared to screening values (see Appendix A). The report concluded that at the Verde River sites, the elements most likely to cause problems for eagles were cadmium and selenium.

- A basic limnological study of Bartlett Reservoir on the Verde River was the subject of a master's thesis at Arizona State University (Parks 1995). This study included a total organic chemical and dissolved organic chemical budget for the Horseshoe Lake-Bartlett Reservoir system. Dissolved organic carbon levels in this drinking water source are of interest because it is known that potentially toxic trihalomethanes can be produced when chlorine (used for disinfection) comes into contact with dissolved organic carbon. Findings and conclusions of this study were:

  - Bartlett Reservoir is a monomictic lake (turnover occurs once a year), with temperature stratification occurring during the summer months. Oxygen depletion and buildup of nutrients occurred in the hypolimnion.
  - This two-reservoir system retained 72% of the particulate organic carbon that entered the reservoir during this study period.
  - Significant dissolved organic carbon was produced within the two-reservoir system. The 41% increase in dissolved organic carbon was probably the result of production by algae.
  - The study suggested that less algal growth would result in less dissolved organic carbon in the outflow. Since algae growth is controlled by nutrients, especially nitrogen, upstream nutrient control may result in less algal mass, and therefore, lower dissolved organic carbon.

- An Irrigation Diversion Improvement Project is being conducted to demonstrate the proper design of irrigation diversion works on the Verde River System. This project, funded by the EPA/ADEQ's Nonpoint Source Program in 1995, will enhance restoration of riparian habitats, decrease turbidity, improve aquatic habitat and recreational opportunities. The project emphasizes education and outreach to water users.

- ADEQ's Oak Creek Public Information and Education Project has been funded in 1996 to provide the public with information about:

  - Implementation of Best Management Practices,
  - Human health risks associated with exposure to contaminated water,
  - Behavior modification, especially during peak recreational seasons, to protect Oak Creek water quality.

CHAPTER 2 - WATER QUALITY MANAGEMENT PROGRAMS AND SPECIAL INITIATIVES

PART I - WATER QUALITY MANAGEMENT PROGRAMS

General Overview

Water quality protection programs in Arizona are based on both federal and state laws, which provide a framework for firm and comprehensive water quality protection regulations and policies. Selected programs are summarized in **Table 25**.

Figure G. Water Quality Programs

Table 25. Selected Arizona Water Quality Protection Programs

PROGRAM	AGENCY	DESCRIPTION AND STATUS	SOURCES/CONTAMINANTS CONTROLLED
Aquifer Protection Permit (APP)	ADEQ	The goal of the Aquifer Protection Program is to prevent pollution of Arizona's groundwater by controlling discharges from wastewater treatment plants, mining operations, and industrial facilities. Discharging facilities are required to apply Best Management Practices (BMPs) and Best Available Demonstrated Control Techniques (BADCTs), and demonstrate effectiveness by monitoring. Best Management Practices for agricultural general permits are required for nitrogen fertilizer application and concentrated animal feeding operations as established in rule.	Landfills, mining operations, injection wells, underground storage and recovery projects, agriculture practices that may contaminate groundwater, and wastewater discharges to the ground or surface water.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	EPA, ADEQ, ADWR	CERCLA is commonly referred to as the federal Superfund Program. Administered by ADEQ, it establishes a comprehensive response program for past hazardous waste activities. Funding and enforcement authority provides for long-term remediation of inactive sites. (See also WQARF Program.)	Hazardous waste.
Comprehensive State Groundwater Protection Program (CSGWPP)	ADEQ	A groundwater management program that integrates efforts and defines roles at the federal, state, and local level that are needed to improve or protect groundwater. A pilot project was implemented in Tucson area. This program is to be incorporated into the Watershed Framework that is being developed.	All activities which might impact groundwater quality within a groundwater basin or "Active Management Area."
Construction Grant and State Revolving Fund (SRF)	EPA, ADEQ	This program allocates financial assistance to construct publicly owned waste treatment works and nonpoint source prevention facilities. The State Revolving Fund replaced the federal Construction Grants program. Indian Nations are also eligible for funds.	Wastewater and nonpoint source pollution activities.
Drywell Registration	ADEQ	Drywell owners are required to register drywells. Rules are still being developed by the Aquifer Protection Program.	Primarily stormwater.
Hazardous Waste Management Program	ADEQ	Under Arizona's Hazardous Waste Management Act and the Federal Resource Conservation and Recovery Act (RCRA) permits are issued for treatment, storage, and disposal of hazardous wastes. The permit specifies design, performance, and operation standards, including groundwater monitoring, to be met by an individual facility. A closure process is also defined when operations at the facility are curtailed or stop.	Hazardous wastes.
Monitoring and Assessments	ADEQ, ADWR, USGS, AGFD, and more	Surface water, groundwater, sediment, animal tissue, habitat, and physical and biological integrity monitoring and assessment are conducted by ADEQ to fulfill requirements of the Clean Water Act and Arizona's Environmental Quality Act. ADEQ attempts to coordinate its monitoring and assessment work with other state and federal agencies (see Chapter 1, Part III).	Assists in identifying all types of water and soil contaminants. Identifies the level of physical, chemical, and biological integrity in Arizona's surface water and groundwater ecosystem.

PROGRAM	AGENCY	DESCRIPTION AND STATUS	SOURCES/CONTAMINANTS CONTROLLED
National Pollutant Discharge Elimination System (NPDES)	EPA, ADEQ	EPA administers the NPDES program in Arizona that requires permits for all discharges to "waters of the United States." NPDES permits regulate the quantity and quality of effluent through treatment and the quality of stormwater discharges through Best Management Practices. Facilities must also obtain an Aquifer Protection Permit.	Wastewater discharges from treatment facilities, discharges from mining operations, stormwater discharges, and more.
Nonpoint Source Program	ADEQ	Under Arizona statutes and the federal Clean Water Act, rules have been (and continue to be) adopted to prevent and remediate nonpoint source pollution. Best Management Practices have been adopted by rule for irrigated agriculture and concentrated animal feeding operations, and Best Management Practices guidance has been developed for many other activities (see **Table 26**). Aquifer Protection Permits are required for many nonpoint source activities.	Mineral extraction and processing, on-site wastewater disposal, recreation, crop production, rangeland practices, silviculture, urban runoff, land development, drywells, and hydrologic modification.
Pesticide Prevention Program	ADEQ, AZ Dept. of Agriculture	A state Pesticide Management Plan has been developed and is being reviewed by EPA for approval. Rules have been developed to control the application of commercially applied pesticides and their impacts on the environment. The use of a specific pesticide can be modified or canceled due to water quality impacts as determined by monitoring soil and water.	Pesticides.
Pollution Prevention Program (Pretreatment)	ADEQ	Arizona's omnibus Hazardous Waste Act of 1991 required that all generators of large quantities of hazardous waste submit pollution prevention plans. These plans require management commitment to reductions in hazardous wastes, employee training, summary of pollution prevention activities, inventory of processes and toxic sources, and the selection and implementation of alternatives to reduce hazardous wastes.	Hazardous wastes.
Poor Quality Groundwater Withdrawal Permit	ADWR	Permits may be issued for non-irrigation use if the groundwater has no other beneficial use and withdrawal is consistent with the Active Management Area's management plan. Permits are issued in conjunction with CERCLA, WQARF, or Underground Storage Tank programs for water treatment.	Poor quality groundwater.
Reuse Permits	ADEQ	This program regulates facilities which provide wastewater for reuse. The permits specify the amounts of effluent to be reused and its chemical quality.	Wastewater.
Safe Drinking Water	ADEQ	"Public" water supplies are required to monitor the quality of their water and to provide drinking water that meets state and federal drinking water standards. A pilot "vulnerability assessment" has been initiated, to determine when monitoring requirements can be reduced because specific chemicals have not been in use in the drainage area.	Natural, anthropogenic, and contaminants created during storage, treatment, and distribution.
Septic System Permits	County Health Depts., ADEQ	Under state statutes and county regulation, the construction and repair of all septic tanks and leaching systems must be approved.	Wastewater.
Sludge Management	ADEQ	The use and disposal of sludge from wastewater treatment plants are monitored as established in NPDES permits. Land application of biosolids is regulated under Arizona Administrative Code R18-13-1501 through 1514 (adopted 1996).	Sludge production and disposal facilities (i.e., wastewater disposal).

PROGRAM	AGENCY	DESCRIPTION AND STATUS	SOURCES/CONTAMINANTS CONTROLLED
Solid Waste Management	ADEQ	Under the State's Solid Waste Management Act and federal RCRA, ADEQ reviews and approves: construction of solid waste management facilities, agricultural application of sewage sludge, and temporary facilities for the treatment of petroleum contaminated soils. An Aquifer Protection Permit is also required for these activities.	Landfills, nonhazardous wastes, petroleum-contaminated soils.
Underground Injection Control	ADEQ EPA	A permit is required for any "well" which would inject wastewater or stormwater into the ground, including drywells and septic tanks. Currently ADEQ is negotiating with EPA to obtain primacy to eliminate duplicate permits, as permits are also required under Arizona's Aquifer Protection Permit Program. [Note that deep injection of hazardous wastes (i.e., below drinking water sources) is prohibited in Arizona.]	Primarily stormwater and domestic wastewater.
Underground Storage and Recovery Projects	ADWR	ADWR issues permits for underground storage and recovery projects. ADWR coordinates with ADEQ to ensure that the project is consistent with water quality requirements as assessed under the Aquifer Protection Permit Program.	Any contaminant which might be transported by this process.
Underground Storage Tanks (UST)	ADEQ	The UST Program is to ensure the proper operation of underground storage tanks and prevent releases, locate and remediate leaking underground storage tanks, and ensure that tank owners and operators are financially capable of cleanup.	Petroleum hydrocarbons (oil and gas) and other chemicals which may be stored underground.
Water Quality Assurance Revolving Fund (WQARF)	ADEQ	The state WQARF program parallels the federal Superfund Program, providing funds for monitoring, risk assessment, matching funds, and remediating hazardous substances which may pose a hazard to "waters of the State." Mitigation of nonhazardous substances is also allowed under state statutes.	Hazardous and nonhazardous wastes.
Water Quality Management Planning	ADEQ, local agencies	ADEQ coordinates water quality management planning in Arizona. Planning provides a mechanism to identify broader goals and strategies to solve water quality problems. ADEQ delegates authority and responsibilities to local agencies.	Pollutant discharges to surface waters primarily from point source discharges.
Wellhead Protection	ADEQ	A voluntary program to promote and support groundwater protection efforts by delineating and managing wellhead protection areas around public drinking water supply wells.	Pollutants from anthropogenic activities in a wellhead protection area.
Well Permits	ADWR	Under state statutes, all wells must be registered, new wells must be approved prior to construction, well drillers must be licensed, a well drilling log must be submitted, and wells must be properly constructed, abandoned or capped.	Contaminants introduced into groundwater by inadequate construction or maintenance of wells.

PART II - NONPOINT SOURCE PROGRAM STATUS REPORT

Overview

The Nonpoint Source Program is a comprehensive program which integrates regulatory and nonregulatory strategies within geographic areas – the Nonpoint Source Management Zones. Activities of the Nonpoint Source Program are summarized in **Table 26**.

ADEQ has received Clean Water Act Section 319 funds for Nonpoint Source Program demonstration projects to provide measurable improvements in water quality. **Table 27** provides a list of these projects. Information concerning completed projects can be obtained through the Nonpoint Source Program. The Oak Creek Project was so successful that the Nonpoint Source Program was redesigned to work in partnership with other agencies and interested parties within the "management zone" concept. This project also resulted in the establishment of a National Monitoring Program Project in Oak Creek by EPA. For this project, $75,000 per year for six to ten years has been dedicated for monitoring to determine the effectiveness of implemented Best Management Practices in this watershed.

Stewardship Training Workshops

Land stewardship concepts are being promoted through workshops presented by Dennis Bowker of the Napa County Resource Conservation District, Napa, California. Through these workshops, land stewardship and watershed plan development are explained through interactive exercises. Land stewardship is an ethic involving cooperation in protecting and enhancing natural resources. Cooperation is key to developing interest-based solutions (i.e., common concerns and interests of landowners, agencies, and stakeholders) and encouraging voluntary commitment to protect natural resources.

During 1995, four Land Stewardship Watershed Planning Workshops were held. These workshops were attended by individuals involved with the Verde Watershed Association, the Gila Monster Watershed Group (made up of interested individuals in both New Mexico and Arizona), and individuals in the Sierra Vista area concerned with issues involving the San Pedro River. Additionally, this workshop was presented to ADEQ's Watershed Strategy Work Group. A grant from EPA will enable presentation of additional workshops during 1996 and 1997.

Table 26. Nonpoint Source Program

PROGRAM COMPONENT	YEAR INITIATED	COMMENTS
Aquifer Protection Permits	1989	Facilities which might contaminate groundwater must demonstrate that water quality standards are maintained and that Best Available Demonstrated Control Technologies (BADCT) will be applied to meet requirements of this permit.
Interagency Agreements	1990	Interagency management agreements identify responsibilities for complying with water quality standards on lands or by resources managed by an agency or Indian nation, and they encourage the exchange of information and data. One agreement established a position funded by two agencies (NRCS and ADEQ). Agreements have been completed between ADEQ and the following entities: U.S. Forest Service (1990), U.S. Bureau of Land Management (1992), Arizona Game and Fish Department (1993), Natural Resources Conservation Service (1996), and San Carlos Apache Nation (1996).
Silviculture	1993	A Timber Technical Advisory Group has been established to identify and evaluate Best Management Practices for timber and timber road management.
Regulated Agricultural Activities	1991	The application of nitrogen fertilizers and concentrated animal feeding operations are regulated through a General Aquifer Protection Program Permit, which requires the implementation of Best Management Practices. A guidance document, videos, and a computerized nitrogen management program are available through the University of Arizona, Cooperative Extension Service (Doerge et al. 1991). A guidance document for concentrated animal feeding operations is expected to be completed in 1996.
Pesticide Contamination Prevention Program	1989	Pesticide Contamination Prevention Rules were adopted in 1992. A Groundwater Protection List of pesticides that are potentially mobile and persistent has been adopted. The Pesticide Monitoring Program monitors soil, sediment, surface water, and groundwater for these listed pesticides.
Rangeland Management	1990	A Technical Advisory Group for Grazing Activities has developed draft Best Management Practices for grazing that will be available through the University of Arizona Cooperative Extension Service when finalized. Demonstration projects have been established in Chino Winds (upper Verde River Watershed) and Coyote Creek (Little Colorado River tributary) areas.
Urban Runoff	1992	Guidance documents to assist in implementing technologies to minimize polluted runoff from urbanized areas are being developed by representatives of a variety of interest groups.
Riparian Area and Wetland Protection Program	1989	Management of hydrologic habitat modification is accomplished primarily through the 404 Permits and 401 Certification Program (dredge and fill permits), implementation of Best Management Practices, and other activities described in the Riparian Area and Wetland Protection section of this chapter.
Resource Extraction	1990	The Watercourse Alteration Technical Advisory Group (WATAG) has developed Best Management Practices and guidance for sand and gravel operations (WATAG 1994).
Non-regulatory Activities	1989	Public participation, education, demonstration projects (**Table 27**), and technical assistance are emphasized within each nonpoint source program.
Nonpoint Source Management Zones	1993	Arizona was divided into fifteen management zones to enhance water quality management through cooperative participation of multiple agencies and other interested parties. Two of the zones, which have been active (i.e., The Verde Zone and The San Carlos-Safford-Duncan Zone), have provided the prototype for the Watershed Protection Approach that is now being developed (see discussion of this approach later in this chapter).

Table 27. Arizona Demonstration Projects

PROJECT NAME, LOCATION	DESCRIPTION	YEAR FUNDED, AMOUNT, STATUS
Aravaipa Creek Project San Pedro-Willcox Playa-Rio Yaqui	Demonstrate Best Management Practices for livestock grazing.	1994 $3,487 Ongoing
Bonita Creek Restoration Project San Carlos-Safford-Duncan Watershed	Initiate rangeland management and riparian protection activities in the Bonita Creek Watershed in conjunction with the San Carlos Apache Nation.	1995 $100,000 Ongoing
Concentrated Animal Feeding Operation Wastewater Project Middle Gila Watershed	Demonstrate Best Management Practices in disposal of wastewater at a commercial scale dairy in Maricopa County.	1996 $179,770 Ongoing
Cave Creek Arsenic Project Middle Gila Watershed	Mitigate arsenic contamination of groundwater. Runoff detention and percolation enhancement facilities have been developed for several washes.	1990 $90,000 Completed
Chino Winds Planned Grazing Project Verde Watershed	Implement grazing Best Management Practices for critical area stabilization, range seeding, water development, and rotational pasture development.	1990 $90,000 Completed 1993 $85,600 Ongoing
Citrus Tree Fertilization Project Colorado-Lower Gila Watershed	Demonstrate Best Management Practices for fertilization of young citrus trees.	1996 $91,194 Ongoing
Constructed Wetland Treatment of Runoff Middle Gila Watershed (Maricopa County Flood Control Vehicle Maintenance Yard)	Test the efficacy of an artificial wetland for removing parking area pollutants from runoff (Wass and Fox 1993).	1992 $32,035 Completed
Constructed Wetland Treatment of Septage Little Colorado-San Juan Watershed	Evaluate an on-site constructed wetland for treatment of septic tank effluent at the Flagstaff Arboretum.	1993 $38,600 Ongoing
Coyote Creek Project Little Colorado River-San Juan Watershed	Develop Best Management Practices for livestock grazing activities.	1992 $95,000 Ongoing
Curriculum Development Project Statewide	Part I - Incorporate Nonpoint Source Program education materials into the kindergarten to 6th grade public school curricula. Part II - Incorporate Nonpoint Source Program education materials in the 7th to 9th grade public school curricula, including Spanish-English bilingual materials. Part III - Develop Nonpoint Source education materials for use in kindergarten to 9th grade home-study curricula. Publish a biannual newsletter for parents and students. Part IV - Develop Nonpoint Source Program educational materials for use in kindergarten to 6th grade in public schools on Apache Tribal lands. Part V - Incorporate principles of Nonpoint Source management into the existing Water Education and Training teachers' workshop curriculum.	Part I - 1993 $15,800 Complete Part II - 1995 $57,361 Ongoing Part III - 1995 $25,000 Ongoing Part IV - 1995 $20,000 Ongoing Part V - 1995 $32,850 Ongoing
Erosion Control Project San Pedro-Willcox Playa-Rio Yaqui	Demonstrate 15 different examples of erosion control structures for urban and rural application in Sierra Vista.	1995 $25,000 Ongoing
Geohydrology Project San Carlos-Safford-Duncan Watershed	Analyze geologic formations within this watershed to identify the effect of regional geology (i.e., natural conditions) on surface and groundwater quality.	1996 $24,250 Ongoing

PROJECT NAME, LOCATION	DESCRIPTION	YEAR FUNDED, AMOUNT, STATUS
Irrigation Diversion Improvement Project Verde Watershed	Demonstrate irrigation diversion methods that should restore riparian habitats, decrease turbidity, improve aquatic habitats, and improve recreation.	1995 $67,990 Ongoing
Moccasin Wash Project Colorado River-Grand Canyon Watershed	Demonstrate streambank stabilization using pole plantings in the wash, and implement grazing and cropland BMPs.	1994 $141,000 Ongoing
Nitrogen Fertilizer Application Project Santa Cruz	Validation of agricultural nitrogen fertilizer application Best Management Practices and guidance practices.	1990 $181,400 Completed
Nitrogen Application Project 1) in Yuma, Arizona area, 2) in Safford, Arizona area, and 3) in the Santa Cruz drainage area.	Evaluate Best Management Practices for the application of nitrogen fertilizers during irrigated crop production. (Depth to groundwater varied between sites, from near surface to more than 500 feet deep.)	1991 $68,035 Completed
Nitrogen Application Education Project Statewide	Educate owners and operators of regulated agricultural activities in managing nitrogen discharges.	1992 $149,447 Ongoing
Nitrate Education Project Colorado-Lower Gila Watershed (Quartzite)	Demonstrate methods in managing nitrogen pollution to groundwater caused by septic systems.	1990 $36,000 Completed
Nonchemical Weed Control Project Santa Cruz-Rio Magdalena-Rio Sonoyta	Demonstrate nonchemical weed control techniques for Arizona's farmers.	1993 $42,900 Ongoing
Oak Creek Watershed Project Verde Watershed	Develop an interagency program to implement water quality improvement projects on a watershed basis.	1991 $100,000 Completed
Oak Creek Public Information Project Verde Watershed	Provide information concerning Best Management Practices and potential health risks associated with contaminated water to modify behaviors and better protect Oak Creek water quality.	1996 $27,550 Ongoing
On-Farm Composting Demonstration Middle Gila Watershed	Demonstrate techniques in composting household yard trimmings combined with livestock manure and crop residues.	1995 $93,200 Ongoing
Pratt Tank Demonstration Project Colorado-Grand Canyon Watershed	Demonstrate the use of high intensity animal impact (hoof action) to reduce soil crust, incorporate carbon into soils, increase herbaceous ground cover, decrease runoff, and decrease rates of soil erosion.	1995 $70,800 Ongoing
Prescott Mining Project Middle Gila Watershed	Phase I - Complete an environmental assessment of a 500 square mile historic mining area. Phase II - Monitor and assess the impacts of abandoned and inactive mining on a focus area. Phase III - Evaluate Best Management Practices to control groundwater contamination from abandoned or inactive mining, and provide a reference document. Phase IV - Implement Best Management Practices in a focus area.	Phase 1 - 1991 $160,664 complete, Phase II to be completed in 1996
Silver Creek Animal Waste Management Little Colorado-San Juan Watershed	Demonstrate Best Management Practices in disposal of wastewater at a concentrated animal feeding operation.	1994 $42,000 Ongoing
Verde River Riparian Project Verde Watershed	Demonstrate the use of revegetation of riparian areas for erosion control and water quality improvements.	1990 $126,000 Completed
Verde Watershed Watch Network Verde Watershed	Demonstrate the use of volunteer school programs to provide surface water monitoring data.	1994 $175,000 Ongoing

Table 28 contains data reporting the impact of nonpoint source loads on streams and lakes in Arizona. "Impaired" indicates those waters that were assessed in partial support or non-support because of natural conditions or sources other than discharges from a pipe or culvert (i.e., point source).

Table 28. Arizona's Nonpoint Source Impaired Waters 1996

	STREAMS (miles)	LAKES (acres)
Total Assessed	5,410	58,860
Total Impaired (all sources)	3,224	58,334
Total Impaired by Nonpoint Sources	3,210	58,334

Although, an interpretation of this data indicates that 99% of the impaired stream miles and 100% of the impaired lake acres were impacted by nonpoint sources, such statistics do not provide the complete picture. In several waterbodies, point sources contribute to the impairment, although they were not the sole source of impairment. For example, recent monitoring indicates that Lake Havasu is impacted by the combination of: municipal treatment plant disposal of effluent by infiltration into groundwater (a point source discharge), effluent reuse for golf course irrigation (a nonpoint source discharge), relatively stagnant flows in backwaters and high temperatures (natural conditions), and heavy recreational use (a nonpoint source).

Natural conditions are included as a nonpoint source category. As shown previously in **Table 9**, natural conditions are the single largest category contributing to impairments of lakes and streams. The proportion of contaminant loads contributed at a specific site is normally unknown. Even though this is a nonpoint source category, natural conditions will generally not be controlled by Nonpoint Source Programs.

Interpretation of this data also suggests that the impact on surface water by point sources is small. This may be true because there are relatively few point source permits issued in Arizona -- only 137 wastewater NPDES permits are listed in **Appendix D**. However, there has also been very little in-stream monitoring below point source discharges.

The individual waterbody assessments provided in **Appendix F** indicate stressors that are probably contributed by nonpoint sources. Stressors are more easily identified than their sources. Implementation of a newly developing program for completing Total Maximum Daily Loads will provide more information about the contribution of specific nonpoint sources on impaired waters (see "water quality limited waters" discussion later in this chapter).

PART III - CLEAN LAKES PROGRAM STATUS REPORT

Background

There are 357 lakes included in the Waterbody System for Arizona. Of these, 122 are located on Indian lands and have not been assessed for this report. Nonetheless, the lakes on Indian lands and the remaining 235 which are located on private and public lands in Arizona represent a crucial resource which has significantly contributed to settlement, domestic water supply, hydropower, agriculture, economic and industrial development, and recreation in Arizona. Because of the importance of these waters, ADEQ has included waters as small as one acre in assessments. Two of the largest manmade waterbodies in the U.S. (Lake Powell and Lake Mead) are also located on Arizona's state boundaries.

The future for further large scale water developments, such as the present dams along the Salt River that created Roosevelt, Apache, Canyon and Saguaro lakes, is limited because of both environmental and economic considerations. Modifications or reconstruction of dams to increase the capacity of reservoirs, to provide additional flood control (e.g., Roosevelt Lake), or to provide for additional water supply (e.g., Lake Pleasant and the Central Arizona Project) may occur in the future.

A triennial watercraft survey prepared for the Arizona State Parks Board indicated that 49 lakes in Arizona had 16,225,098 person use days (Behavior Resource Center 1994). The most frequent water based recreational activities on these lakes were water skiing, fishing, and general pleasure boating followed by jet skiing and swimming. Recreational use of Arizona waters is almost evenly divided between California (48%) and Arizona (47%) residents.

Designated use support and toxic effects on lakes were discussed in Chapter 1.

Control Methods

Procedures and methods to control sources of pollution potentially affecting lakes in Arizona utilize both regulatory and nonregulatory programs such as:

- The 404 permit process (for dredge and fill activities within the normal high water flow) administered by the Corps of Engineers,
- The National Pollutant Discharge Elimination System (NPDES) permits (for wastewater and stormwater discharges to surface waters) administered by EPA in cooperation with ADEQ,
- The State's water quality certification process conducted by ADEQ under Section 401 of the Clean Water Act (state review of federally issued permits),
- The ADEQ's Nonpoint Source Program for regulated agricultural activities, and
- Agreements between ADEQ and other agencies/Indian nations, to implement nonpoint source pollution control programs under Section 319 of the Clean Water Act.

The Aquifer Protection Permit Program administered by ADEQ also complements the surface water and environmental protection programs that address protection and restoration of lake water quality.

Arizona's surface water quality standards apply to lakes and reservoirs as well as to streams. These rules also specify a separate turbidity standard for lakes and nutrient standards for four Arizona lakes (Apache, Canyon,

Saguaro and Roosevelt). The Code of Federal Regulations (40 Code of Federal Regulation 131.31(I)(D)) establishes mean annual total nitrate and phosphate concentrations for the Colorado River and its reservoirs from the Utah border to Morelos Dam south of Yuma. Additional state or local regulations or ordinances specific to protection of lakes have not been documented at the time of this report.

Trophic Status

Data relevant to the trophic status of lakes in Arizona has been collected by ADEQ or provided by other state and federal agencies (i.e., Arizona Game and Fish Department, U.S. Geological Survey, US Army Corps of Engineers, and the U.S. Fish and Wildlife Service). Using data collected in water years 1994 and 1995, the trophic condition of 34 lakes could be evaluated, according to EPA (1974) lake classification criteria:

Trophic Classification Criteria for Lakes and Reservoirs

Trophic State	Chlorophyll *a* µg/l	Total Phosphorus mg/l	Secchi Depth meters
Oligotrophic	<7	<0.010	>3.7
Mesotrophic	7-12	0.010-0.020	2.0-3.7
Eutrophic	>12	>0.020	<2.0

Of 30 lakes with trophic parameter information collected during 1994 and 1995, none were oligotrophic, eight were mesotrophic and 22 were eutrophic. Out of the 75 lakes assessed in 1996, using data collected back to 1991, trophic conditions were estimated on 54 lakes. One-fifth (10) of the lakes were mesotrophic, four-fifths (44) were eutrophic, and none were oligotrophic.

Restoration Efforts

The Clean Lakes Program has not attempted any restoration projects during the past two years. However, a Phase I Diagnostic/Feasibility Study for Rainbow Lake has been in progress and the Arizona Game and Fish Department continues to provide nuisance weed control for some lakes across the State.

Rainbow Lake Study--This study was initiated to determine the cause and impact of eutrophic conditions at Rainbow Lake in Navajo County and to recommend remediation alternatives. The lake is enriched by phosphorus and nitrogen. Historical sources of nutrients to the lake have included nonpoint sources such as agriculture, land disposal (e.g., septic tanks) and point sources (e.g., community wastewater treatment and small package plants). Since 1980, point sources that use to discharge to the Walnut Creek watershed above Rainbow Lake have been intercepted by sewer lines, and now discharge to an artificial wetland treatment system in the Show Low area.

The study concluded that Rainbow Lake is still eutrophic because of internal nutrient cycling from growth and die-off of aquatic vegetation. There is some evidence of improvement in lake conditions over the past decade, and present Walnut Creek nutrient inputs to the lake are comparable to regional reference sites. Outside inputs of nutrients have probably diminished from historic levels with the establishment of the artificial wetland treatment system near Show Low (Baker and Farnsworth 1995). Unfortunately, accurate historic nutrient data is not available for comparison.

It appears that macrophyte harvesting and removal, by the Arizona Game and Fish Department and by a lakeshore property owners association, will continue to be used to decrease nutrient levels in Rainbow Lake. The preferred

alternative for further improving lake conditions involves water conservation efforts, such as lining irrigation canals to increase summer lake levels and volume. This alternative should also help dilute nutrient concentrations. If successful, the lake would have more weed-free area, less exposed lake bottom during late summer, and less odor from decomposing macrophytes (Baker and Farnsworth 1995).

Nuisance Plant Material Removal--Arizona Game and Fish Department restoration activities in lakes around the State have primarily focused on the removal of nuisance plant material by physical and biological methods to improve fishing and recreational activities on Arizona's lakes. Aquatic macrophyte harvesting is the principle physical treatment and stocking of White Amur fish into lakes constitutes the biological treatment.

Macrophytes of major concern to AGFD include water milfoil, *Potamogeton*, and spiny nyad. AGFD has taken aggressive efforts to eliminate *Hydrilla* species wherever they have been found in public waters, including the use of chemicals to accomplish eradication.

The AGFD applied aquatic macrophyte harvesting treatments to 14 lakes in 1994 and 13 lakes in 1995. **Table 29** presents the information on this aquatic macrophyte harvesting by tons removed or acres cut without removal.

Table 29. Aquatic Macrophyte Harvest by AGFD in Arizona Lakes

LAKE NAME	1993	1994	1995
Arivaca	15 acres	15 acres	N/A
Cluff Pond	5 acres	6 acres	63 tons
Concho	180 tons	892 tons	527 tons
Coors	N/A	33 acres	40 tons
Crescent	184 tons	364 tons	730 tons
Goldwater	43 acres	73 acres	60 tons
J.D. Dam	4 acres	4 acres	4 acres
Lower Lake Mary	15 acres	N/A	395 tons
Luna	850 tons	892 tons	527 tons
Lynx	7 acres	5 acres	N/A
Marshall	4 acres	4 acres	4 acres
Nelson	624 tons	400 tons	572 tons
Parker Canyon	27 acres	25 acres	220 tons
Peña Blanca	33 acres	53 acres	280 tons
Rainbow	230 tons	N/A	65 tons
Stoneman Lake	5 acres	5 acres	5 acres

Acid/Alkaline Effects on Lakes

Acid rain or atmospheric deposition in Arizona lakes has not received much attention in Arizona. However, sources of potentially threatening atmospheric pollutants do exist statewide with three large copper smelters and eight coal-fired power generating stations providing sources of sulfur dioxide and nitrogen dioxide emissions.

A study of the potential effects of acid rain in the San Bernardino National Wildlife Refuge was conducted by USFWS (Kepner 1988). This refuge, located in southeastern Arizona on the United States-Mexico border, is in an area where copper smelter operations in Arizona and Mexico had created acidic conditions in the atmosphere due to sulfur dioxide emissions. Mean annual pH of precipitation in this area ranged from 4.7 to 5.0. Spring, stream, and pond water quality was examined during this study. Kepner concluded that the high surface water alkalinity in the region is a factor which should mitigate the impact of acid precipitation on aquatic environments.

In general, water quality data collected during this assessment period suggest that Arizona's alkaline-tending lakes have a greater buffering capacity than waters in regions of the nation which have had acid rain problems. Only water samples taken in the hypoliminion (the deepest strata of a lake water column) at four lakes (i.e., Black Canyon, Stoneman, Willow Springs, and Woods Canyon Lake) had pH levels in the acidic range below surface water standards (i.e., less than 6.5).
During the same sampling event, Stoneman Lake also had pH values in the epiliminion (the highest lake strata) that exceeded the upper limit water quality standard for pH -- above 9.0. Fish were undergoing severe stress in Stoneman Lake as the pH gradient between 6.5 and 9.0 occurred in less than three meters, and a substantial fish kill was observed.

Mormon Lake had the highest pH tested during the assessment period, with a pH reading of 10.46 during a sampling event in August 1995. Although extreme, this pH was probably natural for a very shallow lake, during the hottest part of the year in Arizona.

Trends in Lake Water Quality

Water quality trend information for lakes in Arizona is not available. Trends at surface water monitoring sites on streams have been reported by USGS (Baldys 1990, Baldys et al. 1995). The relationship between trends in streams and trends in lake quality has not been established in Arizona, and there has been insufficient lake monitoring data to complete lake trend studies.

PART IV - WETLANDS AND RIPARIAN AREAS PROTECTION STATUS REPORT

Overview and Definitions of Terms

In the arid Southwest, riparian areas perform important water quality functions and provide benefits similar to those of wetlands in more humid regions of the country. Arizona's riparian areas, the "ribbons of green" within and adjacent to drainageways, are some of the richest ecosystems in the State in terms of plant and animal productivity and diversity. According to Carothers et al. (1974), some of the highest densities of breeding birds in North America are found in riparian areas, particularly in cottonwood-willow forests. These birds include threatened and endangered species and many migratory birds. Riparian areas also provide rich habitats for a vast number of fish, reptiles, amphibians, and other terrestrial species. Javalina and other large mammals depend on these areas for forage, shelter, shade, water, and movement corridors. Ohmart and Anderson (1986) report that more than 60% of vertebrates in the arid Southwest are obligate users of riparian areas. The Arizona Game and Fish Department in the report to the Governor's Riparian Habitat Task Force (1990) estimated that 75% or more of all Arizona's native wildlife species depend on healthy riparian systems during some portion of their life cycle. Riparian areas are critical to the survival of approximately 60% of the fish and wildlife species currently in jeopardy of extirpation from the State of Arizona.

Wetlands are classified as "waters of the United States" and thereby, must meet Arizona surface water standards. ADEQ's surface water rules (R18-11-101) include the following definition:

> "Wetlands mean those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, bogs, cienegas, tinajas, and similar areas."

In 1992, Arizona legislation (Arizona Revised Statutes §45-101) established a definition of riparian areas and assigned various duties to state agencies in an effort to create a body of knowledge and to better understand riparian issues within the state. This statute includes the following definition:

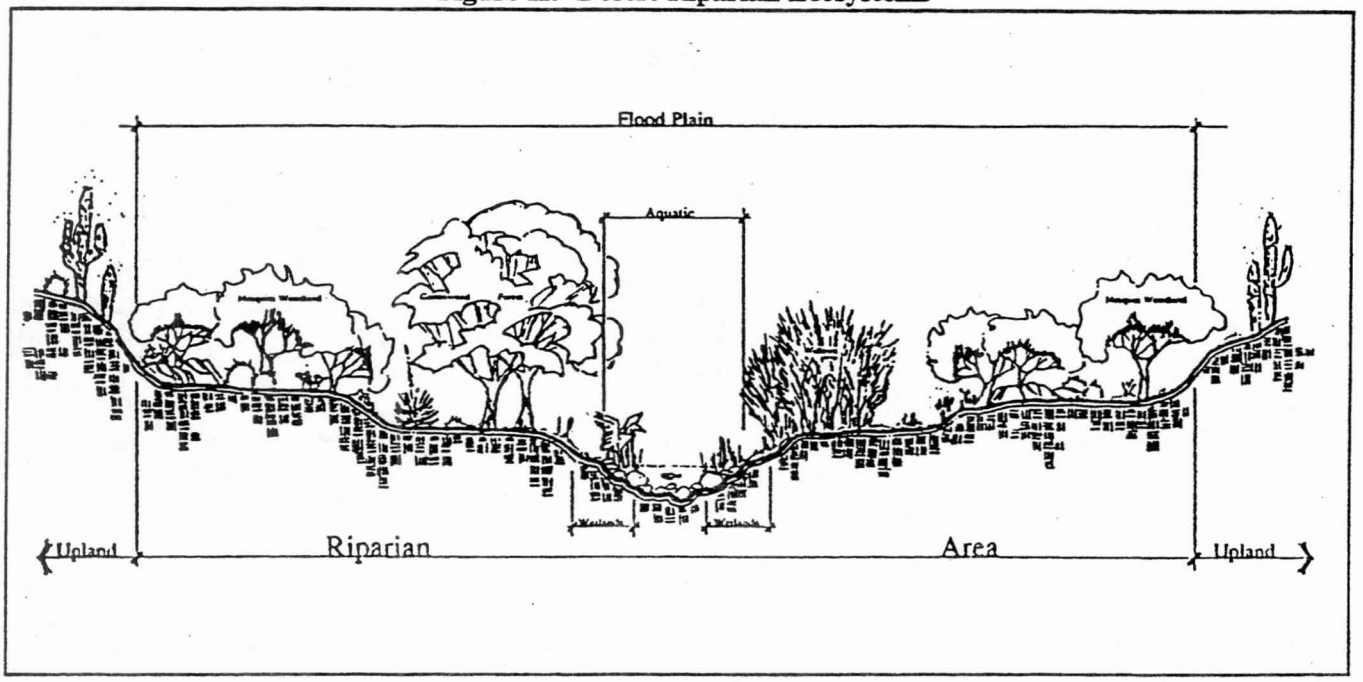
> "Riparian Area means a geographically delineated area with distinct resource values, that is characterized by deep-rooted species that depend on having roots in the water table or its capillary zone, and that occurs within or adjacent to a natural perennial or intermittent stream channel or adjacent to a lake, pond, or marsh bed maintained primarily by natural water sources. Riparian area does not include areas in or adjacent to ephemeral stream channels, artificially created stock ponds, manmade storage reservoirs constructed primarily for conservation or regulatory storage, municipal and industrial ponds, or manmade water and transportation, distribution, or off-stream storage and collection systems."

Activities involving the discharge of dredge or fill material in waters of the United States require a Clean Water Act Section 404 permit from the U.S. Army Corps of Engineers. "Jurisdictional wetlands" are delineated by the Corps on the basis of soil type, hydrology, and vegetation as established by characteristics detailed in the *Corps of Engineers Wetlands Delineation Manual* (1987).

The U.S. Army Corps of Engineers (COE), EPA, and the U.S. Fish and Wildlife Service are discussing whether some riparian areas in the West should be included under the jurisdiction of 404 Permit requirements (U.S. Department of the Interior 1994). Riparian areas in the Southwest vegetated with wetland plants (hydrophytes) often are not identified as wetlands under the current wetland identification procedures. They do not satisfy the established criteria for hydric soils and wetland hydrology. However, riparian areas perform the objective of the Clean Water Act to restore and maintain the integrity of the Nation's waters by providing for groundwater recharge and discharge, flood storage, sediment retention, and fish and wildlife habitats.

Figure H illustrates the overlap between riparian areas and wetlands that is typical for the Southwest. The riparian area includes the natural watercourse and aquatic habitat and extends to the upland area where vegetation transitions into xeric, more drought tolerant species. Riparian areas encompass the wetlands, which make up only a small portion of the total riparian area. Therefore, wetland regulations only protect a small portion of the riparian area.

Figure H. Desert Riparian Ecosystems



Wetlands and Riparian Areas Assessment

ADEQ is testing methods of assessing the functional condition of wetland and riparian areas as a part of its surface water quality monitoring program. This is also being coordinated with a pilot environmental indicator project sponsored by EPA. A wetland-riparian area assessment would measure and evaluate habitat quality and functional condition to determine the biological, chemical, and physical integrity of these areas. Wetland-riparian areas are maintained by the interaction of three components: 1) hydrology, 2) landform/soils, and 3) vegetation.

ADEQ is considering using the Bureau of Land Management's Process for Assessing Proper Functioning Condition (Technical Report 1737-9, 1993). This method rates a wetland-riparian area as in one of the following four possible functional states:

- Proper Functional Condition--An area is rated as functioning properly when adequate vegetation, landform, and large woody debris are present to dissipate stream energy associated with high water flows, thereby reducing erosion and improving water quality. Riparian vegetation aids in filtering sediment, capturing bedload, and floodplain development. It also improves flood-water retention and groundwater recharge, develops root masses that stabilize streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, and water waterfowl breeding.

- Functional-At Risk--Riparian areas rated as in functional condition, but a soil, water, or vegetation attribute makes them susceptible to degradation.

- Nonfunctional--Riparian areas are rated as nonfunctional when there is insufficient vegetation, landform, or large woody debris to dissipate stream energy associated with high flows and thus are not reducing erosion, improving water quality, etc., as listed above. The absence of certain physical attributes are indicators of nonfunctioning conditions.

- Unknown--Insufficient information to rate the riparian area.

Extent of Wetlands and Riparian Areas

The National Wetland Inventory maps, generated by the USFWS, are complete for the entire state of Arizona. These maps are prepared at 1:100,000 scale and are intended to be used as a tool for locating and identifying ecological types of wetlands. Anyone wanting to modify a wetland (or any area that might affect a wetland) needs to contact the Corps of Engineers to determine whether there are applicable regulations. Inventory maps do not have any legal standing in the determination of "jurisdictional wetlands." Recently, major perennial streams in the State have been resurveyed and mapped to 7.5 minute quadrangles. Few of these maps have been digitized for use with Geographic Information Systems, so their use is limited. Inventory maps have been digitized for lands occurring on the Tonto National Forest and portions of the Gila River.

The USFWS is currently delineating wooded riparian habitats to add to existing National Wetland Inventory maps when these maps are updated. Riparian habitats are classified into five representative plant categories: mixed broadleaf species, cottonwood/willow associations, saltcedar, mesquite, and juniper. Vegetation is then classified as either scrub-shrub (averaging less than 20 feet in height) or forested (greater than 20 feet in height).

In 1992, a statewide inventory of riparian areas was initiated by AGFD. This project began with the development of an inventory of riparian areas associated with perennial streams. An inventory of riparian areas associated with intermittent and ephemeral streams has recently been completed and reports are being prepared. The inventory covered 4,628.95 miles of streams and mapped 266,786 acres of riparian vegetation. **Table 30** outlines the relative amounts of riparian vegetation communities associated with perennial waters in Arizona (Valencia et al. 1993).

Table 30. Riparian Vegetation Associated with Perennial Streams in Arizona

Vegetation Community	Percent **	Vegetation Community	Percent**
Tamarisk	20.3	Sycamore	1.2
Mesquite	17.5	Russian olive	<1.0
Arrowweed	14.8	Reed	<1.0
Conifer	11.2	Sacaton grass	<1.0
Mountain meadow	6.3	Mixed canyon scrub	<0.5
Oak	4.4	Acacia	<0.5
Cottonwood-willow	4.2	Desert willow	<0.5
Mixed scrub	3.0	Mexican elder	<0.5
Cattail	2.1		

** Excludes vegetated but scoured by winter flooding before classification with videography (7.4%) and area not classified due to lack of videography coverage (5.4%).

Integrity of Wetland Resources

Evaluation of Riparian Areas--State legislation passed in 1992 (Arizona Revised Statutes §45-101) considered developing a program to protect riparian areas. As a part of that legislation, ADEQ submitted a report entitled *Evaluation of Activities Occurring in Riparian Areas* (1993d). In this report, ADEQ discussed specified activities, operations, and uses that occur in riparian areas of federal, state, and private property in this State. These activities involve removing or depositing material, removing vegetation, or otherwise obstructing, altering, or destroying riparian areas. Twelve activities were identified:

- Timber harvesting
- Agricultural land clearing
- Recreational use and development
- Commercial, industrial and residential development
- Road and bridge construction
- Dam and reservoir construction and operation
- Channelization and bank stabilization
- Sand and gravel extraction
- Wetland drainage
- Grazing
- Landfills and sewage treatment facilities
- Mining and metallurgical operations

The report concluded that the effects of these activities are complex and variable due to the fact that each activity is unique in its frequency, intensity, duration, and spacial extent. The effects of activities (e.g., altering water drainage, altering channel geometry, removing vegetation, contributing contaminants to water) increase with proximity to riparian areas.

Management strategies to protect riparian areas were proposed. Avoidance of riparian areas may be most effective at managing activities that impact high quality riparian areas. Restrictions of activities (such as controlled access) could be used when activities directly affect riparian areas. Reduction of indirect effects using technology or other management tools may be more appropriate for activities which are farther away from riparian areas. For those activities which occur primarily on upland areas, the use of Best Management Practices can help reduce the indirect effects. Best Management Practices, technological controls, restriction of activity, and avoidance of riparian areas can be used in any combination by all activities to protect riparian areas.

The Ecosystems Technical Committee for the Arizona Comparative Environmental Risk Project looked at the resistance and resilience of Arizona's ecosystems, and concluded that for aquatic and riparian systems, the stressors that project the greatest risk are grazing, agriculture, water diversion, groundwater pumping, impoundments, and species introduction (ADEQ 1995e). In a study conducted in 1988, the U.S. General Accounting Office concluded that the principal technique for restoring riparian areas and native vegetation was a change in the management of livestock (GAO 1988).

Arizona Water Protection Fund--In 1994 a significant program to maintain, enhance, and restore riparian habitats was put into effect by the Arizona Legislature. It established the Arizona Water Protection Fund with the primary purpose of providing an annual source of funding to protect water of sufficient quality and quantity to maintain, enhance, and restore rivers and associated riparian habitats, including fish and wildlife that are dependent on these important habitats. This program funded 24 projects in 1995, and approximately eight-million dollars are available for fiscal year 1996-1997. These funds are awarded to projects that relate to the following three categories:

- **Water acquisition, capital projects, and other specific measures**--These projects seek to acquire a contract for Central Arizona Project water or effluent to protect or restore rivers or streams and associated riparian or aquatic habitats by restoring appropriate hydrologic conditions. Other projects include developing and implementing capital projects or other specific measures to protect water quantity and quality in order to maintain, enhance and restore Arizona's rivers, streams and associated riparian or aquatic habitats.

- **Water conservation**--These projects develop, promote, and implement programs designed to conserve water for the purpose of maintaining, enhancing or restoring Arizona's rivers, streams and associated riparian or aquatic habitats.

- **Research and data collection**--These projects conduct research related to the maintenance, enhancement or restoration of Arizona's river, streams and associated riparian habitats.

Section 401--The Rock Products Association had a bill introduced to the Arizona State Legislature to change the way the State certifies Section 404 Permits for aggregate facilities. This legislation was passed and signed by the Governor with an emergency provision making it effective on March 1, 1996. A review of the amended state statute (Arizona Revised Statute 49-202) reveals the following:

- The applicant may deem any requests for additional information as a denial of certification. Denials can be taken to the State Office of Administrative Hearings.

- ADEQ shall grant or deny State Certification and send a copy to the applicant within 30 days.

- Any applicant may appeal any condition that may adversely affect them. The appeal process is filed with the State Office of Administrative Hearings.

- ADEQ may consider only activities within surface waters (i.e., Waters of the United States) and within the project area.

This statutory amendment is under review by the EPA, the Corps of Engineers, and the State Attorney Generals Office to determine whether provisions of this amendment are in conflict with the federal Clean Water Act.

Water Quality Standards

EPA required states to ensure water quality protection for wetlands by the end of the federal water year 1993 (September 30). The State's definition of "waters of the United States" includes wetlands. Definitions of both terms can be found in Arizona Administrative Code R18-11-101. Waters of the United States and wetlands are both subsets of "Waters of the State" as defined in Arizona Revised Statutes 49-201.

The level of protection afforded to wetlands as a result of their inclusion as navigable waters is uncertain because wetland ecosystems are very different from stream and lake ecosystems. The standards promulgated in 1992 protect wetlands at levels that are sufficient to protect streams and lakes for their designated uses, and may be either under-protective or over-protective of wetlands. Wetlands are protected by the standards found in the Arizona Administrative Code as follows: R18-11-108 (narrative standards), R18-11-109 (numeric standards), and R18-11-107 (antidegradation standards). Under the current standards, the designated uses that protect wetlands are the same designated uses that protect other waters; full body contact, partial body contact, drinking water source, fish consumption, agricultural irrigation, agricultural livestock watering, and one of four (cold, warm, effluent dependent or ephemeral) aquatic and wildlife designated uses. No specific designated uses for wetlands were created in the rules adopted in 1996.

Due to the possible deficiency in water quality protection for wetlands, ADEQ began drafting narrative standards that apply specifically to wetlands. Background information of wetland policies and regulations from 21 states and three federal agencies was researched to determine various approaches to regulation of water quality. One of the key findings was that wetlands in Arizona are normally already protected by Arizona's surface water quality standards. However, there may be situations where specific wetlands have unique physical and chemical properties which would require the development of site-specific standards. Narrative standards to protect both the physical and biological integrity of wetlands were drafted. Further development of these standards will require collection of more water quality data.

Innovative Programs and Activities

ADEQ's Wetlands and Riparian Area Protection Program has been instrumental in several innovative projects. The staff has also been involved in many other special initiatives and projects that are described elsewhere in this report (i.e., constructed wetlands, the Watershed Protection Approach, stewardship training workshops, and the Arizona Comparative Environmental Risk Project).

Mapping of 404 Permit Activities--ADEQ is utilizing the Arc/Info Geographic Information System to map Section 404 and Nationwide permits that have been issued in Arizona. Data files have been received from the regional office of the Corps of Engineers in Los Angeles. These files contain information on Section 404 and Nationwide permit activities such as locations (latitude and longitude, county, waterbody), applicant names, dates of application, and status of applications. Data file information will be verified in the field. Activities will be mapped to provide insight into their effects on wetlands and watersheds.

Stream Channel Morphology--ADEQ, in coopération with the Department of Geography at Arizona State University, initiated a study of the Verde River in October 1995. The purpose was to understand the similarities and differences in river behavior as a function of spatial variations within the system. The principles of fluvial geomorphology, hydrology, and hydraulics will be used to assist in the development of water quality standards for chemical, biological, and physical integrity. This Verde River assessment will be completed in early 1997.

A guidance document is also being developed which will describe the fragmentation of channel form, the processes involved, and the sediments that characterize many of Arizona's streams. This document will contain information about:

- Physical processes existing in arid region streams such as force and resistance, flow, magnitude, and frequency of events,
- Physical characteristics of arid region streams such as hydrogeography, geology, climate, and vegetation, and
- Physical integrity measurement methods and parameters.

Development of Stream Ecosystem Monitoring--This project was initiated in July 1996 to assist in developing a stream ecosystem monitoring protocol for ADEQ's surface water quality programs. The protocol will consist of five elements: 1) physical channel features (including sediment transport), 2) riparian habitat, 3) land use, 4) biological features, and 5) chemical and physical features. Monitoring the stream ecosystem will strengthen ADEQ's wetland and riparian area protection program. The protocol will be used by all surface water programs, thus providing consistent data collection.

Environmental Technology Initiative--Concurrent with the development of recommendations by the ADEQ Constructed Wetlands Team, the City of Phoenix and the U.S. Bureau of Reclamation were awarded an Environmental Technology Initiative grant from EPA. The goal of this project is to identify, analyze, evaluate, and resolve policy, regulatory and compliance issues that hinder the utilization of constructed wetlands from use

for treatment and environmental enhancement. City, county, state, and federal agencies are assisting in developing products for this grant.

A primary product of the Environmental Technology Initiative will be a report that examines regulatory barriers associated with constructed wetlands. Eliminating unnecessary barriers and promoting regulations that encourage the treatment and discharge of effluent to constructed wetlands would provide a cost-effective alternative for wastewater treatment and also preserve or enhance riparian and riverine habitats. Recommendations developed by the ADEQ Constructed Wetlands Team will be incorporated into the policy and permitting issues report developed by the Environmental Technology Initiative Team.

Partnering with AGFD for the 401 Certification Program--The Section 401 water quality certification program is seen as an effective tool for protecting Arizona's streams and riparian areas. The certification program enables ADEQ to review activities requiring a Section 404 permit (from the U.S. Army Corps of Engineers) and requires specific conditions for surface water quality protection.

Each year it is estimated that ADEQ reviews approximately 100 projects statewide that are larger than one acre. However, ADEQ is unable to do reconnaissance on all these projects because of limited staff. Arizona Game and Fish Department was identified as an agency to assist ADEQ with some of these projects. AGFD has regional offices and field staff who often have knowledge of proposed project sites. Also, each regional office of AGFD has habitat managers who are familiar with area locations. AGFD's role could be expanded to include evaluating projects for possible water quality impacts and observing current conditions that should be maintained or restored.

Sand and Gravel Industry Guidance Practices--Best Management Practices and guidance practices have been developed for the sand and gravel industry for activities within watercourses in Arizona. These practices were developed by the Watercourse Alteration Technical Advisory Group (WATAG), consisting of individuals representing the sand and gravel industry and federal, state, and county interests. A publication, *Best Management Practices for Sand and Gravel Operations in Arizona*, presents a list of practices and describes the Section 404 permit and Section 401 state water quality certification processes. This publication was developed as a reference for standards of practice commonly used by the sand and gravel industry and for compliance with requirements of Section 401 of the Clean Water Act. This document is available through ADEQ's Nonpoint Source Program.

PART V - SPECIAL INITIATIVES

Arizona's Watershed Protection Approach

Purposes--The Arizona Department of Environmental Quality is in the process of developing a framework for managing water quality on a watershed-by-watershed basis to meet the needs of our increasingly complex society. A watershed is delineated hydrologically, rather than politically. This framework includes the following goals:

- Empower local communities in priority setting,
- Encourage fair and equitable actions through public involvement,
- Coordinate environmental planning and implementation with other agencies and governments,
- Align ADEQ resources to achieve more efficient, effective and responsive customer service,
- Provide a sound technical basis to support environmental decisions, and
- Provide a forum to foster continuous evaluation and improvement of environmental programs and regulations.

In the past, water quality management planning and implementation of strategies to mitigate water quality problems have been limited by political or administrative boundaries that do not coincide with natural water boundaries. Upstream pollution sources combine with downstream pollution to have a cumulative impact on aquatic resources. At the same time, a healthy river system has a limited assimilative capacity to take up excess nutrients and other forms of pollution and recycle them. We can determine how to best use this limited capacity to establish and maintain a sustainable economy and a healthy environment by considering the entire watershed.

Another obstacle for water quality management has been coordinating activities among various agencies. Different agencies and programs are involved in identifying and implementing strategies to reduce water quality impacts, and identifying environmental concerns or issue discharge permits. The need to coordinate numerous local, state, and federal agencies has lead to the creation of Nonpoint Source Program Management Zones, and the Comprehensive State Groundwater Protection Program. However, each of these initiatives was limited by definition and funding sources.

The relationships between surface water and groundwater have frequently been ignored. Simplistically, all groundwater has been surface water at some point in time and may become surface water again. Surface water flows are frequently the result of groundwater intersecting a depression in the land surface, such as a river channel or lake. Because of this relationship, groundwater protection is an important goal of Watershed Protection Approach.

Along similar lines, the relationships between water quantity and water quality have also often been ignored. For this reason, it is important for agencies like ADEQ and ADWR to work in a complimentary fashion so that the long-term health of the environment and the economy can be sustained.

Framework Development Process--A draft framework is being developed by ADEQ's Water Quality Division staff and a draft document is to be released in December 1996. This team was to define a clear picture of how each of the ADEQ programs will fit together and document the details of the strategy for implementing watershed-based management across the State. The draft is to undergo a series of refinements, including briefings of and comment within ADEQ and similar input from potential partners and stakeholders. External outreach and comments on the proposed framework will take place in late 1996, with a final framework document expected in 1997. Several key concepts of the draft Watershed Protection Approach are presented here.

Watershed Zone Delineations--Ten Watershed Zones have been identified. These zones are illustrated on **Map 2** and were used in the presentation of watershed information in the last section of the first chapter. These watersheds consist of Hydrologic Units delineated by the U.S. Geologic Survey. The names are temporary (except for preexisting Nonpoint Source Management Zone names), based on the surface water basins within each watershed zone.

As illustrated on maps in the last section of chapter 1, groundwater basins and watershed zone delineations do not always match. However, because both were based in part on physiographic/geographic characteristics, boundaries generally correspond. Watershed zones will need to have flexible boundaries to accommodate groundwater quality issues which may extend beyond surface water boundaries.

ADEQ management has decided to convert the existing Nonpoint Source Management Zone activities into the initial implementation of the Watershed Protection Approach in the Verde and San Carlos-Safford-Duncan Watersheds. Previously established Local Advisory Groups are being used and water quality concerns have been identified. Activities of the Comprehensive State Groundwater Protection Program, initiated in the Tucson area, will also be incorporated into this process when the Santa Cruz-Rio Magdalena-Rio Sonoyta Watershed Zone is activated.

The Watershed Cycle--A fundamental concept in statewide watershed management is focusing on individual watersheds in a systematic and sequential manner. This means that during any given year, various programs and activities will be emphasized in an individual watershed. During the following year, these efforts will shift to the next watershed in the sequence. By establishing a standard cycle, agencies and individuals with an interest in a watershed can meet and pool resources to implement watershed management activities in a unified and mutually supportive manner.

As a management tool for ADEQ, the watershed approach can guide the allocation of ADEQ resources in a more effective and efficient manner. The common geographic focus and synchronizing of activities enable ADEQ programs, as well as those of other government agencies, to work together.

Not every water quality management program or activity fits within this cyclic concept. For example, programs such as inspection of public drinking water systems, remediation of hazardous contamination, and compliance and enforcement cannot be operated in this cyclic manner. However, certain facets of these programs can support the cyclical watershed approach (i.e., outreach and technical assistance). There is also a need to maintain ambient long-term water quality monitoring to identify trends in water quality.

A five-year cycle is proposed for implementing this program in the ten watersheds. After an initial transition period, ADEQ would be involved in all watersheds but at a different point on the cycle in each watershed. The watershed approach proposes the following initial cycle:

1996 - Verde River Watershed Zone,
1996 - San Carlos-Safford Duncan Safford Watershed Zone,
1997 - Santa Cruz River-Rio Magdalena-Rio Sonoyta Watershed Zone,
1997 - San Pedro River-Willcox Playa-Rio Yaqui Watershed Zone,
1998 - Bill Williams River Watershed Zone,
1998 - Colorado River-Grand Canyon Watershed Zone,
1998 - Colorado River-Lower Gila River Watershed Zone,
1999 - Middle Gila River Watershed Zone,
2000 - Salt River Watershed Zone, and
2000 - Little Colorado River-San Juan River Watershed Zone.

Basic Steps--The following six steps are to be used to develop and implement a regional watershed plan.

1) Stakeholder Outreach Involvement--This step involves identifying potential stakeholders, bringing them together, and enlisting their leadership or involvement in the decision making process. These stakeholders include federal, state, and local government agencies, land use managers, property owners, and the citizens who live and work in a particular watershed. Ideally, one or more of the stakeholders could represent an established organization that can act as local sponsor for the watershed process.

   A watershed characterization document is to be developed in this step, which will be refined during the outreach process and be incorporated in the final watershed plan. A rough draft would be compiled prior to the formation of the local advisory group. It would include background information such as: existing water data, a general description of the culture, economy, and land use of the area, population centers and political jurisdictions in the watershed.

2) Collect and Evaluate Data--This step builds on existing information to develop a strategic monitoring plan to generate the scientific information needed to support sound policy decisions for a particular area. Many types of data are frequently needed (e.g., land use, areas using septic systems, water quality data, biotic contamination concentrations, soils data, etc.). ADEQ has limited resources available to collect data. However, combining resources from multiple agencies and using citizen volunteers may provide adequate resources to address key water quality problems and questions. Evaluation of the information gathered from strategic watershed monitoring should reveal whether a particular concern merits further attention.

3) List and Target Concerns--Based on the results of the previous step, the stakeholders can identify and compare water quality concerns. Parallel to this activity, the resources available to address water quality management can be compiled and used to determine which priority water quality concerns will be addressed. In this manner a complimentary suite of issues can be targeted for further action along with identified sources of funding, thus helping to ensure that the watershed plan can and will be implemented.

4) Develop of Management Strategies and Measures of Success--In this step an overall strategy can be developed to address the targeted concerns for the watershed in a unified manner. Indicators need to be identified to determine how well each component of the strategy improves or protects water quality. Measuring success is a critical step because it allows good ideas to be expanded and repeated and bad ideas to be modified or eliminated.

5) Develop a Watershed Plan Document--The results of the previous steps are documented in the preparation of a consensus-based plan. This step will involve the development of agreements and commitments by various parties to address specific concerns. The plan would include the following three components:

   - Activities that are to be implemented,
   - Resources for each component of the plan, and
   - A timetable for implementation.

   Issues whose resolution can be delayed without significant impact on the environment or which are too long-term to be resolved in the current watershed cycle can be identified for action in subsequent cycles. If available resources are insufficient to provide important water quality information or resolve key problems, strategies will be developed to obtain needed resources.

6) Implement and Evaluate the Watershed Plan--Activities and strategies specified in the watershed plan are pursued in this step, along with evaluation of the success of the various components. This step supports continued progress in subsequent watershed planning cycles.

Arizona Comparative Environmental Risk Project

The Arizona Comparative Environmental Risk Project (ACERP) completed in 1995, developed a baseline of the best available scientific data on environmental risks facing Arizona and the public's perception and values regarding the relative importance of those risks. A copy of this assessment is available from ADEQ.

The environmental risk assessment process occurred in this order:

1. Three technical committees (ecosystems, human health, and quality of life) provided a comprehensive list of environmental issues based on their perspectives.
2. The Steering Committee worked with the technical committees to identify 14 key environmental issues.
3. The technical committees then researched and ranked these 14 issues according to the risk they pose to ecosystems, human health and quality of life in Arizona.
4. A Public Values Assessment was conducted to determine how Arizonans perceive environment concerns and issues in various parts of the State, using focus groups to discuss environmental concerns and a telephone survey of 799 randomly selected adults.
5. A Public Advisory Committee, composed of representatives of various interest groups and agencies (including members of the Steering Committee), completed a final ranking of the stressors.

The findings and conclusions from each group explicitly revealed the differences that exist in the way different segments of society view and rank risk. Highlights from each of the technical committees, the Public Values Assessment, and the Public Advisory Committee follow:

The Ecosystem Technical Committee--This committee identified a list of stressors (or activities) on Arizona's ecosystems, evaluated the effect of each stressor on specific ecosystem types, and determined which stressors had the greatest impact. This committee concluded that:

- For all of Arizona's ecosystems, grazing and species introduction pose the highest risk, followed by fire suppression, mining, timber management, and water management.
- For aquatic and riparian systems in particular, the greatest risks are the result of grazing, agriculture, water diversion, groundwater pumping, impoundments, and species introduction.
- For terrestrial systems, the stressors with the highest risk include grazing, species introduction, and timber management in forest systems.

The Human Health Technical Committee--This committee ranked identified stressors according to the potential risk they present to public health in Arizona. Some stressors were not ranked because of insufficient data (e.g., electromagnetic fields, open air burning in Mexico). The following stressors present a high risk to human health:

- Allergens and Valley Fever,
- Fine particulate matter,
- Ionizing radiation,
- Radon,
- Environmental tobacco smoke,
- Food safety,
- Lead Poisoning,
- Ultraviolet radiation.

The Quality of Life Technical Committee--This committee looked at the issues and stressors identified by the other committees to determine potential impacts on the economy, future generations, aesthetics, peace of mind, social fairness, and recreation. Based on the information gathered, three issues had the highest priority:

- Degradation of the built and cultural environment,
- Physical/biological alteration, fragmentation, and loss of ecosystems, and
- Urban outdoor air pollution.

The Public Values Assessment--The public values survey indicated the following:

- 44% were "greatly concerned" about the environment, while only 9% are "not too concerned" or have "no concern" about the environment.
- Air quality, water quality, and the general quality of the community's environment were believed by 37% to be good for health, by 32% to be bad for health, and by 21% to not affect health at all.
- 50% or more of the respondents had "great concern" about the following environmental topics: outdoor air quality; drinking water quality; pesticides in foods; condition of forests, deserts and other natural areas; bacteria and other organisms in food; future availability of drinking water; disposal of household wastes; quality of surface waters; and disposal of hazardous wastes.
- 74% believed that economic growth and environmental protection can be achieved at the same time.
- 48% believed that in Arizona the government overemphasizes economic growth at the expense of the environment, while only 15% felt that environmental regulation has hurt economic growth.
- 93% agree that industry should pay for the environmental harm it generates.
- 81% agree that we have to protect the environment for future generations, even if it means reducing our standard of living today.
- 67% were willing to pay increased costs for goods and services to protect the environment.
- 52% were willing to pay higher taxes to better protect the environment.

The Public Advisory Committee Final Ranking--The Public Advisory Committee provided the final ranking of the fourteen issues:

VERY HIGH RISK:
- Outdoor air pollution

HIGH RISK:
- Degradation of the built and cultural environment,
- Groundwater contamination,
- Physical alteration, fragmentation, and loss of ecosystems.

MEDIUM RISK
- Biological alteration of ecosystems,
- Food and drink contamination,
- Indoor air pollution,
- Land and soil contamination,
- Surface water contamination.

LOW RISK
- Accidental releases (of toxic contaminants),
- Global climate change and stratospheric ozone depletion,
- Natural hazards (i.e., drought, earthquakes, floods, lightning, and wild fires),
- Radiation (not including radiation in drinking water),
- Workplace and consumer exposure to hazardous materials.

Comprehensive State Groundwater Protection Program

ADEQ initiated a Comprehensive State Groundwater Protection Program to achieve a more efficient, coherent, and comprehensive approach to protecting groundwater resources. Partnerships among EPA, state agencies, Native American tribes, and local governments are a central theme in this initiative. ADEQ completed a draft "Self-Assessment for the Arizona Core Comprehensive State Groundwater Protection Program" in the fall of 1993 that identified the six strategic steps to establishing this statewide program:

1. Establish a common groundwater protection goal that will guide all relevant programs in the state.
2. Establish priorities to achieve this groundwater protection goal, based on resources available, sources of contamination, and programmatic needs.
3. Define authorities, roles, responsibilities, resources, and coordinating mechanisms across relevant federal, state, tribal, and local programs for addressing identified groundwater protection priorities.
4. Implement strategies to accomplish the state's groundwater protection goal.
5. Coordinate information collection and management to measure progress, reevaluate priorities, and support all ground water-related programs.
6. Improve public education and participation in all aspects of groundwater protection that will help achieve the state's groundwater protection goal, priorities, and programs.

ADEQ has recognized the similarities between several initiatives (Wellhead Protection, Source Water Protection, the Nonpoint Source Management Zone Concept, and the Watershed Protection Approach) and is attempting to blend and aggregate these concepts within its Watershed Protection Approach. Although, the Comprehensive State Groundwater Protection Program will not continue on its own, many of its concepts and projects will be incorporated within the Watershed Protection Approach.

For example, the Tucson Implementation Project selected five focus projects to develop strategies to coordinate activities among interested parties to resolve groundwater quality concerns. Various levels of success were achieved in these projects. All of the projects have now ended, many without completing their goals. A brief description of each of these projects follows:

- The ASARCO-Mission Complex Mine is an active copper mine bordered by tribal and non-tribal land. The project sought to establish an Inter-Governmental Agreement among ADEQ, the Department of Interior, the Bureau of Land Management, the Bureau of Indian Affairs, and the Tohono O'Odham Nation to bring the entire facility under a unified mine plan that would conform to the Arizona Aquifer Protection Permit requirements, while respecting tribal sovereignty. After nearly three years, the Inter-Governmental Agreement has been finalized and is nearing signature.

- The Downtown [Tucson] Groundwater Contamination Project sought to coordinate an investigation and remediation of soil and groundwater contamination among various programs, property owners and responsible parties. A forum, known as the Downtown Tucson Technical Group, was established to share information and coordinate activities.

- The Cross-Agency Data Sharing Project was established to develop a shared water quality database. The United States Geological Survey took a lead role, as part of its work within the Intergovernmental Task Force on Monitoring Water Quality (ITFM). This project attempted to develop three things:

  - An interagency Memorandum of Understanding on data sharing,
  - A set of protocols for data sharing, and
  - A computerized directory of water quality databases.

Pima County Association of Governments is currently drafting a data directory.

- The San Xavier Industrial Park Project sought to coordinate pollution prevention and hazardous waste inspection activities at an industrial park located on tribal lands adjacent to the City of Tucson. This project failed to get started due to limitations of tribal resources and a lack of long-term support from ADEQ or EPA staff. The project did bring to light the internal complexities among the Tohono O'Odham Nation and its semi-autonomous San Xavier District, or issues involving leasing allotted tribal lands to non-tribal interests. Subsequent hydrogen sulfide releases from a chemical facility at the industrial park, that sent dozens to the hospital and sparked lawsuits involving the Secretary of the Interior, has moved this project even further out of reach.

- The Use and Susceptibility Waivers for Water Suppliers Project was to help in implementing the Public Water Supply Waiver Program that will reduce monitoring requirements based on potential exposure. Although this project was dropped from the Tucson Implementation Process due to enforcement actions and lack of available staff and funding, it was completed by ADEQ's Safe Drinking Water staff.

Upper Gila River Watershed Program - The Gila Monster

An integrated, holistic watershed management program for the Upper Gila River Watershed in Arizona and New Mexico has been implemented by ADEQ in cooperation with the New Mexico Environmental Department, the U.S. Forest Service, the U.S. Bureau of Land Management, and EPA regions IX and VI. More than 80 interested parties have been represented at meetings that are focused on implementing a nonpoint source management program for this 8,500,000 acre watershed.

Local Advisory Groups have been established in Arizona and New Mexico--three in New Mexico and one in Arizona. The combined San Carlos-Safford-Duncan Advisory Group is developing local management efforts for nonpoint source activities in Arizona. These advisory groups have been successful in bringing together federal, tribal, state and local participants.

Along with the development and implementation of nonpoint source control strategies, the Gila Monster participants are to develop standardized methods for water quality monitoring and a data management system so that all interested parties can use the monitoring and assessment information gathered.

National Water Quality Assessment - Central Arizona Basins

The U.S. Geological Survey initiated a National Water Quality Assessment (NAWQA) study unit in Arizona in 1993, known as the Central Arizona Basins. There are 60 such study units distributed throughout the United States that represent a diversity of geohydrologic settings and most of the Nations's water use. The long-term goals of the program are to describe the current status and trends in the quality of the nations's surface water and groundwater resources and to provide a sound, scientific understanding of the primary natural and human factors affecting the quality of these resources.

Collection, analysis, and interpretation of physical, chemical, and biological data will occur in these 60 units on repetitive 10-year cycles:

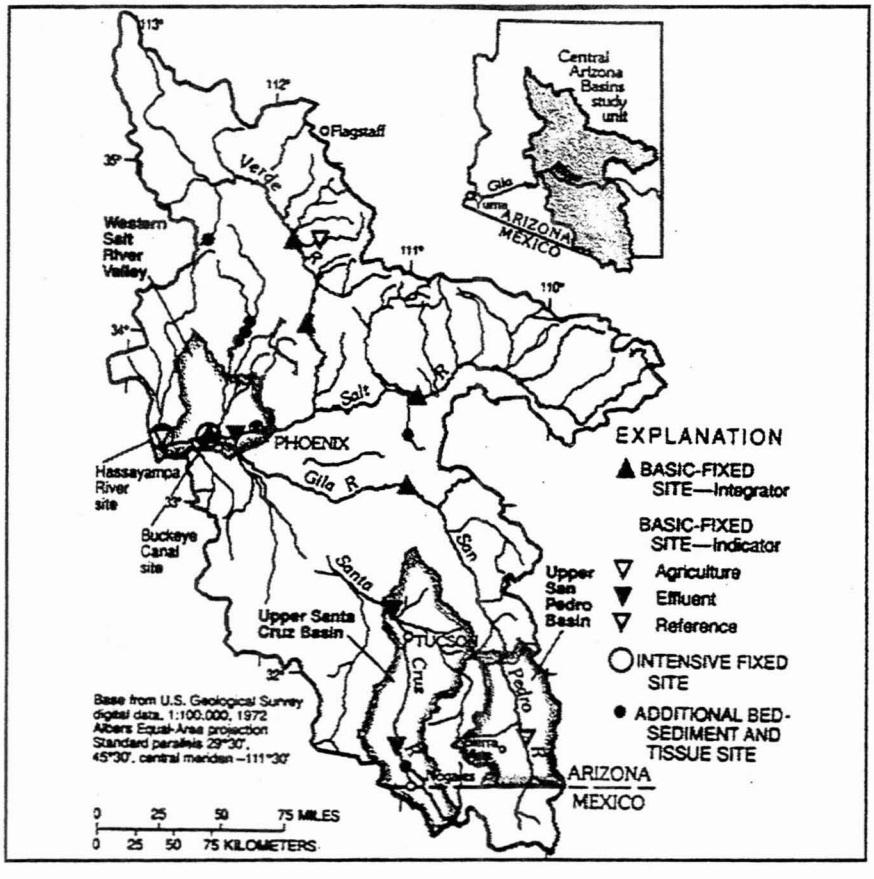
- 1 year for planning,
- 1 year for analysis of existing data and design of studies,
- 3 years of high intensity data collection,
- 1 year for completion of primary reports, and
- 4 years of low intensity monitoring and assessment activities.

The Central Arizona Basins study unit covers 34,700 square miles, and includes all of the Santa Cruz, San Pedro, Salt, and Verde surface water basins, and a portion of the Middle Gila basin.

Surface water is to be evaluated using three components: water column studies, sediment and tissue studies, and ecological studies.

A basic fixed-site network of 11 sites has been established on rivers; five sites represent complex combinations of land use settings (integrator sites), and six represent relatively homogeneous land use and physiographic conditions such as urban or agricultural uses (indicator sites) **(Map 49)**. One integrator site and one indicator site will be sampled intensively for one year to determine the occurrence and seasonal variation in pesticide concentrations related to agriculture.

Map 49. Central Arizona Basins (NAWQA Study)



The groundwater studies relate the quality of recently recharged groundwater with human activities in the drainage area. Two major areas of water use and population have been chosen for this study -- west Salt River Valley (Phoenix) and the upper Santa Cruz Basin (Tucson). The groundwater basin around Sierra Vista will also be monitored for comparison as a less impacted study area. USGS will sample 20 wells in Phoenix and Tucson and ADEQ will sample an additional 30 wells in the Sierra Vista area.

Border Issues with Mexico

Water pollution is one of the principal environmental and public health problems facing the Arizona-Sonora (Mexico) border region. Deficiencies in the treatment of wastewater, the disposal of untreated effluent, and the inadequate operation and maintenance of treatment plants and infrastructure result in health risks to border communities. Additionally, the lack of adequate collection, treatment, and distribution systems for public drinking water provides risks for gastrointestinal infections and other public health problems. In some cases, raw or insufficiently treated wastewater flows to drinking water sources. Although wastewater and drinking water facilities in the United States must meet permit and new construction standards, many of the sewage collection systems are old and leaking.

The lack of basic inventory and monitoring information pertaining to border water resources (quantity and quality) and water dependent environments prevent a comprehensive understanding of watershed issues.

Binational Projects--There are three ongoing binational projects in the Arizona-Sonora Border Area funded by EPA. The environmental problems associated with the rapid demographic and industrial growth in the border communities are being investigated and solved in a binational setting. Contamination knows no border. The scope and status of each of these projects are summarized below:

- The Nogales Wash Groundwater Monitoring Project--Shallow groundwater in the Nogales Wash area (estimated at 15-20 feet below the land surface) is vulnerable to impacts from surface activities in the area. This groundwater is tapped by private drinking water wells in Nogales, Arizona and some municipal wells in Nogales, Sonora. In addition, an international wastewater trunk line runs along the wash, which has deteriorated and infiltration problems are being reported. Nogales Wash flows north through Nogales, Sonora (Mexico) and Nogales, Arizona before discharging to the Santa Cruz River in Arizona. Perennial flow occurs due to springs in its headwaters and due to grey-water and sewage effluent.

  ADEQ has been monitoring surface water flows in Nogales Wash since 1986, and has documented high fecal coliform bacteria levels, ammonia, and heavy metals in the surface water. Leaking wastewater infrastructure has been indicated as the source of this contamination. The imminent public health risk has been temporarily mitigated by replacing some of these lines and chlorinating the water in the wash.

  Many public and drinking water private wells, irrigation wells, and monitoring wells have been sampled by ADEQ (ADEQ 1991, ADEQ 1996). Nitrate, bacteria, and low levels of volatile organic chemicals detected in these wells have been attributed to a leaking international wastewater trunk line that follows Nogales Wash. A Superfund Preliminary Investigation Site has been established at Nogales Wash to determine whether there are additional sources of VOCs. In addition, naturally-occurring uranium contamination has been detected, although it is not exceeding standards.

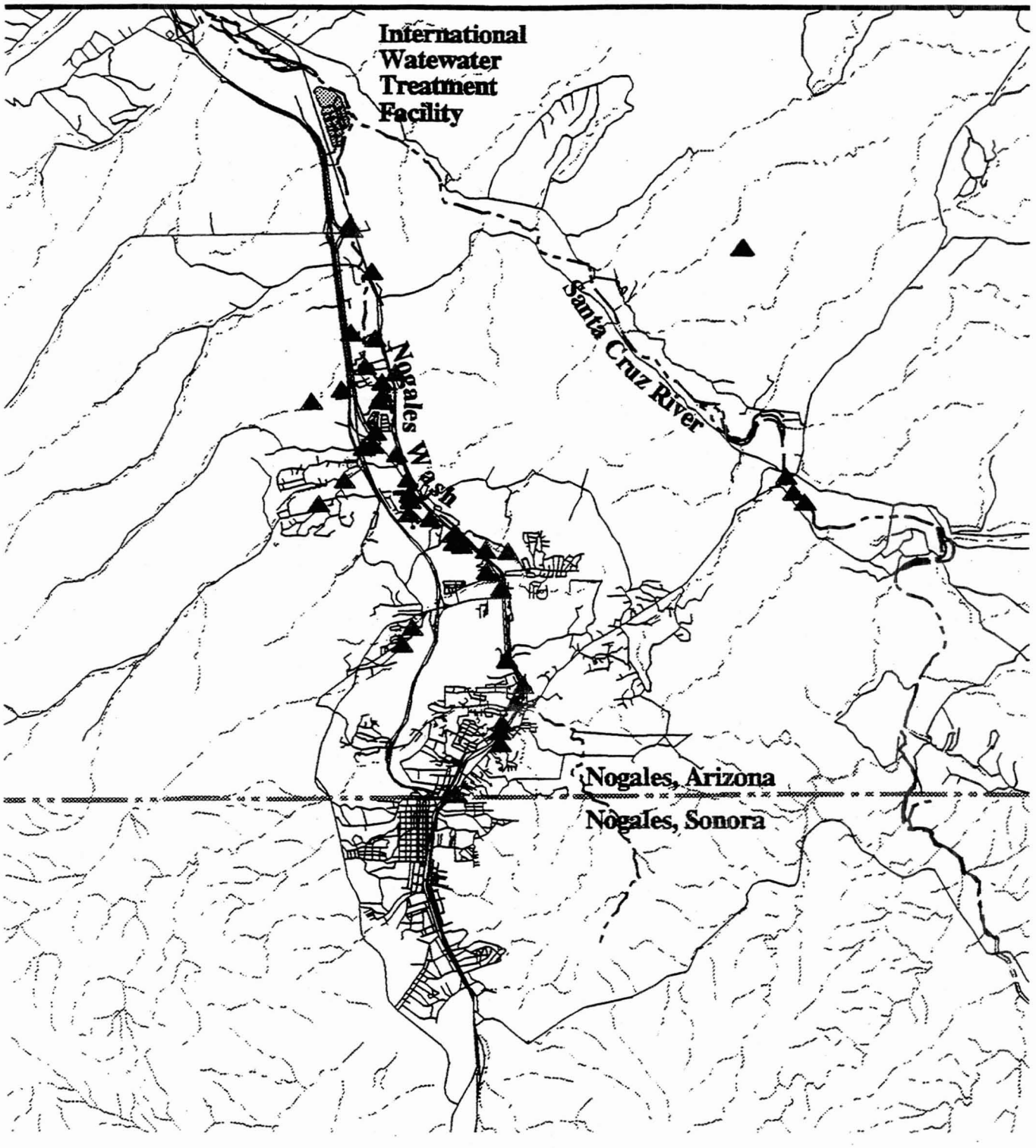
  Currently, a joint United States and Mexico groundwater quality study, coordinated by the International Boundary and Water Commission, is being conducted. Reliable soil and groundwater quality data will be collected from the vadose zone and the alluvial aquifer along the wash **(Map 50)**. Previous groundwater sampling may be unreliable because of problems with well construction and incomplete information concerning well depth. Thirteen new groundwater wells are to be monitored within five miles of the United States-Mexico border to document impacts from surface activities and discharges to the wash on both sides of the border.

- Ambos Nogales Wastewater Treatment Facility Planning Project--Wastewater from the twin cities of Nogales, Arizona and Nogales, Sonora is treated at an international treatment facility in Arizona that discharges to the Santa Cruz River. The plant is rapidly approaching its designed treatment capacity,

sewage overflows into Nogales Wash in Mexico frequently have been reported, and the collection systems for both cities are old and leaking. A binational facility planning project, coordinated by the International Boundary and water Commission, is to find the best technical and economic option for regional wastewater treatment facilities for these cities, which have a combined population of approximately 220,000 (only 20,000 in Nogales, Arizona).

- Lower Colorado River Toxicity Study--The residual Colorado River flow that enters Mexico has greatly affected the ecology of the upper Gulf of California and the Cienega de Santa Clara. A series of meetings among the International Boundary and Water Commissions, EPA, USGS, ADEQ, the State of California, and Mexican counterparts have taken place to discuss a work plan for monitoring the quality of the Colorado River water as it discharges into Mexico. Pesticides have been cited as one of the constituents of concern. A binational one-year study has been implemented and samples are being analyzed.

Border 21 Program--A new effort to promote sustainable development in the border region and address the environmental and health issues present along the United States-Mexico border is the Border 21 Program. This program emphasizes public involvement, decentralized environmental decision making, and improved communication and cooperation among the federal, state, and local agencies. A Border 21 Framework Document has been developed, which outlines the program and identifies general environmental objectives, and describes specific strategies and mechanisms for fulfilling these objectives through the year 2000. One important goal of this process is to establish binational priorities and technical assistance for the development of studies and improvement projects. This document is being distributed to the border communities for comments.



Map 50. Nogales Bi-national Study Area

International Border
Stream
Santa Cruz River & Nogales Wash
Road
Monitored Well

Kilometers 0 1/2 1 2 3
Miles 0 1/2 1 2

N W E S

Lake Havasu Special Investigation

Elevated fecal coliform concentrations were detected in 1994 at several swimming areas in Lake Havasu, an impoundment of the Colorado River **(Map 51)**. Subsequent closing of these popular beaches lead to a multi-agency investigation of surface water and groundwater quality. Contamination was confined to a backwater area known as Thompson Bay, which is a shallow bay in the vicinity of Lake Havasu City, Arizona. The bay is separated from the mainstem Colorado River by Pittsburgh Island. The investigation entailed surface water monitoring, groundwater monitoring, sediment monitoring, inspections of wastewater conveyance and treatment facilities, and investigation of stormwater discharges. These investigations provided the following findings and conclusions:

- Elevated fecal coliform concentrations (up to 80,000 colony forming units [CFU]) occurred only in several shoreline swim areas in Thompson Bay. Elevated levels of fecal coliform did not occur in open water, even within Thompson Bay.

- Three minor discharges were discovered and eliminated; however, their combined discharge did not significantly contribute to the bacteria contamination (Environmental Utilities Services 1994).

- Fecal coliform and *Escherichia coli* are not present in groundwater (ADEQ 1996c).

- Five factors may contribute nutrients to the lake and allow bacteria blooms during summer months (ADEQ 1996c):

  - Irrigation practices (using mainly treated wastewater),
  - Use of fertilizer on parks and golf courses,
  - The wastewater treatment plant on the island,
  - Fluctuating lake levels that influence groundwater movements, and
  - Private septic systems on the mainland.

- Groundwater in the area had three strong influences:

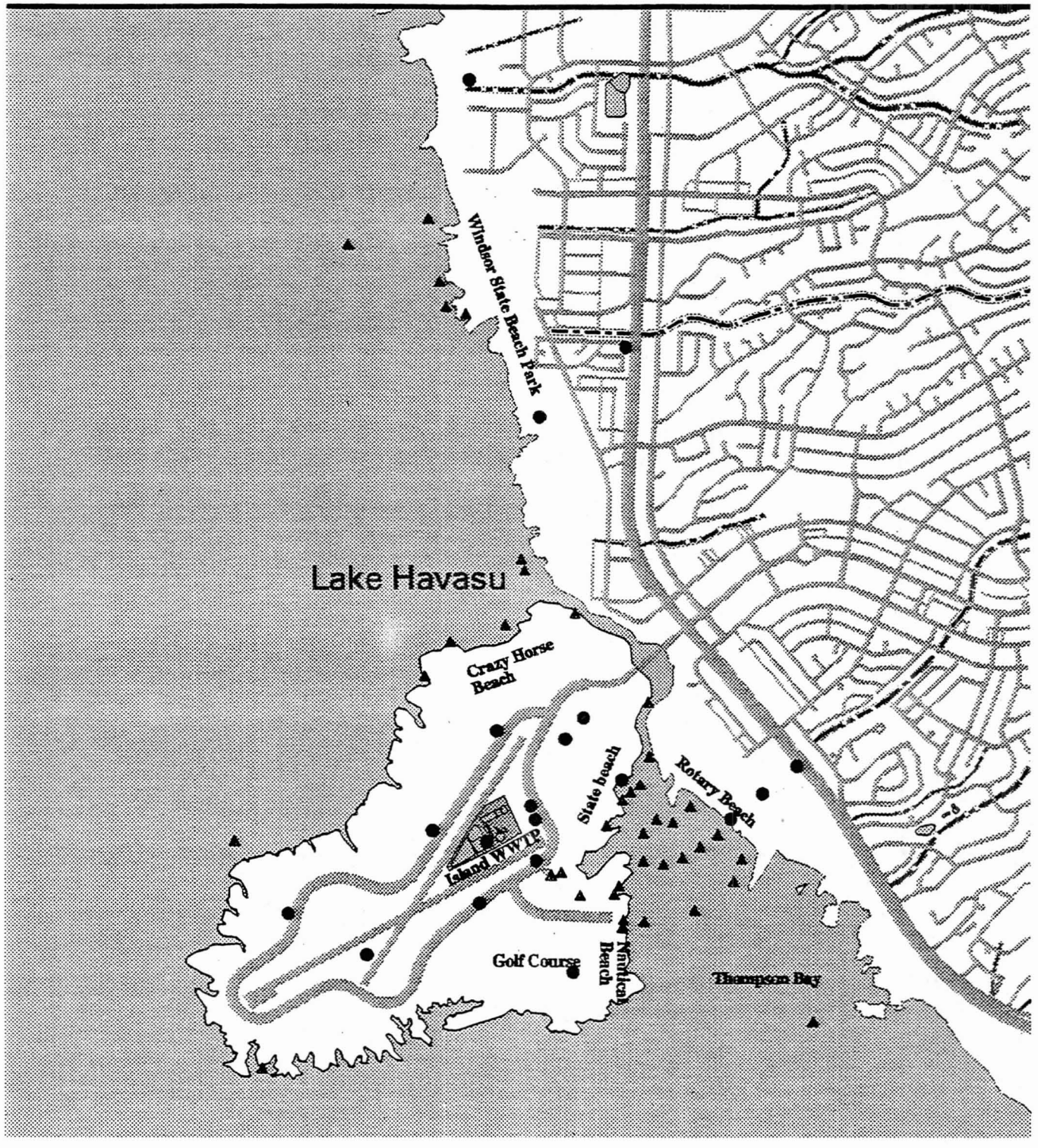
  - Municipal wastewater effluent disposal in a percolation pond on the island in Thompson Bay (300,000 to 800,000 gallons per day [gpd]),
  - Municipal wastewater effluent reuse on the island golf course (450,000 gpd), and
  - Municipal drinking water well pumping on the mainland.

  The amount of effluent disposal versus reuse varied. For example, from June to August the average amount of effluent used for irrigation ranged from 700,000 to 1,260,000 gpd (Dames and Moore 1995).

- Nutrients were contributed to the groundwater by septic systems, the percolation pond, and application of reuse water and fertilizer on the golf course. Nitrate levels were found to be as high as 21 mg/l (background levels were 0.22 mg/l north of the city and 0.2 mg/l in the lake).

- Variations in lake elevation also may contribute to the problem by exposing organically enriched sediments. Fecal coliform concentrations in these sediments were as high as 240,000 CFU/100 grams, while sediments in control areas contained 7 to 23 CFU/100 grams of fecal coliform. The most likely cause of the fecal coliform concentrations at the beaches was enhanced natural microbial growth in the shoreline sediments, stimulated by higher nutrient concentrations and warmer water along the shoreline.

Strategies to mitigate these problems are being developed by Lake Havasu City. Copies of the investigation reports are available through ADEQ.



Map 51. Lake Havasu Study Area

Inter-Agency Task Force on Monitoring

The Intergovernmental Task Force on Monitoring Water Quality (ITFM) was established in 1992 to coordinate water information nationwide. Representatives from 20 federal, state, and interstate governmental groups have been working on the following tasks:

- Intergovernmental framework,
- Data management and information sharing,
- Data collection methods,
- Environmental indicators, and
- Assessment and reporting.

In February 1995, ITFM published its strategy for improving water quality monitoring in the United States (ITFM 1995) to support decision making at all levels of government and in the private sector. Other technical reports will be forthcoming in the next year. This strategy included these key components:

- Monitoring needs to measure progress in meeting clearly stated goals. Data should only be collected when a clearly intended use has been defined.

- Start with existing data, identify data gaps, then fill data gaps by priority ranking as resources allow.

- Establish watershed-oriented monitoring and assessment programs, tailoring the design to the conditions and goals of the watershed.

- Link monitoring programs from a full range of public and private organizations and establish comparable or compatible methods, tools to facilitate information access and transfer, and quality assurance and quality control programs to achieve desired accuracy.

- Regularly interpret and assess measurements, and report conditions and problems.

- Evaluate monitoring activities and identify new monitoring strategies as needed.

Wellhead Protection Program

Wellhead Protection is a pro-active Public Drinking Water Supply Program to protect groundwater sources from contamination. Arizona's Wellhead Protection Program was approved by EPA in 1993. This program is voluntary, a feature that separates it from other programs in the Drinking Water Section.

Currently, there are two active wellhead protection efforts in Arizona. The program can be explained by looking at these two examples.

- The Nogales (Arizona) Wellhead Protection Program has been under development for the past year and a half. This program is proceeding with cooperation from a number of state, federal, local, and international government agencies as well as many private local community-based organizations. This program is finalizing delineation of wellhead protection areas and beginning to evaluate protection measures which are in place. This type of holistic approach will ensure that once the wellhead protection areas are finalized, protection measures designed to maintain the current quality of water will be effective.

- The Wickenburg Wellhead Protection Program has been under development for seven months. This program is currently in the process of delineating the wellhead protection areas for the town's six drinking water wells. The program is proceeding with cooperation from a number of state and local government agencies as well as many private local community-based organizations. The Wickenburg project has received a commitment from the Maricopa Retired Seniors Volunteer Program (RSVP). They will assist the town with its inventory of potential and existing sources of contamination once the wellhead protection areas have been identified.

Many other communities throughout the State have shown interest in developing Wellhead Protection Programs and are currently being assisted by ADEQ in developing strategies for startup activities. The department is preparing a Wellhead Protection Guidance Manual for communities to use to guide them in the steps needed to develop local programs. The manual will be available from ADEQ in late 1996.

Drinking Water Waiver Program

ADEQ's Drinking Water Waiver Program was approved by EPA in January 1996, and is available to community and noncommunity public water systems that would like to reduce the frequency of monitoring required by public water supply regulations for specific chemicals (i.e., for inorganic chemicals, volatile organic chemicals [VOCs], and synthetic organic chemicals [SOCs]). The waiver program for SOCs and VOCs was developed to set monitoring frequencies based on risk rather than rule.

Waivers are determined based on two risk evaluations for the "use" and "screening susceptibility," as follows:

- If specified contaminants have not been used, transported, or stored within an established study area around the wellhead, then a use waiver may be issued.

- If use has occurred within the study area, then a screening susceptibility waiver may be considered, based on how vulnerable the groundwater is to contamination (i.e., soil types, depth to groundwater, and more).

Presently, there are approximately 1,100 systems which qualify to apply for monitoring waivers. The 1,100 systems have been divided into thirds, with one third of the systems applying for waivers at yearly intervals. Currently, the Drinking Water Section has received and evaluated approximately 50 waiver applications. Applications are submitted from systems throughout the State and are not limited to a geographic area.

Constructed Wetlands

Constructed wetlands are engineered systems designed to treat wastewater from municipal, industrial, or agricultural sources. The use of constructed wetlands for such treatment has been increasing in Arizona. Between 1972 and 1995, 25 constructed wetland projects have been built in Arizona, and at least 13 other projects are either under construction or waiting for approval to start construction (Ellman and Karpiscak 1996).

Constructed wetlands mimic natural processes by utilizing wetland plants, soils, and associated microorganisms to remove contaminants from wastewater effluent. As an ancillary benefit, constructed wetlands also provide valuable wetland habitat for wildlife and waterfowl use, benefits that have received strong support from the public. Three constructed wetland projects illustrate this support: Show Low wetlands, Sedona wetlands and Sweetwater wetlands.

The Show Low wetland, Arizona's oldest constructed wetland, was originally developed in 1970 and expanded and enhanced in 1985. Since their creation, the wetlands have developed into important habitat for 14 threatened and endangered or sensitive bird species, including the double-crested cormorant, black-crowned night heron, sora, bald eagle, peregrine falcon, white-faced ibis, and belted kingfisher. Educational and recreational opportunities have been enhanced with the construction of a paved trail, viewing platform and blind at Pintail Marsh. Several educational institutions including local schools and state universities use the wetlands as an outdoor classroom to better understand ecological and biological processes.

In 1990, the Northern Arizona Audubon Society proposed that a constructed wetland be incorporated into the City of Sedona's wastewater treatment construction plan. At that time a small five-acre wetland was created from surplus water released from the rapid infiltration basins located at the end of the treatment train. As with the Show Low wetlands many wetland dependent bird species have been observed at the site, including the white-faced ibis, American avocet, black-necked stilt, yellow-headed blackbird, five duck species and neotropical migrants such as the western kingbird. Currently, the City of Sedona is considering expanding the wetlands as part of a long term plan for effluent disposal.

In Tucson, the Sweetwater wetlands were developed in 1994 after ADEQ and the City of Tucson negotiated an agreement to address alleged violations of state (public water supply) monitoring and reporting requirements. A key element in the development of these wetlands was the inclusion of public input into their design and eventual use. An ad hoc Citizen's Wetlands/Recharge Advisory Committee was appointed by the mayor and city council to provide review and input into the planning process. Many recommendations from the committee for public amenities were incorporated into the core facility design, including visitor areas, access trails around the wetlands, and kiosks providing information on ecological aspects of the constructed wetlands.

In order to respond to the increased interest in constructed wetlands as an effective tool for treating wastewater and providing new aquatic habitats in an arid environment, ADEQ has taken several steps to support the use of wetlands as a method of treatment:

- Through ADEQ's Riparian Area and Wetlands Protection Program, ADEQ contracted to develop the *Arizona Guidance Manual for Constructed Wetlands for Water Quality Improvement* (Knight et al. 1995). This guidance manual consolidated technical and design issues and provided case histories of many projects that have been constructed in arid lands.

- In March 1995, ADEQ's wetlands program hosted a workshop for agency staff and county personnel involved in constructed wetland projects. People who attended this workshop prepared a list of 22 issues that were perceived to pose barriers to the routine use of constructed wetlands as wastewater treatment technology in Arizona.

- ADEQ's Director of Water Quality established a team consisting of agency staff and external stakeholders to address the list of issues prepared by the March 1995 workshop. The goal was to recommend resolutions to the regulatory and technical issues raised by the workshop. A report was submitted to ADEQ in May 1996 with 68 recommendations for 12 regulatory and technical issues. The recommendations were categorized into seven action areas:

  - Improving current business processes,
  - Establishing new policies,
  - Changing rule or statute,
  - Conducting technical studies,
  - Developing guidance documents or technical assistance,
  - Working with other agencies or stakeholders, and
  - Resolving design considerations.

- ADEQ is participating in an EPA Environmental Technology Initiative Grant, entitled *Regulatory Barriers Associated with Establishing Constructed Wetlands for Wastewater Treatment/Reuse and Wildlife Habitat Enhancement*, awarded to the City of Phoenix and Bureau of Reclamation in 1995. The goal of the study is to identify, analyze, evaluate, and resolve policy, regulatory and compliance issues at the federal level that hinder the utilization of constructed wetlands for wastewater treatment and environmental enhancement.

Environmental Indicators

Environmental indicators are measures that communicate progress toward water quality goals or objectives. Indicators can provide information on environmental and ecosystem quality or give reliable evidence of trends in quality. This report uses many environmental indicators, such as designated use support, wells exceeding standards compared to wells monitored, or compliance with permit requirements. An ADEQ team has recently been looking at existing or potential environmental indicators with state or national applicability, in an attempt to find those that will fulfill the following objectives:

- Measure the agency's performance in meeting its mission and goals in water quality.
- Provide a basis for strategic budget decisions within the agency,
- Measure the performance of individual programs and activities,
- Provide meaningful information for the public, and
- Be useful, scientifically valid, and representative of environmental conditions.

After initially evaluating the merits of 86 proposed environmental indicators, the team is currently testing the following indicators:

- Public Water Systems with treatment beyond conventional systems to remove known contaminants,
- Confirmed Maximum Contaminant Level (MCL) violations in Public Water Systems,
- Wellhead Protection,
- Sediment and animal tissue contamination,
- Biological integrity of surface water,
- Proper functional condition of riparian areas,
- Designated use support assessments of surface water,
- Wells exceeding an Aquifer Water Quality Standard,
- Surface water quality changes over time (trends),
- Groundwater quality changes over time (trends),
- Releases to the environment according to the Toxic Release Inventory,
- Point and nonpoint source loads to surface water and groundwater, and
- Compliance with wastewater permit discharge limits.

Preliminary reports are very encouraging. Many of these indicators have recently become available because of field research and protocols established (or being developed) in Arizona. For example, biological integrity, animal tissue and sediment contamination, and riparian and habitat changes over time are based on new research. Others have become available because of recent federal and state initiatives, such as wellhead protection and nonpoint source loads to groundwater and surface water. Most would require tracking new data or developing new methods to interpret existing data, and would require some time before meaningful information is available.

An evaluation report is to be completed by October 1996. ADEQ intends to institute the use of the selected environmental indicators this year, and these will be used in subsequent water quality assessment reports.

CHAPTER 3 - FINAL ANALYSIS

PART I - WATER QUALITY LIMITED WATERS - 1996

Purpose and Definitions

Waterbodies assessed as having impaired uses that require more than existing technology and permit controls to achieve or maintain water quality standards are classified by this Department as "Water Quality Limited Waters." This listing is pursuant to the Clean Water Act Section 303(d), taking into consideration comments and further information received during the four-week public review process.

Water Quality Limited Waters are already impaired by one or more stressors; therefore, entities reviewing plans for future activities in this watershed should take actions to mitigate further contributions of a listed stressor. Further, each waterbody is prioritized for completion of a Total Maximum Daily Load (TMDL) analysis.

Facilities and persons conducting activities discharging to Water Quality Limited Waters with a high or medium ranking may be asked to provide in-stream monitoring data. The accuracy of the loading capacity analysis is largely dependent on the amount of data available; therefore, a discharger may often benefit from providing monitoring data. Without that data the discharger may be erroneously assumed to be the primary contributor.

Listing Criteria

Waterbodies listed as Water Quality Limited in 1996 met these criteria:

1) A fishing, drinking, or swimming advisory has been issued for the waterbody in the past two years; **OR**
2) The waterbody was listed on a prior 303(d) list and insufficient information exists to delist; **OR**
3) The waterbody was assessed in Arizona's 1996 Water Quality Assessment Report (305(b) Report) as in "partial" or "non-support" of designated use(s) based on Arizona's numeric or narrative surface water standards; **AND**
   There was sufficient monitoring within the waterbody to be classified as a "monitored assessment" (see assessment criteria in Appendix C).

Note that waterbodies are not listed as Water Quality Limited on the basis of: an evaluated assessment (i.e., see explanation of evaluated versus monitored assessments in Appendix C), criteria not established in rules (i.e., wildlife tissue criteria, sediment criteria, secondary maximum contaminant levels, etc.), or where enforcement of existing permit requirements can bring the waterbody into compliance. **Therefore, this list is not a prioritization of all water quality problems in Arizona.**

A Water Quality Limited Water does not maintain surface water quality standards for its designated uses, and neither existing technology nor permit controls are sufficient to maintain water quality standards.

A Total Maximum Daily Load (TMDL) is the amount of pollutant that can be discharged to a waterbody and yet meet the water quality standard. A TMDL is calculted for each pollutant separately. A TMDL is the basis for allocating the load to point sources and nonpoint sources.

A waterbody is a lake or stream reach. The streams have been segmented into "reaches" by the Environmental Protection Agency (EPA) and given a unique number -- the reach number.

Delisting--Based on the above criteria, a previously listed waterbody can be delisted based on:

- Monitoring data that shows that the impairment has been eliminated. There must be sufficient monitoring data for a "monitored assessment." Monitoring data and conditions within the watershed indicate that exceedances will not routinely recur; **OR**
- Standards are no longer exceeded because of changes in surface water quality standards; **OR**
- Faulty data or information resulted in a listing error.

The following four stream reaches are no longer listed because of previous listing errors:

REACH NAME AND IDENTIFICATION	REASON DELISTED
Zuni River (at New Mexico border) 15020004-004	Monitoring data published by USGS (1994) was different from draft data available for the 1994 assessment.
Kirkland Creek (in Santa Maria drainage) 15030203-016	Data error: Selenium not exceeding standards.
Sycamore Creek (in Prescott National Forest) 15060202-026	Another Sycamore Creek in this watershed was monitored. This Sycamore Creek is in full support.
Hassayampa River (Martinez-Sols Wash) 15070103-003	Mill drainage not impacting the stream. Original assessment and listing in error.

Ranking and Targeting Waterbodies for TMDLs

Ranking--In 1996, 120 waterbodies in Arizona are listed as Water Quality Limited. ADEQ has ranked and scheduled a few of these waterbodies for a loading analysis (TMDL) sometime in the next two years (**Appendix H**). Ranking is based on the following criteria:

- Extent of impairment (number of contaminants, number of designated uses in "non-support");
- Special status of the waterbody or watershed (designated Wilderness Area, Primitive Area, Wild and Scenic River, Unique Waters, Riparian Conservation Area);
- Fishing, swimming, or drinking advisory has been routinely issued.

Each of the 120 listed waterbodies received a score based on the above criteria; however, the final ranking depended upon the appropriateness or merits of doing the TMDL. Factors used to judge merit included:

- Risk to human health and aquatic life,
- Degree of public interest and support,
- ADEQ support available from programs and initiatives to complete this analysis, and
- Other means available to bring water into compliance (i.e., standards development, enforcement actions, or use attainability analysis).

Those waterbodies listed because of a contaminant that is apparently entirely natural received a low ranking regardless of scores. A TMDL analysis is not an appropriate tool to resolve these water quality problems. Nonetheless, these waterbodies are listed to discourage additional contributions of specified parameters until other actions can be taken (i.e., establish site specific standards or eliminate uses which cannot be supported through a use attainability analysis).

Note that new standards for arsenic (Fish Consumption use) and bacteria (Full Body Contact use - fecal coliform changed to *Escherichia coli*) were adopted by ADEQ in 1996 after assessments were completed. The arsenic standard will be rising from 3.1 µg/l to 1450 µg/l. The change in the bacterial standard will also bring many waters into compliance because fecal coliforms are more ubiquitous and less indicative of wastewater pollution than *Escherichia coli*. Also, there is much less *Escherichia coli* data available for assessments. Waters impaired by only arsenic and fecal coliform remain on the list until they are reassessed; however, they were given a low ranking.

Targeting--ADEQ has established a Watershed Protection Approach for addressing water quality issues. Currently, resources for implementing that framework are directed toward two watersheds: the Verde and the San Carlos/Safford/Duncan watersheds (Upper Gila River Basin). Consequently, the water quality limited waters that are found in these watersheds have been given "high priority" rankings and have been targeted for completion of TMDLs within the next two years.

PART II - COST/BENEFIT ANALYSIS

The Problem

An appraisal of the economic and social costs or benefits of actions necessary to achieve the objectives of the Clean Water Act in Arizona, as requested by EPA for this report, would be an impressive undertaking. There are capital costs of wastewater facilities and infrastructure, and the structural costs of controlling stormwater to prevent surface and groundwater contamination. There are the operational costs of these facilities and the water quality protection programs implemented at the local, county, state, and federal level. There are also the costs associated with mitigation, compliance, and enforcement (monitoring, other facilities, case development, and legal costs). No single agency tracks these expenses. Even the cost of an individual program is difficult to determine because of cost sharing and cooperative efforts among agencies.

An estimate of cost is less complicated than an estimate of benefit. Unlike many parts of the United States, Arizona water was relatively unpolluted by point source discharges when the Clean Water Act was implemented in the early 1970's. While the act has provided a mechanism to control the amount of pollutants being discharged by point sources through a permit system, and more recently through an aggressive pre-treatment program, the amount of harm that has been prevented is difficult to measure.

The Analysis

Part of the Cost--The funds ADEQ received for its water quality programs is one measurable cost. These funds and how that money was distributed in 1994-1995 is shown in **Table 31**. The funding for portions of the Waste Division that are concerned primarily with water quality protection and remediation are also included: the Underground Storage Tank Program (UST), the Water Quality Arizona Revolving Fund (WQARF), and the Aquifer Protection Program (APP).

Table 31. ADEQ Water Quality Program Funding 1994-1995

WATER QUALITY PROGRAM	FISCAL YEAR 1994	FISCAL YEAR 1995
State Funds	6,056,000	6,101,400
Federal Funds	3,698,700	8,851,900
UST Funds	17,203,700	24,716,500
WQARF Funds	2,606,300	3,423,100
APP Funds	--	8,400
TOTAL FUNDING	29,564,700	43,101,300

These costs have grown over the years as ADEQ has established new water quality protection programs. Funding for prior years could not be obtained because of the accounting system that was used previously.

Some of the Benefits--It is difficult to attach a dollar value to the benefits and importance of maintaining a standard of water quality suitable for human use and consumption, wildlife habitat, and water-based recreational activities. It was also not possible to relate the funding for these two years to a measurable benefit. Nevertheless, as the population of Arizona continues to expand **(Figure I)**, the stress placed on the availability of water resources increases and the importance of water quality also continues to grow.

Figure I illustrates the population growth in Arizona from 1985 to 1995, as well as the projected population for 2015 and 2040. In 1950, the State's population numbered 775,000 people. Since then, the population has increased to an estimated 4.2 million in 1995. Much of this increase has occurred in the Phoenix and Tucson metropolitan areas, and recent census data shows the two counties containing these areas contain 76% of the State's total population (SCORP, 1994).

Figure I. Arizona Population Data

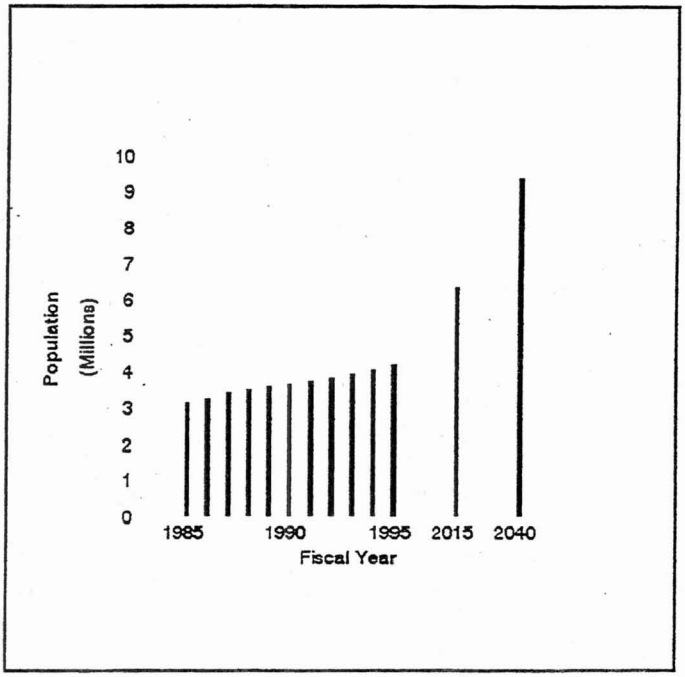
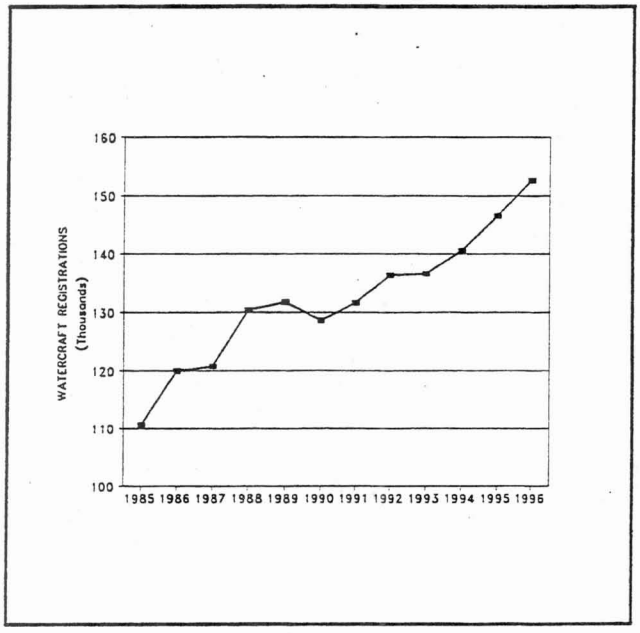


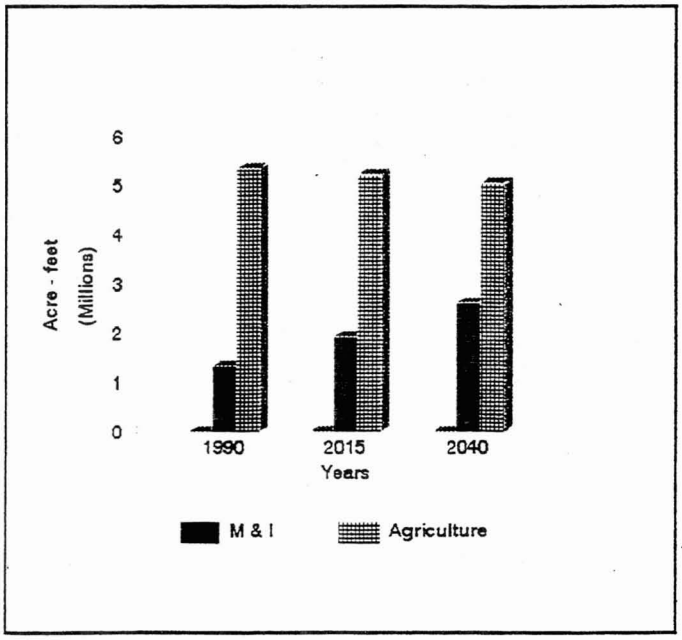
Figure J. Watercraft Registrations



As Arizona's population has increased, the number of people utilizing Arizona's water resources for recreation has also increased. Active watercraft registrations from 1985-1996 are illustrated in **Figure J**.. Associated with these registrations is an implied increased contact with Arizona's water through fishing and swimming.

This population growth has also been accompanied by an increase in water demand and a shift in sources for water supply. **Figure K** presents the estimated future water demand for Arizona from 1990 - 2040, where "M & I" is municipal and industrial uses (ADWR 1994). One reason Arizona has been able to sustain a rapid growth rate within the Phoenix metropolitan area is that agricultural land has been converted into urban uses, as reflected in this figure.

Figure K. Arizona Water Demand



As the population of Arizona continues to grow, additional sources of water will be needed for agricultural, municipal, and industrial uses. Currently 60% of the public drinking water suppliers in Arizona use groundwater. Agriculture also depends heavily on groundwater for irrigation purposes, and several cities depend entirely on groundwater for their water supply. However, in many parts of Arizona, groundwater is a finite resource with slow natural recharge potential.

An estimate of the water supply sources that will be used through the year 2040 is presented in **Table 32** (ADWR 1994). It is anticipated that the use of effluent and surface water sources will need to increase to decrease the demand for groundwater. For example, effluent rather than groundwater will be used for irrigation and by manufacturing facilities.

Table 32. Estimated Arizona Water Supply Sources 1990-2040

WATER SUPPLY						
	1990		2015		2040	
	Acre-feet	Percentage	Acre-feet	Percentage	Acre-feet	Percentage
Groundwater	3,334,400	50.6%	3,351,100	44.4%	3,228,750	39.5%
Effluent	119,000	1.8%	213,900	2.8%	472,500	5.8%
Central Arizona Project	832,900	12.6%	1,234,900	16.4%	1,490,000	18.2%
Colorado River	1,121,200	17.0%	1,310,000	17.4%	1,310,000	16.0%
Other Surface Water Sources	1,185,300	18.0%	1,440,400	19.1%	1,669,600	20.4%

The provision of relatively inexpensive, high quality water is dependent on protecting the source water. The costly alternative to prevention is remediation of contaminated sites. A survey of ADEQ's Superfund remedial projects in 1994 indicated that the average cost of the cleanup was $25.5 million per site. This was further projected to a total of $1.7 billion for the 66 sites!

In summary, Arizona's population pressures will continue to increase the value of high quality water. Also, in the long-term, protection of water quality is less expensive than remediation of contaminated water.

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APPENDIX A - CHEMICAL NAMES, STANDARDS, AND CRITERIA

This appendix is divided into four main sections:

- Groundwater Standards and Criteria (pages A-2 to A-8),
- Selected Soil Standards and Criteria (pages A-9 to A-13),
- Arizona Surface Water Standards and Assessment Criteria (standards adopted in 1992) (pages A-14 to A-19),
- Assessment Criteria for Wildlife Tissue Contamination (pages A-20 to A-24).

This list provides the chemical names used in Arizona's standards, but there are frequently other ways to name these chemicals. To minimize confusion, chemical abbreviations are shown in parenthesis for some chemicals, and trade names or common names are also shown.

Abbreviations, Acronyms, and Terms:

•AWQS = Aquifer Water Quality Standards, Arizona's groundwater standards or Maximum Contaminant Levels.

•AZ Background = The range of levels in Arizona soils (minimum and maximum) reported by USGS and ADEQ (The Earth Technology Corp, 1991). 90th% = 90th percentile of these measures.

•EPA = U.S. Environmental Protection Agency. EPA aquatic tissue screening values based on average consumption of 6.5 grams/day (1.6 ounces per week) and 70 kilograms body weight (154 pounds) (EPA 1995).

•FDA = U.S. Food and Drug Administration. FDA action levels were developed to protect humans from the chronic effects of toxic substances consumed in food stuffs (U.S. FDA 1984).

•HBGL = Health-based Guidance Levels were established by Arizona Department of Health Services (as of October 1995) for drinking water and soil. Interim Soil Cleanup Standards were adopted under emergency rule procedures on December 15, 1995. They are HBGLs for ingestion of soil to protect human health and were not established to protect aquatic and wildlife. HBGLs for soil are divided into two categories depending on land use: residential (Res) and non-residential (Non-res).

•NAS = National Academy of Sciences and National Academy of Engineering. NAS/NAE guidelines were developed to protect aquatic resources (i.e. fish and wildlife). These were published in 1973 in EPA's 1972 water quality criteria document (Blue Book).

•MCL = Maximum Contaminant Level (Safe Drinking Water Act standard, also adopted by Arizona as an Aquifer Protection standard);

•SMCL = Secondary Maximum Contaminant Level is an EPA guidance level for parameters which do not present a human health concern;

•PWS action level = if more than 10% of samples exceed this level, then a corrosion control treatment must be implemented.

*SDWA = Safe Drinking Water Act, used to denote standards promulgated under this law to protect Public Water Supplies.

*PWS = Public Water Supply as defined by the Safe Drinking Water Act. Standards are provided for two categories of PWS:

--COM = Community Water Supply

--NCOM = Non-community Water Supply

•USFWS = U.S. Fish and Wildlife Service. USFWS National Contaminant Biomonitoring Program measured the level of selected metals and pesticides in fish and birds (Schmitt and Brumbaugh 1990) (Schmitt et al. 1990). The 85th or 90th percentile of these data provides an estimation of where tissue samples would be exceeding normal levels.

milligram per liter (mg/l) = parts per million (ppm) = 1 mg/l
microgram per liter (μg/l) = parts per billion (ppb) = 0.001 mg/l
milligram per kilogram (mg/kg) = parts per million (ppm) = microgram per gram (μg/g)
pCi/l = picocuries per liter
CFU/100 ml = colony forming unit per 100 milliliters
SU = standard unit (pH measurement)
t = total (unfiltered sample);
d = dissolved (filtered sample)
NA = Not applicable

Appendix A. Selected Arizona Groundwater Standards and Criteria

CONTAMINANT NAME (ABBREVIATION, TRADE OR GENERIC NAME)	AQUIFER WATER QUALITY STANDARDS (AWQS) AND PUBLIC WATER SUPPLY STANDARDS (These are MCLs and measured as µg/l unless stated)	HEALTH-BASED GUIDANCE LEVEL (HBGL) OR SECONDARY MCL (SMCL) CRITERIA (These are HBGLs, measured as µg/l unless stated)
INORGANICS		
Aluminum (Al)		SMCL = 50-200
Ammonia (NH3)		7 mg/l
Antimony (Sb)	6	2.8
Arsenic (As)	50	0.02
Asbestos	7,000,000 fibers/liter (longer than 10 µm)	
Barium (Ba)	2000	490
Beryllium (Be)	4	0.008
Boron (B)		630
Cadmium (Cd)	5	3.5
Chloride (Cl_2)		SMCL = 250 mg/l
Chromium (total) (Cr)	100	100 Cr(III) = 7,000 Cr(VI) = 35
Copper (Cu)	PWS action level 1.3 mg/l	260
Cyanide (Cn)	200 (as free cyanide)	140
Fluoride (F)	AWQS = 4 mg/l COM = 4.0 mg/l	420 SMCL = 2.0 mg/l
Iron (Fe)		SMCL = 300
Lead (Pb)	AWQS = 50 PWS action level 0.015 mg/l	5

CONTAMINANT NAME (ABBREVIATION, TRADE OR GENERIC NAME)	AQUIFER WATER QUALITY STANDARDS (AWQS) AND PUBLIC WATER SUPPLY STANDARDS (These are MCLs and measured as µg/l unless stated)	HEALTH-BASED GUIDANCE LEVEL (HBGL) OR SECONDARY MCL (SMCL) CRITERIA (These are HBGLs, measured as µg/l unless stated)
Mercury (Hg)	2	2.1
Manganese (Mn)		SMCL = 50
Molybdenum (Mo)		35
Nickel (Ni)	100	140
Nitrate (NO_3 as N)	10.0 mg/l 20 mg/l (alternative available to some NCOM)	11 mg/l
Nitrite (NO_2 as N)	1.0 mg/l	0.7 mg/l
Nitrate + Nitrite (as N)	10 mg/l 20 mg/l (alternative available to some NCOM)	11 mg/l
Selenium (Se)	50	35
Silver (Ag)		35
Sulfate (SO_4)		400 mg/l SMCL = 250 mg/l
Thallium (Tl)	2	0.49
Total Dissolved Solids (TDS)		SMCL = 500 mg/l
Uranium (U)		21
Vanadium (V)		49
Zinc (Zn)		2100 SMCL = 5,000

CONTAMINANT NAME (ABBREVIATION, TRADE OR GENERIC NAME)	AQUIFER WATER QUALITY STANDARDS (AWQS) AND PUBLIC WATER SUPPLY STANDARDS (These are MCLs and measured as µg/l unless stated)	HEALTH-BASED GUIDANCE LEVEL (HBGL) OR SECONDARY MCL (SMCL) CRITERIA (These are HBGLs, measured as µg/l unless stated)
ORGANIC CHEMICALS, PESTICIDES, PETROLEUM HYDROCARBONS, AND POLYCHLORINATED BIPHENYL (PCBs)		
Alachlor (Lasso)	2	0.44
Aldicarb (Temik) Aldicarb sulfoxide Aldicarb sulfone		79.17
Atrazine (Atranex, Crisazina)	3	0.16
Benzene	5	1.2
Benzo(a)pyrene	0.2	
Carbofuran (Furadan 4F)	40	35
Carbon tetrachloride (Freon-10)	5	0.27
Chlordane	2	0.03
Chloroform (Freon-20)		5.7
2,4-D (Formula 40, Weedar 64) 2,4-Dichlorophenoxyacetic Acid	70	70
Dalapon or 2.2-Dichloropropionic acid	200	
Diazinon		6.3
Dibromochloromethane (DBCM or THM)	0.2	0.42
Dibromochloropropane (DBCP)	0.2	
Dicamba or Dichloro-o-anisic acid		210
Dichlorobenzene (DCB)	o-DCB = 600 p-DCB = 75	1,2-DCB = 630 1,3-DCB = 620 1,4-DCB = 1.5 3,3'-DCB = 0.08

CONTAMINANT NAME (ABBREVIATION, TRADE OR GENERIC NAME)	AQUIFER WATER QUALITY STANDARDS (AWQS) AND PUBLIC WATER SUPPLY STANDARDS (These are MCLs and measured as µg/l unless stated)	HEALTH-BASED GUIDANCE LEVEL (HBGL) OR SECONDARY MCL (SMCL) CRITERIA (These are HBGLs, measured as µg/l unless stated)
Dichlorodiphenyldichlorodic (DDD) Dichlorodiphenyldichloroethylene (DDE) Dichlorodiphenyltrichroroethane (DDT)		DDD = 0.15 DDE = 0.1 DDT = 0.1
Dichloroethane (DCA)	1,2-DCA = 5	1,1-DCA = 70 1,2-DCA = 0.38
Dichloroethylene or Dichloroethene (DCE)	1,1-DCE = 7 cis-1,2-DCE = 70 trans-1,2-DCE = 100	1,1-DCE = 0.06 cis-1,2-DCE = 70 trans-1,2-DCE = 140
Dichloromethane	5	
Dichloropropane	1,2-DCP = 5	1,2-DCP = 0.51
Di(2-ethylhexyl)adipate (DOA)	400	
Di(2-ethylhexyl)phthalate (DOP)	6	
Dinoseb 2,4-Dinitro-6-sec-butyl-phenol (DNBP)	7	
Dioxin 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	0.00003	
Diquat or Dihydrodipyrido-pyrazidinium salt	20	
Diuron or 3-(3-4-Dichlorophenly)-1,1-dimethyl urea		14
Endothall or Oxalobicyclo-heptane-dicarbooxylic acid disodium salt	100	
Endrin or Hexachloroepoxyoctahydro-endo-dimethanonaphthalene	2	2.1
Ethylene dibromide (EDB)	0.05	0.0004
Ethylbenzene (ETB)	700	700
Freon-11 or Trichlorofluoromethane		2,100

CONTAMINANT NAME (ABBREVIATION, TRADE OR GENERIC NAME)	AQUIFER WATER QUALITY STANDARDS (AWQS) AND PUBLIC WATER SUPPLY STANDARDS (These are MCLs and measured as µg/l unless stated)	HEALTH-BASED GUIDANCE LEVEL (HBGL) OR SECONDARY MCL (SMCL) CRITERIA (These are HBGLs, measured as µg/l unless stated)
Freon-12 or Dichlorodifluoromethane		1,400
Freon-113 or Trichlorotrifluoroethane		210,000
Glyphosate or N-(phosphonomethyl)glycine	700	
Heptachlor	0.4	0.008
Heptachlor epoxide	0.2	0.004
Hexachlorobenzene or Perchlorobenzene	1	
Hexachlorocyclopentadiene or Perchlorocyclopentadiene	50	
Lindane or gamma-Benzene hexachloride	0.2	0.03
Methyl ethyl ketone (MEK)		4,200
Methoxychlor (Methoxy DDT, DMDT)	40	35
Monochlorobenzene, or Chlorobenzene, or Phenyl chloride	100	
Methyl tertiary butyl ether (MTBE)		35
Oxamyl	200	
Perchloroethylene (PCE) Tetrachloroethylene or Tetrachloroethene	5	0.7
Pentachlorophenol	1	0.29
Picloram	500	
Polychlorinated biphenyl (PCB)	0.5	0.005
Silvex 2-(2,4,5-Trichlorophenoxy)propionic acid	50	70

CONTAMINANT NAME (ABBREVIATION, TRADE OR GENERIC NAME)	AQUIFER WATER QUALITY STANDARDS (AWQS) AND PUBLIC WATER SUPPLY STANDARDS (These are MCLs and measured as µg/l unless stated)	HEALTH-BASED GUIDANCE LEVEL (HBGL) OR SECONDARY MCL (SMCL) CRITERIA (These are HBGLs, measured as µg/l unless stated)
Simazine 2-Chloro-4.6-bis(ethylamino)-2-triazine	4	
Styrene	100	140
Tetrachloroethane (PCA or TET)		1,1,1,2-PCA = 1.3 1,1,2,2-TET = 0.18
1,2,4-Trichlorobenzene	70	
Trichloroethane (TCA)	1,1,1-TCA = 200 1,1,2-TCA = 5	1,1,1-TCA = 630 1,1,2-TCA = 0.61
Trichloroethylene or Trichloroethene (TCE)	5	3.2
Trichlorofluromethane (TCFM)		2100 µg/l
Trinitrotoluene (TNT)		2,4,6-TNT = 1.2
Toluene (TOL)	1000	1,400
Total Trihalomethanes (TTHM)	100 (COM > 10,000 population)	
Toxaphene	3	0.03
Trichlorophenol		2,4,5-Trichlorophenol = 700 2,4,6-Trichlorophenol = 3.2
Vinyl chloride (VC)	2	0.02
Xylene (XYL)	10000	14,000

CONTAMINANT NAME (ABBREVIATION, TRADE OR GENERIC NAME)	AQUIFER WATER QUALITY STANDARDS (AWQS) AND PUBLIC WATER SUPPLY STANDARDS (These are MCLs and measured as µg/l unless stated)	HEALTH-BASED GUIDANCE LEVEL (HBGL) OR SECONDARY MCL (SMCL) CRITERIA (These are HBGLs, measured as µg/l unless stated)
RADIOCHEMICALS, PHYSICAL, BACTERIOLOGICAL		
Beta particle + photon radioactivity from man-made	4 millirem/year	
Coliform Escherichia coli (EC) Fecal coliform (FC) Total coliform (TC)	PWS check sample EC = 0 per 100 ml PWS check sample FC = 0 per 100 ml AQWS and PWS check sampleTC = 0 per 100 ml PWS TC if >40 sample/month ≤ 5% samples PWS TC if<40 sample/month ≤ 1 sample	
Color		SMCL = 15 color units
Corrosivity		SMCL = non-corrosive
Foaming Agents		SMCL = 0.5 mg/l
Gross alpha (include Radium-226, exclude radon & uranium)	15 pCi/l	
Odor		SMCL = 3 (threshold odor)
pH		SMCL = 6.5-8.5
Radium-226 + Radium-228	5 pCi/l	
Strontium-90	4 millirem/year 8 pCi/l in bone marrow	
Tritium	4 millirem/year 20,000 pCi/l in total body	
Turbidity	1 NTU monthly mean; 5 NTU (if 0 fecal coliform after chlorination), 5 NTU (2-day mean)	

Appendix A. Selected Arizona Soil Standards and Criteria

CONTAMINANT ABBREVIATION AND NAME (Trade Name)	INTERIM SOIL CLEANUP STANDARDS (HBGL)		ARIZONA BACKGROUND LEVELS IN SOIL (mg/kg)
	Residential (mg/kg)	Non Residential (mg/kg)	
INORGANICS			
Aluminum (Al)			6,200 to 100,000
Ammonia (NH3)	120,000	420,000	
Antimony (Sb)	47	165	no detection to 3.8
Arsenic (As)	0.91	3.82	1.4 to 97 9.2 = 90th percentile
Barium (Ba)	8,200	28,700	72.6 to 1,500
Beryllium (Be)	0.32	1.34	no detection to 5 1.50 = 90th percentile
Boron (B)	11,000	385,000	
Cadmium (Cd)	58	244	no detection to 1.7
Chromium total (Cr) Chromium III Chromium VI	1700 Cr(III) = 120,000 Cr(VI) = 580	5,950 Cr(III) = 420,000 Cr(IV) = 2,436	5 to 300
Cobalt (Co)			no detection to 30
Copper (Cu)	4,300	15,050	5 to 200
Cyanide	2,300	8,050	
Fluoride (F)	7,000	24,500	
Lead (Pb)	400	1,400	no detection to 100
Mercury (Hg)	35	123	no detection to 0.57
Manganese (Mn)	580	2,030	

CONTAMINANT ABBREVIATION AND NAME (Trade Name)	INTERIM SOIL CLEANUP STANDARDS (HBGL)		ARIZONA BACKGROUND LEVELS IN SOIL (mg/kg)
	Residential (mg/kg)	Non Residential (mg/kg)	
Molybdenum (Mo)	580	2,030	no detection to 3
Nickel (Ni)	2,300	8,050	no detection to 150
Nitrate (as N) (NO_3)	190,000	665,000	
Nitrite (as N) (NO_2)	12,000	42,000	
Nitrate + Nitrite (as N) ($NO_3 + NO_2$)	190,000	665,000	
Selenium (Se)	580	2,030	no detection to 1.6
Silver (Ag)	580	2,030	no detection to 0.8
Sulfate (SO_4)	6,700,000	23,450,000	
Thallium (Tl)	8.2	28.7	0.5 to <1.0
Uranium (U)	350	1,225	1.1 to 3.4
Vanadium (V)	820	2,870	no detection to 300
Zinc (Zn)	35,000	122,500	12 to 150
ORGANIC CHEMICALS, PESTICIDES, PETROLEUM HYDROCARBONS, AND POLYCHLORINATED BIPHENYLS (PCBs)			
Alachlro (Lasso)	17	71	
Aldicarb (Temik) Aldicarb sulfoxide Aldicarb sulfone	120 150 120	420 525 420	
Atrazine (Atranex, Crisazina)	6.1	21.4	
Benzene	47	197	
Carbofuran (Furadan 4F)	580	2,030	
Carbon tetrachloride (Freon-10)	10	42	

CONTAMINANT ABBREVIATION AND NAME (Trade Name)	INTERIM SOIL CLEANUP STANDARDS (HBGL)		ARIZONA BACKGROUND LEVELS IN SOIL (mg/kg)
	Residential (mg/kg)	Non Residential (mg/kg)	
Chlordane	1	4	
Chloroform (Freon-20)	220	924	
2,4-D or 2,4-Dichlorophenoxyacetic Acid (Formula 40, Weedar 64)	1,200	4,200	
Dibromochloromethane (DBCM or THM)	16	56	
Dichloroethane (DCA)	1,1-DCA = 1,200 1,2-DCA = 15	4,200 63	
Dichlorobenzene (DCB)	1,2-DCB = 11,000 1,3-DCB = 10,000 1,4-DCB = 57 3,3'-DCB = 3	38,500 35,000 200 13	
Dichloroethylene or Dichloroethene (DCE)	1,1-DCE = 2.3 cis-1,2-DCE= 1,200 tran-1,2-DCE= 2,300	8 4,200 8,050	
Dichloropropane (DCP)	1,2-DCP = 20	84	
Dichlorodiphenyldichlorodic (DDD) Dichlorodiphenyldichloroethylene (DDE) Dichlorodiphenyltrichroroethane (DDT)	DDD = 5.7 DDE = 4 DDT = 4	DDD = 23.9 DDE = 17 DDT = 17	
Dichlorodiphenyltri (DDT)	4	17	
Diazinon	110	385	
Diuron	230	805	
Endrin	35	123	
Ethylene dibromide (EDB)	0.02	0.08	
Ethylbenzene (ETB)	12,000	42,000	
Freon-11 or Trichlorofluoromethane	35,000	122,500	

CONTAMINANT ABBREVIATION AND NAME (Trade Name)	INTERIM SOIL CLEANUP STANDARDS (IHBGL)		ARIZONA BACKGROUND LEVELS IN SOIL (mg/kg)
	Residential (mg/kg)	Non Residential (mg/kg)	
Freon-12 or Dichlorodifluoromethane	23,000	80,500	
Freon-113 or Trichlorotrifluoroethane	3,500,000	12,250,000	
Heptachlor	0.3	1.3	
Heptachlor epoxide	0.15	0.63	
Lindane or gamma-Benzene hexachloride	1	4	
Methyl ethyl ketone (MEK)	70,000	245,000	
Methoxychlor (DMDT, Marlate)	580	2,030	
Methyl tertiary butyl ether (MTBE) (petroleum biproducts)	580	2,030	
Tetrachloroethane (PCA or TET)	1,1,1,2-PCA = 52 1,1,2,2-TET = 6.8	182 28.6	
Polychlorinated biphenyls (PCBs)	0.18	0.76	
Tetrachloroethylene or Tetrachloroethene or Perchloroethylene (PCE)	27	113	
Pentachlorophenol	11	46	
Styrene	2,300	8,050	
Trichloroethane (TCA)	1,1,1-TCA = 11,000 1,1,2-TCA = 24	38,500 84	
Trichloroethylene or Trichloroethene (TCE)	120	504	
Trichlorofluromethane (TCFM)	35,000	122,500	
Trinitrotoluene (TNT)	2,4,6-TNT = 45	158	
Toluene (TOL)	23,000	80,500	
Toxaphene	1.2	5.0	

CONTAMINANT ABBREVIATION AND NAME (Trade Name)	INTERIM SOIL CLEANUP STANDARDS (IRGL)		ARIZONA BACKGROUND LEVELS IN SOIL (mg/kg)
	Residential (mg/kg)	Non Residential (mg/kg)	
Total petroluem hydrocarbons (TPH)	7,000	24,500	
2,4,5-Trichlorophenoxy proponic acid (Silvex)	940	3,290	
Trichlorophenol	12,000 120	42,000 504	
Vinyl chloride (VC)	0.72	3.02	
Xylene (XYL)	230,000	805,000	
RADIOCHEMICALS, PHYSICAL, BACTERIOLOGICAL			
Strontium-90	70,000	245,000	

Appendix A. Arizona Surface Water Standards and Criteria

PARAMETER	DESIGNATED USE(S)	REGULAR OR ACUTE STANDARDS OR CRITERIA (µg/l unless otherwise stated)	CHRONIC STANDARDS (µg/l unless otherwise stated)
Aluminum (Al)	DWS (SMCL)	50-200	
Ammonia (NH3)	A&Wc/A&Ww	Standard varies by temperature and pH., see equations in standards.	
Antimony d (Sb)	A&Wc/A&Ww A&Wedw	88 1,000	30 600
Antimony t (Sb)	DWS FBC/PBC FC	2.8 56 140	NA
Arsenic d (As)	A&Wc/A&Ww/A&Wedw A&We	360 440	190 230
Arsenic t (As)	FC DWS/FBC AGL AGI PBC Peeple's Canyon Creek	3.1 50 200 2,000 2,800 20	NA
Barium d (Ba)	DWS/FBC	1,000	NA
Beryllium t (Be)	DWS FC FBC A&Wc/A&Ww/A&Wedw PBC	0.006 0.21 0.33 65 700	NA NA NA 5.3 NA
Boron t (B)	AGI	1,000	NA
Cadmium t (Cd)	DWS AgI/AgL FBC/PBC FC	5 50 70 83	NA
Cadmium d (Cd)	A&W	Standard varies by water hardness, see equations in surface water standards.	
Chloride (Cl)	DWS	250 mg/l (SMCL)	NA
Chlorine (total residual) (Cl)	A&Wc/A&Ww/A&Wedw	11 ~~mg/l~~ ug/l	5 ~~mg/l~~ ug/l

PARAMETER	DESIGNATED USE(S)	REGULAR OR ACUTE STANDARDS OR CRITERIA (µg/l unless otherwise stated)	CHRONIC STANDARDS (µg/l unless otherwise stated)
Chromium t (Cr)	DWS AgI/AgL	100 1,000	NA
Chromium III t (Cr III)	FC FBC/PBC	67,000 140,000	NA
Chromium III d (Cr)	A&Ww/A&Wc/A&We/A&Wedw	Standard varies by water hardness, see equations in surface water standards. West Fork Little Colorado River, above Government Springs = 10 µg/l. Oak Creek/West Fork of Oak Creek = 5 µg/l	
Chromium VI t (Cr VI)	FBC/PBC FC	700 3,400	NA
Chromium VI d (Cr VI)	A&Wc/A&Ww/A&Wedw/ A&We	16 34	11 23
	West Fork Little Colorado Oak Creek/West Fork Oak	10 5	NA
Copper d (Cu)	A&Ww/A&Wc/A&We/A&Wedw	Standard varies by water hardness, see equations in surface water standards.	
	PBC/FBC	5,200	NA
Copper t (Cu)	AgL AgI	500 5,000	NA
Cyanide t (Cn)	A&Wc A&Ww/A&Wedw A&We DWS AgL FBC/PBC FC	22 41 84 140 200 3,100 210,000	5.2 9.7 19
Dissolved Oxygen (DO)	A&Ww A&Wc A&Wedw	>6.0 mg/l >7.0 mg/l >1.0 mg/l If greater than 90% saturation, then lower DO ok.	
	West Fork Little Colorado Peeples Canyon Creek	no decrease due to discharge no decrease due to discharge	

PARAMETER	DESIGNATED USE(S)	REGULAR OR ACUTE STANDARDS OR CRITERIA (µg/l unless otherwise stated)	CHRONIC STANDARDS (µg/l unless otherwise stated)
Fecal Coliform	FBC/A&Wedw	30-day geometric mean with 5 sample minimum 10% samples for a 30-day period single sample maximum	200 CFU/100 ml 400 CFU/100 ml 800 CFU/100 ml
	A&Ww/A&Wc/A&We/A&Wedw/ DWS/PBC/AgI/AgL	30-day geometric mean with 5 sample minimum 10% samples for a 30-day period single sample maximum	1,000 CFU/100 ml 2,000 CFU/100 ml 4,000 CFU/100 ml
	Oak Creek/West Oak Creek West Fork Little Colorado Burro Creek/Francis Creek	150 CFU/100 ml (geo. mean of >10 samples/mo) 200 CFU/100 ml 500 CFU/100 ml	
Fluoride (F)	DWS DWS (SMCL)	4 mg/l 2 mg/l	NA
Iron (Fe)	DWS (SMCL)	300	NA
Lead d (Pb)	A&Ww/A&Wc/A&We/A&Wedw	Standard varies by water hardness, see equations in surface water standards.	
Lead t (Pb)	DWS AgL AgI	50 100 10,000	NA
Manganese t (Mn)	DWS (SMCL) AgI Peeple's Canyon Creek Burro Creek/Francis Creek	50 10,000 500 500	NA
Mercury d (Hg)	A&Wc/A&Ww A&Wedw A&We	2.4 2.6 5.0	0.01 0.2 2.7
Mercury t (Hg)	FC DWS AgL FBC/PBC	0.6 2.1 10 42	NA
Nickel d (Ni)	A&W	Standard varies by water hardness, see equations in surface water standards.	
Nickel t (Ni)	DWS FC FBC/PBC	140 400 2,800	140 400

PARAMETER	DESIGNATED USE(S)	REGULAR OR ACUTE STANDARDS OR CRITERIA (µg/l unless otherwise stated)	CHRONIC STANDARDS (µg/l unless otherwise stated)
Nitrate (as N) (NO3)	DWS mean value San Pedro (Curtis-Benson)	10 mg/l 10 mg/l	NA
Nitrite (as N) (NO2)	DWS	1 mg/l	NA
Nitrogen t (N)	See nutrient chart below		
pH	A&W/FBC/PBC DWS DWS (SMCL) AgI West Fork Little Colorado Oak Creek/West Fork Oak	6.5 - 9.0 OR Maximum change due to discharge 0.5 5.0 - 9.0 6.5 - 8.5 4.5 - 9.0 no change due to discharge no change due to discharge	
Phosphate t (P)	See nutrient chart below		
Selenium t (Se)	A&Ww/A&Wc AgI A&We A&Wedw/AgL DWS FBC/PBC FC	20 20 33 50 50 420 90,000	2 NA 2 2 NA NA NA
Silver t (Ag)	DWS (secondary MCL)	100	NA
Silver d (Ag)	A&Ww/A&Wc/A&We/A&Wedw	Standard varies by water hardness, see equations in surface water standards.	
Sulfides (S2)	A&W	0.1 mg/l	NA
Sulfate (SO4)	DWS	250 mg/l (SMCL)	NA
Temperature (maximum increase due to discharge)	A&Wc A&Ww/A&Wedw West Fork Little Colorado Peeple's Canyon	1.0 ° C 3.0 ° C no increase due to discharge no increase due to discharge	NA
Thallium t (Tl)	DWS FC FBC/PBC	0.63 44 3,700	NA
Thallium d (Tl)	A&Wc/A&Ww/A&Wedw	700	150

PARAMETER	DESIGNATED USE(S)	REGULAR OR ACUTE STANDARDS OR CRITERIA (µg/l unless otherwise stated)	CHRONIC STANDARDS (µg/l unless otherwise stated)
Total Dissolved Solids (TDS)	DWS mg/l (SMCL) AgI (EPA criteria) AgL (EPA criteria)	500 1000 2000	NA
	West Fork Little Colorado	no increase due to discharge	NA
	Colorado River: below Hoover Dam below Parker Dam at Imperial Dam	NA	(flow-weighted average annual) 723 747 879
Turbidity (NTU)	A&Wc (streams & lakes) A&Ww (lakes only) A&Ww, FBC, PBC, A&Wedw Oak Creek/West Fork Oak Peeple's Canyon Creek	10 25 50 3 change due to discharge 5 change due to discharge	NA
Uranium d (Ur)	DWS	35	NA
Zinc t (Zn)	DWS AgI AgL FBC/PBC	5,000 10,000 25,000 28,000	NA
Zinc d (Zn)	A&Ww/A&Wc/A&We/A&Wedw West Fork Little Colorado Oak Creek/West Fork Oak	Standard varies by water hardness, see equations in surface water standards. 110 µg/l 50 µg/l	

RADIOCHEMICAL STANDARDS		
Radiochemical	Designated Use	Standard (pCi/l) (mean value)
Gross Alpha (minus Radium-226)	DWS	15
Radium-226 + Radium-228	DWS	5
Strontium 90	DWS	8
Tritium	DWS	20,000

NUTRIENT STANDARDS								
WATERSHED OR SITE SPECIFIC LOCATION	**Annual Mean**		**90th Percentile**		**Single Sample Max**	
Verde River and tributaries (headwaters-Bartlett Lake)	P N	0.10 mg/l 1.00 mg/l	P N	0.30 1.50	P N	1.00 3.00
Oak Creek including West Fork (Unique Waters standard)	P N	0.10 mg/l 1.00 mg/l	P N	0.25 1.50	P N	0.30 2.50
White River, Salt River, Tonto Creek and their tributaries.	P N	0.10 mg/l 0.50 mg/l	P N	0.20 1.00	P N	0.80 2.00
Salt River and tributaries. (except Pinal) (confluence of Black and White to Roosevelt Lake)	P N	0.12 mg/l 0.60 mg/l	P N	0.30 1.20	P N	1.00 2.00
Salt River (Stewart Mountain Dam-Verde)	P N	0.05 mg/l 0.60 mg/l	P N	NNS NNS	P N	0.20 3.00
Roosevelt, Apache, Canyon & Saguaro Lakes (composites at 2- and 5-meter depth)	P N	0.03 mg/l 0.30 mg/l	P N	NNS NNS	P N (maximum of any set)	0.60 1.00
Little Colorado River and tributaries (hdwt-River Res. in Greer); So Fork LCR (hdwt-So Fk Campground);Water Canyon Creek (hdwt-USFS Boundary)	P N	0.08 mg/l 0.60 mg/l	P N	0.10 0.75	P N	0.75 1.10
Little Colorado River (at Apache Co Road No 124)	P N	NNS NNS	P N	NNS NNS	P N	0.75 mg/l 1.80 mg/l
Little Colorado River (Amity Ditch diversion near AZ Hwy 273-Lyman Lake) (only when < 50 NTU)	P N	0.20 mg/l 0.70 mg/l	P N	0.30 1.20	P N	0.75 1.50
Colorado River (at Mexico/US Northern International Border near Morales Dam)	P N	NNS NNS	P N	0.33 2.50	P N	NNS NNS
San Pedro River (Curtiss - Benson)	P N	NNS NNS	P N	NNS NNS	P N as N03 = 10 mg/l	NNS

N = Nitrogen, P = Phosphorus
NA = Not Applicable

Arizona Assessment Criteria for Wildlife Tissue Contamination - 1996

PARAMETER	SCREENING VALUE		COMMENTS
	WILDLIFE PROTECTION	HUMAN HEALTH PROTECTION	
Aldrin	0.1 ppm	0.3 ppm	• NAS recommended guideline for freshwater fish is **0.1 ppm** (1973). • FDA action level for edible portion is **0.3 ppm.**
Alpha-benzene hexachloride or Gamma-benzene hexachloride (BHC) (or mixture)	0.1 ppm	0.07 ppm	• NAS recommended guideline for freshwater fish is **0.1 ppm** (1973). • EPA screening value for fish consumption is **0.07 ppm.** • National Contaminant Biomonitoring Program 90th percentile in fish tissue = 0.01 ppm (mean value is less than detection limit of 0.01 ppm) (Schmitt et al. 1990).
Arsenic (As)	1.3 ppm	3 ppm (inorganic)	• Diminished growth and survival reported in immature bluegills when total arsenic residues in muscle is more than **1.3 ppm** fresh weight, or more than 5 ppm in adults (NRCC 1978). • Whole body fish arsenic above 0.5 ppm may be harmful to fish (Walsh et al. 1977). • National Contaminant Biomonitoring Program 85th percentile in fish tissue is 0.27 ppm (Schmitt and Brumbaugh 1990). • EPA screening value for fish consumption is **3 ppm inorganic arsenic.** • Birds are less sensative, and their diet can contain 100 ppm (Stanley et al. 1994).
Boron (B)	30 ppm (dry weight)	None available	• Mallards with diets between 30-100 ppm (dry weight) were associated with growth reduction (Hoffman et al. 1990). • Mallard diets containing more than 1000 ppm (dry weight) are potentially fatal (Smith and Anders 1989).
Cadmium (Cd)	0.1 ppm	10 ppm	• A conservative estimate is that adverse effects on fish and wildlife are either pronounced or probable when cadmium exceeds **0.1 ppm** in the diet (in prey species) (Eisler 1985). • Cadmium at more than 5.0 ppm whole animal (or 200 ppm in kidney) should be considered life-threatening to the animal (Eisler 1985). • Above 0.5 ppm (0.36 dry weight) is considered harmful to fish and wildlife (Walsh et al. 1977). • National Contaminant Biomonitoring Program 85th percentile in fish tissue is 0.05 ppm. (Schmitt and Brumbaugh 1990). • EPA screening value for fish consumption is **10 ppm.** (Note FDA is preparing criteria documents for this metal.)

PARAMETER	SCREENING VALUE		COMMENTS
	WILDLIFE PROTECTION	HUMAN HEALTH PROTECTION	
Chlordane total (Oxychlordane, Heptachlor, trans-Nonchlor, cis-Nonclor, trans-Chlordane, cis-Chlordane)	0.1 ppm	0.08 ppm	• NAS recommended guideline for freshwater fish is **0.1 ppm** (1973). • FDA action level for edible portion is 0.3 ppm. • EPA screening value for fish consumption is **0.08 ppm.** • National Contaminant Biomonitoring Program 90th percentile in fish tissue = 0.3 ppm, and mean value = 0.15 ppm (Schmitt et al. 1990).
Chromium (Cr)	1.0 ppm (dry weight)	None available	• Fish and wildlife tissues that contain more than 4.0 mg/kg dry weight (equivalent to **0.88** wet weight at 78% moisture) should be viewed as presumptive evidence of chromium contamination (Eisler 1986).
Copper (Cu)	1.0 ppm	30 ppm	• National Contaminant Biomonitoring Program 85th percentile in fish tissue is **1.0 ppm** (Schmitt and Brumbaugh 1990). • Young rainbow trout fed insects between 14-50 ppm experienced 60% mortality after 90 days, and survivors had reduced growth (Woodward et al. 1994). • Australian guideline for edible seafood products is 30 mg/kg copper (eleven other countries have set limits between 10-100 ppm; the US has not established a limit) (California Environmental Protection Agency 1992).
Dacthal	0.01		• National Contaminant Biomonitoring Program 90th percentile in fish tissue = 0.01 ppm (mean less than detection limit of 0.01 ppm) (Schmitt et al. 1990).
DDT (all metabolites)	0.6 ppm	0.3 ppm	• Dietary levels of **0.6** to 3.0 ppm can result in a significant degree of eggshell thinning in a variety of species (McLane and Hall 1972, Stickel 1973, Longcore and Stendell 1982). • Brown pelican reduced productivity above 0.15 ppm and eggshell thinning at 0.5 ppm (EPA 1980). • NAS recommended guideline for freshwater fish is less than 1.0 ppm (1973). • FDA action level for edible portion is 5.0 ppm. • EPA screening value for fish consumption is **0.3 ppm.** • National Contaminant Biomonitoring Program 90th percentile in fish tissue = 0.8 ppm, and mean = 0.26 ppm. Proportion of metabolites were 79-83% DDD, 10-14% DDE, 5-8% DDT. Proportionately high levels of DDT in fish, as compared to DDD and DDE, suggests recent or continuing inputs of DDT to the aquiatic ecosystem) (Schmitt et al. 1990).
Diazinon	None available	0.9 ppm	• EPA screening value for fish consumption is **0.9 ppm.**
Dieldrin	0.1 ppm	0.007 ppm	• NAS recommended guideline for freshwater fish is **0.1 ppm** (1973). • FDA action level for edible portion is 0.3 ppm. • EPA screening value for fish consumption is **0.007 ppm.** • National Contaminant Biomonitoring Program 90th percentile in fish tissue = 0.15 ppm, and mean = 0.04 ppm (Schmitt et al. 1990).

PARAMETER	SCREENING VALUE		COMMENTS
	WILDLIFE PROTECTION	HUMAN HEALTH PROTECTION	
Dioxins/furans	None available	0.0000007 ppm	• EPA screening value for fish consumption is 7×10^{-7} ppm (**0.7 ppt**).
Endosulfan (I & II)	0.1 ppm	60 ppm	• EPA screening value for fish consumption is **60 ppm.** • NAS recommended guideline for freshwater fish is **0.1 ppm** (1973).
Endrin	0.1 ppm	0.3 ppm	• NAS recommended guideline for freshwater fish is **0.1 ppm.** (1973). • FDA action level for edible portion is **0.3 ppm.** • EPA screening value for fish consumption is 3 ppm. • National Contaminant Biomonitoring Program 90th percentile in fish tissue = 0.01 ppm (mean less than detection limit of 0.01 ppm) (Schmitt et al. 1990).
Heptachlor	0.1 ppm	0.3 ppm	• NAS recommended guideline for freshwater fish is **0.1 ppm.** (1973). • FDA action level for edible portion is **0.3 ppm.**
Heptachlor epoxide	0.1 ppm	0.01 ppm	• NAS recommended guideline for freshwater fish is **0.1 ppm.** (1973). • FDA action level for edible portion is 0.3 ppm. • EPA screening value for fish consumption is **0.01 ppm.** • National Contaminant Biomonitoring Program 90th percentile in fish tissue = 0.03 ppm including traces of heptachlor (mean is less than detection limit of 0.01 ppm) (Schmitt et al. 1990).
Hexachlorocyclohexane (total)	0.1 ppm	None available	• NAS recommended guideline for freshwater fish is **0.1 ppm.** (1973).
Lead (Pb)	0.5 ppm	None available	• National Contaminant Biomonitoring Program's 85th percentile is 0.22 ppm (Schmitt and Brumbaugh 1990). • Lead in fish above **0.5** ppm may be harmful to reproduction and survival of fish (Walsh et al. 1977). • Lead in waterfowl liver over 2 ppm is elevated, and over 8 ppm has occurred in poisoned waterfowl. Signs of poisoning were evident in sensitive aquatic biota as low as 2.8 ppm organo-lead (Eisler 1988). • Lead did not accumulate substantially in fish muscle, liver and kidney were better indicators. Scoliosis and reproductive failure occurred at 50 ppm in liver and 179 ppm in kidney (Holcombe et al. 1976). • Lead levels below 100 ppm (dry weight) in the diet cause few significant reproductive effects in birds (Scheuhammer 1987). • 150 ppm lead in earthworms should be considered hazardous to sensitive species that eat earthworms (Beyer and Stafford 1993).
Lindane (gamma-Benzene hexachloride)	0.1 ppm	0.08 ppm	• EPA screening value for fish consumption is **0.08 ppm.** • NAS recommended guideline for freshwater fish is **0.1 ppm.** (1973).

PARAMETER	SCREENING VALUE		COMMENTS
	WILDLIFE PROTECTION	HUMAN HEALTH PROTECTION	
Mercury (Hg)	0.1 ppm	0.6 ppm (methylmercury)	• Above **0.1 ppm** total mercury effects on fish-eating avian predators can be expected, for mammals eating fish the concern level is 1.1 ppm (Eisler 1987). • To protect aquatic life and fish consuming birds, less than 0.5 ppm mercury should be in whole fish (International Joint Commission 1989, NAS 1973). • Ducks fed food contaminated with methylmercuric dicyandiamide at 0.1-0.5 ppm demonstrated reduced juvenile survival and reduced hatching success (Heinz 1979, EPA 1984b). • When mercury in prey species was 0.3-0.4 ppm, egg laying and breeding success were impaired (Barr 1986). • National Contaminant Biomonitoring Program 85th percentile is 0.17 ppm (mean value was 0.1 ppm) (Schmitt and Brumbaugh 1990). • EPA screening value for fish consumption is **0.6 ppm** methylmercury. • FDA action level for edible portion is 1.0 ppm.
Mirex	0.01 ppm		• National Contaminant Biomonitoring Program 90th percentile in fish tissue = 0.01 ppm (mean less than detection limit of 0.01 ppm) (Schmitt et al. 1990).
Polychlorinated biphenyls (PCB) total	0.5 ppm	2.0 ppm	• NAS recommended guideline for freshwater fish is **0.5 ppm** (1973). • FDA action level for edible portion is **2.0 ppm.** • National Contaminant Biomonitoring Program 90th percentile in fish tissue = 1.7 ppm, and mean = 0.39 ppm (Schmitt et al. 1990).
Selenium (Se)	3 ppm (dry weight)	50 ppm	• Food-chain organisms containing 3 ppm dry weight or more should be viewed as potentially harmful to reproduction of fish and aquatic birds that consume them (**0.75** wet weight at 75% moisture) (Lemly 1993). • Biologic effects thresholds for health and reproductive success of freshwater fish and aquatic birds (dry weight, see footnote to convert wet weights): fish: whole body = 4 ppm, muscle = 8 ppm, eggs = 10 ppm birds: liver = 10, eggs = 3 (Lemly 1993). • National Contaminant Biomonitoring Program 85th percentile is 0.73 ppm (Schmitt and Brumbough 1990). • EPA screening value for fish consumption is **50 ppm.** • Naturally high levels of arsenic in the diet of ducklings can alleviate toxic effects of selenium
Toxaphene	0.1 ppm	0.1 ppm	• NAS recommended guideline for freshwater fish is **0.1 ppm** (1973). • Bone deformity and reduced growth in brook trout at >0.4 ppm; bone deformity in channel catfish fry; and reduced egg hatch and growth in fathead minnow fry at 0.4-1.0 ppm (Mayer et al. 1977). • EPA screening value for fish advisories is **0.1** ppm. • FDA action level for edible portion is 5.0 ppm. • National Contaminant Biomonitoring Program 90th percentile in fish tissue = 0.5 ppm, and mean = 0.14 ppm (Schmitt et al. 1990).

PARAMETER	SCREENING VALUE		COMMENTS
	WILDLIFE PROTECTION	HUMAN HEALTH PROTECTION	
Zinc (Zn)	34 ppm	None available	• National Contaminant Biomonitoring Program 85th percentile is **34 ppm** (Schmitt and Brumbough 1990).

All screening values are in parts per million (ppm) (same as mg/kg or μg/g) of wet weight on a whole-body basis unless otherwise noted. Note that most of the dietary exposure levels for birds are considered a dry weight basis (approximately 7-10% moisture). Dry weight equivalents can be calculated where moisture content is known. Wet weight screening values were converted to dry weight values by assuming 75% moisture and multiplying wet weights by 4 (Lemly 1993). Wet weight and dry weight conversions can also be estimated using the following formula (Kirke King, USFWS Phoenix Office, personnel communication): wet weight = (1 minus percent moisture) times dry weight.

Appendix B. Surface Water Monitoring Data

This appendix is a list of the monitoring data that were used in this assessment. Most of the data was collected between October 1, 1990 to September 30, 1995; however, older data is shown if it became recently available or if new assessment criteria changed the indication of use support.

Watersheds--The data are presented in ten tables. Stream data are subdivided by the following watersheds (•) and sub-watersheds (-), with lake data following all of the stream reach data in each watershed.

- Bill Williams Watershed (pages B-3 to B-7)
  - Sub-watersheds: Big Sandy, Burro Creek, Santa Maria, Bill Williams.
- Colorado River - Grand Canyon Watershed (pages B-8 to B-14)
  - Sub-watersheds: Colorado River Main Stem, Kanab Creek, Havasu Creek, Red Lake Playa, Virgin River.
- Colorado River - Lower Gila River Watershed (pages B-15 to B-20)
  - Sub-watersheds: Colorado River Main Stem, Gila River.
- Little Colorado River - San Juan Watershed (pages B-21 to B-29)
  - Sub-watersheds: Silver Creek, Puerco, East Clear, Chevelon, and Canyon Diablo.
- Middle Gila Watershed (pages B-30 to B-49)
  - Sub-watersheds: Gila River, Salt River (below Granite Reef Dam), Agua Fria River, and Hassayampa River.
- Salt River Watershed (pages B-50 to B-56)
  - Sub-watersheds: Black River, White River, Salt River (above Granite Reef Dam), and Tonto Creek.
- San Carlos - Safford - Duncan Watershed (pages B-57 to B-62)
  - Sub-watersheds: Upper Gila River, San Francisco River, San Simon Creek, and San Carlos.
- San Pedro River - Willcox Playa - Rio Yaqui Watershed (pages B-63 to B-70)
  - Sub-watersheds: San Pedro River, Willcox Playa, Rio Yaqui.
- Santa Cruz River - Rio Magdelena - Rio Sonoita Watershed (pages B-71 to B-80)
  - Sub-watersheds: Santa Cruz River, Sonoita Creek, Rillito Creek, Rios de Mexico.
- Verde River (pages B-81 to B-90)
  - Sub-watersheds Big Chino Wash, Verde River, Oak Creek, East Verde River.

Waterbody ID--The identification code is the "hydrologic unit code" (assigned by USGS for the drainage area), and either a stream "reach number" (assigned by EPA) or a lake number (assigned by AGFD). Streams that have not been assigned reach numbers were identified by the hydrologic unit code and reach number of the downstream water receiving the water plus an "OFF" designation. Lakes that have not been assigned a number by AGFD were given an arbitrary number from 0001 to 0010 after the hydrologic unit code. "Reach" maps are available upon request from ADEQ or EPA, and should soon be available for use in a Geographic Information System through Arizona's State Land Department.

Abbreviations, Acronyms, and Terms--(some terms may be defined in **Appendix A** (standards and uses) or **Appendix C** (assessment criteria).

Aquatic and Wildlife use (A&W)
  Sub-categories: coldwater fishery (A&Wc; warmwater fishery (A&Ww), ephemeral (A&We), effluent-dependent water (A&Wedw)),
Fish Consumption use (FC),
Full Body Contact (FBC) (swimming)
Partial Body Contact (PBC) (non-swimming recreation),
Domestic Water Source (DWS) (drinking water use),
Agriculture Irrigation use (AgI),
Agriculture Livestock Watering use (AgL),
Unique Waters (Unique) (established in surface water rules).

ADEQ = Arizona Department of Environmental Quality,
ADWR = Arizona Department of Water Resources,
ARRA = Arizona Regulatory Agency,
EPA = Environmental Protection Agency,
BLM = U.S. Bureau of Land Management,
USFS = U.S. Forest Service,
USFWS = U.S. Fish and Wildlife Service,
USGS = U.S. Geologic Survey,
UofA = University of Arizona.

DO = dissolved oxygen.
"t" total (unfiltered sample) or "d" dissolved (filtered sample).

HBGL = Health Based Guidance Level (see **Appendix A**)
SMCL = secondary maximum contaminant level (established as guidance for public water supplies for aesthetic quality).
NCBP = National Contaminant Biomonitoring Project by USFWS (see **Appendix A**)

Unless otherwise noted, "Samples" were water samples, which were tested for parameters indicated in the information box at the bottom of the page. Otherwise, samples may have the following identification:

"Field" indicates that only field samples were collected.
"Limited" indicates that a full set of samples (as indicated below) were not collected.
If other media were tested, then the type of sample is shown (i.e., fish, sediment, birds, invertebrates, etc).

A mean or median value was calculated when relevant to the standard or criteria (see **Appendix C**). When the median was calculated it is noted as such; otherwise, the mean is shown.

WATER SAMPLES	PARAMETERS MONITORED
Normal Monitoring	
Field measurements	Water and air temperature, pH, specific electrical conductance, dissolved oxygen and percent saturation, chlorine, turbidity, amd discharge.
Laboratory measurments	Total dissolved solids, hardness, total suspended solids, ions, total metals (and metaloids), dissolved metals, nitrogen, phosphorus, ammonia, fecal coliform, *Escherichia coli*, fecal strep, and turbidity.
Other - Site Specific Monitoring	Radiochemicals, semi-volatile organics, and pesticides.
Priority Pollutant Program Monitoring	Metals (and metaloids) and organic pollutants (pesticides, solvents, and other man-made chemicals).

BILL WILLIAMS WATERSHED										
ID NUMBER, REACH OR LAKE NAME, SEGMENT DESCRIPTION.	DESIGNATED USES	AGENCY, PROGRAM, SITE ID, SITE DESCRIPTION	SAMPLES: Year-Number (Type of sample)	STANDARDS OR CRITERIA EXCEEDED (Constituents are shown when results indicate a standard or criterion has been exceeded)						
				CONSTITUENT	UNITS	STANDARD OR CRITERIA	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
BIG SANDY SUB-WATERSHED										
15030201-006 Big Sandy River Stove-Sycamore	A&Ww, FBC, FC, AgL	ADEQ Fixed Station BS1 @ Wikieup blw Hwy 93	1989-4 1990-4 1991-4	Arsenic t	µg/l	3.1	<10-19	2/8	<10	Threat FC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	<0.5-36.7	2/7	<0.5	Partial FBC; Threat FC
				Barium t	mg/l	1000	<50-2380	1/8		Partial FBC
				DO	mg/l	≥6.0	5.2-10.0	1/6		Partial A&Ww
				Lead t	µg/l	100	<10-202	1/8		Partial AgL
				Nickel t	µg/l	400	<50-880	1/8	<100	Threat FC
				Turbidity	NTU	50	0.68-19200	1/8		Partial FBC, A&Ww
		BLM Monitoring BLM-BS1	1994-6 field 1995-2 field	Ok						Too little information to assess
15030201-004 Big Sandy River Sycamore-Burro Creek	A&Ww, FBC, FC, AgL	BLM Monitoring BLM-BS2 @ Signal Rd	1992-11 field 1993-2 field	Turbidity	NTU	50	214-800	2/2 (both unusual rain events)		Partial FBC, A&Ww
15030201-003 Big Sandy River Burro-Groom Springs	A&Ww, FBC, FC, AgL	BLM Monitoring BLM-BS3 @ USGS Gauge	1994-5 field 1995-3 field	Ok						Too little information to assess
15030201-027off Unnamed wash hdwt-Hackberry wash	A&Ww, FBC, FC, AgL	ADEQ - Complaint file: ICE95:0299 Wastewater	1995-water and sediment	Fecal coliform	CFU	800	800-1300			Non FBC
				Sewage and sludge release to wash by one NPDES-permitting facility: narrative violations. Inadequate treatment of sewage at neighboring permitted facility (high fecal coliform counts in water and sediment). Stream degradation observed for at least 1/2 mile.						Non all uses
15030201-014 Trout Creek, Cow-Knight Creek	A&Ww, FBC, FC, AgL	ADEQ Fixed Station TR1 near Wikieup	1991-3 1992-4 1993-6	Arsenic t	µg/l	3.1	<10-15	9/12	12 med	Partial FC
		ADEQ Biocriteria Program	1992-1 1994-1	Arsenic t	µg/l	3.1	13	1/2		Threat FC
BURRO CREEK SUB-WATERSHED										
15030202-009 Burro Creek Pine-Francis Creek	A&Ww, FBC, FC, AgL (Unique)	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Arsenic t	µg/l	3.1	11	1/3	<10 med	Threat FC
		BLM Monitoring BLM-BC1	1992-1 field 1993-3 field 1994-2 field 1995-1 field	Ok						Too little information to assess

BILL WILLIAMS WATERSHED

ID NUMBER, REACH OR LAKE NAME, SEGMENT DESCRIPTION,	DESIGNATED USES	AGENCY, PROGRAM, SITE ID, SITE DESCRIPTION	SAMPLES: Year-Number (Type of sample)	STANDARDS OR CRITERIA EXCEEDED (Constituents are shown when results indicate a standard or criterion has been exceeded)						
				CONSTITUENT	UNITS	STANDARD OR CRITERIA	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15030202-008 Burro Creek, Francis-Boulder Creek	A&Ww, FBC, FC, AgL (unique)	BLM/ADEQ Burro Creek - Unique BC15 below Francis Creek	1990-3 1991-2 1992-3 1993-1 & 1 field 1994-1 & 2 field	Arsenic t	µg/l	3.1	<5-20	4/9	<10 med	Threat FC
				Fecal coliform	CFU	500 (unique)	0-16,000	1/7		Partial FBC, A&Ww, AgL, Unique
				Turbidity	NTU	50	3-260	3/10		Non A&Ww, FBC
	A&Ww, FBC, FC, AgL (unique)	BLM/ADEQ Burro Creek - Unique BC14 above Boulder Creek	1990-3 1991-1 & 1 field 1992-2 & 1 field 1993-1 & 1 field 1994 1 & 1 field	Arsenic t	µg/l	3.1	<5-20	4/8	8 med	Partial FC
				Fecal coliform	CFU	500 (unique)	0-9,000	2/4		Non FBC, A&Ww, AgL
				Turbidity	NTU	50	0.15-320	1/8		Partial A&Ww, FBC
15030202-004 Burro Creek, Boulder-Black Canyon	A&Ww, FBC, FC, AgL (unique)	BLM/ADEQ Burro Creek - Unique BC13 @blw Boulder Creek	1990-2 & 1 field 1992-3 1993-1 & 1 field 1994-1 & 1 field	Arsenic t	µg/l	3.1	<10-75	7/9	10 med	Partial FC
				Fecal coliform	CFU	800	0-1600	1/5		Partial FBC, A&Ww, AgL
				Lead t	µg/l	100	<2-197	1/7		Partial AgL
				Turbidity	NTU	50	<5-270	1/9		Partial FBC, A&Ww
15030202-001 Burro Creek Kaiser Spring-Big Sandy	A&Ww, FBC, FC, AgL	BLM BC10 above campground	1992-12 field 1993-4 field 1994-1 & 5 field 1995-1 & 1 field	Arsenic t	µg/l	3.1	7	1/2		Partial FC
				DO	mg/l	≥6.0	4.0-9.1	1/6		Partial A&Ww
15030202-012 Francis Creek, hdwt-Burro Creek	A&Ww, FBC, FC, DWS, AgL	BLM/ADEQ Francis - Unique BC31	1990-3 1991-2 1992-3 1993-1 & 3 field 1994-2 & 4 field 1995 -1	Arsenic t	µg/l	3.1	<5-20	5/13	<10	Threat FC
				Fecal coliform	CFU	500 (unique)	2-16,000	1/9		Partial FBC, A&Ww, AgL,
				Turbidity	NTU	50	<0.5-260	2/12		Partial A&Ww, FBC
		ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
15030202-009off Conger Creek hdwt-Burro Creek	A&Ww, FBC, FC, AgL	ADEQ Biocriteria Program	1992-1 1993-1	Ok						Full
15030202-005 Boulder Creek Wilder-Burro Creek	A&Ww, FBC, FC, Agl, AgL	ADEQ Cyprus Bagdad Mine Spill Investigation @ blw Copper Creek @ Seepage Pools @ Pond abv Copper @ Pond blw Copper	1991-up to 39 daily samples at 4 sites	Arsenic t	µg/l	3.1	<10-670		<10 med	Threat FC
				Copper t	µg/l	500	1,000-17,450	@ seepage		Non Agl,AgL,A&Ww
				Mercury t	µg/l	0.6	>0.5-1.3	@ below Copper Creek		Partial FC
				pH	SU	6.5-9.0	6.09-6.43	@ Seepage		Partial A&Ww,AgL
				Turbidity	NTU	50	63	@ seepage		Full

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				CONSTITUENT	UNITS	STANDARD OR CRITERIA	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
BILL WILLIAMS WATERSHED										
		ADEQ Complaint Inv 212.260 Hillside Mine	1992-9	Arsenic d	µg/l	360	5,450		1 sites	Non A&Ww
				Arsenic t	µg/l	3.1	10-15,000		7 sites	Non FBC, Partial FC, AgI, AgL
				Beryllium t	µg/l	0.21 FC 0.33 FBC	8-110		5 sites	Non FC, FBC
				Copper d	µg/l	varies (95)	155		1 sites	Partial A&Ww
				Lead t	µg/l	100	130		1 sites	Partial AgL
				Manganese t	µg/l	10,000	13,100-22,000		2 sites	Partial AgI
				Narrative: color, deposits in stream, and noticeable lack of vegetation and other aquatic life						Non A&Ww
				Zinc d	µg/l	varies	1,290-17,000		6 sites	Non A&Ww
				Zinc t	µg/l	10,000	14,300-17,300		2 sites	Partial AgI
			3 radiochemicals	Gross alpha	pCi/l	ARRA - 30 pCi/l (for comparison purposes only).	664-1240		2 sites	No applicable standards available
				Uranium 238	pCi/l		606-664		2 sites	
				Uranium 284	pCi/l		333-577		2 sites	
				Radium 226	pCi/l		71.8		1 sites	
			12 sediments	Arsenic t	mg/kg	HBGL 840	920-2300		7 sites	Sediment contamination
				Beryllium	mg/kg	HBGL 0.32	0.50-3.9		10 sites	
				Lead	mg/kg	HBGL 84	100-1500		6 sites	
				Molybdenum	mg/kg	HBGL 120	200-740		6 sites	
		ADEQ Fixed Station BOL1	1991-4 1992-1	Ok						Full
		ADEQ Fixed Station BOL2	1991-3 1992-2	Arsenic t	µg/l	3.1	< 10-17	5/7	11 med	Partial FC
				Cadmium d (chronic)	µg/l	varies (2)	< 1-6	1/3	2.3	Threat A&Ww
				Zinc d (acute)	µg/l	varies (237-240)	< 50-360	2/3		Non A&Ww
				Zinc d (chronic)	µg/l	varies (214-222)	< 50-360	2/3		Non A&Ww
		ADEQ Priority Pollutant Program Hillside Mine	1992 and 1993 Sediment	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	12-17.2	2/2		Sediment contamination
SANTA MARIA SUB-WATERSHED										
15030203-012 Santa Maria River, 15030203-025-S.Fork	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full

BILL WILLIAMS WATERSHED										
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15030203-001 Santa Maria River, Bridle-Date	A&Ww, FBC, FC, AgI, AgL	BLM Fixed Station BLM-SM1	1992-1 field 1993-1	Ok						Full
		BLM Monitoring BLM-SM2	1992-14 field 1993-1 & 8 field 1994-1 & 6 field 1995-3 field	DO % Saturation	mg/l	≥6.0 90%	5.6-11 86-101%	2/16		Partial A&Ww
				Fecal coliform	CFU	800	0-16,000	1/4		Partial FBC, A&Ww, AgI, AgL
				Turbidity	NTU	50	0.64-115	1/17		Full
		ADEQ Fixed Station SM1 below Hwy-93	1990-4 1991-4	Beryllium t	µg/l	0.21 FC 0.33 FBC	2.7	1/7	<0.5 med	Threat FC Partial FBC
				Turbidity	NTU	50	0.4-975	1/8		Partial FBC, A&Ww
		ADEQ Complaint Inv. 212.269 Santa Maria Mine	1992 2 water 3 sediment	Cyanide t	mg/l	0.041	0.68-2.76	2/3		Non A&Ww, AgL
15030203-024 Cottonwood Creek hdwt-Smith Canyon	A&Ww, FBC, DWS	ADEQ Biocriteria Program	1993-1 1994-1	Ok						Full
15030203-021 Sycamore Creek, hdwt-Tank Creek	A&Ww, FBC, FC, AgL	USFS Prescott National Forest	1991-2	Ok						Full
15030203-016 Kirkland Creek, hdwt-Skull Valley	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station KC1 @ Ritter's Ranch	1992-3 1993-6	Ok						Full
15030203-009off Peeples Creek, hdwt-Santa Maria River	A&Ww, FBC, AgL (Unique)	BLM/ADEQ SPCS Peeples-Unique	1989-3 1990-3	Ok (low DO but old methods)						Full
		ADEQ Biocriteria Program	1992-1	Ok						Full
BILL WILLIAMS SUB-WATERSHED										
15030204-003 Bill Williams River Alamo Lake-Casteneda	A&Ww, FBC, FC, AgL	ADEQ SWMU 212.297 Turbidity	1993-3 sites (2 days)	Ok						Full
15030204-001 Bill Williams River Mineral-Colorado R	A&Ww, FBC, FC, AgL	USGS Fixed Station 09426600 @ Planet	1991-3 1992-4 1993-2 1994-2 1995-2	Arsenic t	µg/l	3.1	5-9	15/15	6 med	Partial FC
				DO	mg/l	≥6.0 90% saturation	5.5-11.4 64-101%	2/15		Partial A&Ww
				Fecal coliform	CFU	800	56-3400	2/11		Partial FBC
				Turbidity	NTU	50	0.2-480	2/15		Partial A&Ww, FBC
		ADEQ - Turbidity SWMU 212.297	1993-2 days	Ok						Full
15030204-003-002-001 Bill Williams River Lake Alamo-Colorado	A&Ww, FBC, FC, AgL	UofA & USFWS Ruiz 1994 7 sites	1992-2 1993-1 sediment, water, algae, tadpoles, invertebrates, birds, & fish	Arsenic t	mg/kg dry wt	3.82 HBGL non-residential	2.96-6.41	4.37 med (22 sediment)		Threat FBC
				Boron	mg/kg dry wt	120 max in diet	19.01-219 algae	125.7 mean (23 algae)		Threat A&Ww
				Cadmium	mg/kg dry wt	0.4 in diet	0.3-1.0 odonata 0.1-0.9 crayfish	0.71 mean (13 odonata) 0.47 med (11 crayfish)		Partial A&Ww

BILL WILLIAMS WATERSHED										
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				CONSTITUENT	UNITS	STANDARD OR CRITERIA	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
				Chromium	mg/kg dry wt	4 presumptive contamination	4.1-25.1 tadpole	14.03 med (9 tadpoles)		Threat A&Ww
				Copper	mg/kg dry wt	4 NCBP 85%	5.75-10.7 m.fish 3.78-13.07 carp	7.4 mean (26 mosquitofish) 6.23 mean (9 carp)		Threat A&Ww
				Mercury	mg/kg dry wt	0.1 fisf predator protection	0.04-1.4 odonata 0.26-0.74 bass	0.46 mean (13 odonata) 0.53 med (6 bass)		Partial A&Ww
				Selenium	mg/kg dry wt	3 predator protection, 4 fish protection, 10 bird liver	0.8-5.5 odonata 1.9-13.0 m-fish 2.06-3.93 bass 2.20-7.44 shiner 5.02-5.57 turtle 12.9 grebe liver	3.3 mean (13 odonata) 3.3 med (26 mosquitofish) 3.43 med (6 bass) 5.78 med. (14 red shiners) 5.28 ave (2 turtles) (1 grebe liver)		Partial A&Ww
				Zinc	mg/kg dry wt	136 NCBP 85%	118-1146 carp 14-179 shiners	208 med (9 carp) 188.5 med (14 red shiners)		Threat A&Ww
LAKES IN BILL WILLIAMS WATERSHED										
15030204-0040 Alamo Lake	A&Ww, FBC, FC	ADEQ Priority Pollutant Program	1992-fish and sediment	Chromium	mg/kg wet wt	1.0 predator protection	0.41-12.9 fish	1/5	0.41 med	Full (A&Ww)
				Copper	mg/kg wet wt	1.0 predator protection	0.31-10.4 fish	1/5	0.56 med	Full (A&Ww)
				Lead	mg/kg wet wt	0.5 fish protection	0.2-13.1 fish	1/5	0.78 med	Full (A&Ww)
				Mercury	mg/kg wet wt	0.1 predator protection	0.1-0.34 fish	3/5	0.25 med	Threat A&Ww
		USFWS Study 1991 Bald Eagle Prey	1988 5 fish	Cadmium	mg/kg wet wt	0.1 predator protection	no det-0.12 fish	1/5	no det med	Full (A&Ww)
				Copper	mg/kg wet wt	1.0 NCBP 85%	0.34-41.60 fish	2/5	med 0.68	Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.15-0.25 fish	5/5	med 0.20	Partial A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85%	11.76-97.52 fish	2/5	14.47 med	Threat A&Ww
		FWS/COE Routine Monitoring	1991-1 & 4 field 1992-7 & 28 field 1993-16 & 27 field 1994-17 & 40 field 1995-19 & 32 field	Sulfide	mg/l	0.1	0.3-2	24/64		Non A&Ww
				DO	mg/l	≥6.0	0.02-14.09	10/131		Full (A&Ww)
15030202-5000 Coors Lake	A&Ww, FBC, FC	ADEQ Clean Lakes Program	1992-1 sites	DO	mg/l	≥6.0	5.73-6.06			Threat A&Ww
		ADEQ Priority Pollutant Program	1992-Sediment	Ok						Full

COLORADO RIVER - GRAND CANYON WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
COLORADO MAIN STEM SUB-BASIN										
14070006-001 Colorado River, Powell-Paria River	A&Wc, FBC, DWS, FC, AgI, AgL	USGS Fixed Station 09380000 @ Lee's Ferry	1991-6 1992-6 1993-6 1994-6 1995-6	Cadmium t	µg/l	5	<1-16	1/36		Threat DWS
				Selenium t	µg/l	2 chronic	<1-3	11/30	2	Threat A&Wc
				Sulfate	mg/l	250 (SMCL)	180-270		232	Full (DWS)
				TDS	mg/l	500 (SMCL)	478-636		547	Partial DWS
14070007-001 Paria River Utah bdr-Colorado River	A&Wc, FBC, DWS, FC	Natl Parks Service Grand Canyon	1992-1 1993-4 1994-3	Arsenic t	µg/l	3.1	<5-49	4/7	8 med	Partial FC
				Beryllium t	µg/l	0.006 DWS 0.21 FC 0.33 FBC	<5-22	2/6	<5 med	Full (DWS) Full (FC) Partial FBC
				Chromium t	µg/l	100	<10-162	1/7	<10 med	Full (DWS)
				Gross alpha	pCi/l	15	2 to 29.6 ± 9.21	1/3		Partial DWS
				Lead t	µg/l	50 DWS	2-142	2/7	7 med	Full (DWS)
				Mercury t	µg/l	0.6 FC	<0.2-1.1	1/7	<0.2 med	Threat DWS
				Nickel t	µg/l	140 DWS	<20-490	2/7	<20 med	Threat DWS
				pH	SU	6.5-9.0	7.92-9.16	1/7		Partial A&Wc, FBC, DWS
				Selenium t	µg/l	2 chronic 20 acute	<5-25	1/7 1/7	<5 med	Threat A&Wc
				Sulfate	mg/l	250 (SMCL)	140-850	5/7	321	Partial DWS
				TDS	mg/l	500 (SMCL)	370-1400	5/7	731 600 med	Partial DWS
				Turbidity	NTU	10 A&Wc 50 FBC	76.6->1000	4/4		Non A&Wc, FBC
15010001-019 Bright Angel Creek, hdwt-Colorado River	A&Wc, FBC, FC, DWS	Natl Parks Service Grand Canyon Three sites	1992-2 1993-3 1994-3 1995-2 limited	Turbidity	NTU	10 A&Wc 50 FBC	1.13-67.7	1/10		Full
15010001-021 Phantom Creek hdwt-Bright Angel Creek	A&Wc, FBC, FC, DWS	Natl Parks Service Grand Canyon	1994-1 limited	pH	SU	6.5-9.0	9.38	1/1		Partial A&Wc, FBC, DWS
15010001-020off6 Roaring Springs Creek hdwt-Bright Angel	A&Wc, FBC, FC, DWS	Natl Parks Service Grand Canyon	1994-2 limited	Ok						Too little information to assess
15010001-017 North Canyon Creek hdwt-Colorado	A&Wc, DWS, FBC, FC	USFS Kaibab NF	1991-3	Ok						Full
		ADEQ Biocriteria Program	1994-1	Ok						Full
		AGFD Routine Monitoring	1992-1 limited	Ok						Too little information to assess

COLORADO RIVER - GRAND CANYON WATERSHED

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15010001-005off Vasey's Paradise hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1992-1 & 1 limit 1993-3 1994-3 1995-2 limited	pH	SU	6.5-9.0	9.10	1/10		Full
15010001-003off Nankoweap Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon @ mouth	1992-1 1993-2 1994-4 1995-1 & 3 limit	pH	SU	6.5-9.0	7.7-9.7	2/11		Partial A&Wc, FBC
				Sulfate	mg/l	250 (SMCL)	66-1200	1/8	105 med	Full
				Turbidity	NTU	10	0.33-21.60	1/11		Full
15010001-003off4 Kwagunt Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon @ mouth	1994-2 & 1 limit 1995-1 & 3 limit	pH	SU	6.5-9.0	7.5-9.41	1/7		Partial A&Wc, FBC
				Sulfate	mg/l	250 (SMCL)	280-290	3/3	283	Partial DWS
				TDS	mg/l	500 (SMCL)	562-670	4/4	620	Partial DWS
15010001-002off19 Unkar Creek hdwt-Colorado River	A&Wc, FBC, FC, DWS	Natl Park Service Grand Canyon	1995-1 limited	Ok						Too little information to assess
15010001-002off3 Clear Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon @ mouth	1992-1 limited 1993-2 limited 1994-2 1995-1 & 2 limit	Ok						Full
15010001-002off Lava / Chuar Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon Lava Canyon @ mouth	1992-1 1993-2 1994-3 1995-1 & 2 limit	Arsenic t	µg/l	3.1 FC 50 FBC & DWS	42-77	7/7	60	Partial FC Non DWS, FBC
				Chloride	mg/l	250 (SMCL)	380-1140	7/7	507	Partial DWS
				Gross Alpha	pCi/l	15	4 ± 3 to 46 ± 5	1/2		Partial DWS
				Sulfate	mg/l	250 (SMCL)	160-920	6/7	554	Partial DWS
				TDS	mg/l	500 (SMCL)	1400-3300	8/8	1875 1515 med	Partial DWS
				Turbidity	NTU	10 A&Wc 50 FBC	0.60-373	3/8		Partial A&Wc, FBC
15010001-002offCOT Cottonwood Canyon hdwt-Colorado River	A&Wc, FBC, DWS, FC, AgI, AgL	Natl Park Service Grand Canyon near springs	1994 - 2 sites limited parameters	Ok						Too little information to assess
15010002-013off63 Garden Creek hdwt-Colorado River	A&Wc, FBC, FC, DWS	Natl Park Service Grand Canyon blw pumphouse	1994-4 limited (2 sites 1994) 1995-1 limited	Ok						Too little information to assess
15010002-013off62 Horn Creek hdwt-Colorado River	A&Wc, FBC, FC, DWS	Natl Park Service Grand Canyon in East fork	1995-3 limited (2 sites)	DO	mg/l	≥7.0 90% saturation	5.6 81%	1/1		Too little information to assess. Natural low DO near spring sources.
		Univ. of Nevada Las Vegas (Prof. Kramer)	1994-1 1995-2 radiochems only	Alpha from uranium	pCi/l	15 (total alpha)	17-61	3/3	32.5	Non DWS
				Uranium	µg/l	35	24.7-92.7	1/3	48.3	Non DWS

COLORADO RIVER - GRAND CANYON WATERSHED

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15010002-013off57 Monument Creek hdwt-Colorado River	A&Wc, FBC, FC, DWS	Natl Park Service Grand Canyon 3 sites	1992-1 limited 1993-2 limited 1994-1 limited 1995-1 & 7 limit	Chloride	mg/l	250	490-582	2/2		Partial DWS
				DO	mg/l	≥7.0 90% saturation	5.7-14 84-116%	1/9		Partial A&Wc
				pH	SU	6.5-9.0	6.25-9.3	2/9		Partial A&Wc, FBC
				TDS	mg/l	500 (SMCL)	1300	1/1		Partial DWS
15010002-013off56 Hermit Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon 2 sites	1992-1 & 1 limit 1993-2 1994-4 & 2 limit 1995-1 & 4 limit	Arsenic t	µg/l	3.1	< 5 - 18	6/8	16 med	Partial FC
				Gross Alpha	pCi/l	15	41 ± 4	1/3	15.8 4.41 med	Partial DWS
				TDS	mg/l	500 (SMCL)	210-580	2/10	399 440 med	Full
15010002-013off53 Boucher Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1994-1 limited	Ok						Too little information to assess
15010002-013off51 Crystal Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon @ mouth	1992-1 1993-2 1994-4 1995-1 & 3 limit	Arsenic t	µg/l	3.1 FC 50 FBC & DWS	21-59	8/8 3/8	45	Partial FC Partial FBC Threat DWS
				Chloride	mg/l	250 (SMCL)	47-360	4/8	235 med	Threat DWS
				TDS	mg/l	500	220-1100	5/8	710 med	Partial DWS
				Turbidity	NTU	10	0.67-19.2	1/11		Full
15010002-013off42 Shinumo Creek, hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1992-1 1993-2 1994-4 1995-1 & 1 limit	pH	SU	6.5-9.0	8.10-9.01	1/9		Partial A&Wc, FBC
				Turbidity	NTU	10	14.7	1/9		Partial A&Wc
15010002-013off11 Stone Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1992-1 limited 1993-2 limited 1994-2 & 1 limit 1995-1 & 2 limit	Ok						Full
15010002-013off9 Royal Arch hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1992-1 1993-2 1994-4 1995-4 limited	Selenium t	µg/l	2 chronic	5-9	6/6	7	Non A&Ww
				Sulfate	mg/l	250 (SMCL)	390	1/7	230 med	Full
				TDS	mg/l	500 (SMCL)	500-540	7/7	510 med	Partial DWS
15010002-013off9 Tapeats Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1992-2 1993-2 1994-3 1995-1 & 3 limit	Turbidity	NTU	10 A&Wc 50 FBC	0.20->1000	2/11		Partial A&Wc Partial FBC
15010002-013off9offT Thunder River hdwt-Tapeats Creek	A&Wc, FBC, FC, DWS, AgL	Natl Park Service Grand Canyon	1993-1 1995-1	Ok						Full
15010002-013off9offS Saddle Cyn Creek hdwt-Tapeats Creek	A&Wc, FBC, FC	Natl Park Service Grand Canyon	1992-1 limited 1993-2 limited 1994-1 & 1 limited 1995-2 limited	Ok						Full

COLORADO RIVER - GRAND CANYON WATERSHED

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15010002-013off7 Deer Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon @ mouth	1992-1 limited 1993-2 limited 1994-3 1995-1 & 3 limit	pH	SU	6.5-9.0	5.27-9.08	2/11		Full (marginally elevated pH natural during low flow).
				Turbidity	mg/l	10 A&Wc 50 FBC	1.19-76.2	1/11		Full
15010002-013offP Pipe Creek hdwt-Garden Creek	A&Wc, FBC, DWS, FC	Natl Park Service 2 sites	1994-4 limited 1995-5 limited	Turbidity	NTU	10	0.30->1000	1/8		Partial A&Wc, FBC
15010002-013offE Eremita Wash hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon @ Dripping Springs	1994-1 limited	Ok						Too little information to assess
15010002-012off Matkatamiba Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1992-1 1993-2 1994-2 1995-2	Selenium t	mg/l	2 chronic	<5-10	4/5	10 med	Non A&Ww
				Sulfate	mg/l	250 (SMCL)	550-650	5/5	612	Partial DWS
				TDS	mg/l	500 (SMCL)	1100	5/5	1100	Partial DWS
15010002-010 National Cyn Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1992-1 1993-2 1994-4 1995-2 limited	Sulfate	mg/l	250 (SMCL)	1000-1300	7/7	1114	Partial DWS
				TDS	mg/l	500 (SMCL)	1700-2000	7/7	1743	Partial DWS
15010002-009offFG Fern Glen hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1995-1 limited	DO	mg/l	≥7.0 90% saturation	5.8 82%	1/1		Full - naturally low DO at springs.
15010002-005off Warm Springs hdwt-Colorado River	A&Ww, FBC, DWS	Natl Park Service Grand Canyon	1992-1 limited 1993-1 & 1 limit 1994-2 1995-1 & 2 limit	DO	mg/l	≥6.0	5.7-7.9	1/6		Full - natural low DO at spring source
				TDS	mg/l	500 (SMCL)	810-840	4/4	823	Partial DWS
15010002-003off Three Springs hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1992-1 limit 1993-1 & 1 limit 1994-3 1995-1 & 3 limit	Arsenic t	µg/l	3.1	7-12	5/5	8 med	Partial FC
				Fecal coliform	CFU	800	<1-866	1/9		Partial FBC
15010002-003offP Pumpkin Springs hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1992-1 1993-1	Arsenic t	µg/l	3.1 FC 50 DWS, FBC	1,100-1,180	2/2	1140	Non FBC, FC, DWS
				Chloride	mg/l	250	3920	1/1		Non DWS
				DO	mg/l	≥7.0 90% saturation	0.4-0.8 7-14%	2/2		Full - normal at spring sources
				Sulfate	mg/l	250 (SMCL)	320	1/1		Partial DWS
				Turbidity	NTU	10	30.4-30.7	2/2		Non A&Wc
15010002-003off20 Spring Canyon Creek hdwt-Colorado River	A&Wc, FBC, DWS, FC	Natl Park Service Grand Canyon	1992-1 1993-2 1994-4 1995-1 & 3 limit	Arsenic t	µg/l	3.1	8-11	8/8	10	Partial FC
				DO	mg/l	≥7.0 90% saturation	6.1 83%	1/11		Full
15010002-002 Diamond Creek hdwt-Colorado River	A&Wc, FBC, FC	Natl Park Service Grand Canyon @ mouth	1992-1 limited	Turbidity	NTU	10	12.22	1/1		Partial A&Wc

COLORADO RIVER - GRAND CANYON WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
KANAB CREEK SUB-WATERSHED										
15010003-025 Kanab Creek Utah bdr-Cottonwood	A&Ww, DWS, FBC, FC, AgL	ADEQ Biocriteria Program near Fredonia	1994-1	Sulfate	mg/l	250 (SMCL)	1130	1/1		Partial DWS
				TDS	mg/l	500 (SMCL)	2430	1/1		Partial DWS
15010003-001 Kanab Creek Jumpup-Colorado	A&Ww, DWS, FBC, FC, AgL	ADEQ Priority Pollutant Prog. above confluence	1994 sediment	Ok						Full
		Natl Park Service Grand Canyon @ 4.5 miles WSW of North Rim entrance station	1992-2 1993-3 1994-3 1995-1 & 3 limit	Arsenic t	µg/l	3.1	<5-22	2/9	<5 med	Full
				Chromium	µg/l	100	109	1/9	>10 med	Full
				Lead	µg/l	50 DWS	50	1/9	>2 med	Full
				Gross Alpha	pCi	15	2.79 ± 1.91 to 40 ± 16	1/3	17 mean 7.62 med	Threat DWS
				Sulfate	mg/l	250 (SMCL)	300-720	7/9	512	Partial DWS
				TDS	mg/l	500 (SMCL)	520-1300	9/9	910	Partial DWS
				Turbidity	NTU	50	0.42-77.50	1/11		Full
HAVASU SUB-WATERSHED										
15010004-001 Havasu Creek, L.Coyote-Colorado	A&Wc, FC, DWS, FBC, AgI, AgL	Natl Park Service Grand Canyon @ mouth	1992-2 1993-3 1994-3 1995-1 & 1 limit	Arsenic t	µg/l	3.1	9-11	9/9	10	Partial FC
				Turbidity	NTU	10	1.5-19.5	2/10		Partial A&Wc
RED LAKE PLAYA SUB-WATERSHED										
15010007-002off unnamed wash hdwt-Truxton	A&Ww, FBC	ADEQ Complaint SWMU 212.243.1 @ De La Fontaine Mine	1992-2 sites	(Gross alpha	pCi/l	15 DWS	44-56	2 sites		No applicable standard
				Zinc t	µg/l	28,000	42,500	1 site		Non FBC
				Zinc d	µg/l	10,800	40,000	1 site		Non A&Ww
		ADEQ Complaint Inv. SWMU 212.243.1 @ American Legion Mine	1992-5 sites 1994-5 sites	Copper d	µg/l	varies (285)	65-1000	2 sites		Non A&Ww
				pH	SU	6.5-9.0	3.59-7.95	at springs below Am. Legion Mine		Non A&Ww, FBC (observed use by cows - Non AgL)
				Lead t	µg/l	100 AgL	216	at spring just below Am. Legion Mine		(observed use by cows - Non AgL)
				Note that radiochemical standards only apply when waters have Domestic Water Source as a use (not on these waters); however gross alpha, uranium, and radium all exceed Arizona Radiation Regulatory Administration levels for discharges to surface waters as well as DWS surface water standards. (Gross alpha up to 98.61 pCi/l, radium-226 up to 18.54 pCi/l, radium-228 up to 4.43 pCi/l, uranium up to 172 µg/l).					No applicable standards
				Zinc t	µg/l	(25,000 AgL) 28,000 PBC	<50-98,400	highest at spring just below Am. Legion Mine		Non FBC (observed use by cows - Non AgL)
				Zinc d	µg/l	(varies)	<50-97,300	highest at adit and spring below Am. Legion Mine		Non A&Ww

COLORADO RIVER - GRAND CANYON WATERSHED										
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15010007-002off Stockton Wash hdwt-Truxton	A&We, PBC	ADEQ Complaint SWMU 212.243.1 @ Stockton Mine	1994-1 (as control site to Am. Legion Mine)	Ok						Full
15010007-003 Wright Canyon Creek, hdwt-Truxton Wash	A&We, PBC	ADEQ WCV1 @ Valentine	1992-2 1993-6	Ok						Full
VIRGIN RIVER SUB-WATERSHED										
15010010-003 Virgin River, Beaver Dam-Big Bend	A&Ww, FBC, FC, AgI, AgL	USGS Fixed Station 0941500 @ Littlefield	1991-6 1992-6 1993-6 1994-6	Arsenic t	µg/l	3.1	7-9	5/5	8 med	Partial FC
				TDS	mg/l	1000	660-2690		1980	Partial AgI
				Turbidity	NTU	50	170-530	13/24		Non A&Ww, FBC
		ADEQ Priority Pollutant Prog.	1993 sediment	Ok						Full
15010010-009 Beaver Dam Wash hdwt-Virgin River	A&Ww, FBC, FC, AgI, AgL	ADEQ Intensive Survey 8 sites	1994 4-8 samples/site	Ok (natural low DO near spring sources)						Full
DETRITAL WASH SUB-WATERSHED										
15010014-005off Tennesee Wash & tributaries Cerbat Wash & tributaries hdwt-Detrital Wash	A&We, PBC	Roesner Inv. @ Chloride Mining District	1995-10 sites	Cadmium t	µg/l	(200 if AgL)	<5-264	below Minn-Connor Mine		(observed grazing, AgL not supported)
				Cadmium t	µg/l	70 PBC (50 if AgL)	<5-610	below Tennessee Mine @ Eureka Mine tunnel blw Cyprus Min Park Mine		Non PBC (observed grazing, AgL not supported)
				Chromium t	µg/l	(1000 if AgL)	<50-1,100	@ Tennessee Mine		(observed grazing, AgL not supported)
				Copper t	µg/l	(500 if AgL)	<50-51,000	@ Tennessee Mine 3 sites Eureka Canyon blw Cyprus Min Park Mine		(observed grazing, AgL not supported)
				Lead t	µg/l	(100 if AgL)	<5-170	below Tennessee Mine		(observed grazing, AgL not supported)
				pH	µg/l	6.5-9.0	3.0-8.4	@ Tennessee Mine @ Eureka Mine tunnel blw Cyprus Min Park Mine		Non PBC, A&Ww
				Zinc t	µg/l	28,000 PBC (25,000 if AgL)	60-200,000	@ Tennessee Mine blw Cyprus Min Park Mine		Non PBC (observed grazing, AgL not supported

COLORADO RIVER - GRAND CANYON WATERSHED										
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LAKES IN THE COLORADO RIVER - GRAND CANYON WATERSHED										
15010004-0280 Cataract Lake	A&Wc, FBC, DWS, FC, AgL	ADEQ Priority Pollutant Prog.	1993 sediment & fish	Mercury	mg/kg fish	0.1 predator protection	0.15 fish	1/1		Threat A&Wc
		ADEQ Clean Lakes Program	1993-1	Manganese	µg/l	50 SMCL	80	1/1		Threat DWS
				Turbidity	NTU	10	44	1/1		Partial A&Wc
15010004-0480 Dogtown Reservoir hdwt-Cataract	A&Wc, DWS, FBC, FC, AgI, AgL	USFS Kaibab NF @ Dog Lake	1991-1	Ok						Full
		ADEQ Clean Lakes Program	1993-1	Iron	µg/l	300 SMCL	1,280	1/1		Partial DWS
				Managanese	µg/l	50 SMCL	90	1/1		Threat DWS
		AGFD Fish Stocking Program	1990-1	Ok						Full
15010004-0710 Kaibab Lake	A&Wc, FBC, DWS, FC, AgI, AgL	Clean Lakes Program	1993-1	DO	mg/l	≥7.0	6.76-7.02	1/1		Threat (A&Wc)
				Iron	µg/l	300 SMCL	1,280	1/1		Partial DWS
				Manganese	µg/l	50 SMCL	90	1/1		Partial DWS
15010004-1340 Sante Fe Reservoir	A&Wc, FBC, DWS, FC	ADEQ Clean Lakes Program	1993-1	Iron	µg/l	300 SMCL	1,780	1/1		Partial DWS
				Manganese	µg/l	50 SMCL	80	1/1		Partial DWS

COLORADO RIVER - LOWER GILA WATERSHED

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COLORADO RIVER MAIN STEM SUB-WATERSHED										
15030101-015 Colorado River, Hoover-Lake Mohave	A&Wc, FBC, DWS, FC, Agl, AgL	USGS Fixed Station 09421500 blw Hoover Dam	1991-6 1992-5 1993-5 1994-5	DO	mg/l	≥6.0 90% saturation	5.6-9.9 56-101%	1/17		Full (A&Ww)
				Sulfate	mg/l	250 SMCL	250-290	20/21	269	Partial DWS
				TDS	mg/l	500 SMCL 723-Hoover Dam	570-679	21/21 0/21	656	Partial DWS
15030104-020 Colorado River, B.William-Osborn	A&Ww, DWS, FBC, FC, Agl, AgL	USGS Fixed Station 09427520 @ Parker Dam	1991-12 1992-12 1993-12 1995- 6	Arsenic t	µg/l	3.1	2-4	4/42	2	Full (FC)
				Selenium t	µg/l	2 chronic	<1-3	10/42	2	Threat A&Ww
				Sulfate	mg/l	250 SMCL	130-280	34/42	264	Partial DWS
				TDS	mg/l	500 SMCL 747-Parker Dam	369-680	39/42 0/42	639	Partial DWS
15030104-009 Colorado River Vinegre-Julian	A&Ww, DWS, FBC, FC, Agl, AgL	UofA & USFWS Lusk 1993	1991-1992 sediments, fish, invertebrates	Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	<4.8-15.2 inverts 5.46-12.5 fish	9.85 med (inverts) 6.95 med (fish)		Partial A&Ww
15030104-008 Colorado River Julian-Yuma Wash	A&Ww, DWS, FBC, FC, Agl, AgL	UofA & USFWS McCaulou et al 1994	1994 4 clams	Selenium	mg/kg dry wt	3 predator protection	6.2-10.4 clams	7.84 med (clams)		Partial A&Ww
15030104-006 Colorado River Yuma-McAllister	A&Ww, DWS, FBC, FC, Agl, AgL	UofA & USFWS Lusk 1993	1991-1992 sediments, fish, invertebrates	Selenium	mg/kg dry wt	3 predator protecton, 4 fish protection	4.4-21.67 inverts 3.20-13.1 fish	10.7 med (inverts) 6.47 med (fish)		Partial A&Ww
		UofA & USFWS McCaulou et al 1994	1994 4 clams	Selenium	mg/kg dry wt	3 predator protection	7.0-9.4 clams	8.19 med (clams)		Partial A&Ww
15030104-001 Colorado River Senator-Imperial Dam	A&Ww, FBC, FC, DWS, Agl, AgL	USGS Fixed Station 09429490	1991-6 1992-5	Sulfate	mg/l	250 SMCL	300-360	11/11	317	Partial DWS
				TDS	mg/l	500 SMCL	747-945	11/11	822	Partial DWS
15030107-003 Colorado River Imperial Dam-Gila River	A&Ww, DWS, FBC, FC, Agl, AgL	ADEQ Priority Pollutant Program	1995-1 fish (mercury)	Ok						Too little information to assess.
15030107-001 Colorado River Main Cnl-Mexico	A&Ww, DWS, FBC, FC, Agl, AgL	USGS Fixed Station 09522000 above Morelos Dam (Northerly International Border with Mexico)	1991-12 1992-12 1993-12 1994-12 1995- 6	Arsenic t	µg/l	3.1	2-15	21/54	3 med	Threat FC
				Iron t	µg/l	300 SMCL	<10-40,000	38/53	440 med	Partial DWS
				Lead t	µg/l	50	<1-64	2/54		Full (DWS)
				Manganese t	µg/l	50 SMCL	<10-2000	38/39	180 med	Partial DWS
				Selenium t	µg/l	2 chronic	<1-3	5/54	2 med	Threat A&Ww
				Sulfate	mg/l	250 SMCL	110-400	40/54	288	Partial DWS
				TDS	mg/l	500 SMCL 879-Imperial Dam	466-1100	51/54 22/54	853	Partial DWS
				Turbidity	NTU	50	1-630	10/54		Partial FBC, A&Ww

COLORADO RIVER - LOWER GILA WATERSHED										
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		USFWS Study 1992 Yuma Valley @ Pilot Knob	1989 water, fish, sediment	Arsenic	mg/kg	3.82 HBGL 9.2 AZ 90th%	4.3			Threat A&Ww
					mg/kg wet wt	1.3 fish protection	1.85 mullet			Threat A&Ww
				Copper	mg/kg wet wt	1.0 NCBP 85th%	3.08 mullet			Threat A&Ww
				DDT metabolites	mg/kg wet wt	0.6 predator protection, 0.3 EPA screen	0.31 mullet			Threat A&Ww
				Dieldrin	mg/kg wet wt	0.1 predator protection, 0.007 EPA screen	0.01 mullet			Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.111 mullet			Threat A&Ww
				Selenium	mg/kg dry wt	3 predator protection	3.4 mullet			Threat A&Ww
15030107-003OFFWM Wellton-Mohawk Canal, Gila Gravity Main-Split (Wellton Canal/Mohawk Canal)	AgI, AgL (DWS)	USFWS Study 1992 Yuma Valley @ Yuma Main Drain	1989 water, fish, sediment	Copper	mg/kg wet wt	1.0 NCBP 85th% 9.2 AZ 90th%	0.51-6.75 catfish			Meet standards for AgI and AgL; however, pose threat to A&W use in waterbodies receiving this drainage.
				DDT metabolies	mg/kg wet wt	0.3 EPA screen 0.6 predator protection	0.38-0.46 catfish			
				Toxaphene	mg/kg wet wt	0.1 predator protection	0.29-0.34 catfish			
15030108-003OFFDR Yuma Main Drain Canal, W.Main-S.Luis	AgI, AgL	USFWS Study 1992 Yuma Valley @ Yuma Main Drain	1989 water, fish, sediment	Arsenic	mg/kg	3.82 HBGL 9.2 AZ 90th%	4.9			Meet standards for AgI and AgL; however, pose threat to A&W use in waterbodies receiving this drainage.
				Chlordane	mg/kg wet wt	0.1 predator protection, 0.08 EPA screen	0.09 catfish			
				DDT metabolies	mg/kg wet wt	0.3 EPA screen 0.6 predator protection	1.65 catfish			
				Dieldrin	mg/kg wet wt	0.1 predator protection, 0.007 EPA screen	0.01 catfish			
				Toxaphene	mg/kg wet wt	0.1 predator protection	0.38 catfish			
GILA RIVER SUB-WATERSHED										
15070201-006 Gila River San Cristobal-Big Eye	A&Ww, PBC, AgI, AgL	ADEQ Investigation SWMU 301.210 Wellton Study	1994 - 1 site water and sediment	Boron t	µg/l	1000	1150	1/1		Non AgI
				Arsenic and selenium in streambed sediment exceed Health-based Guidance Levels established for ingestion; however, these levels were not generally higher than background levels.						

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COLORADO RIVER - LOWER GILA WATERSHED										
15070201-003 Gila River Coyote-Fortuna	A&Ww, PBC, AgI, AgL	ADEQ Fixed station LGR1 near Dome	1993-5 1994-6	Boron t	µg/l	1000	190-1440	3/10		Non AgI
				DO	mg/l	≥6.0 90% saturation	5.34-15.05 85.3-144.5%	1/10		Full (A&Ww)
				Turbidity	NTU	50	0.97-420	2/10		Full (only during flood)
		ADEQ SWMU 301.210 Wellton Study	1994-2 and sediment	Boron t	ug/l	1000	1,140-1,240	2/2		Non AgI
				Arsenic and selenium in streambed sediment exceed Health-based Guidance Levels established for ingestion; however, these levels were not generally higher than background levels.						
		USGS Fixed Station 09520500 near Dome	1991-12 1992-12 1994-6	Boron t	µg/l	1000	130-1400	6/32		Partial AgI
				DO	mg/l	≥6.0 90% saturation	3.8-13.2 50-143%	2/32		Full (A&Ww)
				TDS	mg/l	1000	524-5270	18/32		Non AgI
				Turbidity	NTU	50	1.5-200	6/32		Partial PBC, A&Ww
LAKES IN COLORADO RIVER - LOWER GILA WATERSHED										
15030104-0001 Adobe Lake (Colorado River backwater lake) Imperial Natl Wildlife Refuge	A&Ww, DWS, FC, FBC, AgI, AgL	UofA and USFWS Martinez 1994	1993 - 18 birds, 2 bird eggs	Selenium	mg/kg dry wt	3 bird egg 10 bird liver	4.8-5.6 (eggs) 6.88-28.5 (b.l)	13.5 med bird livers		Partial A&Ww
		UofA and USFWS Lusk 1993	1991-1992 sediments, fish, invertebrates etc	Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	5.82-28.5 invertebrates	12.0 med invertebrates		Partial A&Ww
15030104-0002 Bee Lake (Colorado River backwater lake) Imperial National Wildlife Refuge	A&Ww, DWS, FC, FBC, AgI, AgL	UofA and USFWS Martinez 1994	1993 15 bird livers	Selenium	mg/kg dry wt	10 bird liver	10-35.6	15.58 med bird liver		Partial A&Ww
		UofA and USFWS Lusk 1993	1991-1992 sediments, fish, invertebrates etc	Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	5.95-35.7 inverts 3.87-10.0 fish	12.38 med inverts 7.48 med fish		Partial A&Ww
				Arsenic t	mg/kg dry wt	12 EPA edible	1.34-17.2 fish	2.46 med fish		Threat FC
				Zinc	mg/kg dry wt	136 NCBP 85th%	96-222 fish	133 med fish		Partial A&Ww
15030104-0003 Butler Lake (Colorado River backwater lake) Imperial National Wildlife Refuge	A&Ww, DWS, FC, FBC, AgI, AgL	UofA and USFWS Martinez 1994	1993 18 bird livers, 1 bird egg	Selenium	mg/kg dry wt	3 bird egg 10 bird liver	8.7 egg 3/36-72.7 bird liver	8.7 med bird egg 6.75 med bird livers		Partial A&Ww
		UofA and USFWS Lusk 1993	1991-1992 sediments, fish invertebrates	Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	1.47-5.55 inverts 1.60-5.73 fish	2.55 med invertebrate 3.42 med fish		Threat A&Ww
				Mercury	mg/kg dry wt	0.1 predator protection	0.306-0.639 carp			Threat A&Ww

COLORADO RIVER - LOWER GILA WATERSHED

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15030104-0330 Cibola Lake	A&Ww, FBC, FC	USFWS Study 1993 Colorado River Refuges	1988 fish and sediment	Lead	mg/kg wet wt	0.5 fish protection	no det-0.84 fish	3/8		Threat A&Ww
				Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	4.5-9.1 fish	8/8		Partial A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85th%	4.2-48.8 fish	1/8		Threat A&Ww
		UofA & USFWS Welsh & Maughan, 1994	1989-1990 sunfish, sediment, water	Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	5.7-6.2	5.9 med sunfish		Partial A&Ww
				Zinc	mg/kg dry wt	34 NCBP 85th%	23.9-41.7	31.5 mean sunfish		Threat A&Ww
		UofA & USFWS McCaulou et al 1994	1993 8 clams	Selenium	mg/kg dry wt	3 predator protection	5.2-11.4	7.25 med clams		Partial A&Ww
		UofA & USFWS Villegas 1994	1994 fish, water, sediment	Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	4.79-6.17	5.37 med sunfish		Partial A&Ww
		UofA & USFWS Rusk 1991	1990-1991 marsh birds, crayfish, invertebrates	Selenium	mg/kg dry wt	3 predator protection	3.7-51.4 birds 2.23-3.66 crayfish	12.0 med birds 2.52 crayfish		Threat A&Ww
15030104-0670 Imperial Reservoir (Colorado River)	A&Ww, DWS, FBC, FC, Agl, AgL	USGS Fixed Station	See Imperial Dam on Colorado R							
		UofA/USFWS Rusk 1991	1990-1991 marsh birds, crayfish, invertebrates	Selenium	mg/kg dry wt	3 predator protection	1.8-31.3 birds, 2.94-6.54 inverts, 1.57-4.99 crayfsh	6.35 med birds, 2.76 crayfish, 6.35 invertebrates		Partial A&Ww
		UofA/USFWS McCaulou 1994	1994 4 clams	Selenium	mg/kg dry wt	3 predator protection	11.3-20.8 clams	14.2 med clams		Partial A&Ww
15030104-0004 Island Lake (Colorado River backwater lake) Imperial National Wildlife Refuge	A&Ww, DWS, FBC, FC, Agl, AgL	UofA USFWS Martinez 1994	1993 21 marsh birds	Selenium	mg/kg dry wt	10 bird liver	6.26-42.8 b.liver	17.9 med bird liver		Partial A&Ww
		UofA and USFWS Lusk 1993	1991-1992 sediments, inverts, & fish.	Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	7.54-26.5 inverts 2.07-17.9 fish	10.2 med inverts, 9.35 med fish		Partial A&Ww

COLORADO RIVER - LOWER GILA WATERSHED

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15030101-0590 Lake Havasu	A&Ww, FBC, DWS, FC, AgI, AgL	Mohave County (ADEQ) Lake Complaint	1991-11 sites 1992-11 sites 1993-11 sites 1994-27 sites 1995-16 sites	In 1991, three beaches were closed for two weeks due to fecal coliform. (In 1992 & 1993, laboratory methods not appropriate for compliance purposes.) In 1994, eight beaches were closed due to fecal coliform for two to ten weeks. In 1995, six beaches were closed for one to four weeks due to fecal coliform. (Frequency of monitoring varied by season.)						Non FBC
		UofA & USFWS McCaulou 1994 @ Sandy Point	1994-4 clams	Selenium	mg/kg dry wt	3 predator protection	11/2-13.4 clams	12.2 med clams		Partial A&Ww
		ADEQ Clean Lakes Program	1991-5 1992-5 1993-3 1994-3 & 70 field 1995-27 & 133 field	Sulfate	mg/l	250	59-384	20/43	259	Partial DWS
				Turbidity	NTU	25	0.2-54.8	3/58		Full (A&Ww)
				TDS	mg/l	500	368-735	73/75	687	Partial DWS
		ADEQ Clean Lakes Program Special Inv.	1993-8 sites Spring runoff	Turbidity	NTU	25	31-150		6	Partial A&Ww, FBC
				TDS	mg/l	500	633-695		577	Partial DWS
15030101-0960 Lake Mohave	A&Wc, FBC, DWS, FC, AgI, AgL	AGFD Fish Stocking Prog.	1993-3 limited 1994-21 limited 1995-25 limited	Ok (TDS, selenium, sulfate not tested)						Full
15030104-0005 McAllister Lake (Colorado River backwater lake) Imperial National Wildlife Refuge	A&Ww, DWS, FC, FBC, AgI, AgL	UofA and USFWS Martinez 1994	1993-18 marsh birds	Selenium	mg/kg dry wt	10 bird livers	4.3-20.1 b.liver	8.99 med bird liver		Partial A&Ww
		UofA and USFWS Lusk 1993	1991-1992 sediments, inverts, & fish.	Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	3.22-27.6 inverts 3.97-6.36 fish	7.93 med inverts, 4.95 med fish		Partial A&Ww
15030104-0880 Martinez Lake	A&Ww, FBC, FC, AgI, AgL	USFWS Study 1993 Wildlife Refuges	1988 sediment & fish	Copper	mg/kg wet wt	1.0 NCBP 85th%	0.2-18.8 fish	0.45 med fish		Threat A&Ww
				Selenium	mg/kg	no det-1.6 AZ background	2.7-4.5 sediment	2.7 med sediment		Sediment contamination
					mg/kg dry wt	3 predator protection, 4 fish protection	8.0-12.0 fish	9.4 med fish		Partial A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85th%	5.9-82.1	13.8 med fish		Threat A&Ww
15030107-0950 Mittry Lake	A&Ww, FBC, FC	UofA and USFWS Rusk 1991	1990-1991 marsh birds	Selenium	mg/kg dry wt	3 predator protection, 10 bird livers	No det-19.0 birds 4-10 bird livers	8.7 med birds 5.9 med bird livers		Partial A&Ww
		UofA and USFWS McCaulou 1994	1994 8 clams	Selenium	mg/kg dry wt	3 predator protection	3.8-9.1 clams	5.97 med clams		Partial A&Ww

COLORADO RIVER - LOWER GILA WATERSHED									
ID NUMBER REACH OR LAKE NAME, REACH DESCRIPTION	DESIGNATED USES	AGENCY PROGRAM SITE ID SITE DESCRIPTION	SAMPLES: Year-Number (type of sample)	STANDARDS OR CRITERIA EXCEEDED (Only listed constituents which did not meet a standard or criterion.)						
				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15070201-1010 Painted Rock (Borrow Pit) Lake	A&Ww, FBC, AgI, AgL	ADEQ Priority Pollutant Program	1993-sediment 1994-fish & birds	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	4.3-10.2			Sediment contamination
				DDT metabolites	mg/kg wet wt	0.3 EPA screen 0.6 predator protection	1.2 fish 2.7 birds			Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.36 fish			Threat A&Ww
				Selenium	mg/kg wet wt	0.75 predator protection, (75% moisture)	0.75 fish 0.14 birds			Threat A&Ww
		USFWS/COE Routine monitoring	1991-2 1992-6 1993-7 & 3 field 1994-1 & 6 field 1995-10	DO	mg/l	≥6.0	0.01-17.89	6/33		Partial A&Ww
				Fecal coliform	CFU	800 FBC 4000 A&Ww, AgI AgL	<10-8,000	2/58		Threat FBC, A&Ww, AgI, AgL
				pH	SU	6.5-9.0	5.94-9.46	4/34		Partial A&Ww, FBC, AgI, AgL
				Turbidity	NTU	25	1.3-59.3	4/8		Partial A&Ww
		ADEQ Clean Lakes Program	1992-sediment	DDE	mg/kg	HBGL 4	0.003-0.006	2/2		sediment contamination
		ADEQ Clean Lakes Program	1992-1 & 3 field 1993-2 & 1 field	DO	mg/l	≥6.0	2.93-5.59	3/7		Non A&Ww
15030101-1530 Topock Marsh	A&Ww, FBC, FC, DWS, AgI, AgL	UofA / USFWS Rusk 1991	1990-1991 birds & inverts.	Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	3.3-35.4 birds 6.1-7.14 inverts	6.5 med birds 7.04 med inverts.		Partial A&Ww
		USFWS Study King et al 1993 Colorado River Refuges	1988-89 fish	Cadmium	mg/kg wet wt	0.1 predator protection	no det-0.25 fish	0.05 med		Full
				Copper	mg/kg wet wt	1.0 NCBP 85th%	0.16-2.36 fish	0.31 med		Threat A&Ww
				Lead	mg/kg wet wt	0.5 predator protection	0.1-0.94 fish	0.2 med		Full
				Mercury	mg/kg wet wt	0.1 predator protection	0.01-0.12 fish	0.01 med		Full
				Selenium	mg/kg dry wt	3 predator protection, 4 fish protection	4.3-17.9 fish	9.2 med		Partial A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85th%	4.3-46.0 fish	10.2 med		Full
		UofA / USFWS McCaulou et al 1994	1994 8 clams	Selenium	mg/kg dry wt	3 predator protection	11.0-18.6 clams	18.89 med		Partial A&Ww

LITTLE COLORADO - SAN JUAN WATERSHED										
ID NUMBER REACH OR LAKE NAME, SEGMENT DESCRITPION	DESIGNATED USES	AGENCY, PROGRAM, SITE ID, SITE DESCRIPTION	SAMPLES: Year, Number, Type of sample	STANDARDS OR CRITERIA EXCEEDED (Constituents are shown when results indicate a standard or criterion has been exceeded.)						
				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
LITTLE COLORADO RIVER (LCR) SUB-WATERSHED (see also 15020008 page B-26, and 15020016 page B-28)										
15020001-011 Little Colorado River Hall Creek-So. Fork LCR	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1 1995-1	Ok						Full
15020001-010 Little Colorado River South Fk LCR-Nutrioso	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1	Ok						Full
		ADEQ Complaint Invest SWMU 212.237	1993 4 bacts	Fecal coliform	CFU	800	2166	1/4		Partial FBC
15020001-009 Little Colorado River, Nutrioso-Carnero	A&Wc, FBC, FC, AgI, AgL	ADEQ Fixed Station LC048 @ Springerville	1991-5 1992-6 1993-3	Fecal coliform	SU	800 FBC	0-1400	1/9		Partial FBC
				Copper d	µg/l	varies (25)	4450	1/5		Non A&Wc
				Turbidity	NTU	10	3.9-47	7/14		Non A&Wc
		ADEQ Fixed Station LC050 abv Hwy-60	1994-6 1995-6	Turbidity	NTU	10	3.5-15.6	4/13		Non A&Wc
		ADEQ Complaint SWMU 212.237	1993 4 bacts	Fecal coliform	CFU	800	1040	1/4		Partial FBC
		ADEQ Biocriteria Program	1992-1	Turbidity	NTU	10	16.2	1/1		Partial A&Wc
15020001-001 Little Colorado River Lyman Lake-A	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1994-1 limited	Ok						Too little information to assess
15020001-013 West Fork LCR, hdwt-Little Colorado	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-2 sites 1993-2 sites 1994-2 sites 1995-2 sites	Ok						Full
		AGFD Fish Stocking Program	1993-1 & 1 limited 1994-2 limited 1995- 2 limited	Turbidity	NTU	10	17	1/1		Non A&Wc
		ADEQ Fixed station WLC1 @ Govt. Spring	before 1991-25 1994-6 1995-6	Copper d	µg/l	varies (5)	<10-10	1/12		Threat A&Wc
		ADEQ Fixed Station WLC2 @ Sheeps Xing	1990-1 1991-4 1992-5 1995-6	Cadmium d	µg/l	varies (0.5)	<1-1.6	1/7		Non A&Wc
15020001-013off5 East Fork LCR hdwt-Hall	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1	DO	mg/l	≥7.0 90% saturation	6.8	1/1		Full (slightly reduced dissolved oxyen natural)
		ADEQ Fixed station EFLC1 @ Wilderness	1993-1	Ok						Full

LITTLE COLORADO - SAN JUAN WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15020001-014 So. Fork LCR hdwt-Little Colorado	A&Wc, FBC, FC, AgI, AgL	USFS Apache-Sitgreaves @ campground	1991-3	Ok						Full
		ADEQ Biocriteria Program	1992-1 1993-1 1994-1 1995-1	DO	mg/l	≥7.0 90% saturation	6.8-8.9 73-110%	1/4		Full (slightly reduced DO was natural).
		ADEQ Fixed Station SFLC1	1992-6 1993-3	Ok						Full
		AGFD Fish Stocking Program	1991-1 limited 1992-1 limited	Ok						Too little information to assess
15020001-017 Nutrioso Creek hdwt-Picnic Creek	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program 2 sites	1994-4 limited 1995-2 limited	Turbidity	NTU	10	4-34	3/4		Non A&Wc
		ADEQ Fixed Station NC035 abv Nelson Reservoir	1995-6	Turbidity	NTU	10 A&Wc 50 FBC	8.23-82	5/6 1/6		Non A&Wc Partial FBC
15020001-015 Nutrioso Creek, Picnic-LCR	A&Wc, FBC, FC, AgI, AgL	ADEQ POTW inv. @ Springerville SWMU 212.207	1991-0	narrative						Non-support
		ADEQ POTW inv SWMU 212.327	1993 3 sites 4 days 1 site 3 days 2 sites 1 day	Turbidity	NTU	10 A&Wc 50 FBC	27-57	3/3 1/3		Non A&Wc, Partial FBC
				Fecal coliform	CFU	800	850-6000	6/17		Non FBC
15020001-017off20 Paddy Creek, hdwt-Nutrioso Creek	A&Wc, FBC, FC,	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	DO	mg/l	≥7.0 90% saturation	6.9 72%	1/3		Threat A&Wc
		AGFD AGF-PADDY	1994-2 limited 1995-1 limited	Turbidity	NTU	10	2-11	1/2		Partial A&Wc
15020001-017offR Rudd Creek hdwt-Nutrioso	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
		AGFD 2 sites	1994-4 limited 1995-2 limited	DO	mg/l	≥7.0 90% saturation	6.5-8.9	1/6		Threat A&Wc
				Turbidity	NTU	10	6-14	1/3		Partial A&Wc
15020001-017offA Auger Creek hdwt-Nutrioso	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1994-2 limited 1995-2 limited	Turbidity	NTU	10	4-15	1/3		Partial A&Wc
15020001-017offB Benton Creek hdwt-Rudd Creek	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1994-2 limited 1995-1 limited	Ok						Too few parameters to access
15020001-017offC Colter Creek hdwt-Nutrioso Creek	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1994-2 limited 1995-1 limited	Turbidity	NTU	10	8-15	1/2		Partial A&Wc
15020001-018 Coyote Creek New Mexico border-LCR	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1991-2 1992-1 1993-1	Ok						Too few parameters to access

LITTLE COLORADO - SAN JUAN WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15020001-018off28 Mamie Creek, hdwt-Coyote Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
15020001-019off Lily Creek hdwt-Coyote Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
15020002-024 Little Colorado River A-15020002-025	A&Ww, DWS, FBC, FC, AgI, AgL	USGS station above Salado Springs #342453109241001	1991-2 1992-2 1993-2	Chloride	mg/l	250 SMCL	10-420	4/6	238	Partial DWS
				Sulfate	mg/l	250 SMCL	20-670	4/6	405	Partial DWS
				TDS	mg/l	500 SMCL	194-2080	4/6	1319	Partial DWS
		USGS station below Salado Springs #342600109224001	1991-2 1992-2 1993-2 1994-2	Chloride	mg/l	250 SMCL	17-440	7/8	305	Partial DWS
				Sulfate	mg/l	250 SMCL	20-700	7/8	500	Partial DWS
				TDS	mg/l	500 SMCL	235-2120	7/8	1602	Partial DWS, AgI
15020002-020 Little Colorado River, Carrizo-Zion Reservoir	A&Ww, DWS, FBC, FC, AgI, AgL	USGS Fixed Station 09386030 abv Zion Reservoir	1991-2 1992-2 1993-2 1994-2 (no turbidity test)	Chloride	mg/l	250 SMCL	30-560	7/8	374	Partial DWS
				Manganese	µg/l	50	6-780	5/8	191	Partial DWS
				Sulfate	mg/l	250 SMCL	52-960	7/8	737	Partial DWS
				TDS	mg/l	500 SMCL 1000 AgI	200-2300	7/8 7/8	1924	Partial DWS Partial AgI
15020002-004 Little Colorado River, Silver Creek-Carr	A&Ww, FBC, DWS, FC, AgI, AgL	USGS (1994) Puerco River Study @ Woodruff	1989-91 5 dissolved metals in water, 5 metals in suspended solids, 9 radiochems	Arsenic t	µg/l	3.1	4-6 (d)	3/3	5 med	Partial FC
				Beryllium t	µg/l	0.006 DWS 0.21 FC 0.33 FBC	<0.5-0.5 (d)	1/5	<0.5	Partial FBC
				Copper d	µg/l	varies	<10-50	4/5		Non A&Ww
				Gross alpha	pCi/l	15	315-260	3/3	260 med	Non DWS
				pH	SU	6.5-9.0	7.3-9.5	1/4		Partial FBC, A&Ww, DWS, AgL
				Zinc d	µg/l	varies	<3-26	1/5		Non A&Ww
		ADEQ Fixed station LCWD1 @ Woodruff	1993-5	Arsenic t	µg/l	3.1	<1-43	1/5	<1	Threat FC
				Beryllium t	µg/l	0.006 DWS 0.21 FC 0.33 FBC	<0.5-20.2	1/5 1/5 1/5	<0.5 med	Threat DWS Threat FC Partial FBC
				Iron t	µg/l	300 SMCL	290-83,400	4/5	840 med	Partial DWS
				Lead t	µg/l	50 DWS 100 AgL	<5-154	1/5 1/5	<5 med	Threat DWS Partial AgL
				Manganese t	µg/l	50	<50-7260	3/5	50 med	Partial DWS
				Nickel t	µg/l	140	<100-170	1/5	<100 med	Full (DWS)
				pH	SU	6.5-9.0	8.62-9.31	2/5		Partial FBC, A&Ww, DWS, AgI
				TDS	mg/l	500 SMCL 1000 AgI	310-1060	1/5 1/5	854 med	Threat DWS Partial AgI
				Turbidity	NTU	50	14-18,300	1/5		Partial A&Ww, FBC

LITTLE COLORADO - SAN JUAN WATERSHED										
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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15020002-022 Big Hollow Wash hdwt-LCR	A&Ww, FBC, DWS, FC, AgI, AgL	USGS Special monitoring @ spring	1991-2 1992-2 1993-2 1994-2	Boron t	µg/l	1000	930-1300	7/8	1074	Partial AgI
				Sulfate	mg/l	250 SMCL	180-310	5/8	256	Partial DWS
				TDS	mg/l	500 SMCL 1000 AgI	235-2030	7/8 5/8	1012	Partial DWS Partial AgI
15020002-015 Concho Creek hdwt-Concho Creek	A&Ww, FBC, FC, AgL	USGS Special monitoring @ Concho Springs	1991-2 1992-2 1993-2 1994-2	Ok						Full
15020002-015off10 Mineral Creek hdwt-Concho Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
		ADEQ Priority Pollutant Program	1992-1	Beryllium	mg/kg	1.34 HBGL 1.50 AZ 90th %	2.2	1/1		Sediment contamination
				Cadmium	mg/kg	no detect-1.7 AZ background	11	1/1		
				Copper	mg/kg	5-200 AZ background	1700	1/1		
				Zinc	mg/kg	12-150 AZ background	890	1/1		
15020004-004 Zuni River In New Mexico	A&Ww, FBC, AgI, AgL (in Arizona)	USGS Fixed Station 09386950 abv Black Rock Res.	1991-5 1992-2 1993-2	Parameters Ok Note: Flow up to 650 cfs resulted in suspended solids 17,600 mg/l.						Threat A&Ww
		USGS (1994) Puerco River Study @ Black Rock Reservoir, New Mexico	1989-91 18 metals d 9 metals in suspended solids 15 radiochems	Gross alpha	pCi/l	no standard (DWS 15 pCi/l)	<0.6-821	5/7	616 med	Full (no applicable standards)
				Arsenic t	mg/kg	3.82 (HBGL) 9.2 (AZ 90th %)	<10-10	3/7		Sediment contamination.
				Beryllium	mg/kg	1.34 (HBGL) 1.50 (AZ 90th%)	2-3	7/7		Sediment contamination.
SILVER CREEK SUB-WATERSHED										
15020005-015 Silver Creek, hdwt-Brown Creek	A&Wc, FBC, FC, AgI, AgL	AGFD Monitoring near Hatchery	1992-2 field	Ok						Too little information to assess

LITTLE COLORADO - SAN JUAN WATERSHED										
ID NUMBER REACH OR LAKE NAME, SEGMENT DESCRITPION	**DESIGNATED USES**	**AGENCY, PROGRAM, SITE ID, SITE DESCRIPTION**	**SAMPLES: Year, Number, Type of sample**	**STANDARDS OR CRITERIA EXCEEDED (Constituents are shown when results indicate a standard or criterion has been exceeded.)**						
				CONSTITUENT	**UNITS**	**STANDARD OR CRITERION**	**RANGE OF VALUES**	**FREQUENCY EXCEEDED**	**MEAN OR MEDIAN**	**USE SUPPORT**
15020005-009 Silver Creek, Show Low-Cottonwd	A&Wc, FBC, FC, AgI, AgL	ADEQ Fixed station SLC3 near Snowflake below USGS gage	1991-4 1992-6 1993-3	Beryllium t	µg/l	0.21 FC 0.33 FBC	<5-7.2	1/13	<0.5 med	Threat FC, FBC
				Copper t	µg/l	5005000	<10-6120	1/12 1/12		Threat AgI, AgL
				Copper d	µg/l	varies (27)	4290	1/5		Non A&Wc
				Lead t	µg/l	100	<2-240	1/12		Threat AgL
				Mercury t	µg/l	0.6	>0.5-8.0	1/12	>0.5 med	Threat FC
				Mercury d	µg/l	2.4	>0.5-7.7	1/5		Non A&Wc
				Turbidity	NTU	1050	11-494	13/13 7/13		Non A&Wc Non FBC
				Zinc d	µg/l	varies (263)	<50-2410	1/5		Non A&Wc
15020005-003 Silver Creek, Cottonwood-7-Mile Draw	A&Wc, FBC, FC, AgI, AgL	ADEQ/Kleinfelder 304(l)	1990-2	Ok						Full
		ADEQ Fixed station SLC5 @ 5-Mile Draw	1991-1 & 1 bact 1992-2 bact	Turbidity	NTU	10	30.5	1/1		Non A&Wc
15020005-012 Show Low, hdwt-Linden Wash	A&Wc, FBC, FC, AgI, AgL	ADEQ Fixed station SHL1 @ Show Low	1990-5 1991-5 1992-6	DO	mg/l	≥7.0 90% saturation	6.0-11.1 70.9-124%	3/15		Partial A&Wc
				Turbidity	NTU	10	9.1-32	15/16		Non A&Wc
15020005-012offFH Fools Hollow Wash hdwt-Show Low Wash	A&Wc, FBC, FC, AgL	ADEQ Investigation FHW1 abv Fools Hollow Lk	1995-1 nutrients only	Ok						Too little information to assess
15020005-012off Billy Creek hdwt-Show Low Creek	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1992-6 limited	Ok						Too little information to assess
PUERCO RIVER SUB-WATERSHED										
15020006-003 Puerco River Manelito Cyn-Whitewater (Navaho Reservation)	A&Ww, FBC, AgI, AgL	USFWS Study 1995 Fish & Wildlife in Puerco and LCR	1993 - radiochemicals in invertebrates	No criteria or standards available						No standards or criteria available
15020007-012 Puerco River Black-15020007-013	A&Ww, FBC, AgI, AgL	USFWS Study 1995 Fish & Wildlife in Puerco and LCR	1993 - radiochemicals in invertebrates	No criteria or standards available						No standards or criteria available.
15020007-011 Puerco River 15020007-013 TO 010	A&Ww, FBC, AgI, AgL	USGS - 1994 Puerco River Study @ Chambers Az	1989-91 9 dis. metals, 9 metals in sus. solids, 12 radiochems	Lead d	µg/l	vary (4)	<10-20	1/9		Non A&Ww
				Gross alpha	pCi/l	no standard (15 DWS)	1.7-1642	11/12	630 med	Full - no applicable standard

LITTLE COLORADO - SAN JUAN WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
LITTLE COLORADO RIVER SUB-WATERSHED (see also 15020001 and 15020002 page B-21, and 15020016 page 28)										
15020008-020 Little Colorado River Puerco-Leroux	A&Ww, DWS, FBC, FC, AgI, AgL	USFWS Study 1995 Fish and Wildlife in Puerco and Little Colorado Rivers	1993-fish, bird, & invertebrates	Arsenic	mg/kg wet wt	1.3 immature fish	1.49 - minnow 1.99 killifish			Threat A&Ww
				Cadmium	mg/kg wet wt	0.1 predator protection	no det-0.15 fathead minnow			Threat A&Ww
				Chromium	mg/kg wet wt	1.0 presumptive contamination	5.75 minnow 3.16 killifish 6.45 sucker 2.28 sandpiper			Threat A&Ww
				Copper	mg/kg wet wt	1.0 NCBP 85th% (fish)	92.34 f. minnow 24.70 killifish 9.67 sucker			Threat A&Ww
				Lead	mg/kg wet wt	0.5 fish protection	8.82 minnow 1.23 killifish 1.35 sucker			Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.11 minnow 0.14 killifish			Threat A&Ww
				Nickel	mg/kg wet wt	0.9 presumptive contamination	3.40 minnow 1.11 sucker			Threat A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85th%	202.22 minnow 164.58 killifish 85.76 sucker			Threat A&Ww
				Radiochemcials are elevated but no standards or criteria applicable.						
15020008-017 Little Colorado, Porter-McDonalds	A&Ww, DWS, FBC, FC, AgI, AgL	USGS Fixed Station 09397300 @ Joseph City	1992-4 1993-2 1994-5	Arsenic t	µg/l	3.1	3-12	10/11	7.5	Partial FC
				Beryllium t	µg/l	0.006 DWS 0.21 FC 0.33 FBC	<5-1	4/11 4/11 4/11	<0.5 med	Threat DWS Threat FC Partial FBC
				Copper d	µg/l	varies	10-80	9/11		Non A&Ww
				DO	mg/l	≥6.0 90% saturation	4.5-11.9 52-100%	1/11		Full (A&Ww)
				pH	SU	6.5-9.0	7.9-9.4	3/11		Partial A&Ww, FBC, DWS
				Silver d	µg/l	varies (0)	<1-2	3/11		Non A&Ww
				Zinc d	µg/l	varies (5)	<3-9	1/11		Full (A&Ww)
				Suspended solids (no standards) 45,300-37,800 at 544-1480 cfs. (No turbidity measurements)						Threat A&Ww, FBC
		USGS (1994) Puerco River Study @ Joseph City	1989-91 6 dis. metals, 1 metals in susp. solids, 14 radiochems	Gross alpha	pCi/l	15	<0.6-890	11/13	589 med	Non DWS
				Arsenic t	µg/l	3.1	2-8 d	4/6	5.5 med	Partial FC
				Beryllium t	µg/l	0.006 DWS 0.21 FC 0.33 FBC	<0.5-0.5	1/6	<0.5 med	Partial FBC
				Copper d	µg/l	varies (3-5)	<10-40	3/6		Non A&Ww

LITTLE COLORADO - SAN JUAN WATERSHED										
ID NUMBER REACH OR LAKE NAME, SEGMENT DESCRITPION	**DESIGNATED USES**	**AGENCY, PROGRAM, SITE ID, SITE DESCRIPTION**	**SAMPLES: Year, Number, Type of sample**	**STANDARDS OR CRITERIA EXCEEDED (Constituents are shown when results indicate a standard or criterion has been exceeded.)**						
				CONSTITUENT	**UNITS**	**STANDARD OR CRITERION**	**RANGE OF VALUES**	**FREQUENCY EXCEEDED**	**MEAN OR MEDIAN**	**USE SUPPORT**
15020008-003 Little Colorado River Jack-Corn Creek	A&Ww, DWS, FBC, FC, AgI, AgL	USFWS Study 1995 Fish and Wildlife in Puerco and Little Colorado Rivers	1993-fish, bird, & invertebrates	Chromium	mg/kg wet wt	1.0 presumptive contamination	8.84 minnow 2.01 killifish 2.28 sandpiper			Threat A&Ww
				Copper	mg/kg wet wt	1.0 NCBP 85th% (fish)	27.43 f. minnow 12.40 killifish			Threat A&Ww
				Lead	mg/kg wet wt	0.5 Fish protection	2.24 minnow 0.57 killifish			Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.38 minnow 0.51 killifish			Threat A&Ww
				Nickel	mg/kg wet wt	0.9 presumptive contamination	1.04 minnow			Threat A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85th%	127.93 minnow 87.68 killifish			Threat A&Ww
				Radiochemcials	no standards or criteria available					--
15020008-001 Little Colorado River, 15020016-Dinnebito (Indian Reservation)	A&Ww, DWS, FBC, FC, AgI, AgL	USGS Fixed Station 09401000 @ Grand Falls	1992-5 1993-4 1994-5	Arsenic t	µg/l	3.1	1-9		2 med	Full (FC)
				Copper d	µg/l	varies 3-13	<10-50	8/12		Non A&Ww
				Suspended solids	(no standards) 23,000-78,300 @ 1060-2790 cfs (no turbidity measures)					No applicable standard.
		USGS (Fisk 1994) Puerco Study Site @ Grand Falls	1989-91 10 dis. metals, 6 radiochems, 10 metals in susp. solids	Arsenic t	µg/l	3.1	2-10 (d)	6/10	4.5 med	Partial FC
				Copper d	µg/l	varies (3-13)	<01-70	3/10	<10 med	Non A&Ww
				Gross alpha	pCi/l	15	82-3353	6/6	856 med	Non DWS
EAST CLEAR CREEK SUB-WATERSHED										
15020008-009 East Clear Creek hdwt-Yeager Canyon	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1	Ok						Full
15020008-008 East Clear Creek, Yeager-Willow	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program @ Macks Xing @ Kinder Xing	1992-2 sites 1993-1 1994-1	Ok						Full
15020008-009off4 Barbershop Canyon, hdwt-East Clear Creek	A&Wc, FC, FBC, AgL	ADEQ Biocriteria Program @ Merrit Draw @ mouth	1992-2 sites 1993-2 sites 1994-2 sites	Ok						Full
15020008-008offBUCK Buck Spring Creek, hdwt-Leonard Cyn Creek	A&Wc, FBC, FC, AgL	ADEQ Biocriteria Program	1995-2 sites	DO	mg/l	≥7.0 90% saturation	6.1-6.8 68-89%	2/2		Partial A&Wc
				Turbidity	NTU	10	9.5-14.6	1/2		Partial A&Wc

LITTLE COLORADO - SAN JUAN WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
CHEVELON CREEK SUB-WATERSHED										
15020010-006 Chevelon Creek hdwt-West Chevelon	A&Wc, FBC, FC, AgI, AgL	ADEQ Fixed station CHV2 @ Chevelon Crossing	1993-1	Ok						Full
		ADEQ Biocriteria Program @ Telephone Ridge @ Long Tom @ Chevelon Xing @ Chevelon Ridge	1992-3 sites 1993-3 sites 1994-1 site	Ok						Full
15020010-001 Chevelon Creek Black Canyon-LCR River	A&Wc, FBC, FC, AgI, AgL	ADEQ Fixed Station CHV1 near Winslow	1990-6 1991-7	Copper t	µg/l	500	<10-4040	1/13		Threat AgL
				DO	mg/l	≥7.0 90% saturation	5.9-13.8 88.9-122.4	1/13		Full
				Lead t	µg/l	100	208	1/13		Threat AgL
				TDS	mg/l	1000	103-2200	9/13	1624	Part AgI
				Turbidity	NTU	1050	15-110	11/13 1/13		Non A&Wc; Full FBC
CANYON DIABLO WASH SUB-WATERSHED										
15020015-004 Rio de Flag hdwt-San Francisco W	A&Wedw, PBC	ADEQ Priority Pollutant Program	1993-sediment	Ok						Full
		ADEQ Biocriteria Program	1994-1	Ok						Full
LITTLE COLORADO RIVER SUB-WATERSHED (see also 15020001 and 15020002 page B-21, and 15020008 page B-26)										
15020016-001 Little Colorado River, Lee Cyn-Colorado River	A&Ww, FBC, DWS, FC, AgI, AgL	Natl Park Service Grand Canyon 0.6 miles above mouth	1992-1 1993-3 1994-3 1995-1	Arsenic t	µg/l	3.1	5-11	8/8	7.4	Partial FC
				Chloride	mg/l	250 SMCL	133-1,240	7/8	1190 med	Partial DWS
				Turbidity	NTU	50	>meter can read	1/5		Partial A&Ww, FBC
				TDS	mg/l	500 SMCL 1000 AgI	2,300-2,600	8/8	2500	Partial DWS, AgI
(SAN JUAN SUB-WATERSHED ENTIRELY ON INDIAN RESERVATION) no data										
LAKES IN LITTLE COLORADO RIVER BASIN										
15020010-0180 Black Canyon Lake	A&Wc, FBC, DWS, FC, AgI, AgL	ADEQ Clean Lakes Program	1995-1	Arsenic t	µg/l	3.1	15-17			Partial FC
				Iron t	µg/l	300	1,800-3,000			Partial DWS
				Manganese t	µg/l	50	100-210			Partial DWS
15020015-0001 Deep Lake (marsh)	no designated uses	ADEQ Priority Pollutant Program	1994-1 water & sediment	pH	SU	6.5-9.0	10.28	1/1		No applicable standards
15020005-0530 Fools Hollow Lake	A&Wc, FBC, FC, AgL	ADEQ Clean Lakes Program	1993-2	Narrative		Analysis of white bottom deposit indicated the presence of diazinon insecticide and bromoxynil herbicide and aromatic hydrocarbons.				Partial A&Ww
		AGFD Fish Stocking Program	1993-2	Ok						Full

LITTLE COLORADO - SAN JUAN WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15020015-0890 Lake Mary (lower)	A&Wc, FBC, FC, AgL	AGFD Fish Stocking Program	1993-2	pH	SU	6.5-9.0	9.8	1/2		Partial A&Wc, FBC, AgL
				Turbidity	NTU	10	16-19	2/2		Partial A&Wc
15020015-0900 Lake Mary (upper)	A&Wc, FBC, DWS, FC, AgL	ADEQ Clean Lakes Program	1993-1	Iron t	µg/l	300 SMCL	870	1/1		Partial DWS
15020001-0850 Lyman Lake	A&Wc, FBC, FC, AGI, AgL	AGFD Fish Stocking Program	1993-1 limited 1994-2 limited	Turbidity	NTU	10	146	1/1		Partial A&Wc
15020015-0870 Marshall Lake	A&Wc, FBC, FC, AgL	AGFD Fish Stocking Program	1993-2 sites	pH	SU	6.5-9.0	9-10	1/2		Partial A&Wc
				Turbidity	NTU	10	23-35	1/1		Partial A&Wc
15020015-0970 Mormon Lake	A&Wc, FBC, FC, DWS, Agl, AgL	AGFD Fish Stocking Program	1993-1 few parameters	DO	mg/l	≥6.0 90% saturation	5	1/1		Partial A&Wc
				Iron t	µg/l	300	18,840	1/1		Partial DWS
				Manganese t	µg/l	50	168	1/1		Partial DWS
				Turbidity	NTU	10	438	1/1		Non A&Wc, FBC
		ADEQ Clean Lakes Program	1995-1	pH	SU	6.5-9.0	9.93-10.46	1/1		Partial A&Wc, FBC, DWS, Agl, AgL
				Turbidity	NTU	10	0-81	1/1		Partial A&Wc
15020005-5000 Pintail Lake	A&Wedw, PBC	ADEQ Priority Pollutant Program	1994 3 water sites, 1 sediment	pH	SU	6.5-9.0	9.07-10.87	3/3		Non A&Wedw, PBC
15020005-1170 Rainbow Lake	A&Wc, FBC, FC, Agl, AgL	ADEQ Clean Lakes Program	1992-1 limited 1993-13	pH	SU	6.5-9.0	7.02-10.17	9/14		Non A&Wc, FBC, Agl, AgL
15020005-1360 Scotts Reservoir	A&Wc, FBC, FC, Agl, AgL	AGFD Fish Stocking Program	1993-1 limited 1994-1 limited	Ok						Full support
15020005-1380 Show Low Lake	A&Wc, FBC, FC, Agl, AgL	AGFD Fish Stocking Program	1993-2 limited	Turbidity	NTU	10	15	1/2		Partial A&Wc
15020005-5001 Sponseller Lake	A&Ww, FBC	AGFD Fish Stocking Program	1994-1 limited	Ok						Full
15020005-1500 Telephone Lake	A&Wedw, PBC	ADEQ Priority Pollutant Program	1994-sediment, birds, water	Ok						Full
15020005-0001 White Lake (playa)	A&Wc, PBC, FC	ADEQ Priority Pollutant Program	1994-sediment and water	Ok						Full
15020010-1670 Willow Springs	A&Wc, FBC, FC, Agl, AgL	ADEQ Clean Lakes Program	1994-1	Ok						Full
15020005-1690 Woodland Lake	A&Wc, FBC, FC, Agl, AgL	ADEQ Clean Lakes Program	1992-1 1993-3	pH	SU	6.5-9.0	9.8-9.98	2/4		Partial A&Wc, FBC, Agl, AgL
		AGFD Fish Stocking Program	1993-2	pH	SU	6.5-9.0	8.35-9.83	1/3		Partial A&Wc, FBC, Agl, AgL
15020010-1700 Woods Canyon Lake	A&Wc, FBC, FC DWS, Agl, AgL	ADEQ Clean Lakes Program	1995-1	Iron t	µg/l	300 SMCL	310-5,110	1/1		Partial DWS
				Manganese t	µg/l	50 SMCL	70-430	1/1		Partial DWS

MIDDLE GILA WATERSHED										
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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
GILA RIVER SUB-WATERSHED (see also 15070101 page 35)										
15050100-009 Gila River Drip Springs-San Pedro	A&Ww, FBC, FC, AgL	ADEQ Ray Mine above San Pedro	1990-1 Background	Ok						Full
		USFWS (1995) Middle Gila Study 3 sites	1991-1992 sediment	Ok						Too little information to assess
15050100-008 Gila River San Pedro-Mineral Creek	A&Ww, FBC, FC, AgI, AgL	EPA/ASARCO Cu. Mine Initiative NPDES Monitoring @ Hayden tailings	1993-1	Turbidity	NTU	50	200			Not assessed - occurred during flood event
		USFWS (1995) Middle Gila Study 2 sites	1991-1992 sediment	Ok						Too little information to assess
15050100-007 Gila River Mineral Creek-Donnelly	A&Ww, FBC, FC, AgI, AgL	ADEQ Investigation ASARCO Hayden Tailings Spill 1993 SWMU-212.305	1994-14 sediment only + 6 controls	Tailings were ubiquitous, found in every sample; however, they were not concentrated enough to be visually recognized, nor did the concentrations exceed Health Based Guidance Levels.						Full
		USFWS (1995) Middle Gila Study 2 sites	1991-1992 sediment	Copper	mg/kg	5-200 AZ background	169-267	1/2 sediment		Sediment Contamination
15050100-003 Gila River Box O Wash-Queen	A&Ww, FBC, FC, AgI, AgL	USFWS (1995) Middle Gila Study 2 sites	1991-1992 sediment & fish	Copper	mg/kg wet wt	1.0 NCBP 85%	0.38-4.43	carp & sucker exceeded, catfish ok		Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.12-0.26	carp, sucker, & catfish exceeded		Threat A&Ww
				Selenium	mg/kg dry wt	3 predator protection 4 fish toxicity	1.26-4.09	carp exceeded, catfish and sucker ok		Threat A&Ww
		ADEQ Ray Mine Inv	1990-1	Arsenic t	µg/l	3.1	11		10 med	Partial FC
				TDS	mg/l	1000	1050			Partial AgI
15050100-001 Gila River Santa Cruz-Salt River	A&Ww, PBC, AgL	ADEQ Fixed Station MGR2 above Salt River (on Indian Res)	1990-10 1991-3	DO	mg/l	≥6.0	5.0-12.6	3/13		Partial A&Ww
				Selenium t	mg/l	20	>5-32	2/13		Partial A&Ww
				Turbidity	NTU	50	9.6-194	4/13		Partial A&Ww, PBC
15050100-013 Queen Creek hdwt-Witlow Canyon	A&Ww, PBC, AgL	ADEQ Complaint Inv SWMU 212.291 Queen Creek	1993-2 sites	Ok						Full
		ADEQ Biocriteria Program @ Boyce Thompson	1994-1	Ok						Full

MIDDLE GILA WATERSHED

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15050100-012 Mineral Creek hdwt-Gila	A&Ww, FBC, FC, AgL	ADEQ Investigation Gibson Mine SWMU-212.155 @ Pasquale Adit (provides most of the perennial flow to Mineral Creek)	1991-2 1992-3 1994-2	Beryllium t	µg/l	0.21 FC 0.33 FBC	2.5	1/1 1/1		Partial FC Non FBC
				Copper d	µg/l	varies (227)	5,140	1/1		Non A&Ww
				Copper t	µg/l	500	640-65,800	7/7		Non AgL
				pH	SU	6.5-9.0	6.25-7.35	3/7		Non A&Ww, FBC
		ADEQ Investigation Gibson Mine SWMU-212.155 @ In situ adit (flow to Mineral Creek)	1991-2 1992-1 1994-2	Beryllium t	µg/l	0.21 FC 0.33 FBC	38	1/1		Partial FC Non FBC
				Copper d	µg/l	varies (227)	144,000	1/1		Non A&Ww
				Copper t	µg/l	500	43,000-1,100,000	5/5		Non AgL
				pH	SU	6.5-9.0	2.64-3.37	5/5		Non A&Ww, FBC, AgL
				Zinc d	µg/l	varies (1,160)	2,270	1/1		Non A&Ww
		ADEQ/EPA Copper Mine tour SWMU 210.154 @ Highway 177	1992-2 sites (abv & blw Ray mine)	Copper d	µg/l	varies (69)	145	only below mine		Non A&Ww
		USFWS (1995) Middle Gila Study 1 site	1991-1992 sediment	Copper	mg/kg	5-200 AZ background	2,660			Sediment contamination
				Zinc	mg/kg	12-150 AZ background	200.3			Sediment contamination
		ADEQ/EPA Copper Mine tour SWMU 210.154	1992-1 (below all mines)	pH	SU	6.5-9.0	6.4	1/1		Partial A&Ww, FBC, AgL
				Copper t	µg/l	500	72,500	1/1		Non AgL
		AGFD above Ray Mine	1992-1	Arsenic t	µg/l	3.1	3.7-3.6	2/2		Partial A&Ww
		AGFD below Ray Mine	1992-1	Copper d	µg/l	varies (120)	696			Non A&Ww
				Copper t	µg/l	500	1400			Non AgL
		ADEQ above Ray Mine SWMU 212.147	1990-4 1992-2	Arsenic t	µg/l	3.1	11		<detect. level	Threat FC
				Copper d	µg/l	varies	18-272	2/6		Non A&Ww
		ADEQ below Ray Mine SWMU 212.147	1990-3 1991-1 1992-1 1992-5 sites	Arsenic t	µg/l	3.1	19-21		19 med	Partial FC
				Copper d	µg/l	varies	19-1,910	6/9		Non A&Ww
				Copper t	µg/l	500	210-5,360	2/9		Partial AgL
				Turbidity	NTU	50	850	1	25%	Partial A&Ww, FBC

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MIDDLE GILA WATERSHED										
		ADEQ Fixed Station MIN1	1993-11	Beryllium t	µg/l	0.21 0.33	<0.5-1.31	6/11	0.6 med	Partial FC, Non FBC
				Copper d (acute)	µg/l	varies (44-195)	310-1110	11/11		Non A&Ww
				Copper d (chronic)	µg/l	varies (28-93)	310-1110	11/11		Non A&Ww
				Copper t	µg/l	500	390-2700	10/11		Non AgL
				Turbidity	NTU	50	0.48-280	3/10		Non FBC, A&Ww
		ADEQ ASARCO, Ray Mine SWMU 212.251	1992-7 sites	Copper d	µg/l	varies	190-9,240	4 sites		Non A&Ww
15050100-010off9 Mescal Creek hdwt-Gila River	A&Ww, FBC, FC, AgI, AgL	BLM Routine Monitoring BLM-M1	1990-1 1991-1 1993-1 Bact	Fecal coliform	CFU	800	5,000	1/1		Partial FBC,A&Ww,AgI,AgL
				pH	SU	6.5-9.0	9.1	1/2		Partial A&Ww,FBC,AgI
15050100-000 Weekes Wash (near Queen Creek)	unlisted	ADEQ Priority Pollutant Program	1992-Fish, Sediment & Water	Ok						No designated uses
SALT RIVER SUB-WATERSHED (below Granite Reef Dam diversions)										
15060106-001 Salt River Granite Reef-I-10 Bridge	A&We, PBC	Phoenix/USGS Stormwater Inv 09512165 @ Priest	1993-4	Ok						Full
		ADEQ Tri-City Landfill SWMU 212.281 SWMU 212.228	1993-3 sites	pH	SU	6.5-9.0	6.2-6.3	2 sites		Non-A&Wedw/PBC
				Narrative violation: refuse deposited on banks, bottom, and floating as debris						
15060106-001 Salt River I-10 Bridge-23rd Ave	A&Ww, PBC	Phoenix/USGS Stormwater Inv 09512190 @24th St	1993-1	Ok						Full
		ADEQ Tri-City Landfill SWMU 212.281	1993-1	Turbidity	NTU	50	344	1/1		Non A&Ww
				Narrative violation: refuse deposit on banks, bottom and floating debris from landfill.						Non all uses

MIDDLE GILA WATERSHED

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15060106-001 Salt River 23rd Ave-Gila River	A&Wedw, PBC, FC, AgI, AgL	ADEQ Fixed Station SLR1 @ 107th Ave	1990-9 1991-3	Arsenic t	µg/l	3.1	<5-22	2/13	<10	Threat FC
				Fecal coliform	CFU	800	20-900	1/13		Full (FBC)
				Mercury t	µg/l	0.6	<0.2-2.1	2/13	<0.5	Threat FC
				pH	SU	6.5-9.0	5.3-7.56	2/13		Partial A&Wedw, PBC, AgL
				TDS	mg/l	1000	1050-1270		1215	Partial AgI
		ADEQ Biocriteria Program abv mouth	1994-1	TDS	mg/l	1000	1250	1/1		Partial AgI
		ADEQ Priority Pollutant Program @ 91st Ave	1994 fish and sediment	Heptachlor epoxide	mg/kg wet wt	0.010 EPA screening value	0.035 fish	1/1		Threat FC
				Zinc	mg/kg wet wt	34 NCBP 85th%	68.2 fish	1/1		Threat A&Ww
		ADEQ Tri-City Landfill Erosion SWMU 212.281	1993-2 sites	Turbidity	NTU	50	210-276	2 sites		Non A&Wedw
				Narrative violation: refuse deposits on banks, bottom and floating debris from landfill.						Non all uses
15060106-001offAC Arizona Canal	DWS, AgI, AgL	SRP Monitoring @ 28th Drive	1991-4	TDS	mg/l	500 (SMCL)	359-533		416	Full (DWS)
		ADEQ Priority Pollutant Program (10 sites)	1992-Fish and Sediment	Ok						Full
		SRP Monitoring @ Granite Reef	1991-4 limited 1992-12 1993-12 1994-12	Chloride	mg/l	250 (SMCL)	16-288		103	Full (DWS)
				TDS	mg/l	500 (SMCL)	164-677		433	Full (DWS)
		SRP Monitoring @ 72nd Ave @ proposed WTP	1993-12 1994-12	Iron	mg/l	300 (SMCL)	5-727		64	Full (DWS)
		SRP Monitoring @ Invergordon (64th St)	1991-4 limited 1992-12 1993-12 1994-12	Chloride	mg/l	250 (SMCL)	16-306		116	Full (DWS)
				Iron	mg/l	300 (SMCL)	5-1500		202	Full (DWS)
				Manganese	mg/l	50 (SMCL)	<5-150		10	Full (DWS)
				TDS	mg/l	500 (SMCL)	157-696		423	Full (DWS)
15060106-001offCC Consolidated Canal		SRP Monitoring @ Pecos	1990-4 1991-4 few parameters	Chloride	mg/l	250 (SMCL)	15-559		153 1991-305	Full (DWS)
				TDS	mg/l	500 (SMCL)	199-1372		468 1991-710	Full (DWS)

MIDDLE GILA WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15060106-001offSC Southern Canal		SRP Monitoring @ Granite Creek	1991-4 1992-12 1993-12 1994-12	Chloride	mg/l	250 (SMCL)	15-308		124	Full (DWS)
				TDS	mg/l	500 (SMCL)	199-695		341 1991-559	Full (DWS)
		SRP Monitoring near Brown	1992-12 1993-12 1994-12	Ok						Full
15060106-001offE Eastern Canal		SRP Monitoring @ Warner Road	1992-12 1993-12 1994-12	Ok						Full
		SRP Monitoring @ below Pecos	1991-4 1992-12 1993-12 1994-12	Ok						Full
15060106-001TC Tempe Canal		SRP Monitoring @ Guadalupe @ Tempe WWTP	1992-12 1993-12 1994-12	Ok						Full
15060106-001offWC Western Canal	AgI AgL	SRP Monitoring @ 19th Ave @ lateral 12.8	1991-4 1992-12 1993-12 1994-12	Ok						Full
15060106-001TD Tempe Drain		ADEQ Priority Pollutant Program	1993-sediments	Ok						Full
15060106-001SD Storm Drain to Salt River		ADEQ Complaint	1991-1 oily-sludge							
15060106-001GC Grand Canal		SRP Monitoring @ lateral	1992-12	Ok						Full
15060106-026 Cave Creek hdwt-Arizona Canal	A&Ww, FBC, FC, AgI, AgL	USFS Tonto National Forest	1991-3	Ok						Full
		ADEQ Complaint SWMU 212.299 blw dam - skin rash	1993-1 (2 soil)	Ok						Full
		ADEQ Fixed Station CAV1 @ sec 9 Picnic	1992-1 1993-5	Ok						Full

MIDDLE GILA WATERSHED

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GILA RIVER SUB-WATERSHED (see also 15050100 page B-30)										
15070101-015 Gila River Salt-Agua Fria River	A&Wedw, PBC, FC, AgI, AgL	ADEQ Fixed Station MGR1 @ Phx Intl Raceway	1990-11 1991-3	Arsenic t	µg/l	3.1	5	1/14	<10	Full
				Beryllium t	µg/l	0.21 FC 0.33 FBC	0.5	1/14	<DL	Full
				DO	mg/l	1.0 (EDW)	0.6	1/12		Full
				Mercury t	µg/l	0.6	<0.2-1.8	2/14		Partial FC
				pH	SU	6.5-9.0	4.86-7.6	1/12		Full
15070101-010 Gila River Waterman-Hassayampa	A&Wedw, PBC, FC, AgI, AgL	ADEQ Clean Lakes Program Painted Rock Study	1992-sediments 1 site heavy metals and pesticides	DDT metabolites	mg/kg	<detection	0.008	1/1		Sediment contamination
15070101-009 Gila River Hassayampa-15070101-016	A&Wedw, PBC, FC, AgI, AgL	ADEQ Clean Lakes Program Painted Rock Study	1992-sediments 1 site heavy metals and pesticides	Ok						Full
15070101-008 Gila River 15070101-016-Centenial	A&Wedw, PBC, FC, AgI, AgL	ADEQ Clean Lakes Program Painted Rock Study	1992-sediments 1 site heavy metals and pesticides	DDT metabolites	mg/kg	<detection	0.01	1/1		Sediment contamination
15070101-007 Gila River Centennial-Gillespie Dam	A&Wedw, PBC, FC, AgI, AgL	USGS Fixed Station 09518000 abv Gillespie Dam	1991-12 1992-12 1993-12 1994-12 1995-6	Arsenic t	µg/l	3.1	5-13	54/54	9 med	Partial FC
				Boron t	µg/l	1000	100-2600	41/53	1242	Partial AgI, A&Wedw
				Copper t	µg/l	500	3-550	1/54		Full (AgL)
				Fecal coliform	CFU	800 A&Wedw 4000 PBC, Ag	13-4700	19/54 1/54		Non A&Wedw
				Lead d	µg/l	varies (67)	<10-70	1/54		Full (A&Wedw)
				Lead t	µg/l	100	<1-340	3/54		Threat AgL (during 1993 floods)
				Mercury t	µg/l	0.6	<0.1-1.0	2/48	<0.10	Full (FC)
				TDS	mg/l	1,000	331-3350	44/54	1892	Partial AgI
				Turbidity	NTU	50	4.3-2200	12/54		Partial A&Wedw, PBC
		ADEQ Clean Lakes Program Painted Rock Study	1992-sediments 5 sites heavy metals and pesticides	DDT metabolites	mg/kg	<detection	0.008-0.01	4/16		Sediment contamination
15070101-005 Gila River Gillespie D-Sand Tank	A&Ww, FBC, FC, AgI, AgL	ADEQ Clean Lakes Program Painted Rock Study	1992-sediments (pesticides and metals) 2 sites	Ok						Full

MIDDLE GILA WATERSHED										
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15070101-001 Gila River (Painted Rock Reservoir)	A&Ww, FBC, FC, AgI, AgL	ADEQ Clean Lakes Program Painted Rock Study above dam	1992-sediments (pesticides and metals) 2 sites	DDT metabolites	mg/kg	< detection levels	0.008	1/2		Sediment contamination
		ADEQ Priority Pollutant Program	1989-water, fish, sediment	Ok						Full
AGUA FRIA SUB-WATERSHED										
15070102-023 Agua Fria River Sycamore-Big Bug	A&Ww, FBC, DWS, FC, AgI, AgL	BLM Fixed station BLM-A2	1992-9 limited 1993-9 limited 1994-7 limited 1995-1 limited	Fecal coliform	CFU	800 FBC 4000 A&W, DWS, AgI, AgL	11->16,000	1/2		Partial FBC, A&Ww, DWS, AgI, AgL
				Turbidity	NTU	50	1.02->1000	3/17		Partial A&Ww, FBC
		BLM Fixed station BLM-A3	1992-5 limited 1993-7 limited 1994-4 limited 1995-2 limited	DO % Saturation	mg/l	≥6.0 90%	4.9-10.5 67-99%	3/14		Partial A&Ww
				Turbidity	NTU	50	0.84->1000	3/12		Partial A&Ww, FBC
15070102-022 Agua Fria River Big Bug-Squaw Creek	A&Ww, FBC, DWS, FC, AgI, AgL	ADEQ Biocriteria Program below Big Bug Creek	1992-1 1993-1 1994-1 1995-1	Arsenic t	µg/l	3.1	<10-11		<10 med	Full (FC)
				Iron t	µg/l	300	150-580	1/3	220 med	Full (DWS)
				TDS	mg/l	500	477-515	1/4	495	Full (DWS)
		BLM Fixed Station BLM-A2	1992-9 limited 1993-9 limited 1994-7 limited 1995-1 limited	Arsenic t	µg/l	3.1	9	1/1		Partial FC
				Fecal coliform	CFU	800 FBC 4000 A&W, DWS, AgI, AgL	11-16,000	1/2		Partial FBC, DWS, A&W, AgI, AgL
				Turbidity	NTU	50	1.02->1000	3/17		Partial A&Ww, FBC
15070102-019 Agua Fria River Blk Cyn-Ltl Squaw	A&Ww, FBC, DWS, FC, AgI, AgL	USGS Fixed Station 09512800 @ Rock Springs	1991-12 1992-12 1993-12 1994-12 1995-12	Arsenic t	µg/l	3.1 FC 50 FBC, DWS	8-67	60/60	14 med	Partial FC
				DO	mg/l	≥6.0 90% saturation	3.6-11.7 47-136%	6/60		Full (A&Ww)
				Fecal coliform	CFU	800	<1-3100	2/60		Full (FBC)
				Iron t	µg/l	300 (SMCL)	20-36,000	19/60	170 med	Full (DWS)
				Manganese t	µg/l	50 (SMCL	<10-1400	17/60	20 med	Full (DWS)
				Turbidity	NTU	50	0.5-3,300	4/60		Threat FBC, A&Ww
		BLM Fixed Station BLM-A1	1992-22 limited 1993-10 limited 1994-7 limited 1995-4 limited	DO % Saturation	mg/l	≥6.0 90%	5:8-10.0 73-111%	2/22		Full
				Fecal coliform	CFU	800 FBC 4000 A&W, DWS, AgI, AgL	5,000	2/4		Partial FBC, A&Ww, AgI, AgL
				Turbidity	NTU	50	0.92-401	2/22		Full

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15070102-008 Agua Fria River Lk Pleasant-Beardsley	A&Ww, FBC, FC, AgI, AgL	USGS Fixed Station 09513600 blw Waddell Dam	1991-6 1992-6 1993-7 1994-6 1995-7	Arsenic t	µg/l	3.1	3-12	31/32	6 med	Partial FC
15070102-033 Lynx Creek hdwt-Agua Fria River	A&Ww, PBC, AgL	USFS Prescott National Forest	1991-2	Ok						Full
		ADEQ Priority Pollutant Program	1993-Fish and sediment	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	33.9	1/1		Sediment contamination
				Cadmium	mg/kg	No det-1.7 AZ background	2.3	1/1		
				Copper	mg/kg	<5-200 AZ background	408	1/1		
				Lead	mg/kg	0-100 AZ background	280	1/1		
		ADEQ Fixed station LNX1 above Lynx Lake	1993-3	Copper d	µg/l	varies (29.5)	30	1/1		Non A&Ww
				Zinc d	µg/l	varies (201)	430	1/1		Non A&Ww
		Prescott National Forest Abandoned Mine @ Az Victory M	1990-1	Ok						Full
		AGFD Abandoned Mines @ Walker Mine	1990-1 Below mines	Ok						Full
		ADEQ - Complaint Mercury Inv. SWMU 212.257	1992-3 (1992-11 soil)	Ok						Full
		Prescott National Forest Abandoned Mines at Lynx Creek	1990-1	Ok						Full
15070102-033off Knapp Gulch hdwt-Lynx Creek	A&Ww, PBC, AgL	Prescott National Forest Abandoned Mines @ placer mine	1990-1	Ok						Full
15070102-033off Pine Creek hdwt-Lynx Creek	A&Ww, PBC, AgL	ADEQ Priority Pollutant Program Sheldon Mine	1994 sediment	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	84.4	1/1		Sediment contamination

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15070102-035 Black Canyon hdwt-Agua Fria River	A&Ww, FBC, AgI, AgL	BLM Fixed Station 2 sites:BLM-B1 & BLM-B2	1992-15 limited 1993-1, 11 limited 1994-11 limited 1995-2 limited	DO	mg/l	≥6.0 90% saturation	5.2-9.9 65-112%	1/22		Full
		Bur. of Mines/ADEQ Prescott Mining Proj	1994-1 1995-1	Ok						Full
		ADEQ Fixed Station BCC1 abv. Bl Canyon City	1993-2	Ok						Full
15070102-035offCB Crazy Basin Creek hdwt-Black Canyon	A&Ww, FBC, AgI, AgL	Bur. of Mines/ADEQ Prescott Mining Proj.	1994-5 1995-6	Ok (note pH dropped to 6.6 once, norm 8.4)						Full
15070102-035offD Dripping Spring hdwt-Black Canyon	A&Ww, FBC, AgI, AgL	BLM Monitoring site BLM-DR1	1992-1 limited 1993-2 limited 1994-3 limited 1995-1 limited	DO	mg/l	≥6.0 90% saturation	4.4-8.3 53-98%	4/7		Non A&Ww
				Fecal coliform	CFU	800	23-900	1/2		Partial FBC
15070102-035offR Rock Springs Creek hdwt-Black Canyon	A&Ww, FBC, AgI, AgL	ADEQ Complaint Inv SWMU 212.283 Rock Springs Cafe	1993-2	Ok						Full
15070102-037 Poland Creek hdwt-Black Canyon	A&Ww, FBC, AgI, AgL	ADEQ Biocriteria Program	1992-1	Ok						Full
		Bur. of Mines/ADEQ Prescott Mining Proj.	1994-2 1995-2	Ok						Full
		USFS Prescott National Forest	1991-2	Ok						Full
15070102-036 Turkey Creek, hdwt-Poland Creek	A&Ww, FBC, AgI, AgL	Labat-Anderson Prescott National Forest @ Golden Belt Mine	1990-4 (@ mine during runoff event)	Antimony t	µg/l	560	<1.5-2,500	1/3		Partial FBC
				Arsenic t	µg/l	50	790-91,600	3/3	790 med	Non FBC
				Cadmium t	µg/l	50	300-1,700	3/3		Non AgI, AgL, FBC
				Copper t	µg/l	500 AgL 5000 AgI	7,700-40,300	3/3		Non AgL, AgI
				Cyanide t	µg/l	41	170-340	3/3		Non A&Ww, AgL
				Lead t	µg/l	100	<500-2,400	2/3		Non AgL
				Zinc t	µg/l	10,000	39,900-214,000	3/3		Non FBC, AgI, AgL
		Bur. of Mines/ADEQ Prescott Mining Proj	1994-13 1995-12	TDS	mg/l	1000 (EPA criteria)	257-2200	5/26		Partial AgI
		ADEQ Biocriteria Program @ spring blw Golden Turkey Mine	1995-1	Ok						Full
		USFS Prescott National Forest	1991-3	Ok						Full

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15070102-035offA Antelope Creek hdwt-Bumble Bee Creek	A&Ww, FBC, AgI, AgL	BLM Monitoring site BLM-AN1	1994-2 limited 1995-3 limited	Fecal coliform	CFU	800	300-1600	1/2		Partial FBC
15070102-034 Big Bug, hdwt-Agua Fria River	A&Ww, FBC, FC, AgI, AgL	BLM Fixed Station BLM-BB1	1992-9 limited 1993-8 limited 1994-7 limited 1995-1 limited	Fecal coliform	CFU	800 FBC 4000 A&W, DWS, AgI, AgL	2 - >16,000	1/2		Partial, FBC, A&Ww, AgI, AgL
15070102-031off11 Galena Gulch, hdwt-Agua Fria River	A&Ww, PBC, AgL	Hargis + Assoc. McCabe Mine (Magma Copper Company) @ McCabe Mine Sediment samples	1990 1 set of 12 sediment sites	Lead	mg/kg	0-100 AZ background	180-700	3 sites		Sediment contamination
				Zinc	mg/kg	12-150 AZ background	890-2,200	2/8		
			Cistern 1990 - 5 1991 - 6 1992 - 6 1993 - 4	Lead t	µg/l	100	180-200	2/20		Threat AgL
				Cyanide t	µg/l	41 A&W 200 AgL	50-1,100	23/33		Non A&Ww, AgL
			1990 - 7 sites 1991 - 3 sites (below tailings pond)	Lead t	µg/l	100	210	1/10		Threat AgL
				Cyanide t	µg/l	41 A&W 200 AgL	220-730	8/10		Non A&Ww, Partial AgL
15070102-028 Ash Creek, hdwt-Yellow Jacket	A&Ww, FBC, FC, AgI, AgL	BLM Fixed station BLM-AA1	1992-2 limited 1993-5 limited 1994-4 limited 1995-9 limited	DO % Saturation	mg/l	≥6.0 90%	5.9-10.0 78-104%	1/15		Full (A&Ww)
				Fecal coliform	CFU	800	3,000	1/2		Partial FBC
		ADEQ Biocriteria Program	1992-1 1994-1	Ok						Full
15070102-026off1 Little Ash Creek hdwt-Ash Creek	A&Ww, FC, FBC, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1 1995-1	DO	mg/l	≥6.0 90% saturation	5.7-8.5 60-92%	2/4		Full - natural low DO at spring source
		BLM Fixed station 2 sites: BLM-LA1, BLM-LA2	1992-2 limited 1993-10 limited 1994-6 limited 1995-4 limited	DO % Saturation	mg/l	≥6.0 90%	4.3-12/4 58-104%	1/22		Too little information to assess
15070102-026offD Dry Creek hdwt-Little Ash Creek	A&Ww, FC, FBC, AgL	BLM Monitoring site BLM-D1	1992-1 limited 1993-5 limited 1994-3 limited 1995-2 limited	Ok						Too little information to assess

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15070102-024 Sycamore Creek hdwt-Agua Fria River	A&Wc, FBC, FC, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1 1995-1	Ok						Full
		BLM Monitoring site BLM-S1	1992-1 limited 1993-3 limited 1994-1 & 1 limited 1995-1 limited	Ok						Full
15070102-022offI Indian Creek, hdwt-Agua Fria River	A&Ww, FBC, DWS, FC, AgI, AgL	BLM Monitoring site BLM-IND	1992-3 limited 1993-3 limited 1994-3 limited	Fecal coliform	CFU	800 FBC 4000 A&W, DWS, AgI, AgL	9,000	2/2		Partial A&Ww, FBC, DWS, AgI, AgL
15070102-022offL Lousy Canyon, hdwt-Agua Fria River	A&Ww, FBC, DWS, FC, AgI, AgL	BLM Monitoring site BLM-LR2	1992-1 limited 1993-6 limited 1994-4 limited 1995 1 limited	DO % Saturation	mg/l	≥6.0 90%	5.8-8.7 74-103%	2/11		Partial A&Ww
				Fecal coliform	CFU	800	<2-2,400	1/3		Partial FBC
15070102-022offLAR Larry Creek hdwt-Agua Fria River	A&Ww, FBC, DWS, FC, AgI, AgL	BLM 2 sites: BLM-LR1 BLM-LR2 (tributary)	1992-2 limited 1993-3 limited 1994-3 limited 1995-2 limited	Fecal coliform	CFU	800	23-900	1/4		Partial FBC
15070102-022offS Silver Creek, hdwt-Agua Fria River	A&Ww, FBC, DWS, FC, AgI, AgL	BLM Monitoring site BLM-S1	1992-1 limited 1993-3 limited 1994-1 & 3 limited 1995-2 limited	Fecal coliform	CFU	800	23-900	1/4		Partial FBC
15070102-016offT Tule Creek hdwt-Agua Fria River	A&Ww, FBC, FC, AgI, AgL	BLM Monitoring site	1993-1 limited	Ok						Too little information to assess
		ADEQ Biocriteria Program	1993-1	Arsenic t	µg/l	3.1	41	1/1		Partial FC
15070102-042off Ad Wash hdwt-Castle Creek	A&Ww, FBC, FC, AgI, AgL	BLM Monitoring site BLM-ADW	1993-1 bact	Ok						Too little information to assess
15070102-007offDY Dysart Drain to Agua Fria River	AgI, AgL	ADEQ Priority Pollutant Program	1994 fish & sediment	DDT metabolites	mg/kg wet wt	0.3 EPA screen 0.6 fish protection	24 fish	fish		(posted no fish consumption)
				Zinc	mg/kg wet wt	34 NCBP 85%	47.5 fish	fish		

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15070102-007offD Dale Creek hdwt-Agua Fria River	A&Ww, PBC, AgI, AgL	ADEQ Priority Pollutant Program (Luke Air Force B)	1993-fish & sediments 1994 fish & sediments	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	4.2-15.75 sediment	2/2		Sediment contamination
				Cadmium	mg/kg	AZ background No det-1.7	0.83-3.2 sediment	2/2		
				Chromium	mg/kg wet wt	1.0 presumptive contamination	no detect-2.5 fish	1/2		Threat A&Ww
				Lead	mg/kg wet wt	0.3 NCBP 85th%	0.28-1.5 fish	1/2		Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.11-0.18 fish	2/2		Threat A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85th%	48 fish	1/1		Threat A&Ww
		ADEQ Complaint Luke USAF Base Retention Basin	1994-1	pH	SU	6.5-9.0	9.2	1/1		Partial A&Ww, PBC
				Turbidity	NTU	50	117	1/1		Partial A&Ww
15070102-002 New River, Skunk-Agua Fria River	A&Ww, FBC, FC, AgI, AgL	ADEQ Auto Shredder Complaint Inv blw Beardsley Rd	1991 1 set 4 soil	Cadmium	mg/kg	AZ background No det-1.7	36-72	4/4		Sediment contamination
				Lead	mg/kg	AZ background No det.-100	3,200-7,500	4/4		
15070102-003offS Scatter Wash, hdwt-Skunk Wash	A&Ww, FBC, FC, AgI, AgL	ADEQ Complaint Telephone Pole Fire	1994-2 sites (runoff water from fire)	Acenaphthylene	µg/l	0.002 FC 0.003 DWS 0.12 FBC	10-15	2/2 2/2 2/2		Non FC Non DWS Non FBC
				Arsenic t	µg/l	3.1 FC 50 DWS/FBC 200 AgL	260-470	2/2 2/2 2/2		Non FC Non FBC, DWS Non AgL
				Benzo(a)-anthracene	µg/l	0.00008 FC 0.003 DWS 0.12 FBC	2	2/2 2/2 2/2		Non FC Non DWS Non FBC
				Chrysene	µg/l	0.0001 FC 0.003 DWS 0.12 FBC	2-3	2/2 2/2 2/2		Non FC Non DWS Non FBC
				Phenanthrene	µg/l	0.0005 FC 0.12 FBC 30.0 A&Ww	38-47	2/2 2/2 2/2		Non FC, Non FBC, Non A&Ww

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HSSAYAMPA RIVER SUB-WATERSHED										
15070103-007 Hassayampa River, hdwt-Blind Indian Creek	A&Ww, FBC, FC, AgI, AgL	Prescott National Forest	1991-3	Ok						Full
		ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
		ADEQ Complaint Inv. SWMU 212. Senator Mine	1993-2 sites (one sampled twice)	Cadmium d	mg/l	varies	0.058-0.073	2/3		Non A&Ww
				Cadmium t	mg/l	0.05	0.051-0.070	2/3		Non AgI, AgL
				Copper d	mg/l	varies	0.958-3.39	3/3		Non A&Ww
				Copper t	mg/l	0.5	0.715-2.13	2/3		Non AgL
				pH	SU	6.5-9.0	3.62-5.26	3/3		Non A&Ww, FBC, AgI, AgL
				Zinc d	mg/l	varies	362-526	3/3		Non A&Ww
			2 stream bed/bank pairs	Lead	mg/kg	AZ background no det.-100	430		1 site	Sediment Contamination
		Prescott National Forest Abandoned Mines @ Senator Mine	1990 set of 3	Arsenic t	µg/l	3.1	5-8		5 med	Partial FC
				Copper t	µg/l	500	1200	1/3		Non AgL
				Mercury t	µg/l	0.6	3-5	2/3		Partial FC
				pH	SU	6.5-9.0	5.9	1/3		Non A&Ww, FBC
		USFS Prescott National Forest @ FR #798	1991-1	Ok						Full
		ADEQ Fixed Station HR4 abv Senator Mine	1992-4	Cadmium d (acute)	µg/l	varies (6-25)	15-65	2/2		Non A&Ww
				Cadmium t	µg/l	50	4.5-70	1/4		Partial AgL/AgI
				Copper d (acute)	µg/l	varies (24-83)	14-280	1/2		Non A&Ww
				Zinc d (acute)	µg/l	varies (150-465)	830-3900	2/2		Non A&Ww
				Copper, cadmium, and zinc chronic standards were also exceeded in 2 of 2 samples; however, samples were collected only 1 month apart and may not represent chronic conditions.						

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		ADEQ Priority Pollutant Program blw Senator Mine	1993-sediment	Arsenic t	mg/kg	3.28 HBGL 9.2 AZ 90th%	248	1/1		Sediment contamination
				Beryllium	mg/kg	1.34 HBGL 1.5 AZ 90th%	9.2	1/1		
				Cadmium	mg/kg	244 HBGL	1,090	1/1		
				Copper	mg/kg	AZ background 5-200	18,400	1/1		
				Lead	mg/kg	1400 HBGL	2200	1/1		
				Mercury	mg/kg	AZ background No det-0.57	1.70	1/1		
				Selenium	mg/kg	AZ background 0.1-1.6	4.70	1/1		
				Thallium	mg/kg	AZ background 0.5-1	6.7	1/1		
		ADEQ Fixed Station HR5 blw Senator Mine	1992-4	Arsenic t	µg/l	3.1	<10-13	1/4		Partial FC
				Cadmium d	µg/l	varies (7.5-22)	20-56.4	2/2		Non A&Ww
				Cadmium t	µg/l	50 (Agl AgL) 70 (FBC)	17.5-81.3	3/4 2/4		Non Agl AgL Non FBC
				Copper d	µg/l	varies (29.5)	12-580	1/2		Non A&Ww
				Copper t	µg/l	500	55-1140	2/4		Non AgL
				Lead t	µg/l	100	110	1/4		Partial AgL
				pH	SU	6.5-9.0	5.28-7.91	1/4		Partial A&Ww, FBC
				Zinc d	µg/l	varies (183-426)	1140-3570	2/2		Non A&Ww
				Turbidity	NTU	50	2.0-108	1/4		Partial A&Ww, FBC
		ADEQ Fixed Station HR3 near Wagoner	1991-4 1992-4 1993-6 1995-5	Turbidity	NTU	50	0.21-91	1/19		Full
				Beryllium t	µg/l	0.21 FC 0.33 FBC	0.5 (d)	1/19		Threat FC, FBC
				Mercury t	µg/l	0.6	1.6	1/12	<DL	Threat FC
15070103-004 Hassayampa River, Cottonwood-Martinez	A&Ww, FBC, FC, Agl, AgL	ADEQ Fixed station HR2 @ Box Canyon	1990-6 1991-4 1993-6	Turbidity	NTU	50	0.3-144	2/10		Partial A&Ww, FBC
		BLM Monitoring site Fixed station HR2	1994-1	Arsenic t	µg/l	3.1	5	1/1		Partial FC
		ADEQ (WQARF) Wickenburg Mill abv/blw mill	1991 set of 2	Ok						Full

MIDDLE GILA WATERSHED

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15070103-003 Hassayampa River Martinez-Sols Wash	A&Ww, FBC, FC AgI, AgL	ADEQ Vulture Mill SWMU-212.239	1992-2 sites (10 soil)	Turbidity	NTU	50	118-120	2		Partial A&Ww, FBC
15070103-002 Hassayampa River, Sols-Jackrabbit	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station HR1 near Wickenburg	1990-5 1991-4	DO	mg/l	≥6.0	1.6-7.3	6/7		Non A&Ww - natural
				Turbidity	NTU	50	0.10-194	1/9		Part A&Ww, FBC
		ADEQ Biocriteria Program	1993-1 1994-1	Ok						Full
		ADEQ Priority Pollutant Program	1993 fish	Ok						Full
15070103-001 Hassayampa River, Jackrabbit-Gila River	A&We, PBC	ADEQ Clean Lakes Program Painted Rocks Study	1992-1 sediment (metals and pesticides	DDT-metabolites	mg/kg	should not detect	0.5	1/1		Sediment contamination
15070103-007off2 French Gulch hdwt-Hassayampa River	A&Ww, FBC, FC, AgI, AgL	ADEQ Zonia Mine Inv @ Zonia Mine	1989-4 sites 1991-12 sites	Cadmium t	µg/l	50	1,180-1,360	3/4		At Zonia Springs--Non A&Ww, FBC, AgL, AgI, part FC; At French Gulch Springs--Non AgI.
				Copper t	µg/l	500	1,600-1,420,000	4		
				Manganese t	µg/l	10,000	18,400-843,000	5		
				Mercury t	µg/l	0.6	0.8-1.1	2		
				pH	SU	6.5-9.0	2.91-6.05	4		
				TDS	mg/l	1,000			2,660	
				Zinc d	µg/l	varies	8,710	1		
		ADEQ Zonia Mine Inv SWMU 212.068	1992-3 sites	Cadmium t	µg/l	50	75.7	1		Non AgI, AgL, FBC
				Copper t	µg/l	500	1,070-1,950	2		Non AgL
				Copper d	µg/l	varies	481-1,900	2		Non A&Ww
				Manganese t	µg/l	10,000	27,500-44,200	2		Non AgL
				TDS	mg/l	1000	2850-3650	3		Non AgI
				Zinc d	µg/l	varies	7,540	3		Non A&Ww
		ADEQ Priority Pollutant Program	1993-sediment	Arsenic t	mg/kg	3.28 HBGL 9.2 AZ 90%	15.1	1/1		Sediment contamination
		ADEQ Zonia Mine Inv SWMU 212.068	1993-3 sites during a runoff event	Beryllium t	µg/l	0.21	2.6-8.0	3		Non FBC, partial FC
				Cadmium t	µg/l	50	200-540	3		Non AgI,AgL,FBC,
				Copper t	µg/l	500	78,000-264,000	3		Non AgI, AgL
				Manganese	µg/l	10,000	79,200-174,000	3		Non AgL
				pH	SU	6.5-9.0	4.28-5.83	3		Non A&Ww, FBC,
				TDS	mg/l	1,000	3570-5520	3		Non AgI
				Turbidity	NTU	50	91-83	2		Non A&Ww, FBC
				Zinc t	µg/l	10,000	26,300-55,200	3		Non AgI, Non AgL

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15070103-007off Cash Mine Tributary hdwt-Hassayampa	A&Ww, FBC, FC, AgI, AgL	ADEQ/Kleinfelder 304(l) Inv. Cash Mine	1990-1	Cadmium t	µg/l	50	76	1		Partial AgL, FBC
				Copper t	µg/l	500	1,890	1		Non AgL
		ADEQ Fixed station HR7 Cash Mine	1993-1 1994-3	Beryllium t	µg/l	0.21 0.33	<0.5-1.3	3/4 3/4		Partial FC Non FBC
				Cadmium d (acute)	µg/l	varies (4-114)	14.0-41.5	2/4		Non A&Ww
				Cadmium d (chronic)	µg/l	varies (1-12)	14.0-41.5	4/4		Non A&Ww
				Copper d	µg/l	5200	1560-5980	1/4		Partial FBC
				Copper d (acute)	µg/l	varies (16-295)	1560-5980	4/4		Non A&Ww
				Copper d (chronic)	µg/l	varies (11-152)	1560-5980	4/4		Non A&Ww
				Copper t	µg/l	500 5000	1500-5900	3/3 1/3		Non AgL Non AgI
				Lead d (chronic)	µg/l	varies (3-142)	14-94	3/4		Non A&Ww
				pH	SU	6.5-9.0 4.5-9.0 AgI	3.92-4.54	4/4 3/4		Non A&Ww, FBC Non AgI
				Zinc d (chronic)	µg/l	varies (96-1333)	1080-2810	4/4		Non A&Ww
				Zinc d (acute)	µg/l	varies (107-1470)	1080-2810	4/4		Non A&Ww
		ADEQ Investigation McCleur Tailings	1995-2 sites (+ one control)	Arsenic t	µg/l	3.1 FC 50 FBC 200 AgL 2000 AgI	<det. level-3,750	@ pool in spoils		Partial FC Non FBC Non AgL Non AgI
				Beryllium t	µg/l	0.21 FC 0.33 FBC	<det. level-55	@ pool in spoils @ HR7 site		Partial FC Non FBC
				Copper t	µg/l	500	425-228,000	@ pool in spoils @ HR7 site		Non AgL
				Manganese t	µg/l	10,000	80-90,700	@ pool in spoils		Non AgL
				Mercury t	µg/l	0.6	nd-0.7	@ pool in spoils		Partial FC
				pH	µg/l	6.5-9.0	1.92-5.82	all sites		Non A&Ww, FBC, AgL, AgI
		ADEQ Fixed station HR8 Cash Mine	1993-1	Copper t	µg/l	500	2100	1/1		Non AgL
				pH	SU	6.5-9.0	5.50	1/1		Non A&Ww, FBC

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		Prescott National Forest Abandoned Mines Stevens & Assoc. @ McCleur Tailings	1990 1 set 4 sites	Arsenic t	µg/l	3.1	6-35		8.5 med	Partial FC
				Cadmium t	µg/l	50	120-260	3/4		Non AgI, AgL, FBC, Part FC
				Copper t	µg/l	500	1,500-9,400	4/4		Non AgI, AgL
				DO	mg/l	≥6.0	5.5	1/4		Partial A&Ww
				Mercury t	µg/l	0.6	1-11	2/4		Partial FC
				pH	SU	6.5-9.0	2.5-4.8	4/4		Non A&Ww, FBC, AgI
				Zinc t	µg/l	10,000	14,200	1/4		Partial AgI
15070103-007off Unnamed tributary hdwt-Hassayampa	A&Ww, FBC, FC, AgI, AgL	ADEQ/Kleinfelder 304(l) Inv. @ Senator Mine	1990-1	Copper t	mg/l	0.5	0.58	1		Partial AgL
15070103-010 Antelope Creek hdwt-Martinez Creek	A&Ww, PBC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1 1995-1	Ok						Full
15070103-010offL Lion Canyon Creek hdwt-Antelope	A&Ww, PBC, AgI, AgL	ADEQ Biocriteria Program abv Weaver Creek	1992-1 1993-1	DO	mg/l	≥6.0 90% saturation	5.6-8.12 88.6%	1/2		Full - low DO natural at spring source.
15070103-001offB Buckeye Canal Gila-Hassayampa River	AgI, AgL	ADEQ Priority Pollutant Program	1994-fish & sediment	DDT metabolites	mg/kg wet wt	0.3 EPA screen 0.6 fish prot	5.63 fish	fish		Full (Impacting receiving waterbodies which have fish ban due to DDT)
				Zinc	mg/kg wet wt	34 NCBP 85%	71.4 fish	fish		
		ADEQ Clean Lakes Program Painted Rocks Study	1992-sediment 1 site metals and pesticides	DDT-metabolites	mg/kg	should not detect	0.4 sediment	1/1		Sediment contamination
15070103-001offR Roosevelt Canal Agua Fria-Hassayampa	AgI, AgL	ADEQ Priority Pollutant Program	1994 fish & sediment	DDT metabolites	mg/kg wet wt	0.3 EPA screen 0.6 fish prot	3.456 fish	1/1		Full (Impacting receiving waterbodies which have fish ban due to DDT)
				Selenium	mg/kg wet wt	0.75 predator protection	1.1 fish	1/1		

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LAKES IN MIDDLE GILA WATERSHED										
15060106-0050 Alvord Park Lake	A&Ww, PBC, FC	ADEQ Priority Pollutant Program	1992-Fish and sediment	Ok						Full
		AGFD Fish Stocking Program	1988-1 1992-2	Turbidity	NTU	25	28.6	1/1		Threat A&Ww
15060106-0300 Chaparral Lake	A&Ww, PBC, FC, AgI	ADEQ Priority Pollutant Program	1992-Fish and sediment	DDT metabolites	mg/kg wet wt	0.6 predator protection 0.3 human health	0.711 fish	1/1		Threat A&Ww, FC
		ADGF Fish Stocking Program	1992-1 limited	Ok						Too little information to assess
15070103-3160 Hassayampa Lake	A&Wc, FBC, DWS	ADEQ Priority Pollutant Program	1993-Fish and sediment	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	13.6	1/1		Sediment contamination
				Copper	mg/kg	No det-200 AZ background	280	1/1		
				Lead	mg/kg	No det-100 AZ background	154	1/1		
15070102-0630 Horsethief Basin Lake	A&Ww, FBC, DWS, FC, AgL	AGFD Fish Stocking Program	1994-1 limited	DO	mg/l	≥7.0 90% saturation	5.4	1/1		Partial A&Ww
				Iron	µg/l	300 SMCL	338 @ 1 meter (m) 13,300 @ 7.5 m	1/1		Partial DWS
				Manganese	µg/l	50 SMCL	<50 @ 1 m 1,540 @ 7.5 m	1/1		Partial DWS
15060106-0740 Kiwanis Park Lake	A&Ww, PBC, FC, AgI	AGFD Fish Stocking Program	1989-2 limited 1991-1 limited	Ok						Full
		ADEQ Priority Pollutant Program	1992-sediment	Ok						Full

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15070102-1100 Lake Pleasant	A&Ww, FBC, FC, AgI, AgL	ADEQ Priority Pollutant Program	1992-Fish and sediment 1994 Fish & Sediment	Arsenic t	mg/kg	3.82 HBGL 9.2 90th %	6.2 sediment	1/1		Sediment contamination
				Mercury	mg/kg wet wt	0.1 predator protection	0.15-0.76 fish	2/2		Threat A&Ww
				Selenium	mg/kg wet wt	0.75 predator protection	<0.23-0.91 fish	1/2		Threat A&Ww
		USGS temp station	1991-1	Arsenic t	µg/l	3.1	8			Partial FC
		AGFD Fish Stocking Program	1994-9 limited 1995-3 limited	Ok						Too little information to assess
		ADEQ Clean Lakes Program	1992-2	Arsenic t	µg/l	3.1	7-9		8 med	Partial FC
		USFWS Study 1991 Bald Eagle Prey	1988 6 fish	Copper	mg/kg wet wt	1.0 NCBP 85th%	0.60-8.12 fish	4/6	2.18 med	Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.06-0.97 fish	4/6	0.35 med	Partial A&Ww
				Selenium	mg/kg wet wt	0.75 predator protection	0.36-1.27 fish	2/6	0.66 med	Threat A&Ww
				Zinc	mg/kg wet wt wet wt	34 NCBP 85th%	13.59-52.61 fish	1/6	15.02 med	Threat A&Ww
15070102-0860 Lynx Lake	A&Wc, FBC, DWS, FC, AgI, AgL	ADEQ Priority Pollutant Program	1992-Sediment 1993-Fish and Sediment	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	13-25.1 soil	2/2		Sediment contamination
				Cadmium	mg/kg	No det-1.7 AZ background	0.3-2.3 soil	1/2		
				Copper	mg/kg	5-200 AZ background	30-270 soil	1/2		
				Lead	mg/kg	No det-100 AZ background	16-176 soil	1/2		
				Lead	mg/kg wet wt	0.22 NCBP 85th%	0.6 fish	1/1		Threat A&Ww
		ADEQ Clean Lakes Program	1992-2 & 4 field	Ok						Full
15060106-0920 McKellips Lake	A&Ww, PBC, FC, AgI	ADEQ Priority Pollutant Program	1992-Fish and Sediment	DDT Metabolites	mg/kg wet wt	0.6 predator protection 0.3 EPA screening	0.921 fish	1\1		Threat A&Ww, FC
				Dieldrin	mg/kg wet wt	0.007 EPA screening	0.027 fish	1/1		Threat FC
				Mercury	mg/kg wet wt	0.1 predator protection	0.15 fish	1/1		Threat A&Ww
		AGFD Fish Stocking Program	1992-2 few parameters	Ok						Too little information to assess

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15070101-1020 Painted Rock Reservoir	A&Ww, FBC, FC, AgI, AgL	COE/USFWS Routine	1992-3 1993-11 1994-5 1995-8	Fecal coliform	CFU	800	4-900	1/43		Full
				pH	SU	6.5-9.0	6.8-10.05	11/45		Partial A&Ww, FBC, AgI, AgL
				TDS	mg/l	1000 EPA	158-5200	6/27	1224 mean 590 med	Partial AgI
				Turbidity	NTU	25	0.8-1000	4/11		Partial A&Ww, FBC
		ADEQ Clean Lakes Program Painted Rocks Study	1992 sediment	DDT metabolite	mg/kg	59414.385	0.008 (lab estimate)	1	92.94	Sediment contamination

SALT RIVER WATERSHED										
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BLACK RIVER SUB-WATERSHED										
15060101-007 Black River Beaver-Reservation	A&Wc, FBC, DWS, FC, Agl, AgL	USFS Apache-Sitgreaves @ Wildcat Crossing	1991-3	Nitrogen t	mg/l	mean 0.5		0.57 mean		Partial A&Wc
15060101-008OFFH Horton Creek hdwt-Beaver Creek	A&Wc, FBC, FC, Agl, AgL	ADEQ Biocriteria Program	1992-1 1993-1	Ok						Full
15060101-010 Reservation Creek, hdwt-Black River	A&Wc, FBC, FC, Agl, AgL	AGFD Fish Stocking Program	1990-1 & 2 limited	Ok						Full
		ADEQ Biocriteria Program	1992-1 1993-1 1994-1 limited 1995-1	Ok						Full
15060101-009 East Fork Black, hdwt-Black River	A&Wc, FBC, DWS, FC, Agl, AgL	USFS Apache-Sitgreaves	1991-3	Ok						Full
		ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Iron t	µg/l	300 (SMCL)	180-350	1/2	265	Full (DWS)
		ADEQ Fixed Station EFBR1 @ Buffalo Crossing	1992-1 1993-3	Turbidity	NTU	10	0.60-18.1	2/4		Partial A&Wc
15060101-009off1 West Fork Black River, hdwt-East Fork Black	A&Wc, FBC, FC, DWS, Agl, AgL	USFS Apache-Sitgreaves	1991-3	Ok						Full
		ADEQ Fixed Station WFBR1 @ Buffalo Crossing	1992-1 1993-3	Turbidity	NTU	10	0.60-18.1	2/4		Non A&Wc
		ADEQ Biocriteria Program abv campground	1992-1 1993-1 1994-1 limited 1995-1 limited	Iron t	µg/l	300 (SMCL)	210-520	1/3	313	Partial DWS
15060101-009off Hayground (Hay) Creek, hdwt-West Fork Black	A&Wc, FBC, FC	AGFD Fish Stocking Program	1990-3	Ok						Full
15060101-009off Stinky, hdwt-West Fork Black	A&Wc, FBC, FC	AGFD Fish Stocking Program	1990-1 & 2 limited	Ok						Full
15060101-009off Home Creek, hdwt-West Fork Black	A&Wc, FBC, FC	AGFD Fish Stocking Program	1990-I & 2 limited	Ok						Full

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15060101-008 Beaver Creek, hdwt-Black River	A&Wc, FBC, FC, AgI, AgL	USFS Apache-Sitgreaves	1991-3	Ok						Full
		ADEQ Fixed Station BVR1 near Sprucedale	1992-4	Phosphorus t	mg/l	0.1 annual mean	0.12-0.25	4/4	0.155	Partial A&Wc
				Turbidity	NTU	10	3.9-45	2/4		Non A&Wc
15060101-008off8 Hannagan Creek, hdwt-Beaver Creek	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1990-1 & 2 limited	Ok						Full
15060101-007off Double Cienega Creek, hdwt-Fish Creek	A&Wc, FBC, FC	AGFD Fish Stocking Program	1990-1 & 2 limited	Ok						Full
15060101-007off1 Conklin Creek, hdwt-Black River	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1990-1 & 2 limited	Ok						Full
		ADEQ Biocriteria Program	1992-1 1993-1	Ok						Full
15060101-007off Fish Creek, hdwt-Black River	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1990-1 & 2 limited	Ok						Full
15060101-006off Bear Wallow, N.& S.Forks-Black	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1990-1 & 2 limited	Ok						Full
15060101-006off44off No Fk. Bear Wallow, hdwt-Bear Wallow	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1 limited 1995-1	Ok						Full
WHITE RIVER SUB-WATERSHED (Entirely on Indian Reservation)										
SALT RIVER SUB-WATERSHED (above Granite Reef Dam diversions) (see also 15060106)										
15060103-006 Salt River Cherry Creek-Pinal Creek	A&Ww, FBC, FC, AgI, AgL	USFWS (King et al 1991) Eagle Prey Study Redmond site	1988-2 fish	Mercury	mg/kg wet wt	0.1 predator protection	0.20-0.21 fish	2/2		Threat A&Ww
15060103-004 Salt River Pinal Creek-Roosevelt	A&Ww, FBC, FC, AgI, AgL	USGS Fixed Station 09498500 above Roosevelt Lake	1991-12 1992-12 1993-12 1994-12 1995-6	Arsenic t	µg/l	3.1	1-30	30/53	5 med	Partial FC
				Fecal coliform	CFU	800	1-3,100	3/53		Threat FBC
				Nitrogen t	mg/l mg/l	single sample 3 mean 0.6	0.14-5.0		0.49	Threat A&Ww (flood related)
				TDS	mg/l	1,000	105-2290	28/53	955	Full (AgI)
				Turbidity	NTU	50	0.3-1300	7/53		Partial A&Ww, FBC

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15060103-015 Cherry Creek, hdwt-Salt River	A&Wc, FBC, FC, AgI, AgL	ADEQ Fixed Station CC2 abv USFS Rd #203	1991-4 1992-6	Ok						Full
		ADEQ Biocriteria Program	1992-2 sites 1993-2 sites 1994-2 sites	Ok						Full
15060103-015offDC Devils Chasm hdwt-Cherry Creek	A&Wc, FBC, FC	ADEQ Biocriteria Program	1993-1	Ok						Full
15060103-014 Canyon Creek, hdwt-Oak Creek	A&Wc, FBC, FC, DWS, AgI, AgL	ADEQ Fixed Station CAN1 blw OW Ranch Road	1991-6 1992-6 1993-5	Arsenic t	µg/l	3.1	<10-18	1/18	<10 med	Full (FC)
				Mercury t	µg/l	0.6	<10-0.7	1/18	<0.5 med	Full (FC)
				Turbidity	NTU	10	0.37-14.6	2/18		Partial A&Wc
		ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
		AGFD Hatchery 2 sites	1991-8 limited 1992-2 limited	Ok						Too little information to assess.
15060103-006OFFC Coon Creek hdwt-Salt River	A&Ww, FBC	ADEQ Fixed Station abv Forest Rd 203	1995-6	Ok						Full
15060103-005 Pinal Creek, hdwt-Salt River	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station @ Inspiration Dam	1993-1	Manganese t	µg/l	10,000	39,000	1/1		Non AgI
				TDS	mg/l	1,000	2,900	1/1		Non AGI
		ADEQ Biocriteria Program abv Radium	1994-1	pH	SU	6.5-9.0	10.0	1/1		Non A&Wedw, PBC, AgI, AgL
		USGS Fixed Station 09498400 @ Inspiration Dam	1991-6 1992-6 1993-6 1994-6 1995-6	Manganese t	µg/l	10,000	6,200-58,000	28/30		Non AgI
				Nickel t	µg/l	400	400-500	2/5	460	Partial FC
				TDS	mg/l	1,000	247-3,370	28/30	2649	Non AgI
				During Jan 1993 floods (1200 cfs compared to normal maximum of 100 cfs), several chemicals dramatically increased (i.e. copper, lead, & arsenic exceeded standards), other parameters temporily decreased (i.e. manganese, TDS, etc).						
				Turbidity	NTU	50	0.4-3000	3/30		Threat A&Ww, FBC
		ADEQ Complaint Inv. SWMU 212.328	1993 4 sites	Beryllium t	µg/l	0.21 FC 0.33 FBC	0.81	1 site		Partial FC, FBC
				Copper t	µg/l	500	1.7-16.2	2 sites		Non AgL, partial AgI
				Manganese t	µg/l	10,000	25.4-42.8	2 sites		Non AgI
				pH	SU	6.5-9.0	4.3	1 site		Partial A&We,PBC,AgI, AgL
				TDS	mg/l	1000 EPA criteria	3100	4 sites		Non AgI

SALT RIVER WATERSHED										
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		ADEQ Investigation SWMU-	1991-5 sites	Manganese t	µg/l	10,000	30.3-70.8	5/5		Non Agl
				Nickel t	µg/l	400	0.65-0.76	2/4		Partial FC
				pH	SU	6.5-9.0	5.90	3/9		Partial A&Ww,FBC,AgL
				TDS	mg/l	1000 (EPA criteria)	3180-3308	4/4		Non Agl
15060103-005off13off Bloody Tanks Wash hdwt-Miami Wash	A&We, PBC, AgL	EPA/Cyprus NPDES Monitoring @ Oxide blw Cyprus Miami @ Triple Nickel above Miami W	1993-1 4 sites	Copper d	µg/l	varies (17)	89.7-125	4/4		Non A&Ww
15060103-018 Pinto Creek, hdwt-Spring Creek	A&Ww, FBC, FC, Agl, AgL	Hargis + Assoc. tailing spill SWMU 212.276	1993-12 sites	Copper d	µg/l	varies	18-53	10/12		Non A&Ww (during major tailings spills)
		ADEQ Magma Copper @ Tailings Dam #3	1991-0 Tailings Spill	Narrative						Non A&W, FBC, Agl, AgL, partial FC
		ADEQ/EPA Copper Mine Initiative abv Gibson Mine trib blw Gibson Mine trib abv Carlotta Mine blw Carlotta Mine	1992-1 at 4 sites	Copper d	µg/l	varies	80 (blw Gibson mine)	1/4		Non A&Ww
15060103-017 Pinto Creek, Spring-Roosevelt Lake	A&Ww, FBC, FC, Agl, AgL	ADEQ Fixed Station PC1 abv Henderson Rch	1991-6 1992-6 1993-6 1994-6 1995-6	Selenium t	µg/l	20	>5-25	1/25		Threat A&Ww
15060103-018off Gibson Mine Tributary hdwt-Pinto Creek	A&Ww, FBC, FC, Agl, AgL	ADEQ Investigation Gibson Mine SWMU-212.155 @ Upper Gibson Mine tributary @ Lower Gibon Mine tributary	1991-4 1992-5 1994-2	Copper d	µg/l	varies A&Ww 5,200 FBC	3,300-236,000	11/11 11/11		Non A&Ww (acute & chronic), Non FBC
				Copper t	µg/l	500 AgL 5,000 Agl	2,920-249,000	11/11 8/11		Non Agl, AgL
				Manganese t	µg/l	10,000	600-48,800	3/11		Non Agl (for 6 months after 1990 spill)
				pH	SU	6.5-9.0	3.63-6.40	11/11		Non A&Ww,FBC,Agl,AgL
				Zinc d	µg/l	varies	up to 3,300	4/11		Non A&Ww
		ADEQ/EPA Copper Mine Init NPDES Monitoring	1992-1	Copper d	mg/l	varies (0.033)	3.34	1	100%	Non A&Ww
				Copper t	mg/l	0.5	2.92	1	100%	Non AgL
				pH	SU	6.5-9.0	5.5	1	100%	Partial A&Ww, FBC, AgL

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15060103-022 Salome Creek hdwt-Roosevelt Lake	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program blw Little Turkey	1992-1 1993-1 1994-1	Ok						Full
15060103-022off9 Reynolds Creek, hdwt-Salome	A&Wc, FBC, FC, AgL	ADEQ Biocriteria Program blw McFadden Creek	1992-1 1993-1 1994-1	Ok						Full
15060103-022off8 Workman Creek, hdwt-Salome	A&Wc, FBC, DWS, FC, AgI, AgL	ADEQ Biocriteria Program blw falls	1992-1 1993-1 1994-1	Iron	µg/l	300 (SMCL)	340 (SMCL)		200 med	Full
15060103-017off Campaign Creek hdwt-Pinto Spring (Roosevelt Lake)	A&Ww, FBC, DWS, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1994-1	Ok						Full
TONTO CREEK SUB-WATERSHED										
15060105-013 Tonto Creek, hdwt-Haigler Creek	A&Wc, FBC, FC, AgI, AgL	AGFD NPDES Monitoring @ fish hatchery	1991-10 limit 1992-8 limited (2 sites)	Phosphorus t	mg/l	0.1 annual mean	0.4-0.29	blw hatchery only	0.14 (1991 & 1992)	Partial A&Wc
		ADEQ Investigation abv campground blw campground abv Baptist Camp abv fish hatchery blw fish hatchery blw Camp Tontozona blw Kohls Ranch	1994-36 7 sites	Nitrogen t	mg/l	0.5 annual mean	0.5-0.98	blw hatchery only	0.61	Partial A&Wc (below hatchery to Horton Creek)
15060105-011 Tonto Creek Haigler-Spring Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1993-1 1994-1	Ok						Full
15060105-009 Tonto Creek, Spring Creek-Rye Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1	Ok						Full
15060105-008 Tonto Creek, Rye Creek-Gun Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Fixed Station TC1 abv Gun Creek	1991-7 1992-5 1993-6 1994-6 1995-6	Beryllium t	µg/l	0.21 FC 0.33 FBC	0.6	1/36		Full
				Turbidity	NTU	10	12.6-500	5/30		Partial A&Wc
15060105-006 Tonto Creek, Gun Creek-Greenback	A&Wc, FBC, FC, AgI, AgL	SRP Monitoring @ Pumpkin Center	1990-4 few parameters	Ok						Full
		USFWS (King et al 1991) Eagle Prey Study Sheep site	1988-1 fish (bullhead)	Mercury	mg/kg wet wt	0.1 predator protection	0.18 fish	1/1		Threat A&Ww
		USFS Tonto National Forest	1991-3	Ok						Full

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15060105-014 Rye Creek, hdwt-Tonto Creek	A&Ww, FBC, FC, AgL	USFS Tonto National Forest	1991-3	Ok						Full
15060105-014offD Deer Creek hdwt-Rye Creek	A&Wc, FBC, FC	ADEQ Biocriteria Program @ Mazatzal Wildernes	1992-1 1993-1 1994-1	Ok						Full
15060105-013off8 Christopher Creek, hdwt-Tonto	A&Wc, FBC, FC, AgI, AgL	USFS Tonto National Forest	1991-3	Ok						Full
		ADEQ Mnt Meadows River SWMU 212.357	1993-4 sites (illegal discharge)	TDS	mg/l	1000	1050	1		Partial AgI
				Phosphorus t	mg/l	1.00	2.95	1		Partial A&Wc
				Nitrogen t	mg/l	2.00	21.98	1		Partial A&Wc
15060105-012 Haigler Creek, hdwt-Tonto	A&Wc, FBC, FC, AgI, AgL	ADEQ Fixed Station HAG1 (near Young)	1992-6 1993-6	Ok						Full
		ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
		USFS Tonto National Forest	1991-3	Ok						Full
15060105-012off Gordon Creek, hdwt-Haigler Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1993-1 1994-1	Turbidity	NTU	10	2.4-20	1/2		Partial A&Wc
		ADEQ Fixed Station GOR1 @ Colcord Rd	1993-5	Ok						Full
15060105-010 Spring Creek, hdwt-Tonto Creek	A&Wc, FBC, FC, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
15060105-005 Greenback Creek, hdwt-Tonto Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1	Ok						Full
SALT RIVER SUB-WATERSHED (see also 15060103 and 15060104)										
15060106-003 Salt River, Stewart Dam-Verde	A&Wc, FBC, DWS, FC, AgI, AgL	USGS Fixed Station 09502000 blw Stewart Mtn Dam	1991-6 1992-6	Arsenic t	µg/l	3.1	2-7	2/12	3 med	Full (FC)
				Chloride	mg/l	250 (SMCL)	150-340	7/12	259	Partial DWS
				TDS	mg/l	500 (SMCL)	409-789	9/12	622	Partial DWS
15060106-002 Salt River, Verde-Granite Reef	A&Ww, FBC, DWS, FC, AgI, AgL	USFS Salt River Tubing 5 sites	Summer 1991 5 Sets per site bact only	Ok						Full

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LAKES IN THE SALT RIVER WATERSHED										
15060101-0160 Big Lake	A&Wc, FBC, DWS, FC, AgI, AgL	ADEQ Clean Lakes Program	1995-1	Arsenic t	µg/l	3.1	9	1/1		Partial FC
				Iron t	µg/l	300	290-430	1/1		Partial DWS
15060103-1240 Roosevelt Lake	A&Ww, FBC, DWS, FC, AgI, AgL	ADEQ/USGS Clean Lakes Program (Ham, 1995)	1991-92 44 samples	Arsenic t	µg/l	3.1	4-6		<10 med	Threat FC
				Beryllium t	µg/l	0.008 DWS 0.21 FC 0.33 FBC	0.5-0.7	5/44	<0.5 med	Partial FBC, Threat FC, DWS
				Chloride	mg/l	250 (SMCL)	280-450	230 mean		Partial DWS
				TDS	mg/l	500 (SMCL)	526-1100	557 mean		Partial DWS
		USFWS Study King et al 1991 Eagle Prey Study	1988-4 fish	Copper	mg/kg wet wt	1.0 NCBP 85th%	0.25-1.34 fish	1/4	0.75 med	Threat A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85th%	12.08-53.22 fish	1/4	13.5 med	Threat A&Ww
15060106-1290 Saguaro Lake	A&Wc, FBC, DWS, FC, AgI, AgL	ADEQ Clean Lakes Program	1995-1	TDS	mg/l	500 (SMCL)	540	1/1	540	Partial DWS

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GILA RIVER SUB-WATERSHED (see also 15040005 page B-59)										
15040002-004 Gila River New Mexico border to Bitter Creek	(A&Ww, FBC, FC, AgI, AgL when in Arizona)	USGS Fixed Station 0943100 @ Redrock NM	1991-12 1992-12 1993-12	Turbidity	NTU	50	3.4-1200	10/36		Non A&Ww, FBC
				Fecal coliform	CFU	800 FBC 4000 A&Ww, Ag	1-4800	1/36		Full
		USFWS (Baker & King 1994) Upper Gila Study @ Virden	1990 sediment, water, lizards	Arsenic t	µg/l	3.1	71 water	1/1		Partial FC
				Cadmium	mg/kg	no det-1.75 AZ background	4.4 sediment	1/1		Sediment contamination
15040002-001 Gila River Skully-San Francisco	A&Ww, FBC, FC, AgI, AgL	BLM Routine monitoring	1993-2	Turbidity	NTU	50	215	1/2		Partial A&Ww, FBC
		USFWS (Baker & King 1994) Upper Gila Study @ Guthrie	1990 water, sediment, fish	Arsenic t	µg/l	3.1	34 water	1/1		Partial A&Ww
				Cadmium	mg/kg	no det-1.75 AZ background	2.4 sediment			Sediment contamination
				Mercury	mg/kg wet wt	0.1 predator protection	0.15-0.18 fish	2/2		Threat A&Ww
				Thallium	mg/kg	23.7 HBGL	189 sediment			Sediment contamination
SAN FRANCISCO RIVER BASIN										
15040004-023 San Francisco hdwt-New Mexico	A&Wc, FBC, FC, AgI, AgL	ADEQ Fixed Station SFR3 @ Co Rd 2311	1992-1 1993-1	Fecal coliform	CFU	800	1,900-3,340	2/2		Non FBC
		ADEQ Fixed Station SFR1 above Luna Lake	1995-6	Turbidity	NTU	10	1.06-14.3	3/6		Partial A&Wc
		ADHS/ADEQ Alpine POTW SWMU-212.262	1992-10 sites bact only	Fecal coliform	CFU	800	1,200	1/10		Threat FBC
		ADEQ Biocriteria Program @ N.M. border	1993-1 limited	Ok						Full
15040004-003 San Francisco Blue River-Limestone	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1	Ok						Full
		USFWS (Baker & King 1994) Upper Gila Study above Clifton	1990 water & sediment	Arsenic t	µg/l	3.1	66	1/1		Partial FC
				Cadmium	mg/kg	no det-1.75 AZ background	5.7			Sediment contamination
		AGFD Monitoring at Rocky Gulch	1993-1 limited 1994-2 limited	Ok						Too little information to assess

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15040004-001 San Francisco River Limestone-Gila	A&Ww, FBC, FC, AgI, AgL	USGS Fixed Station 0944460 @ Clifton	1991-6 1992-6 1993-6	Copper d	µg/l	varies	2-270	5/18		Non A&Ww
				Copper t	µg/l	500	4-4200	2/18		Partial AgL
				Fecal coliform	CFU	800 FBC 4000 A&Ww, Ag	3-14,000	3/16 1/16		Partial FBC Threat A&Ww, AgI, AgL
				Mercury t	µg/l	0.6	<0.10-2.5	1/18		Threat FC
				Turbidity	NTU	50	1-1200	7/18		Non A&Ww, FBC
		USFWS (Baker & King 1994) Upper Gila Study @ below Clifton	1990 water, sediment, fish	Arsenic t	µg/l	3.1	20	1/1		Partial FC
				Beryllium	mg/kg	1.34 HBGL 1.5 AZ 90th%	3.7 sediment			Sediment contamination
				Cadmium	mg/kg	no det-1.75 AZ background	9.9 sediment			Sediment contamination
				Copper	mg/kg	5-200 AZ background	521 sediment			Sediment contamination
				Copper	mg/kg wet wt	1.0 NCBP 85th%	0.3-1.5 fish			A&Ww threat
				Mercury	mg/kg wet wt	0.1 predator protection	0.1-0.3 fish			A&Ww threat
				TDS	mg/l	1000 (EPA criteria)	1010 water			Partial AgI
		ADEQ - Clifton Lift Station Inv WQMU 212.256	1992-1	Turbidity	NTU	50	225	1/1		Non A&Ww, FBC
		AGFD Monitoring @ Wards Canyon	1994	Arsenic t	µg/l	3.1	4.03-4.28	2/2		Partial FC
		ADEQ Fixed Station SFR2 blw Clifton	1994-6 1995-6	Copper d	µg/l	varies (21.5)	18-22	1/6		Non A&Ww
15040004-027 Blue River hdwt-Campbell Blue	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program blw Jackson Box	1992-1 1993-1 1994-1	pH	SU	6.5-9.0	8.1-9.07	1/3		Threat A&Wc, FBC, AgI, AgL
				Turbidity	NTU	10	0.6-46	1/3		Partial A&Wc
15040004-025 Blue River KP Cr.-San Francisco	A&Wc, FBC, FC, AgI, AgL	USGS Fixed Station 09444200 near Clifton	1991-5 limited 1992-6 limited 1993-6 limited	Turbidity	NTU	10 A&Wc 50 FBC	0.2-310	8/18 3/18		Non A&Wc; Partial FBC
		ADEQ Biocriteria Program abv Fritz Ranch	1992-1 1993-1 1994-1	Ok						Full

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15040004-028 Campbell Blue hdwt-Blue River	A&Wc, FBC, FC	USFS Apache-Sitgreaves	1991-3	Ok						Full
		ADEQ Biocriteria Program 1 mi. abv Blue	1992-1 1993-1 1994-1	DO	mg/l	≥7.0 90% saturation	6.4-9.8 81.6-100%	1/3		Full - natural minor reduction in DO
		AGFD Fish Stocking Program	1991-2 limited 1992-1 limited 1993-1 limited	pH	SU	6.5-9.0	9.1	1/3		Full (elevated pH is natural for low flow.)
15040004-028off Castle Creek hdwt-Campbell Blue	A&Wc, FBC, FC	AGFD Fish Stocking Program	1991-3 1992-1 1993-1	Ok						Too little information to assess
15040004-028off Coleman Creek hdwt-Campbell Blue	A&Wc, FBC, FC	AGFD Fish Stocking Program	1991-3 1992-1 1993-1	Ok						Too little information to assess
		ADEQ Biocriteria Program blw Turkey Creek	1992-1 1993-1 1994-1	Ok						Full
15040004-029 KP Creek, hdwt-Campbell Blue	A&Wc, FBC, DWS, FC, AgL	AGFD Fish Stocking Program	1991-3 limited 1992-1 limited 1993-1 limited	Ok						Too little information to assess
15940004-025off Pigeon Creek hdwt-Blue River	A&Ww, FBC, AgL	ADEQ Biocriteria Program	1993-1	Ok						Full
15040004-026off Lanphier Creek, hdwt-Blue River	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
15040004-026off Grant Creek hdwt-Blue River	A&Wc, FBC, FC	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
		AGFD Fish Stocking Program	1991-3 limited 1992-1 limited 1993-1 limited	Ok						Too little information to assess
GILA RIVER SUB-WATERSHED (see also 15040002 page B-57)										
15040005-022 Gila River Bonita Creek-Yuma Wash	A&Ww, FBC, FC, AgI, AgL	USGS Fixed Station 09448500 @ Solomon	1991-6 1992-6 1993-6 1994-6 1995-6	Arsenic t	µg/l	3.1	2-4	4/30	2 med	Full (A&Ww)
				Copper d	µg/l	varies	15-44	5/30 acute 7/30 chronic		Non A&Ww
				Copper t	µg/l	500	<1-850	1/30		Full (AgL)
				Fecal coliform	CFU	800	2-2300	3/29		Partial FBC
				Mercury t	mg/l	0.6	1.5	2/30		Threat FC
				Turbidity	NTU	50	0.7-790	10/30		Non A&Ww, FBC

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15040005-020 Gila River Yuma Wash-San Simon	A&Ww, FBC, FC, AgI, AgL	USFWS (Baker & King 1994) Upper Gila Study @ San Jose	1990 water, birds, fish, & sediment	Arsenic t	µg/l	3.1	17 water	1/1		Partial FC
				Cadmium	mg/kg	no det-1.75 AZ background	6.6 sediment			Sediment contamination
				Mercury	mg/kg wet wt	0.1 predator protection	0.18-0.19 fish	2/2		Threat A&Ww
15040005-015 Gila River Coyote-Peck	A&Ww, FBC, FC, AgI, AgL	USFWS (Baker & King 1994) Upper Gila Study @ Pima	1990 water, birds, sediment, fish	Arsenic t	µg/l	3.1	25 water	1/1		Partial FC
				Cadmium	mg/kg	no det-1.75 AZ background	5.1 sediment			Sediment contamination
				Copper	mg/kg wet wt	1.0 NCBP 85th%	2.1 fish			Threat A&Ww
				Thallium	mg/kg	23.7 HBGL	187 sediment			Sediment contamination
				Zinc	mg/kg wet wt	34 NCBP 85th%	56.5 fish			Threat A&Ww
15040005-012 Gila River Underwood-Bylas Salt	A&Ww, FBC, FC, AgI, AgL	USFWS (Baker & King 1994) Upper Gila Study @ Fort Thomas	1990 water, birds, sediment, fish	Arsenic t	µg/l	3.1	10 water	1/1		Partial FC
				Copper	mg/kg wet wt	1.0 NCBP 85th%	0.3-1.3 fish			Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.08-0.3 (fish)			Threat A&Ww
				Thallium	mg/kg	23.7 HBGL	159 sediment			Sediment contamination
				TDS	mg/l	1000 (EPA criteria)	1490 water			Partial AgI
				Zinc	mg/kg wet wt	34 NCBP 85th%	7.3-41.1 fish			Threat A&Ww
15040005-011 Gila River Bylas Salt-Salt Creek (Indian Reservation)	(Indian Res)	USGS Fixed Station 09466500 @ Calva	1991-10 1992-4 1993-4 1994-4	Arsenic t	µg/l	3.1	4-6	3/8	5 med	No applicable standards. For information use only.
				Fecal coliform	CFU	800 FBC 4000 A&W, Ag	9-25,000	2/20		
				TDS	mg/l	1000 (EPA criteria)	314-2690		1262	
				Turbidity	NTU	50	0.8-1200	9/22		
15040005-033 Watson Wash hdwt to Gila River	A&Ww, FBC, FC, AgI, AgL	BLM Monitoring @ artesian well BLM-WW	1993-1	Arsenic t	µg/l	3.1	12	1/1		Partial FC
				TDS	mg/l	1000 (EPA criteria)	2760	1/1		Non AgI
				Zinc d	µg/l	varies (117)	246	1/1		Non A&Ww

SAN CARLOS - SAFFORD - DUNCAN WATERSHED

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15040005-032 Bonita Creek hdwt-Park Creek (Indian Reservation)		BLM Monitoring BLM-BON3	1991-1	Ok						No applicable standards. For information use only.
		BLM Monitoring BLM-BON4	1991-1 1993-3 field	pH	SU	6.5-9.0	8.6-9.2	1/3		
15040005-030 Bonita Creek Park Creek-Gila River	A&Ww, FBC, FC, DWS, AgL Unique	BLM Monitoring @ mouth BLM-BON1	1991-2 1993-4	Arsenic t	µg/l	3.1	<5-6		<5 med	Full (FC)
				pH	SU	6.5-9.0	8.22-9.2	2/4		Part A&Ww, FBC, AgI, DWS
		ADEQ Biocriteria dev	1993-1 1994-1	Iron t	µg/l	300 (SMCL)	<100-400			Full (DWS)
		BLM Monitoring BLM-BON2	1990-2	Zinc d	µg/l	varies (156)	270	1/2		Non A&Ww
15040005-028 Eagle Creek hdwt-Willow Creek	A&Wc, FBC, DWS, FC, AgI, AgL	ADEQ Biocriteria Program abv campground	1992-1 1993-1 1994-1	Ok						Full
15040005-025 Eagle Creek Sheep Wash-Gila River	A&Wc, FBC, DWS, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	pH	SU	6.5-9.0	7.1-9.09	1/3		Partial A&Wc FBC, DWS, AgI
15040005-020off Frye Creek hdwt-Highland Canal	A&Wc; FBC, FC, AgL	ADEQ Biocriteria Program @ xing #36	1992-1 1993-1 1994-1	Ok						Full
15040005-018off1 Marijilda Creek hdwt-Stockton Wash	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
		AGFD Fish Stocking Program	1994-1	Arsenic t	µg/l	3.1	4.68	1/1		Partial FC
				TDS	mg/l	1000 (EPA criteria)	1330	1/1		Partial AgI
15040005-015off Ash Creek hdwt-Gila River	A&Ww, FBC, FC, AgL	ADEQ Fixed Station AC2 abv Bible Camp Rd	1992-1	pH	SU	6.5-9.0	6.36	1/1		Partial A&Ww FBC
15040005-014off1 Markham Creek hdwt-Gila River	A&Ww, FBC, AGL	BLM Monitoring BLM-MARK	1991-2 1993-1	Ok						Full
15040005-012off Black Rock Canyon hdwt-Gila	A&Ww, FBC, FC, AgI, AgL	BLM/Safford Monitoring	1991-1	Ok						Full
15040005-012off Fishhooks Creek hdwt-Gila River	A&Ww, FBC, FC, AgI, AgL	BLM/Safford Monitoring	1991-1 1993-1	Ok						Full

SAN CARLOS - SAFFORD - DUNCAN WATERSHED										
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SAN SIMON CREEK SUB-WATERSHED										
15040006-AAA South Fork Cave Creek hdwt-Cave Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program blw campground	1992-1 1993-1 1994-1 1995-1	DO	mg/l	≥7.0 90% saturation	6.1-9.7 54-85%	1/4		Full - natural low DO near spring source
15040006-006off East Turkey Creek hdwt-San Simon	A&Ww, PBC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1 1995-1	Ok						Full
SAN CARLOS RIVER SUB-WATERSHED (entirely on Indian Reservation)										
LAKES IN THE UPPER GILA RIVER BASIN										
15040004-0840 Luna Lake	A&Wc, FBC, FC, AgL	ADEQ Clean Lakes Program	1995-1	pH	SU	6.5-9.0	8.31-9.74	1/1		Partial A&Wc, FBC, AgL
15040006-1250 Roper Lake	A&Ww, FBC, FC	AGFD Fish Stocking Program	1989-4 sites 1990-1 sites 1991-3 sites	pH	SU	6.5-9.0	9.9-9.92	4/8		Non A&Ww, FBC
				DO	mg/l	≥6.0	5.2	1	12%	Partial A&Ww

SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
WILLCOX PLAYA BASIN										
15050201-001offP Post Creek hdwt-Grant Creek	A&wc, FBC, FC, AgI, AgL	ADEQ Fixed station PCR1 @ St Rte 366	1991-1 1992-1	Chromium d	µg/l	varies	100	1/2		Non A&Wc
				pH	SU	6.5-9.0	5.9	1/2		Part A&Wc, FBC
15050201-001off10 Grant Creek hdwt-Post Creek	A&Wc, FBC, DWS, FC, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
15050201-001offG Goudy Creek hdwt-Grant Creek	A&Wc FBC, DWS, FC, AgI, AgL	ADEQ Biocriteria Program	1992-1 1993-1	Ok						Full
15050201-002offW Ward Canyon hdwt-Turkey Creek	A&Ww, FBC, FC, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1 1995-1	Ok						Full
SAN PEDRO RIVER BASIN										
15050202-008 San Pedro River Mexico-Charleston	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station SP11 @ Lewis Springs	1991-6 1992-13 1993-4 1994-1	Arsenic t	µg/l	3.1 FC 50 FBC	<5-62 1/23	4/23	<10 med	Threat FC Threat FBC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	<0.1-17	2/21 2/21	<5 med	Threat FC, Partial FBC
				Copper t	µg/l	500	<10-886	1/23		Threat AgL
				DO	mg/l	≥6.0 90% saturation	5.5-11.3 72-113%	2/22		Full (A&Ww)
				Fecal coliform	CFU	800	1-2400	1/8		Partial FBC
				Lead t	µg/l	100	2-230	1/23		Threat AgL
				Turbidity	NTU	50	4.02-377	1/12		Full (A&Ww)
		ADEQ Priority Pollutant Program	1992-Fish 1994- Sediment	Ok						Full
		ADEQ Fixed Station SP13 @ Charleston Rd Bridge	1992-4 1994-6 1995-5	Beryllium t	µg/l	0.21 FC 0.33 FBC	<5-0.7	2/11	<5	Threat FC Partial FBC
				DO	mg/l	≥6.0 90% saturation	5.57-11 66.5-121%	1/14		Full (A&Ww)
				Fecal coliform	CFU	800	8-920	1/9		Partial FBC
				Turbidity	NTU	50	3.6-751	2/10		Partial FBC, A&Ww

SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
		ADEQ Fixed Station SP1 @ Palominas	1991-5 1992-7 1993-6 1994-6 1995-4	Arsenic t	µg/l	3.1	<5-12	3/23	<10 med	Threat FC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	<0.1-0.8	1/20 1/20	<5 med	Threat FC Threat FBC
				DO	mg/l	≥6.0 90% saturation	5.72-10.99 78.7-135.5%	3/24		Partial A&Ww
				Fecal coliform	CFU	800 FBC 4000 A&Ww Ag	2-4300	2/14 1/14		Partial FBC Threat A&Ww, Agl, AgL
				Turbidity	NTU	50	0.52-882	6/16		Partial A&Ww, FBC
15050202-006 San Pedro River Charleston-Walnut	A&Ww, FBC, FC, Agl, AgL	USGS Fixed Station 09471000 @ Charleston	1991-6 1992-11 1993-12	Arsenic t	µg/l	3.1	1-12	9/29	3 med	Full (FC)
				Copper t	µg/l	500	2-1200	1/29		Threat AgL
				Fecal coliform	CFU	800	8-15,000	2/24		Threat FBC, A&Ww, AgL
				Lead t	µg/l	100	<1-250	2/28		Threat AgL
				Turbidity	NTU	50	0.9-3600	4/26		Partial A&Ww, FBC
		ADEQ Biocriteria Program	1992-1 1993-1 1994-1 1995-1	Ok						Full
15050202-003 San Pedro River Babocomari-Dragoon	A&Ww, FBC, FC, Agl, AgL	ADEQ Fixed Station SP10 @ Fairbank (Hwy-82 bridge)	1991-5 1992-11 1993-5	Arsenic t	µg/l	3.1	<5-36	2/18	<10	Threat FC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	<0.1-13	1/13	<5	Threat FC, FBC
				Copper t	µg/l	500	<4-547	1/18		Threat AgL
				Fecal coliform	CFU	800	4-1800	2/12		Partial FBC
				Lead t	µg/l	100	<2-120	1/18		Full (AgL)
				Turbidity	NTU	50	1.98-463	1/9		Partial A&Ww, FBC
		ADEQ Fixed Station SP7 @ Curtis Siding	1991-1 1992-5 1993-6	Arsenic t	µg/l	3.1	<5-13	2/11	<10 med	Threat FC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	<0.5-1.2	1/10 1/10	<0.5	Threat FC Threat FBC
				DO	mg/l	≥6.0 90% saturation	5.25-10.79 73.7-120.2%	1/10		Full
				Fecal coliform	CFU	800 FBC 4000 A&Ww,Ag	46-5000	2/6 1/6		Partial FBC, A&Ww, Agl, AgL
				Mercury t	µg/l	0.6	<0.2-0.9	1/11		Full
				Turbidity	NTU	50	0.7-1034	3/10		Non FBC, A&Ww
		ADEQ Fixed Station SP5 @ St David	1991-3 1992-1	Ok						Full

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		ADEQ Fixed Station SP2 @ St David at bridge north of Hwy-80	1991-5 1992-9 1993-6 1994-6 1995-4	Arsenic t	µg/l	3.1 FC 50 FBC	<5-69	4/29 1/29	<10 med	Threat FC, FBC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	<0.1-45	3/25 3/25	<5 med	Threat FC, Partial FBC
				Copper t	µg/l	500	4-3930	1/29		Threat AgL
				DO	mg/l	≥6.0 90% saturation	5.60-14.19 74.4-188.7%	2/30		Full (A&Ww)
				Fecal coliform	CFU	800 FBC 4000 A&Ww, AgL, Agl	7-9,200	3/18 2/18		Partial A&Ww, FBC, Agl, AgL
				Lead t	µg/l	100	<5-810	1/29		Threat AgL
				Mercury t	µg/l	0.6	1.2	1/29		Threat FC
				Nitrate	mg/l	10	0.06-27.89	5/11		Non A&Ww
				Turbidity	NTU	50	1.11-2,400	6/21		Partial A&Ww, FBC
15050202-008off16 Miller Canyon hdwt-San Pedro	A&Wc, FBC, FC, AgL	ADEQ Biocriteria Program	1995-1	Ok						Full
15050202-008off15 Carr Canyon Creek hdwt-San Pedro	A&Wc, FBC, FC, AgL	ADEQ Biocriteria Program	1995-1	Ok						Full
15050202-008off14 Ramsey Canyon hdwt-San Pedro	A&Wc, FBC, DWS, FC, Agl, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1 1995-1	Ok						Full
15050202-008off16E Banning Creek hdwt-San Pedro	A&Ww, FBC, FC, AgL	ADEQ Fixed Station BC1 West of tunnel	1990-1	Ok						Full
15050202-004 Babocomari River hdwt-San Pedro	A&Ww, FBC, FC, AgL	BLM Monitoring @ mouth BLM-BAB1	1993-1	Ok						Full
		BLM Monitoring @ SPRNCA Bdry	1991-1 1993-2	Ok						Full
		ADEQ Priority Pollutant Program	1993-Fish and sediment	Ok						Full
		AGFD Monitoring above road crossing	1993-1	Ok						Full
		ADEQ Fixed Station BCR5 @ Bowers Rd	1992-4	DO	mg/l	≥6.0 90% saturation	4.4-7.8 63.5-90.9%	2/3		Full - naturally low DO at spring source
		BLM BLM-BAB2 (at H-90)	1993-1	Ok						Full
		BLM @ Mary Diamonds	1991-1 1993-2	Barium	µg/l	1000	3000	1/3		Partial FBC

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		ADEQ - Complaint BCR4	1993-1	Ok						Full
15050203-011 San Pedro River Hot Springs-Redfield	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station SP12 @ Cascabel	1992-4	Ok						Full
		ADEQ Fixed Station SP12A @ Redington	1991-1	Ok						Full
15050203-008 San Pedro River Bollen W-Peppersauce	A&Ww, FBC, AgL	EPA Copper Mine NPDES Monitoring Oracle Ridge Mine	1993-1	Turbidity	NTU	50	200	1/1		Partial A&Ww, FBC (During heavy flow)
15050203-003 San Pedro River Peppersauce-Aravaipa	A&Ww, FBC, AgL	EPA/Magma Copper Cu Mine Initiative NPDES Monitoring	1993-1 above mine	Turbidity	NTU	50	200	1/1		Partial A&Ww, FBC (During heavy flow)
			1993-1 below mine	Turbidity	NTU	50	200	1/1		Partial A&Ww, FBC (During heavy flow)
		ADEQ Priority Pollutant Program @ San Manuel tailing @ Mammoth	1994 sediment (2 sites)	Copper	mg/kg	5-200 AZ background	246-340 sediment			Sediment contamination
15050203-001 San Pedro River Arivaipa-Gila River	A&Ww, FBC, AgL	ADEQ Ray Mine SWMU 212.	1990-1 Background	Ok						Full
		USFWS 1995 Middle Gila R Study @ Gila confluence	1991-1992 sediment	Ok						Full
		ADEQ Fixed Station SP15 blw Arivaipa Creek	1993-4 1994-1	Turbidity	NTU	50	4.77-109	2/5		Non A&Ww, FBC
		USGS Sediment study	1990-suspended solids	Suspended solids greater than 27,400 mg/l occurred when flows exceeded 30 cfs.						
15050203-014 Redfield Canyon hdwt-San Pedro	A&Ww, FBC, FC, AgL	ADEQ Fixed Station RFC1 near Redington	1991-4 1992-1 1993-1	Arsenic t	µg/l	3.1	<5-8	6-8	7	Partial FC
				DO	mg/l	≥6.0 90% saturation	5.1-9.02 62.7-94.2%	1/3		Partial A&Ww
		BLM Monitoring BLM-RF	1990-2 1993-2	Chromium VI d	µg/l	16	28	1/4		Non A&Ww
				Zinc d	µg/l	varies (132)	900	1/4		Non A&Ww
		ADEQ Biocriteria Program below Sycamore Cyn	1992-1 1993-1 1994-1	Ok						Full

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15050203-013 Hot Springs Canyon hdwt-San Pedro River	A&Ww, FBC, FC, AgL	ADEQ Fixed Station HSC1 near Cascabel	1991-4 1992-1	Arsenic t	µg/l	3.1	<5-6	1/3	<5 med	Threat FC
		ADEQ Biocriteria Program	1992-1 1993-1	Ok						Full
		BLM Monitoring BLM-HS	1990-3 1993-2	Chromium VI d	µg/l	16	14-23	1/3		Non A&Ww
				Fecal coliform	CFU	800	2-1600	1/2		Partial FBC
15050203-013off Wildcat Canyon hdwt-Hot Springs	A&Ww, FBC, FC, AgL	BLM Monitoring BLM-WC	1991-1 1993-1	Arsenic t	µg/l	3.1	8	1/2		Partial FC
15050203-013off Bass Canyon hdwt-Hotsprings	A&Ww, FC, FBC, AgL	BLM Monitoring BLM-BC	1990-3 1991-2 1993-1	Chromium IV d	µg/l	16	17	1/6		Non A&Ww
				Copper d	µg/l	varies (53)	86	1/6		Non A&Ww
		ADEQ Biocriteria Program abv Hot Springs Cyn	1992-1 1993-1 1994-1	Ok						Full
15050203-010 Buehman Creek hdwt-San Pedro	A&Ww, FBC, AgL	USFS Coronado National Forest	1991-3	Ok						Full
15050203-008off4.5off Geesaman Wash hdwt-Alder Wash	A&Ww, FBC, AgL	ADEQ Oracle Ridge Mine Complaint Inv. SWMU 212.245	1992-4 sites (5 paired soils)	Copper d	µg/l	varies	110-131	below mine all samples		Non A&Ww
				Copper t	µg/l	500	1,080			Non AgL
				(no aquatic insects in stream water)						
		Oracle Ridge Mn SWMU 212.245	1993-3 sites	Copper t	mg/l	0.5	1.2-2.6	2/3		Non AgL
15050203-008off Gibbs Wash hdwt-Stratton Wash	A&Ww, FBC, AgL	ADEQ Oracle Ridge Mine Complaint Inv. SWMU 212.245	1993-8 10 sediment 10 stream bank	Copper t	mg/l	0.5	1.13-4.00	2/8		Partial AgL
				Turbidity	NTU	50	220-590	2/8		Partial A&Ww, FBC
15050203-003off Copper Creek hdwt-San Pedro	A&Ww, PBC, AgI, AgL	EPA Cu. Mine Initiative NPDES Monitoring	1993-1	Copper d	µg/l	varies (78)	4830	1/1		Non A&Ww
				Turbidity	NTU	50	200	1/1		Partial A&Ww, PBC
		BLM Monitoring BLM-COP	1993-1	Ok						Full
15050203-003off Mulberry Creek hdwt to San Pedro	A&Ww, FBC, AgL	BLM Monitoring	1993-1	Cadmium t	µg/l	50	62	1/1		Non AgL
				Copper d	µg/l	varies (250)	10,400	1/1		Non A&Ww
				pH	SU	6.5-9.0	4.9	1/1		Non AW&w, FBC, AgL

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SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED										
15050203-006 Aravaipa Canyon Creek hdwt-Rattlesnake	A&Ww, FBC, DWS, FC, AgL	BLM Monitoring 2 sites (east and west of gage)	1991-3 1993-6	Manganese t	µg/l	50	7-640	4/7	52	Partial DWS
				pH	SU	6.5-9.0	8.5 - 9.2	1/4		Full - slight elevation natural in low flow.
				Prior samples and occasional spikes indicate excessive heavy metals (manganese, lead) and cyanide						Threat A&Ww, DWS
15050203-004 Aravaipa Canyon Creek Rattlesnake-San Pedro	A&Ww, FBC, DWS, FC, AgL	ADEQ Klondyke Mine Inv SWMU-212.303	1993-2 (3 sediments) (10 tailings)	Ok						Full
		USGS Fixed Station 09473000	1989-1992 sediment samples only	Ok						Too little information to assess
		ADEQ Priority Pollutant Program	1993-Fish	Lead	mg/kg wet wt	0.22 NCBP 85th%	2.0			Threat A&Ww
				Selenium	mg/kg wet wt	0.75 predator protection	0.86			Threat A&Ww
		ADEQ Biocriteria Program @ Parsons Canyon	1992-1 1993-1 1994-1	Iron t	µg/l	300 (SMCL)	140-780	1/3	200 med	Full (DWS)
		ADEQ Biocriteria Program @ Hells Half Acre	1992-1 1993-1 1994-1	Iron t	µg/l	300 (SMCL)	200-940	1/3	230 med	Full (DWS)
				Mercury	µg/l	0.6	<0.5 - 0.8	1/3	<0.5	Full (FC)
		BLM Monitoring @ W. Wilderness	1990-2 1991-1	Zinc d	µg/l	varies (192)	361	1/3		Non A&Ww
		ADEQ Fixed Station AVP1 @ Woods Rch	1992-4 1993-4 1994-1	Turbidity	NTU	50	3-95.2	1/9		Partial A&Ww, FBC
15050203-004off Oak Grove Canyon hdwt-Aravaipa	A&Ww, FBC, DWS, FC, AgL	BLM Monitoring BLM-OG	1991-1 1993-2	pH	SU	6.5-9.0	8.9-9.2	1/2		Partial A&Ww, FBC, DWS
15050203-004off Javalina Canyon hdwt-Aravaipa	A&Ww, FBC, DWS, FC, AgL	BLM Monitoring BLM-J	1991-1	Ok						Full
RIOS DE YAQUI										
15080301-004off Rucker Canyon hdwt-Whitewater Dr	A&Wc, FBC, DWS, FC, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1 1995-1	Ok						Full
		ADEQ Complaint Inv. SWMU-212.108	1990-1	Arsenic t	µg/l	3.1	40	1/1		Partial FC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	0.5	1/1		Partial FC and FBC

SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED

ID NUMBER REACH OR LAKE NAME, SEGMENT DESCRIPTION	DESIGNATED USE	AGENCY, PROGRAM, SITE ID, SITE DESCRIPTION	SAMPLES: Year-Number (Type of sample)	STANDARDS OR CRITERIA EXCEEDED (Constituents are shown when results indicate a standard or criterion has been exceeded.)						
				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15080301-002 Whitewater Draw Mule Gulch-Mexico border	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed station WD1 @ Highway 80	1992-2	Arsenic t	µg/l	3.1	12-15	2/2	13.5	Partial FC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	2-<5	1/2		Partial FC, FBC
				DO	mg/l	≥6.0 90% saturation	4.55 59.5%	1/1		Non A&Ww
				Fecal coliform	CFU	800	1560-1700	2/2		Non FBC
				Turbidity	NTU	50	171-999	2/2		Non FBC
		ADEQ Fixed station WD1A @ Intl border	1992-2	Arsenic t	µg/l	3.1	15-17	2/2	16	Partial FC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	3.0-<5	1/2		Partial FC, FBC
				DO	mg/l	≥6.0 90% saturation	5.9 76.4%	1/1		Partial A&Ww
				Fecal coliform	CFU	800	1060-1560	2/2		Non FBC
				Lead t	µg/l	100	135	1/2		Partial AgL
				Turbidity	NTU	50	78-999	2/2		Non A&Ww, FBC
15080301-004off Mule Gulch hdwt-Whitewater Dr	A&Wedw, PBC, AgL	ADEQ Fixed Station MG1 @ Elfrida cutoff	1990-1 (low flow) 1992-2 1993-1	Copper d	µg/l	varies (65)	3750	1/1		Non A&Wedw
				Copper t	µg/l	500	195-4200	1/3		Non AgL
				pH	SU	6.5-9.0	5.0-8.17	1/4		Part A&Wedw, PBC, AgL
				Turbidity	NTU	50	5-83.1	1/3		Part A&Wedw, PBC
				Zinc d	µg/l	varies (375)	6140	1/1		Non A&Wedw
	A&Ww, PBC, AgI, AgL	ADEQ Complaint Inv SWMU-212.159	1992-5	Copper d	µg/l	varies	109-12,000	3/5		Non A&Ww
				Copper t	µg/l	500 AgL	1,540-11,600	3/5		Non AgL
				pH	SU	6.5-9.0	3.29-6.42	2/5		Non A&Ww, PBC
				Zinc d	µg/l	varies	340-4,250	2/5		Non A&Ww
		ADEQ Fixed station MG2 @ Inn @ Castle Rock	1990-1 (low flow) 1992-2 1993-1	pH	SU	6.5-9.0	6.0-8.83	1/3		Part A&Ww, PBC
15080302-002 Guadalupe Canyon New Mexico-Mexico	(not listed)	BLM/Safford Monitoring	1991-1	Ok						No standards listed

SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED										
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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
SAN PEDRO - WILLCOX PLAYA - RIO YAQUI LAKES										
AZL15050201-1892 Willcox Playa	A&Ww, FBC, AgL	ADEQ Fixed station WIL1 near Willcox	1995-1	Arsenic t	µg/l	50	136	1/1		Non FBC
				Beryllium t	µg/l	0.33	169	1/1		Non FBC
				Turbidity	NTU	50	8710	1/1		Non FBC, A&Ww
		ADEQ Priority Pollutant Program @ Arizona Electric Power Cooperative discharge	1994 sediment, fish, & birds	Arsenic	mg/kg	3.82 HBGL 9.2 AZ 90th%	19.7 sediment			Sediment contamination
				Cadmium	mg/kg wet wt	0.1 predator protection	0.59-0.64 birds	2/2		Threat A&Ww
				Chromium	mg/kg wet wt	1.0 presumptive contamination	1.1 fish 0.93-0.98 birds			Threat A&Ww
				DDT metabolites	mg/kg wet wt	0.3 EPA screen 0.6 predator protection	0.270-1.1 birds			Threat A&Ww
				Selenium	mg/kg wet wt	0.75 predator protection	1.1 fish 3.1-9.3 birds			Threat A&Ww

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED										
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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
SANTA CRUZ RIVER SUB-WATERSHED (see also 15050303 on page B-78)										
15050301-012off Santa Cruz River hdwt-Mexico border	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station SC13 near Lochiel	1990-2 1991-2 1992-4 1993-3 1994-1	Ok						Full
		ADEQ Priority Pollutant Program	1994 sediment, fish & birds	Chromium	mg/kg wet wt	1.0 presumptive contamination	1.3 fish			Threat A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85th%	49.5 fish			Threat A&Ww
		ADEQ Biocriteria Program near Lochiel	1992-1	Ok						Full
15050301-012 Santa Cruz River Mexico bdr-B	A&Ww, DWS, FBC, AgI, AgL	ADEQ Fixed Station SC5 @ Mexican border	1991-12 1992-5 1993-6 1994-6 1995-5	DO	mg/l	≥6.0 90% saturation	5.6-11.7 85.8-134.4%	2/24		Full
				Fecal coliform	CFU	800	2300	1/12		Full
				Turbidity	NTU	50	0.2-1140	2/18		Partial FBC, A&Ww
		ADEQ Cooperative Study Nogales Wash Santa Cruz Co, Nogales, IBWC	1991-7 bact-virus-parasites	No standards for viruses, parasites or fecal strep. Fecal coliform ok.						
			1991-4	Ok						Full
		ADEQ Fixed Station SC19 @ Guevavi Ranch	1993-9 1995-5	Turbidity	NTU	50	0.66-146	4/11		Partial FBC, A&Ww
15050301-010 Santa Cruz River Nogales-Sonoita	A&Ww, DWS, FBC, AgI, AgL	IBWC (before POTW)	1991 2 sites	Ok						Full

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15050301-009 Santa Cruz River Sonoita-Josephine	A&Wedw, PBC	ADEQ Priority Pollutant Program Rio Rico	1993 sediment, fish & birds 1994 sediment, fish & birds	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	4.3-15.4			Sediment contamination
				Chromium	mg/kg wet wt	1.0 presumptive contamination	1.5 fish 1.1 birds			Threat A&Wedw
				DDT metabolites	mg/kg wet wt	0.3 EPA screen	0.181-0.360 fish			Full (FC not a designated use)
				Dieldrin	mg/kg wet wt	0.007 EPA screen	0.033 fish			Full (FC not a designated use)
				Mercury	mg/kg wet wt	0.1 predator protection	0.06-0.23 fish	1/2		Threat A&Wedw
				Zinc	mg/kg wet wt	34 NCBP 85th%	73.8 fish			Threat A&Wedw
		ADEQ Fixed Station SC2 @ Rio Rico	1991-13 1992-5 1993-10 1994-6 1995-6	Cyanide t	µg/l	9.1 (chronic) 41 (acute) 3,100 PBC	<7-26,700	2/7 2/7 2/7		Partial PBC, acute and chronic A&Wedw
				Fecal coliform	CFU	4,000	2-6,000	1/22		Threat PBC, A&Wedw
				Turbidity	NTU	50	4.75-157	3/22		Partial A&Wedw,PBC
		ADEQ Cooperative Study Nogales Wash Santa Cruz Co, Nogales, IBWC @ Calabasas Road	1991-20 bact-virus-parasites	No standards for viruses, parasites or fecal strep.						
				Fecal coliform	CFU	800 200 30-day geometric mean	2,160-TNTC mean 4,670	5/20		Partial A&Wedw, PBC
			1991-8	Cyanide t	µg/l	41	60	1	12%	Partial A&Wedw
15050301-008 Santa Cruz River Josephine-Sopori	A&We, PBC, AgL	ADEQ Fixed Station SC17 @ Chavez Siding Rd	1992-1 1993-8 1994-4 1995-6	Turbicity	NTU	50	3.95-151	3/15		Partial PBC
		ADEQ Fixed Station SC16 @ Tubac	1992-1 1994-2	Turbidity	NTU	50	6.25-72	1/3		Partial PBC, A&We
	A&Wedw, PBC	ADEQ Fixed Station SC20 @ Santa Gurtrudis Ln in Tumacacori	1993-5 1994-9 limited 1995-6 limited	Copper d	µg/l	varies (35)	4-70	1/3		Partial A&Wedw
				Cyanide t	µg/l	41	7-1500	1/5		Partial A&Wedw
				Turbidity	NTU	50	6.5-114	1/16		Full

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED									
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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
		ADEQ Fixed Station SC18 @ Rancho Santa Cruz	1993-4	Turbidity	NTU	50	6.4-132	1/3		Partial A&Wedw, PBC
		ADEQ Priority Pollutant Program	1994 sediment fish & birds	Chromium	mg/kg wet wt	1.0 presumptive contamination	1.4 fish 1.1 birds			Threat A&Wedw
				DDT metabolites	mg/kg wet wt	0.3 EPA screen 0.6 predator protection	1.2 fish			Threat A&Wedw
				Zinc	mg/kg wet wt	34 NCBP 85th%	63.9 fish			Threat A&Wedw
15050301-003 Santa Cruz River wash - Rillito Creek	A&We, PBC, AgL	ADEQ Fixed Station SC12 @ Congress St. Bridge	1991-1	Ok						Full
15050301-001 Santa Cruz River Canada del Oro-Guild	A&Wedw, PBC	ADEQ Fixed Station SC1 @ Cortaro	1991-8 1992-6 1993-6	Turbidity	NTU	50	10.3-8970	1/12		Threat A&Wedw
		ADEQ Priority Pollutant Program	1993-Bird and sediment	DDT metabolites	mg/kg wet wt	0.5 eggshell thining, 0.15 reduced reproduction	9.3 birds (but different species than criteria)	1/1		Threat to A&Wedw
15050301-012off Washington Gulch hdwt-Duquesne Wash	A&Ww, FBC, FC, AgI, AgL	ADEQ Washington Camp Mine Complaint Inv. SWMU-212.358	1992-6 sites	Copper d	mg/l	varies	0.07-3.15	2/6		Non A&Ww
				Copper t	mg/l	0.5	0.55-6.02	2/6		Non AgL; partial AgI
				Lead t	mg/l	0.1	0.18	1/6		Partial AgL
				TDS	mg/l	1000	1010	1/6		Partial AgI
				Zinc t	mg/l	10	16.1	1/6		Partial AgL
				Zinc d	mg/l	varies	3.28-14.5	3/6		Non A&Ww
15050301-012off Providencia Canyon hdwt-Santa Cruz River	A&Ww, DWS, FBC, AgI, AgL	USFS Coronado National Forest	1991-1	Ok						Full

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED

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15050301-011 Nogales Wash Mexico bdr-Santa Cruz River	A&Ww, PBC, AgI, AgL	ADEQ Nogales Wash Inv SWMU-210.131 @ 7 locations	1990-1991 Metals only	Ok						Full
		ADEQ Priority Pollutant Program	1994 sediment	Ok						Full
		Santa Cruz Co H Nogales Wash Inv SWMU-210.131 Doe St (after CI)	1990-22 Bact only	Fecal coliform	CFU	4,000	160,000-1.8x10^6	2/20		Full
		ADEQ/IBWC/Santa Cruz Co,/Nogales Cooperative Study Nogales Wash above WWTP	1991-8	Ok						Full
			1991-20 bact-virus-parasites	Fecal coliform	CFU	4,000	4,560-18,600	3/20		Partial
				No standards for parasites or viruses						
		ADEQ Fixed Station SC4 @ Morley St Tunnel	1991-8 1992-5 1993-6 1994-4 1995-5	Chlorine (free)	µg/l	11	120	1/1		Non A&Ww
				Fecal coliform	CFU	4,000	1-4,400	1/18		Threat A&Ww, AgL, PBC, AgI
				Lead t	µg/l	100	2-430	2/27		Full
				Turbidity	NTU	50	2.78-6220	6/20		Partial A&Ww, PBC
15050301-011off Franklin Street Wash hdwt-Nogales Wash	A&Ww, PBC, AgI, AgL	ADEQ Priority Pollutant Program	1994 sediment	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	15.3	1/1		Sediment contamination
				Zinc	mg/kg	12-150 AZ background	391	1/1		
15050301-011off Tributaries to Nogales Wash: Cerro Pelon Wash, E. Nogales Wash, Las Cuevitas Wash, Potrero Creek, Trickey Wash, W. Nogales Wash,	A&Ww, PBC, AgI, AgL	ADEQ Nogales Wash Inv SWMU-210.131 Cooperative Study Santa Cruz Co., Nogales, ADEQ and IBWC	1990 97 bact only	Fecal coliform	CFU	4,000	8,000-9X10^6	2/3		Non A&Ww, PBC, AgI, AgL
			1991 79 bact-parasites-viruses	Fecal coliform	CFU	4,000	14,600-TNTC	4	5%	Threat A&Ww, PBC, AgI, AgL
				No standards for viruses or parasites						
			1991-8 East Fk 1991-8 West Fk	Ok						Full
15050301-009off Peck Canyon Creek hdwt-Santa Cruz River	A&We, PBC, AgL	ADEQ Fixed Station PEC1 (near Rio Rico)	1991-1	Ok						Full

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED										
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15050301-006off4 Madera Canyon Creek hdwt-Santa Cruz River	A&Ww, FBC, FC	ADEQ Fixed Station MAD1 @ Round-up	1990-1	Ok						Full
		ADEQ Fixed Station MAD2 @ Whitehorse	1990-1	Ok						Full
		ADEQ Biocriteria Program Blw Sprung Springs	1992-1 1993-1 1994-1	Ok						Full
15050301-006off Demetrie Wash hdwt-Santa Cruz River	A&Ww, FBC, FC	EPA/Cyprus Sierrita NPDES Monitoring	1993-1 (up to 31 partial)	Copper d	µg/l	varies (263)	3170	1/1		Non A&Ww
				Copper t	µg/l	500	3520	1/1		(Partial AgL)
				pH	SU	6.5-9.0	5.70	1/1		Partial A&Ww, FBC
15050301-017 Canada del Oro hdwt-Big Wash	A&Ww, FBC, DWS, FC, Agl, AgL	ADEQ Biocriteria Program	1992-1 1993-1 1994-1	Ok						Full
15050301-017off1 Romero Canyon hdwt-Canada del Oro	A&Wc, FBC, FC	ADEQ Biocriteria Program	1993-1	Ok						Full
		USFS Coronado National Forest	1991-3	Ok						Full
SONOITA CREEK SUB-WATERSHED										
15050301-013 Sonoita Creek hdwt-Santa Cruz	A&Ww, FBC, FC, Agl, AgL	ADEQ Fixed Station SC6 blw Patagonia WWTP	1991-8 1992-5 1993-6	Arsenic t	µg/l	3.1	<5-10		<5	Full
				DO	mg/l	≥6.0 90% saturation	5.12-8.62 57.9-99%	7/19		Non A&Ww
				Turbidity	NTU	50	0.41-70.3	1/11		Full
		ADEQ Fixed Station SC6A @ Pennsylvania Ave	1991-1 1992-1 4 limited	DO	mg/l	≥6.0 90% saturation	5.7-7.75 76.7-90.4	1/3		Partial A&Ww
				Lead t	µg/l	100	<2-410	1/2		Partial AgL
		ADEQ Fixed Station SC6B @ Patagonia WWTP	1992-4 1993-1 (nutrients/phys)	Ok						Full
	A&Ww, PBC, Agl, AgL	ADEQ Fixed Station SC6C @ The Nature Cons.	1992-1 & 4 field 1993-1 field	Ok						Full
		ADEQ Fixed Station SC6F blw Alum Canyon	1992-1 1993-1 field	Arsenic t	µg/l	3.1	30	1/1		Partial FC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	3.3	1/1 1/1		Partial FC, PBC
				Lead t	µg/l	100	320	1/1		Partial AgL
				Mercury t	µg/l	0.6	0.7	1/1		Partial FC

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED

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15050301-013off Alum Canyon hdwt-Sonoita Creek	A&We, PBC,	ADEQ Fixed Station SC6E @ mouth	1992-1	Ok						Full
		ADEQ Investigation ASARCO-Trench Camp Mine on Alum and Humbolt washes Inv # 103051	1995-7 sites blw mine 1 site abv mine (also see sites on Harshaw)	Cadmium t	µg/l	70 PBC	4.9-1,750	7/8		Non PBC
				Copper d	µg/l	varies	640-3,000	8/8		Non A&We
				pH	SU	6.5-9.0	3.44-4.22	8/8		Non PBC, A&We
				Zinc t	µg/l	28,000	890-740,000	5/8		Non PBC
				Zinc d	µg/l	varies	920-740,000	7/8		Non A&We
15050301-013off Harshaw Creek hdwt-Sonoita Creek	A&Ww, PBC, AgL	ADEQ Priority Pollutant Program	1994 sediment	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	22.2	1/1		Sediment contamination
		ADEQ Investigation ASARCO-Trench Camp Mine on Harshaw Creek Inv.# 103051	1995-2 sites blw mine 1 site abv mine (also see sites on Alum)	Ok						Full
		ADEQ Endless Chain Mine SWMU-212.300	1993-3 sites	Copper d	mg/l	varies	0.425-6.8	3 sites		Non A&Ww
				Copper t	mg/l	0.5	0.72-7.3	3 sites		Non AgL
				pH	SU	6.5-9.0	3.77-4.78	2 sites		Non A&Ww, PBC, AgL
				Zinc d	mg/l	varies	1/43-10.6	3 sites		Non A&Ww
15050301-013offR Three-R Canyon, hdwt-Sonoita Creek	A&Ww, FBC, FC, Agl, AgL	ADEQ Three-R Mine Inv SWMU 212.261	1993-3 sites	Arsenic t	µg/l	3.1	32	1 sites		Partial FC
				Beryllium t	µg/l	0.21	1.9-5.8	2 sites		Partial FC, FBC
				Cadmium t	µg/l	50	70	1 site		Non Agl, AgL, FBC
				Cadmium d	µg/l	varies	65	1 site		Non A&Ww
				Copper t	µg/l	500	45,000-69,000	2 sites		Non Agl, AgL
				Copper d	µg/l	varies	73,500-46,100	2 sites		Non A&Ww
				pH	SU	6.5-9.0	3.14-3.37	2 sites		Non A&Ww,FBC,Agl,AgL
				Zinc d	µg/l	varies	1,240-1,280	2 sites		Non A&Ww
			1993 4 radiochemicals	Gross Alpha	pCi/l	30 ARRA	150-425	2		Full - No uses apply; radiochemical contamination of water
				Gross Beta	pCi/l	30 ARRA	42-142	2		
				Radium 228	pCi/l	30 ARRA	49-60	2		
				Uranium 234	pCi/l	30 ARRA	30-59	2		
15050301-013off17Soff Redrock Canyon hdwt-Harshaw Creek	A&Ww, FBC, FC	ADEQ Biocriteria Program near Canelo Hills	1993-1	Ok						Full

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED										
15050301-013offT Temporal Gulch hdwt-Sonoita Creek	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station SC6D @ mouth	1992-1	Ok						Full
RILLITO CREEK SUB-WATERSHED										
15050302-003 Rillito Creek hdwt-unnamed wash	A&We, PBC, AgL	ADEQ Fixed Station RC1 @ Dodge Bridge	1991-1	Ok						Full
15050302-001 Rillito Creek unnamed wash-Santa Cruz	A&We, PBC, AgL	Pima County NPDES stormwater 2 sites: #4 (commercial), #5 (Industrial)	1993-3 1994-4 1995-1	Chromium IV d	µg/l	34	70 (indust) 120-130 (comm)	3/3		Non A&We
				Oil & grease	mg/l	Narrative standard - free of any	no detect-42	14/15 (com) 2/9 (Indust)		Non A&We
				pH	SU	6.5-9.0	4.2-8.1	1/5		Partial A&We, PBC
15050302-001off7 Unnamed wash hdwt-Rillito Creek	A&We, PBC, AgL	ADEQ Complaint Inv SWMU 212.180 @ Del Sol Stables	1991-0 Manure in wash	Narrative						Non A&We, PBC
15050302-009 Tanque Verde hdwt-Rillito Creek	A&Ww, FBC, AgL	USFS Coronado National Forest Tanque Verde Falls	1991-3	Ok						Full
15050302-009off3 Sabino Cyn Creek hdwt-Tanque Verde	A&Wc, FBC, DWS, FC, AgI, AgL	USFSCoronado National Forest Lower Sabino Canyon	1991-1	Ok						Full
		USFS Coronado National Forest Upper Sabino Canyon	1991-1	Ok						Full
		ADEQ Biocriteria Program abv East Fork	1992-1 1993-1 1994-1	Ok						Full
		ADEQ Fixed Station SC15 blw Summerhaven	1991-9 1992-1 & 5 bacts 1993-3 bacts	Ok						Full
		ADEQ Fixed Station SC10 @ USGS gage	1991-2	Ok						Full
15050302-009off7 Agua Caliente Wash hdwt-Tanque Verde	A&Ww, FBC, AgL	ADEQ Biocriteria Program	1995-1	Ok						Full

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED										
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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15050302-006 Cienega Creek, hdwt-Pantano Wash	A&Ww, FBC, AgL (part is a Unique Water)	ADEQ Fixed Station SC7 @ Marsh Station Rd	1991-6 1992-6 1993-4 1994-6 1995-4	DO	mg/l	≥6.0 90% saturation	4.75-11.2 60.6-110%	1/25		Full
		ADEQ Fixed Station SC8 @ Tilted Bed	1990-3 1993-2	Ok						Full
		ADEQ Fixed Station SC14 @ BLM ECRR	1992-4 1993-4 1994-1	Ok						Full
		ADEQ Biocriteria Program abv The Narrows	1992-1 1993-1 1994-1	Ok						Full
		BLM Monitoring BLM-CC	1993-2 sites	Ok						Full
15050302-006off Cave Creek hdwt-Cienega Creek	A&Ww, FBC, AgL	ADEQ Biocriteria Program Mt Wrightson Wild.	1992-1	Ok						Full
15050302-006off Gardner Creek hdwt-Cienega Creek	A&Ww, FBC, AgL	ADEQ Biocriteria Program	1992-1	Ok						Full
SANTA CRUZ SUB-WATERSHED (see also 15050301)										
15050303-006off Ajo Detention Basin hdwt-Santa Cruz River	A&Ww, FBC, AgI, AgL	ADEQ Priority Pollutant Program	1993 sediments	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	7.5	1/1		Ok within background limits
15050304-008 Arivaca Creek, hdwt-Puertocito	A&Ww, FBC, AgL	ADEQ Fixed Station AVC1 @ headwater spring	1991-4 1992-1 1993-1	DO	mg/l	≥6.0 90% saturation	5.2-6.91 60.6-77.1%	3/6		At springs so probably naturally low DO
		ADEQ Fixed Station AVC2 @ Ruby Rd	1991-8 1992-6 1993-4	DO	mg/l	≥6.0 90% saturation	1.1-12.0 14.2-119%	8/18		PartialA&Ww
		ADEQ Fixed Station AVC3 @ Figueroa Spring	1990-6 1991-6 1992-6 1993-4	DO	mg/l	≥6.0 90% saturation	5.3-10.1 68.5-128.6%	1/10		Full
15050305-001off El Tiro, hdwt-Aguirre Wash	A&We, PBC (evidence of livestock grazing)	ADEQ Silverbell Mine SWMU-212.273	1993-2	Copper d	µg/l	varies	620-120,000	2/2		Non A&We
				Cadmium t	µg/l	70	1,400	1/2		Partial PBC (AgL)
				pH	SU	6.5-9.0	3.41	1/2		Partial A&We, PBC, (AgL)
				Selenium	µg/l	33	150-190	1/2		Non A&We
				Zinc t	µg/l	28,000	78,000	1/2		Partial PBC (AgL)

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED										
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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
RIOS DE MEXICO (RIO MAGDALENA AND RIO SONOITA)										
15080200-000 California Gulch hdwt-Mexico border	A&We, PBC, AgL	ADEQ Complaint Inv Montana Mine @ Ruby SWMU-212.114	1990 set of 4	Cadmium	mg/kg	<10 @ control AZ background no det-1.7	33			Contaminated sediments
				Lead	mg/kg	<50 @ control AZ background no det.-100	560			
				Manganese	mg/kg	2030 HBGL	3200			
				Zinc	mg/kg	75 @ control AZ background 12-150	3400			
15080200-002 Sycamore Creek hdwt-Mexico border	A&Ww, FBC, AgL	ADEQ Biocriteria Devel	1992-1 1993-1 1994-1	DO	mg/l	≥6.0 90% saturation	4.3-6.8 44%	1/2		Full - natural low DO in stagnant pools
LAKES IN SANTA CRUZ RIVER BASIN, RIO MAGDALENA BASIN, AND RIO SONOITA BASIN										
15050304-0080 Arivaca Lake	A&Ww, FBC, FC, AgI, AgL	ADEQ Priority Pollutant Program	1995-6 fish mercury only	Mercury t	mg/kg	0.1 predator protection 0.6 EPA screen	1.25-1.81 fish	5/5	1.63	Non A&Ww
15050301-0720 Kennedy Lake	none listed, but a public lake with a fishing program.	AGFD Fish Stocking Program	1991-1 1993-1 limited 1994-2 limited	pH	SU	6.5-9.0	8.9-9.5	2/2		(Partial A&Ww, PBC)
		ADEQ/AGFD Clean Lakes Program	1992-1 1993-1	pH	SU	6.5-9.0	7.19-9.24	½		(Partial A&Ww, PBC)
		ADEQ Priority Pollutant Program	1992-Fish and sediment	Ok						Full
15050302-0760 Lakeside Lake	A&WW, PBC (Uses derived by tributary rule, a public lake with fishing)	AGFD Fish Stocking Program	1994-4 limited 1995-2 limited	DO	mg/l	≥6.0	0.0-7.1	3/6		Non A&Ww
		ADEQ Priority Pollutant Program	1992-Fish and sediment	Ok						Full
		ADEQ/AGFD Clean Lakes Program	1992-2 1993-1	Ammonia	mg/l	varies (2.4)	2.43	1/3		Partial A&Ww
				Arsenic t	µg/l	3.1	7	2/3		(Partial FC)
				Lead d	µg/l	varies (21.5)	30	1/1		Partial A&Ww
				Mercury t	µg/l	0.6	0.9	1/3		(Partial FC)
				pH	SU	6.5-9.0	9.8	1/3		Partial A&Ww, PBC
15050301-1040 Parker Canyon Lake	A&Wc, FBC, FC, AgI, AgL	ADEQ Clean Lakes Program	1992-1	Ok						Full

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED

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15050301-1050 Patagonia Lake	A&Wc, FBC, FC, DWS, AgI, AgL	ADEQ Clean Lakes Program	1992-5 sites	Ok						Full
		ADEQ Priority Pollutant Program	1993 fish	Mercury	mg/kg wet wt	0.1 predator protection	0.14 fish	1/1		Threat A&Ww
		AGFD Fish Stocking Program	1993-1	Manganese	µg/l	50 SMCL	104	1/1		Partial DWS
				TDS	mg/l	500	518	1/1		Threat DWS
15050301-1070 Pena Blanca Lake	A&Wc, FBC, FC, AgI, AgL	ADEQ Clean Lakes Program	1992-1 1994-1 1995-1 & 2 field	pH	SU	6.5-9.0	6.6-9.11	1/5		Threat A&Wc, FBC, AgI, AgL
				Turbidity	NTU	10	0.61-11	1/2		Threat A&Wc
		ADEQ Priority Pollutant Program	1994 sediment & fish	Beryllium	mg/kg	1.34 HBGL 1.5 AZ 90th%	2.2	1/1		Sediment contamination
				Mercury	mg/kg wet wt	0.1 predator protection, 0.6 EPA screen	1.44 mean largemouth bass 0.47 mean sunfish 1.0 mean all fish			Non A&Wc, FC
		AGFD Fish Stocking Program	1994-1 limited	Ok						Full
		ADEQ Montana Mine - Inv.	1990-1	Ok						Full
15050301-1400 Silverbell Lake	None (But a public lake with a fishing program)	ADEQ Clean Lakes Program	1992-1 1993-1	Arsenic t	µg/l	3.1	non-det.-9	1/2		(Partial FC)
				pH	SU	6.5-9.0	9.04	1/2		(Threat A&Ww)
		AGFD Fish Stocking Program	1994-1 limited 1995-1 limited	pH	SU	6.5-9.0	9.12-9.20	2/2		(Partial A&Ww)
		ADEQ Priority Pollutant Program	1992 Fish & Sediment	Lead	mg/kg wet wt	0.5 predator protection	5.6	1/1		(Threat A&Ww)

VERDE WATERSHED

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BIG CHINO SUB-WATERSHED										
15060201-019 Apache Creek hdwt-Walnut Creek	A&Ww, FBC, DWS, FC, AgI, AgL	ADEQ Biocriteria Program near Apache seep	1995-1	Ok						Full
15060201-002off Walnut Creek hdwt-Chino Wash	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station WAL1	1993-5	DO	mg/l	≥6.0 90% saturation	5.98-10.8 62.1-108%	1/5		Full (natural low flows)
		ADEQ Biocriteria Program	1995-1	Ok						Full
VERDE RIVER SUB-WATERSHED (see also 15060203)										
15060202-052 Verde River, Granite Creek-Hell Cyn	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station VRP2 @ Paulden	1990-2 1991-4	Arsenic t	µg/l	3.1	21-28		23 med	Partial FC
				Nitrogen t	mg/l	1.0 annual mean	0.85-1.73	3/4	1.2 annual	Partial A&Ww
		ADEQ Biocriteria Program	1995-1	Arsenic t	µg/l	3.1	25	1/1		Partial FC
15060202-038 Verde River, Hell-15060202-065	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program @ Perkinsville	1992-1 1993-2 1994-1 1995-1	Arsenic t	µg/l	3.1	12-26	8/8	21	Partial FC
15060202-037 Verde River, A-Railroad Dr	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station VRP1 @ Perkinsville	1991-6 1992-6 1993-6	Arsenic t	µg/l	3.1	<10-28	14/17	20 med	Partial FC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	<0.5-0.9	1/18	<0.5 med	Threat FC, FBC
				Phosphorus t	mg/l	0.1 annual mean	<0.05-0.96	9/18	0.11-1991 0.26-1992	Partial A&Ww
				Turbidity	NTU	50	2.0-390	1/17		Full (A&Ww, FBC)
		ADEQ RR Coal Spill SWMU-212.253	1992-4 sites	Arsenic t	µg/l	3.1	20-25	4/4	23 med	Partial FC
15060202-025 Verde River, Sycamore-Oak Creek	A&Ww, FBC, FC, AgI, AgL	USGS Fixed Station 09504000 @ Clarkdale	1991-12 1992-12 1993-12 1994-6 1995-6	Arsenic t	µg/l	3.1	2-21	45/48	16 med	Partial FC
				Turbidity	NTU	50	0.6-460	8/48		Partial A&Ww, FBC
		ADEQ Biocriteria Program @ Cottonwood	1993-1 1995-1	Arsenic t	µg/l	3.1	<10-12	1/2		Partial FC
		ADEQ Fixed Station VRDH1 @ Deadhorse Rch	1990-6 limited 1991-11 limit	Turbidity	NTU	50	3.6-396	2/16		Partial A&Ww, FBC

VERDE WATERSHED

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		ADEQ Fixed Station VRCW1 blw Cottonwood	1992-6	Arsenic t	µg/l	3.1	<10-14		12 med	Partial FC
				Turbidity	NTU	50	9.1-60	1/4		Partial A&Ww, FBC
		ADEQ Fixed Station VRC3 blw Sycamore	1990-2 1991-4	Arsenic t	µg/l	3.1	12-16		15	Partial FC
				Turbidity	NTU	50	2.6-1190	1/6		Partial A&Ww, FBC
15060202-015 Verde River, Oak Creek-Beaver Creek	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program blw Oak Creek	1995-1	Ok						Full
		ADEQ Fixed Station VR1000 @ 1000 Trails	1990-5 limited 1991-11 limit	DO	mg/l	≥6.0 90% saturation	5.9-11.6 74.5-122%	1/13		Full (A&Ww)
				Turbidity	NTU	50	4.8-165	1/16		Full (A&Ww, FBC)
		ADEQ Fixed Station VRI-17 abv I-17 bridge	1990-5 limited 1991-11 limit	DO	mg/l	≥6.0 90% saturation	5.8-10.8 84.5-132%	1/14		Full (A&Ww)
				Turbidity	NTU	50	5.3-106	2/16		Partial A&Ww, FBC
15060202-059 Granite Creek hdwt-15060202-060	A&Ww, FBC, AgI, AgL	ADEQ Sewers & Floods SWMU-212.307	1993-4 bact only	Fecal coliform	CFU	800	1,400	1/4		Partial FBC (during flood) Insufficient info for assessment.
15060202-049 Hell Canyon, hdwt-unnamed wash	A&Ww, PBC, FC, AgL	USFS -- Kaibab National Forest below Rd #108	1991-1	Ok						Full
15060202-033 Tule Wash, hdwt-Sycamore Creek	A&Wc, FBC, FC, AgI, AgL	USFS -- Kaibab National Forest Upper Tule Wash	1991-1	Ok						Full
15060202-033off3 JD Wash, hdwt-Tule Tank Wash	A&Wc, FBC, FC, AgI, AgL	USFS -- Kaibab National Forest @ JD Dam	1991-1	Ok						Full
15060202-028offV Volunteer Wash hdwt-Sycamore Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Priority Pollutants Program	1993-2 sites 2 sediments	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th%	5.65-8.55			Probably normal background.
15060202-026 Sycamore Creek, Cedar Creek-Verde River	A&Wc, FBC, FC, AgI, AgL	USFS -- Coconino National Forest	1991-3	Ok						Full
		ADEQ Biocriteria Program @ Summers Spring	1993-2 1994-2 field 1995-1	Ok						Full
15060202-032 Big Springs, hdwt-Sycamore Creek	A&Wc, FBC, FC, AgI, AgL	USFS -- Kaibab National Forest	1991-3	Ok						Full

VERDE WATERSHED

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15060202-025off Bitter Creek hdwt-Verde River	A&Ww, PBC, AgL	ADEQ APP Inv. @ United Verde Mine (100536) a. spring @ toe of 500 level dump. b. Section House Springs above Hopewell Tunnel.	1990-1 set 1991-1 set 1993-1 set 1995-1 set	During high flows (March 1993), discharges from settling ponds into natural drainages, did not meet all surface water quality standards.						Non all uses
				Cadmium t	µg/l	50 AgL 70 PBC	30-687	3/4 @ spring 3/4 @ spring		Non AgL Non PBC
				Copper t	µg/l	500	1,800 <50-46,700	@ toe 3/4 @ spring		Non AgL
				Copper d	µg/l	varies (84)	190	@ toe		Non A&Ww
				pH	SU	6.5-9.0	2.54-7.29	2/4 @ spring		Non A&Ww, PBC, AgL
				Zinc t	µg/l	25,000	1,100-167,000	2/4 @ spring		Non AgL
				Zinc d	µg/l	varies (473)	0.82-1,090	@ toe		Non A&Ww
	A&Wedw, PBC	ADEQ Biocriteria Program blw Jerome WWTP	1995-1	Ok						Full
	A&Ww, FBC, AgI, AgL	ADEQ Fixed Station BTC1 @ Clarkdale	1990-6 1991-6 1992-6 1993-2	Copper t	µg/l	500	<10-5390	1/14		Threat AgI, AgL
				Lead t	µg/l	100	<2-260	1/14		Threat AgL
				TDS	mg/l	1000 (EPA)	519-1230	1/14	703	Full (AgI)
15060202-015off Unnamed wash hdwt-Verde	A&Ww, FBC, FC,AgI, AgL	ADEQ Complaint SWMU 212.503 Transylvania, Intl near Cottonwood AZ	1994-3 sediment (deisel fuel release)	Total petroleum hydrocarbons	mg/kg	7,000 (HBGL)	330-55,000	2/3		Sediment contamination
				Narrative standards violated by the release of diesel fuel to ditch.						
15060202-025off Black Canyon, hdwt-Verde	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria dev blw Gaddes Cyn	1992-2 1993-2 1994-1 1995-1	Ok						Full
15060202-011 Dry Beaver Creek, Rattlesnake-Jack	A&Ww, FBC, FC, AgI, AgL	USFS -- Coconino National Forest	1991-3	Ok						Full
		ADEQ Biocriteria Program blw Jacks Cyn	1995-1	Ok						Full
15060202-010 Dry Beaver Creek, Jack-Wet Beaver Creek	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station DBC1 @ Hwy 175 bridge	1991-3 1992-4 1993-1	Ok						Full
		ADEQ Complaint SWMU 212.234 B&B Materials	1992-3	Ok						Full

VERDE WATERSHED

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15060202-004 Wet Beaver Creek, Long Cyn-Rarick	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program abv USGS gage	1992-2 1993-3 1994-2 1995-1	Arsenic t	µg/l	3.1 (FC)	<10-13	2/8	<10 med	Full
				Turbidity	NTU	10	0.3-14	1/8		Partial A&Wc
		ADEQ Fixed Station WBC2 abv Ranger Station near Rimrock	1990-7 1991-6	Arsenic t	µg/l	3.1	<10-14		11.5 med	Partial FC
				DO	mg/l	≥7.0 90% saturation	6.6-11.0 86.2-111.9%	1/12		Full
				Turbidity	NTU	10	0.1-44	2/12		Partial A&Wc
15060202-003 Wet Beaver Creek, Rarick-Dry Beaver Creek	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program @ campground @ Montezuma Well	1995-1 2 sites	Turbidity	NTU	10	7-15	1/2		Partial A&Wc
15060202-002 Wet Beaver Creek, Dry Beaver-Verde River	A&Wc, FBC, FC, AgI, AgL	ADEQ Fixed Station WBC1 abv Camp Verde	1990-7 1991-6	Arsenic t	µg/l	3.1	<10-14	4/12	15 med	Partial FC
				DO	mg/l	≥7.0 90% saturation	4.6-10.9 66.2-104.4%	3/11		Non A&Wc
				Mercury t	µg/l	0.6	0.7	1/12		Full (FC)
				Turbidity	NTU	10 A&Wc 50 FBC	0.82-114	5/11 3/11		Non A&Wc, FBC
		ADEQ Biocriteria Program	1993-1 1995-1	Arsenic t	µg/l	3.1	<10-19	1/2		Partial FC
				Turbidity	NTU	10	13.1-34.5	2/2		Non A&Wc
OAK CREEK SUB-WATERSHED										
15060202-019 Oak Creek, hdwt-West Fork	A&Wc, FBC, FC, DWS, AgI, AgL, Unique	ADEQ Fixed Station OC1 - abv W.Fork	1991-1	Ok						Full
		ADEQ Biocriteria Program abv Cave Sp Camp	1994-1 1995-2	Ok						Full
		ADEQ Biocriteria Program abv Pine Flat	1992-2 1993-3 1994-1	DO	mg/l	≥7.0 90% saturation	6.6-13.1 63-141%	1/6		Partial A&Wc
				Turbidity	NTU	10	0.5-20.1	1/6		Partial A&Wc
15060202-018 Oak Creek, West Fork Oak-Dry Creek	A&Wc, FBC, FC, DWS, AgI, AgL, Unique	USGS Fixed Station 09504440 Red Rock Crossing	1991-12 1992-12 1993-12 1994-1	Arsenic t	µg/l	3.1	<1-6	27/37	5 med	Partial FC
				Fecal coliform	CFU	800	1-1300	1/37		Full (FBC)
				Turbidity	NTU	10 A&Wc	0.4-24	5/37		Partial A&Wc
		ADEQ Fixed Station OC13 @ Lomacasi	1992-6	Iron t	mg/l	300 (SMCL)	<100-620	1/6	<100 med	Full (DWS)
		ADEQ Fixed Station OC017 @ Red Rock X-ing	1994-6 1995-6	Iron t	mg/l	300 (SMCL)	<100-770	3/12	150 med	Full (DWS)
				Turbidity	NTU	10 A&Wc	0.63-12.51	1/12		Full
		ADEQ Biocriteria Program @ Slide Rock @ Grasshopper Pt @ Chavez Crossing	1995-1 3 sites	Ok						Full

VERDE WATERSHED

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		ADEQ Biocriteria Program @ Red Rock	1992-1 1993-1 1995-1	Turbidity	NTU	10	0.9-13.9	1/3		Partial A&Wc
		SRP Monitoring	1991-4 few parameters	Ok						Full
15060202-017 Oak Creek, Dry Creek-Spring	A&Wc, FBC, FC, DWS, AgI, AgL, Unique	ADEQ Complaint SWMU-212.237 Wilkinson	1992-1	Arsenic t	µg/l	3.1	14	1/1		Partial FC
				Iron t	µg/l	300 (SMCL)	920	1/1		Partial DWS
				Turbidity	NTU	10	16.8	1/1		Non A&Wc
		ADEQ Biocriteria Program abv Page Spr Hatch blw Page Spr Hatch	1995-1 2 sites	Arsenic t	µg/l	3.1	<10-14	1/2		Partial FC
		AGFD abv Page Spr Hatch blw Page Spr Hatch	1991-9 limited 1992-6 limited	Ok						Too little information to assess
15060202-016 Oak Creek Spring-Verde River	A&Wc, FBC, FC, DWS, AgI, AgL, Unique	ADEQ Coop Study Lower Oak Creek Estate SWMU 210.156	1992-8 sites (bacts) 1992-6 sites	Arsenic t	µg/l	3.1	16-17	2/2	16.5	Partial FC
				Iron t	µg/l	300	830-1040	2/2	935	Partial DWS
				Turbidity	NTU	10	27-40	2/2		Non A&Wc
		ADEQ Fixed Station OC021 near mouth	1992-6	Arsenic t	µg/l	3.1	<10-19	5/6	12.3	Partial FC
				DO	mg/l	≥7.0 90% saturation	5.9-11.7 78.7-111.1%	1/6		Partial A&Wc
				Iron t	µg/l	300 (SMCL)	260-1040	5/6	572	Partial DWS
				Mercury t	µg/l	0.6	<0.5-1.5	1/6	<0.5	Full
				Turbidity	NTU	10 A&Wc 3 Unique Water	4.1-23	2/6		Non A&Wc
15060202-019off Pumphouse Wash, hdwt-Oak Creek	A&Wc, FBC, FC, DWS, AgI, AgL	ADEQ Fixed Station PW1 blw H-89A	1990-1 1991-3 1992-4 1993-1	Copper d	µg/l	varies (13)	<10-18	1/5		Non A&Wc
				DO	mg/l	≥7.0 90% saturation	5.3-11.8 52.9-117.2%	3/7		Non A&Wc
				Iron t	µg/l	300 (SMCL)	<100-2110	5/9		Partial DWS
				Turbidity	NTU	10 (A&Wc) 50 (FBC)	0.65-58	4/8 1/8		Non A&Wc Partial FBC
15060202-020 West Fork Oak Creek, hdwt-Oak Creek	A&Wc, FBC, FC, AgL, Unique	ADEQ Biocriteria Program	1992-2 1993-2 1994-2 1995-1	Ok						Full
15060202-022 Spring Creek hdwt-Oak Creek	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1995-1	Ok						Full

VERDE WATERSHED										
ID NUMBER REACH OR LAKE NAME, SEGMENT DESCRIPTION	DESIGNATED USES	AGENCY, PROGRAM, SITE ID SITE DESCRIPTION	SAMPLES: Year-Number (Type of samples)	STANDARDS OR CRITERIA EXCEEDED (Constituents are shown when results indicate a standard or criterion has been exceeded.)						
				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15060202-018off Munds Creek, hdwt-Oak Creek	A&Wc, FBC, FC, DWS, AgI, AgL	ADEQ Fixed Station MC1 @ Indian Gardens	1991-6 1992-6 1993-1	Arsenic t	µg/l	3.1	<10-10	2/12	<10 med	Full (FC)
				Iron t	µg/l	300 (SMCL)	<100-1190	3/13	150 med	Full (DWS)
				Turbidity	NTU	10	0.12-39	3/12		Partial A&Wc
		ADEQ Fixed Station MC2 @ Munds Park (@ 1-17 Bridge)	1991-5 1992-6 1993-1	DO	mg/l	≥6.0 90% saturation	3.75-10.4 44-101.7%	3/8		Non A&Wc
				Iron t	µg/l	300 (SMCL)	150-1470	7/12		Partial DWS
				Manganese t	µg/l	50	<50-730	7/12	170 med	Partial DWS
				Nitrogen t	mg/l	1.0 annual mean 3.0 grab sample	0.55-9.04	1992 1/12	2.12	Partial A&Wc
				Phosphorus t	mg/l	1.0 grab sample 0.1 annual mean	<0.1-1.85	1/12	mean exceeded: 1991 & 1992	Partial A&Wc
				Turbidity	NTU	10 A&Wc	1.6-44	3/12		Partial A&Wc
		ADEQ Complaint SWMU 212.355 Pinewood WWTP	1993 13 sites on 4 dates	Fecal coliform	CFU	800	1,800-500,000	13/13		Non FBC, A&Wc, DWS, AgI, AgL
				Nitrogen t	mg/l	3.0	12.9	1/4		Partial FBC, A&Wc
				Phosphorus t	mg/l	1.0	3.72	1/4		Partial FBC, A&Wc
		ADEQ Complaint SWMU 212.020 Pinewood/Munds Pk @ I17 Bridge	1988-2 1990-2 1991-5 1992-5	Fecal coliform	CFU	800 FBC 4000 others	6500	1/6 1/6		Partial A&Ww,FBC,DWS,AgI,AgL
				Nitrogen t	mg/l	3.0 grab sample 1.0 annual mean	3.06-9.04		mean exceeded 1991 & 1992	Partial A&Ww, FBC
				Phosphorus t	mg/l	1.0 grab sample 0.1 annual mean	0.48-1.85		mean exceeded '88,'90,'91,'92	Partial A&Ww, FBC
15060202-018offC Carroll Canyon Wash, hdwt-Oak Creek	A&Wc, FBC, FC, DWS, AgI, AgL	ADEQ Shelby WWTP SWMU-212.226	1992-2 sites	Fecal coliform	CFU	800 FBC 4000 others	130->16,000	1/2		Partial A&Wc, FBC, DWS, AgI, AgL
				Turbidity	NTU	10	<1-40	1/2		Non A&Wc
15060202-021off Unnamed wash hdwt-Dry Creek	A&Wc, FBC, FC, DWS, AgI,AgL	ADEQ Sedona Seep SWMU 212.337	1993-1	TDS	mg/l	500 (SMCL)	1060	1/1		Partial DWS
VERDE RIVER SUB-WATERSHED (see also 15060202)										
15060203-027 Verde River, Wash-West Clear Creek	A&Ww, FBC, FC, AgI, AgL	USGS Fixed Station 09506000 @ Camp Verde	1992-12 1993-12 1994-6 1995-5	Arsenic t	µg/l	3.1	5-27	36/36	19 med	Partial FC
				Turbidity	NTU	50	0.7-320	7/36		Partial A&Ww, FBC
		ADEQ Biocriteria Program abv W. Clear	1993- 1 field 1995-1	Turbidity	NTU	50	8.9-60	1/2		Partial A&Ww

VERDE WATERSHED

ID NUMBER REACH OR LAKE NAME, SEGMENT DESCRIPTION	DESIGNATED USES	AGENCY, PROGRAM, SITE ID SITE DESCRIPTION	SAMPLES: Year-Number (Type of samples)	STANDARDS OR CRITERIA EXCEEDED (Constituents are shown when results indicate a standard or criterion has been exceeded.)						
				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15060203-025 Verde River, West Clear-Fossil Creek	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station VRC2 @ Beasley Flats	1990-7 1991-8	Arsenic t	µg/l	3.1	<10-28	10/11	15 med	Partial FC
				Turbidity	NTU	50	6.3-93	3/17		Partial A&Ww, FBC
		USFWS Study 1991 Eagle Prey Study Verde Ladders site	1988-5 fish	Copper	mg/kg wet wt	1.0 NCBP 85th%	0.94-5.93 fish	3/5	1.39 med	Threat A&Ww
				Chromium	mg/kg wet wt	1.0 presumptive contamination	0.24-1.80 fish	1/5	0.44 med	Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.04-0.11 fish	1/5	0.07 med	Threat A&Ww
				Nickel	mg/kg wet wt	0.9 presumptive contamination	0.16-1.62 fish	1/5	0.39 med	Threat A&Ww
				Selenium	mg/kg wet wt	0.75 predator protection	0.46-1.01 fish	1/5	0.69 med	Threat A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85th%	15.46-43.64 fish	1/5	17.64 med	Threat A&Ww
		ADEQ Biocriteria Program @ Beasley Flats	1995-1	Turbidity	NTU	50	61	1/1		Partial A&Ww, FBC
15060203-018 Verde River Tangle Creek-Ister Flat	A&Ww, FBC, FC, AgI, AgL	SRP Monitoring abv Horseshoe Res	1990-4 1991-4	Ok						Full
		ADEQ Biocriteria Program @ Sheeps Br	1993-1 1995-1	Arsenic t	µg/l	3.1	15-20		18	Partial FC
				Turbidity	NTU	50	64-90	2/2		Non A&Ww & FBC
		USGS Fixed Station 09508500 blw Tangle Creek	1991-12 1992-12 1993-12 1994-6 1995-5	Arsenic t	µg/l	3.1	5-31	48/48	19 med	Partial FC
				Turbidity	NTU	50	0.2-89	2/48		Full
15060203-008 Verde River Horseshoe-Alder Creek	A&Ww, FBC, FC, AgI, AgL	USFWS Study 1991 Eagle Prey Study Verde Ladders site	1988-2 fish	Copper	mg/kg wet wt	1.0 NCBP 85th%	0.88-1.49 fish	1/2		Threat A&Ww
				Mercury	mg/kg wet wt	0.1 predator protection	0.11-0.12 fish	2/2		Threat A&Ww
				Selenium	mg/kg wet wt	0.75 predator protection	0.21-0.87 fish	1/2		Threat A&Ww
				Zinc	mg/kg wet wt	34 NCBP 85th%	14.47-40.25 fish	1/2		Threat A&Ww
15060203-004 Verde River Bartlett-Camp Creek	A&Ww, FBC, FC, AgI, AgL, DWS	USGS Fixed Station 09510000 Below Bartlett Dam	1991-6 1992-6	Arsenic t	µg/l	3.1	8-20	12/12	9.5 med	Partial FC
15060203-030 Lime Creek hdwt-Horseshoe Res	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program 1 mile abv mouth	1995-1	Arsenic t	µg/l	3.1	17	1/1		Partial FC

VERDE WATERSHED

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				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15060203-028 Tangle Creek hdwt-Verde River	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program TGL1	1995-1	Arsenic t	µg/l	3.1	18	1/1		Partial FC
15060203-028off Roundtree Creek hdwt-Tangle Creek	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program	1992-2 1993-2 1994-1 1995-2	Arsenic t	µg/l	3.1	<10-10		<10	Threat FC
15060203-026 West Clear Creek, hdwt-Verde River	A&Wc, FBC, FC, AgL	USFS Coconino National Forest @ Campground @ Tramway @ Bull Pen	1991-6	Ok						Full
		ADEQ Biocriteria Program @ Maxwell Trail @ Bullpen Ranch @ campground @ Calloway Butte	1992-4 2sites 1993-6 3sites 1994-4 2sites 1995-6 3sites	Turbidity	NTU	<0.5-10	12.9	1/20		Full
15060203-024 Fossil Creek, hdwt-Verde River	A&Ww, FBC, FC, AgI, AgL	ADEQ Fixed Station FOS1 near Strawberry	1990-5 1991-7	Nickel t	µg/l	400	<50-660	1/11	<100	Full (FC)
15060203-021offH Houston Creek hdwt-Verde River	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program abv road xing	1995-1	Arsenic t	µg/l	3.1	20	1/1		Partial FC
15060203-020 Wet Bottom Creek, hdwt-Verde	A&Ww, FBC, FC, AgI, AgL	USGS Fixed Station 09508300 @ Childs	1991-4 1992-4 1993-4 1994-4 1995-4	Arsenic t	µg/l	3.1	<1-25	8/9	12 med	Partial FC
				Beryllium t	µg/l	0.21 FC 0.33 FBC	<0.5-0.8	2/4 2/4	<0.5-0.7 med	Threat FC Partial FBC
15060203-019offR Red Creek hdwt-Verde River	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program abv 2nd road xing	1995-1	Arsenic t	µg/l	3.1	10	1/1		Partial FC
15060203-018offS Sycamore Creek hdwt-Verde River	A&Ww, FBC, FC, AgI, AgL	ADEQ Biocriteria Program abv Horseshoe Res	1992-2 1993-2 1994-1 1995-1	Arsenic t	µg/l	3.1	16-21	6/6	17	Partial FC
				DO	mg/l	≥6.0 90% saturation	5.0-7.7 57-80%	2/5		Full (slighly lowered DO under natural conditions)
15060203-002 Sycamore Creek, hdwt-Verde River	A&Ww, FBC, FC, AgI, AgL	USFS - Tonto	1991-3	Ok						Full
		ADEQ Biocriteria Program	1992-2 1993-1 1994-2 1995-1	Ok						Full
		ADEQ Fixed station SYC1 @ Sheep Brdg	1992-5	Arsenic t	µg/l	3.1	14-29	5/5	18 med	Partial FC
		ADEQ Priority Pollutant Program	1993 sediments	Arsenic t	mg/kg	3.82 HBGL 9.2 AZ 90th %	6.1			Threat A&Ww

VERDE WATERSHED

ID NUMBER REACH OR LAKE NAME, SEGMENT DESCRIPTION	DESIGNATED USES	AGENCY, PROGRAM, SITE ID SITE DESCRIPTION	SAMPLES: Year-Number (Type of samples)	STANDARDS OR CRITERIA EXCEEDED (Constituents are shown when results indicate a standard or criterion has been exceeded.)						
				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15060203-002off E.Fork Sycamore Creek, hdwt-Sycamore Creek	A&Ww, FBC, FC, AgI, AgL	ADEQ Duncan Mill Site	1992-5 sites	Arsenic t	µg/l	3.1	12	1		Partial FC
			1992-1 sediment	Lead	mg/kg	AZ background no det.-100	440			Sediment contamination
				Mercury	mg/kg	AZ background no det-0.57	45.3			
EAST VERDE RIVER SUB-WATERSHED										
15060203-022 East Verde River, hdwt-Verde River	A&Wc, FBC, FC, AgI, AgL, DWS	USGS Fixed Station 09507980 @ Childs	1991-6 1992-6 1993-6 1994-6 1995-6	Arsenic t	µg/l	3.1 FC 50 FBC, DWS	<1-150	29/30 2/30	16 med	Partial FC Threat (FBC, DWS)
				Mercury t	µg/l	0.6	<0.1-1.6	1/30		Full (FC)
				Turbidity	NTU	10	0.6-73	2/30		Full
		ADEQ - Biocriteria blw Washington Pk @ Bushy Canyon abv 2nd Xing Camp blw Pine Creek abv mouth	1992-4 2sites 1993-1 1 site 1994-1 1 site 1995-9 5sites	Arsenic t	µg/l	3.1	<10-20	2/15	<10 med	Threat FC
				Iron t	µg/l	300 (SMCL)	<100-310	1/15	190 med	Full
				Turbidity	NTU	10	0.5-11.2			Full
		ADEQ Fixed Station EVR2 above Hwy 87	1990-6 1991-6	Arsenic t	µg/l	3.1	<10-12	1/12	<10 med	Full (FC)
				DO	mg/l	≥7.0 90% saturation	6.2-11.4 81.9-105.8%	2/11		Partial A&Wc
				Iron t	µg/l	300 (SMCL)	<100-3770	5/12	170	Threat (DWS)
				Manganese t	µg/l	50	<50-180	3/12	<50	Threat (DWS)
				Turbidity	NTU	10 A&Wc 50 FBC	1.32-73	3/12 2/12		Partial A&Wc Partial FBC
15060203-022offAM American Gulch hdwt-East Verde River	A&Wedw, PBC	ADEQ Biocriteria dev blw Payson WWTP	1994-1	Ok						Full
15060203-022offB Bonita Creek, hdwt-East Verde River	A&Wc, FBC, DWS, FC	USFS -- Tonto @ Upper Bonita Cr @ Lower Bonita Cr	1991-6 2 sites	Ok						Full
15060203-022offD Dude Creek, hdwt-East Verde River	A&Wc, FBC, FC, AgI, AgL	USFS -- Tonto National Forest	1991-3	Ok						Full
15060203-022offE Ellison Creek, hdwt-East Verde River	A&Wc, FBC, FC, AgL	USFS -- Tonto National Forest	1991-3	Ok						Full
		ADEQ Biocriteria Program @ mouth @ headwaters	1995-2 2 sites	Ok						Full
		ADEQ Fixed Station ELC1 near Tonto Village SWMU-210.138	1991-6 1992-6 1993-6	Beryllium t	µg/l	0.21 FC 0.33 FBC	<0.5-4.8	1/11 1/11		Full (FC) Threat FBC
				Phosphorus t	mg/l	1.0	1.78	1/15		Full (A&Wc)
				Turbidity	NTU	10 A&Wc 50 FBC	0.9-1260	2/10 1/10		Partial A&Wc Full (FBC)

VERDE WATERSHED

ID NUMBER REACH OR LAKE NAME, SEGMENT DESCRIPTION	DESIGNATED USES	AGENCY, PROGRAM, SITE ID SITE DESCRIPTION	SAMPLES: Year-Number (Type of samples)	STANDARDS OR CRITERIA EXCEEDED (Constituents are shown when results indicate a standard or criterion has been exceeded.)						
				CONSTITUENT	UNITS	STANDARD OR CRITERION	RANGE OF VALUES	FREQUENCY EXCEEDED	MEAN OR MEDIAN	USE SUPPORT
15060203-022offGAP Gap Creek, hdwt-East Verde River	A&Wc, FBC, FC, AgI, AgL	ADEQ Biocriteria Program abv Salt Mine Rd	1995-1	Arsenic t	µg/l	3.1	11	1/1		Partial FC
15060203-022offP Pearly Creek, hdwt-East Verde River	A&Wc, FBC, FC, AgI, AgL	USFS -- Tonto National Forest	1991-1	Ok						Full
15060203-022offF Pine Creek, hdwt-East Verde River	A&Wc, FBC, FC, DWS, AgI, AgL	USFS -- Tonto National Forest	1991-3	Turbidity	NTU	10	13.2	1/3		Partial A&Wc
		ADEQ Biocriteria Program @ mouth @ headwaters	1992-2 1993-2 1994-2 1995-1 2sites	Ok						Full
15060203-022offX Webber Creek hdwt-East Verde River	A&Wc, FBC, FC, AgL	ADEQ Biocriteria Program blw Geronimo BSC	1992-2 1993-2 1994-2 1995-1	Ok						Full
VERDE WATERSHED LAKES										
15060203-0110 Bartlett Lake	A&Ww, FBC, DWS, FC, AgI, AgL	ADEQ Clean Lakes Program	1992-1 1993-2 1994-3 1995-4	Arsenic t	µg/l	3.1	10-21	21/24	16 med	Partial FC
15060202-0580 Granite Basin Lake	A&Ww, FBC, FC, AgI, AgL	ADEQ Clean Lakes Program	1992-1 1993-1	pH	SU	6.5-9.0	8.98-9.32	2/4		Partial A&Ww, FBC, AgI, AgL
15060202-0700 J.D. Dam Lake	A&Wc, FBC, FC, AgI, AgL	AGFD Fish Stocking Program	1990-1 1993-1	pH	SU	6.5-9.0	9.6	1/2		Partial A&Wc, FBC, AgI, AgL
				Turbidity	NTU	10	16-20	1/2		Partial A&Wc
Pecks Lake 15060202-1060	A&Ww, FBC, FC, AgI, AgL	Ecology & Env. Inc CERCLA Preliminary Investigation	1993-6 sites, water/sediment	Arsenic	µg/l	3.1	9.0-40.8	6/6		Partial FC
				Arsenic	mg/kg	3.82 (HBGL)	6.6-224	2/2		Sediment contamination
				Beryllium	mg/kg	1.34	0.56-2.8	1/2		Sediment contamination
15060202-1490 Stoneman Lake	A&Wc, FBC, FC, AgI, AgL	ADEQ Clean Lakes Program Fish kill	1995-1	DO	mg/l	≥7.0	0.06-3.61	1/1		Non A&Wc
				pH	SU	6.5-9.0	6.42-9.94	1/1		Non A&Wc Partial FBC, AgI, AgL
15060202-1590 Watson Lake	A&Ww, FBC, FC, AgI, AgL	ADEQ Priority Pollutant Program	1994 fish	Mercury	mg/kg wet wt	0.1 predator protection	0.35 fish			Threat A&Ww
15060202-1630 Whitehorse Lake	A&Wc, FBC, DWS, FC, AgI, AgL	AGFD Fish Stocking Program	1993-1	Iron	µg/l	300 SMCL	204-5,830	1/1	3,020	Partial DWS
				Manganese	µg/l	50 SMCL	1,650	1/1	1,650	Partial DWS
				Turbidity	NTU	10	14-21	2		Partial A&Wc
		ADEQ Clean Lakes Program	1993-1	Ok						Full

Appendix C. Surface Water Assessment Criteria

The assessment criteria used for this report are provided in three tables, based on designated uses, to facilitate comparisons with future and past assessments. Assessments were based primarily on chemical and physical monitoring data, as well as field observations of use support or narrative standard violations. For each waterbody, each designated use was assessed independently, then an overall use support assessment was made based on the most impaired use. See **Appendix A** for standards and criteria used in this assessment and **Appendix F** for waterbody assessments.

There are two categories of assessments based on the amount of data available: monitored and evaluated.

- **Monitored Assessments**--These assessments are based on current monitoring data (normally within the past five years) of two types:
  - Chemical/physical monitoring occurred at least once per quarter for perennial waters, or at least four times in two years for non-perennial streams, or
  - Samples are collected as part of an intensive survey using multiple sites and/or multiple media samples (i.e. fish tissue, sediment, water), collected over a shorter period of time.
- **Evaluated Assessment**--There is insufficient data for a monitored assessment, but sufficient data for an assessment based on:
  - Nominal monitoring data or data older than 5-years that is compared to numeric surface water standards,
  - Sediment, animal tissue, or water sample data that is compared to applicable criteria, such as:
    - Health Based Guidance Levels (HBGLs) for sediment samples,
    - Secondary Maximum Contamination Levels (SMCLs), if Domestic Water Source is a designated use of the waterbody,
    - EPA's Total Dissolved Solids criteria if Agriculture Irrigation is a designated use,
    - Fish tissue or wildlife tissue criteria.
  - Reliable information concerning non-compliance with narrative surface water standards (e.g., debris, films, toxicants in toxic amounts, accumulation of bottom deposits),
  - Reliable information concerning conditions judged to cause impairment (i.e., reduced fish reproduction, excessive algae blooms or weed harvesting, fish kills), or
  - Extrapolation of data from upstream or downstream monitoring sites.

Designated Use Support--There are four categories of designated use support. Assessments vary based on the waterbody's designated uses.

- **Full Support** - No uses are impaired. No numeric or narrative standards violations. No conditions exist which suggest that the waterbody is impaired.
- **Threatened** - (A subcategory of Full Support.) No conditions exist that suggest that the waterbody is impaired; however, occasional exceedances of standards suggest intermittent impairment. Sediment contamination suggest transport of toxicants during runoff events. Elevated levels of contaminants in biotic tissues suggests risks to these animals or animals which consume them.
- **Partial Support** - One or more uses are impaired, but no uses are in non-support. Narrative violations occur seasonally (e.g. excessive algal blooms or weeds). Toxic spill or discharge occurred with nominal or short term effects.
- **Non-Support** - There is substantial impairment of one or more uses based on frequent numeric standard violations, toxic chemical violations, or conditions occurring in the watershed (e.g. fish kills, bathing area closures, cattle deaths).

Nominal Data--Note that when water sample data are limited (only one or two samples), then the single sample or the average of the two samples is used as a mean value in this assessment process. There is low confidence in such assessments. Therefore, when only nominal data are available, the assessed impairment is normally limited to partial support. An assessment of non-support would require more data or documentation of impairment (e.g. fish kills).

Sediment and Animal Tissue Data--Contaminated sediment data are used to assess a threat to designated uses. Uses are not assessed as in partial or non-support based only on sediment data. Similarly, animal tissue samples with levels over screening values are used to assess a threat to Fish Consumption or Aquatic and Wildlife uses until there is enough data to establish that the median value (requiring three or more samples) exceeds the screening value.

Data Conflicts--Any conflicts in use support determination based on type of data will be resolved by considering the weight of evidence available.

Biological Community Data and Public Water Supply Data--Methods for using these biological community data and Public Water Supply data are provided; however, this criteria had limited use because of a lack of biocriteria and data problems.

Biological community data for this assessment was limited to fish survey work completed by the Arizona Game and Fish Department, where findings were related to water quality problems in the watershed by the field biologist. Biocriteria have not yet been established in surface water standards for any communities.

Public Water Supply data was not used for this assessment because the monitoring point is normally at the point of entry into the system, after treatment and blending with other sources. Therefore it may not characterize the source water quality. Also, Arizona laboratories recently used an inappropriate laboratory method which created many administrative "exceedances" in ADEQ's monitoring tracking system (an inappropriate laboratory detection level was reported).

Definitions for assessment criteria tables:

- Conventional parameters = non-toxic parameters that have established standards to protect human health, and aquatic and wildlife health (i.e., fecal coliform, dissolved oxygen, turbidity, pH, temperature, and nutrients).
- Biological communities = fish, macroinvertebrates, algae, or riparian vegetation.
- Narrative standards are defined in Arizona's surface water standards (R18-11-108), and include: bottom deposits, scum, debris, films, objectionable odor, off-flavor of drinking water, aquatic organisms, or waterfowl, toxicants, nuisance growth of plants or algae, or a change in color.
- A Public Water Supply is defined under the Safe Drinking Water Act and Arizona's drinking waters standards as a system which conveys water for human consumption to 15 or more service connections or serves an average of at least 25 per day.
- A confirmed exceedance = re-sampling also shows an exceedance. For example, Public Water Supply data is collected by the system (self-monitored) with potentially low level quality control; therefore, confirmation sampling is required within the rules which govern this monitoring.
- Increased monitoring is imposed on a Public Water Supply either because of an occasional exceedance or because of a detection of a man-made constituent which does not yet have a standard.
- Toxicant = a toxic constituent as defined in Arizona's surface water rules (R18-11-101), and normally includes: priority pollutants, radiochemicals, ammonia, and chlorine.
- Best Available Technology = treatment beyond conventional (conventional treatment includes disinfection, coagulation, sedimentation, and sand filtration).
- Choice of mean or median = mean is used if the data set is symmetrical (little variation), while median is used if the data set is asymmetrical or skewed (some of the data varies so greatly that a few readings would shift the mean value). (See discussion of nominal data above.)

Aquatic and Wildlife Designated Use Assessment Criteria

USE SUPPORT	CHEMICAL/PHYSICAL BASIS	BIOLOGICAL/HABITAT BASIS
FULL SUPPORT	ACUTE TOXIC PARAMETER, MORE THAN 10 SAMPLES (in a 3-year period): No toxicant exceeds a standard more than once.	ANIMAL TISSUE: Tissue concentrations do not exceed a "level of concern", "screening level", or other criteria (see Appendix A).
	ACUTE TOXIC PARAMETER, LESS THAN 10 SAMPLES (in a 3-year period): No toxicant exceeds a standard.	No NARRATIVE STANDARDS violations (e.g., nuisance growth of plants or algae, toxicants, scum, bottom deposits, debris, etc.).
	CHRONIC TOXIC PARAMETER: Mean or median of results does not exceed a standard.	BIOLOGICAL COMMUNITIES or assemblages: Have not been modified beyond natural range or reference condition.
	CONVENTIONAL PARAMETER: Standard is exceeded in 10% or fewer samples. Nutrient and fecal coliform standards not exceeded.	SEDIMENT: Sediment concentrations do not exceed background levels or interim soil cleanup standards.
THREATENED	ACUTE TOXIC PARAMETER, MORE THAN 10 SAMPLES (in a 3-year period): One sample exceeded the standard at a magnitude that raises concerns.	ANIMAL TISSUE: Some values above an "screening value, "level of concern", or other criteria (see Appendix A); however, median/mean does not exceed criteria, or nominal data available.
	CHRONIC TOXIC PARAMETER: Occasional exceedance at a magnitude that raises concerns.	SEDIMENT contamination exceeds a background level or other criteria, but does not exceed interim soil cleanup standards.
	TRENDS: Physical/chemical data analysis indicates decline in water quality over time but standards are not yet exceeded.	Decline in BIOLOGIC COMMUNITY or habitat quality over time, but impairment not clearly demonstrated.
PARTIAL SUPPORT	ACUTE TOXIC PARAMETER, MORE THAN 10 SAMPLES (in a 3-year period): Standard is exceeded in 10% or fewer samples.	NARRATIVE STANDARDS violations of low magnitude or short duration.
	CONVENTIONAL PARAMETER: Standard exceeded in 11% to 25% of samples. Nutrient and fecal coliform single sample standards exceeded but not the various cumulative monitoring standards (e.g. geometric mean).	ANIMAL TISSUE: Median/mean concentration exceeds criteria; however, no fish advisory issued, nor have impacts on aquatic life or predators been established.
		Moderate modification of at least one BIOLOGIC COMMUNITY.
NON-SUPPORT	ACUTE TOXIC PARAMETER, MORE THAN 10 SAMPLES (in a 3-year period): Standard exceeded in more than 10% of samples.	Severe modification of at least one BIOLOGIC COMMUNITY or assemblage.
	ACUTE TOXIC PARAMETER, LESS THAN 10 SAMPLES (in a 3-year period): Standard exceeded one or more times.	NARRATIVE STANDARDS violation of high magnitude or long duration.
	CHRONIC TOXIC PARAMETER: Mean or median of results exceeds a standard.	ANIMAL TISSUE: Median/mean concentration (at least one species) exceeds criteria (see Appendix A); fish advisory issued, or impacts on aquatic life or predators have been established.
	CONVENTIONAL PARAMETER: Standard exceeded in more than 25% of samples.	

Domestic Water Source Designated Use Assessment Criteria

USE SUPPORT	IN-STREAM MONITORING	OTHER INDICATORS
FULL SUPPORT	Mean or median of each parameter does not exceed surface water standards.	No confirmed exceedance of any Maximum Contamination Levels, using Public Water Supply self-monitoring data.
		No drinking water use restrictions (i.e., closures or advisories) based on water quality.
		No narrative violations (i.e., taste and odor).
THREATENED	Assessed as full support; however, magnitude of an occasional exceedance indicates intermittent stressors.	Assessed as full support; however: • Increased monitoring imposed on Public Water System due to water quality, or • Documented water quality degradation of the waterbody is occurring which may impair this use in the future, or • An exceedance in the Public Water System self-monitoring data, and confirmation analysis not available.
PARTIAL SUPPORT	Mean or median of measurements of a non-toxic constituent exceeds a standard.	Best Available Technology implemented at a Public Water Supply due to source water quality problems.
	Mean or median of measurements of Total Dissolved Solids, Chloride, or Sulfate exceeds a Secondary Maximum Contamination Levels (SMCLs).	A public water supply advisory issued due to source water exceedance.
NON-SUPPORT	Mean or median of measurements of a toxicant exceeds a standard.	A confirmed exceedance in Public Water Supply self-monitoring data, which existing treatment does not eliminate in water supplied at user tap. Public or private systems no longer using this water source due to exceedances of MCLs. Contaminants found to be at levels toxic to humans or pets. Epidemiological evidence of a water-borne illness associated with using this water (even after adequate conventional treatment).

Full Body Contact or Partial Body Contact Designated Use Assessment Criteria
Agriculture Livestock Watering and Agriculture Irrigation Designated Use Assessment Criteria

USE SUPPORT	IN-STREAM MONITORING	OTHER INDICATORS
FULL SUPPORT	Numeric standards exceeded in less than or equal to 10% of measurements (except for fecal coliform standards).	No narrative standards violations.
	Fecal coliform standards not exceeded.	
THREATENED	Full support, but the magnitude of an occasional exceedance indicates intermittent sources.	
PARTIAL SUPPORT	Numeric standards exceeded in 11-25% of measurements.	Narrative standards violations, but use(s) impaired for a short period of time.
	Fecal coliform single sample standards exceeded, but geometric mean or 30-day standards not exceeded	
NON-SUPPORT	Numeric standards exceeded in more than 25% of measurements.	Narrative standards violations indicate use(s) impaired for an extended period of time.
	Fecal coliform geometric mean or 30-day standard exceeded, or fecal coliform single samples exceeding more than 25% of measurements.	Beach closures (or other action taken) due to water quality problems.

Fish Consumption Designated Use Assessment Criteria

USE SUPPORT	IN-STREAM MONITORING	OTHER INDICATORS
FULL SUPPORT	Mean or median of measurements do not exceed a surface water standard.	No consumption advisories issued.
		No narrative violations.
THREATENED	Full support, but an occasional exceedance indicates intermittent stressors.	
PARTIAL SUPPORT	Mean or median of measurements exceeds a surface water standard; however, no consumption restriction or advisory has been established.	Narrative violation: Off-flavor in aquatic organisms or waterfowl.
NON-SUPPORT	Fish tissue (or other edible aquatic life) sample exceeds US Food and Drug Administration criteria.	An advisory or ban exists which restricts eating of one or more aquatic life form found in the waterbody.
		Narrative violations: Confirmed cases of indirect toxicity to man through the aquatic food chain.

Appendix D. National Pollutant Discharge Elimination System (NPDES) Wastewater Permits in Arizona

This appendix is a list of facilities that discharge to surface waters, organized by watershed. Information on compliance records can be obtained by contacting ADEQ's Water Quality Compliance Section.

Waterbody ID--The identification code is the "hydrologic unit code" (assigned by USGS for the drainage area), and either a stream "reach number" (assigned by EPA) or a lake number (assigned by AGFD). Streams that have not been assigned reach numbers were identified by the hydrologic unit code and reach number of the downstream water receiving the water plus an "OFF" designation. Lakes that have not been assigned a number by AGFD were given an arbitrary number from 0001 to 0010 after the hydrologic unit code. "Reach" maps are available upon request from ADEQ or EPA, and should soon be available for use in a Geographic Information System through Arizona's State Land Department.

Abbreviations--

ADEQ = Arizona Department of Environmental Quality
AGFD = Arizona Game and Fish Department
EPA = U.S. Environmental Protection Agency
NPDES = National Pollutant Discharge Elimination System (a federal permit required to discharge to a surface water).
USBR = U.S. Bureau of Reclamation
USFWS = U.S. Fish and Wildlife Service
USNPS = National Park Service

FACILITY NAME	NPDES NUMBER	DISCHARGE LOCATION	REACH NUMBER
BILL WILLIAMS WATERSHED			
Blake Ranch R.V. Park	23507	Tributary to Big Sandy Wash	15030201-013off
Blue Beacon of Kingman	23035	Hackberry Wash	15030201-026off
Cyprus Bagdad Copper	22268	Copper Creek	15030202-005off
		Mulholland Wash	15030202-005off
		Mammoth Wash	15030202-004off12
Petro Stopping Ctr.	22756	off Hackberry Wash	15030201-026off
COLORADO - GRAND CANYON WATERSHED			
Energy Fuels - Kanab North Mine	22322	Snake Gulch off Kanab Creek	15010003-007
Grand Canyon Railroad	23566	Tributary to Santa Fe Wash	15010004-007off
Harold I. Bowman & Sons	110272	Rock Canyon Creek	15010003-018off
Senita Village RecreationalVehicle Park.	23698	Tributary to Virgin River	15010010-002
Tusayan Wastewater Treatment Plant South Grand Canyon Sanitation Dist.	23477	Tributary to Coconino Wash	15010004-004off
USBR -- Glen Canyon Dam	110019	Colorado River	14070006-001
USNPS -- Grand Canyon Indian Garden	23621	Garden Creek	15010002-013off63
USNPS -- Grand Canyon North Rim	110426	Bright Angel Creek	15010001-019off6
USNPS -- Grand Canyon South Rim	22152	Tributary to Coconino Wash	150100042-004off
Williams Publicly Owned Treatment Works	20346	Cataract Creek	15010004-007off19
Williams Publicly Owned Treatment Works	23361	Cataract Creek	15010004-007off19

FACILITY NAME	NPDES NUMBER	DISCHARGE LOCATION	REACH NUMBER
COLORADO - LOWER GILA WATERSHED			
Citizen Utility Riverbend/Riviera (Bullhead)	21024	Colorado River	15030101-011
Colorado River Joint Venture (Parker)	21415	Irrigation drain to Colorado River	15030104-018
Harrison Mining -- Tyro Mine	22187	Tributary to Lake Mohave	15030101-012off2
Kingman Publicly Owned Treatment Works	22489	Holy Moses Wash to Sacramento Wash	15030103-008
Mohave Toprock Compressor - (El Paso Gas)	23647	Colorado River	15030101-010
Parker Publicly Owned Treatment Works	22284	Colorado River	15030104-018
Quartzite Publicly Owned Treatment Works	23752	Tyson Wash	15030106-003
Somerton Publicly Owned Treatment Works	23051	Tributary to Yuma Main Drain Canal	15030108-003
USBR -- Davis Dam	110248	Colorado River	15030101-011
USBR -- Hoover Dam	110329	Colorado River	15030101-015
USFWS -- Willow Beach	00132	Lake Mohave	15030101-0960
USNPS -- Katherine's Landing	23523	Lake Mohave	15030101-0960
Yuma Publicly Owned Treatment Works -- Figueroa	20443	Colorado River	15030107-001
Yuma Publicly Owned Treatment Works -- Jones	21563	Colorado River	15030107-002
LITTLE COLORADO - SAN JUAN RIVER BASIN			
Az Public Service -- Cholla	23311	Little Colorado River	15020008-020
Biltmore Prop/Kachina Gardens	22411	Tributary to Little Colorado River	15020008-003off21
Flagstaff Publicly Owned Treatment Works -- Wildcat Hill	20427	Rio de Flag (Walnut Canyon)	15020015-004
Flagstaff Publicly Owned Treatment Works	23639	Rio de Flag	15020015-004
Holbrook Publicly Owned Treatment Works	20257	Leroux Wash	15020009-001
Lake Inv Co (LIVCO) -- Concho	22918	Concho Creek	15020002-015

FACILITY NAME	NPDES NUMBER	DISCHARGE LOCATION	REACH NUMBER
St. Johns Publicly Owned Treatment Works	22772	Little Colorado River	15020002-023
Stone Forest Industries	21474	Rio de Flag	15020015-004
USNPS -- Desert View	23612	Tributary to Cedar Canyon Creek	15020016-005off
Winslow Publicly Owned Treatment Works	23833	Ruby Wash	15052008-003off
MIDDLE GILA RIVER BASIN			
Az. Dept. of Corrections--Eyman	23485	Gila River	15050100-009
AMERON Inc.	21794	Storm drain to Salt River	15060106-001off16
ASARCO Inc. -- Ray Unit	00035	Mineral Creek	15050100-012
Avondale Publicly Owned Treatment Works	23281	Agua Fria River	15070102-001
Florence Wastewater Treatment Plant	22691	Gila River	15050100-003
Buckeye Publicly Owned Treatment Works - Lower Buckeye	22900	Arlington Canal	15070101-010off4
Cyprus -- Miami Mine/Christmas	20516	Dripping Springs Wash	15050100-011off1.5
Florence Publicly Owned Treatment Works	22594	Gila River	15050100-003
Gila Bend Publicly Owned Treatment Works	20231	Tributary to Gila River	15070101-003off3
Goodyear Publicly Owned Treatment Works	22357	Agua Fria River	15070102-001
Goodyear/Estrella Publicly Owned Treatment Works	23582	Corgett Wash	15070101-014off
El Mirage Publicly Owned Treatment Works	23272	Agua Fria River	15070102-007
Kearny Publicly Owned Treatment Works	21827	Gila River	15050100-008
Kings Ranch Unit II	23060	Agua Fria River	15070102-019
Loral Corp. -- Litchfield	00108	Buckeye Canal	15070102-001off2
Magma Copper Company -- Superior	20389	Tributary to Queen Creek	15050100-014off7
Magma Copper -- MaCabe Mining	22233	Galena Gulch	15070102-031off11

FACILITY NAME	NPDES NUMBER	DISCHARGE LOCATION	REACH NUMBER
Mining Camp Restaurant	21825	Siphon Draw to Gila River	15050100-013off11.5
One Camelback	23868	Storm drain to Salt River	1506106-001
Prescott Valley Publicly Owned Treatment Works	23761	Agua Fria River	15070102-032
Pebblecreek Golf Resort	23680	Bullard Wash to Gila River	R15070101-015off
Phoenix Publicly Owned Treatment Works -- 23rd Avenue	20559	Tributary to Salt River	15060106-001off13
Phoenix Publicly Owned Treatment Works -- 91st Avenue	20524	Tributary to Salt River	15060106-001off11
Queen Valley Sanitary District	22071	Queen Creek	15050100-014off0.2
Rafter Eleven Recreational Vehicle Park	23256	Lynx Creek	15070102-033
Roadhaven Recreational Vehicle Park	23515	Tributary to Queen Creek	15050100-013off
Shadow Mountain Mobile Home Park	22241	Tributary to Lynx Creek	15070102-033off4.5
Soft Winds Mobile Home Park	22128	Tributary to Agua Fria River	15070102-031off13
Spur Cross Ranch Wastewater Treatment Plant	23167	Cave Creek	15060106-026
Salt River Project -- Agua Fria Steam Plant	23531	Grand Canal	15060106-001offG
Salt River Project -- Kyrene Steam Plant	23540	Western Canal	15060106-001offW
Salt River Project -- Santan Generating Plant	23558	Eastern Canal	150601060991offE
Salt River Project -- Well 28	23825	Salt River	15060106-001
Superior Sanitary District	21199	Tributary to Queen Creek	15050100-014off7
Tempe Publicly Owned Treatment Works-- Kyrene Reclamation	23248	Western Canal	15060106-001offW
Tempe Publicly Owned Treatment Works -- Papago Park	23451	Tributary to Salt River	150601001off
Tolleson Publicly Owned Treatment Works	20338	Salt River	15060106-001
Town and Country Properties	22446	Lynx Creek	15070102-003
USAF -- Williams Air Force Base	110230	Roosevelt Canal	15050100-013off11.5

FACILITY NAME	NPDES NUMBER	DISCHARGE LOCATION	REACH NUMBER
USAF -- Luke Air Force Base (Gila Bend)	110469	Quilotosa Wash	15070101-005off4.5
USAF -- Luke Air Force Base (Phoenix)	110221	Agua Fria River	15070102-007
USBR -- Agua Fria Siphon	23876	Agua Fria River	15070102-007
USBR -- Coolidge Dam	23671	Gila River	15050100-010
USBR -- New River	23353	New River	15070102-006
USBR -- New Waddell Dam	22578	Agua Fria River	15070102-008
USBR -- Salt River Siphon	23736	Salt River	15060106-001
USFS -- Prescott (Crown King)	110515	Wash to Poland Creek	15070102-037off7
Union Rock & Mineral -- Central Ave Landfill	22730	Salt River	15060106-001
Villages at Lynx Creek	23141	Lynx Creek	15070102-003
Wash Cotton Service Corp (Anderson Clayton)	20397	Roosevelt Canal	15060106-001off0.2
Wickenberg Concrete & Material	23094	Monarch Wash	15070103-002off30
Wickenburg Concrete & Material	23817	San Domingo Wash	15070103-002off
Wickenburg Publicly Owned Treatment Works	20044	Hassayampa River	15070103-002
Winkleman Publicly Owned Treatment Works	20176	Gila River	15050100-008
SALT RIVER BASIN			
AGFD -- Canyon Creek Hatchery	21229	Canyon Creek	15060103-014
AGFD -- Tonto Creek Hatchery	21211	Tonto Creek	15060105-013
Canyon Lake Associates	21440	Canyon Lake	15060106-0250
Cobre Valley Assoc (Claypool)	20745	Miami Wash	15060103-005off13
Cyprus -- Miami Mine/Inspir.	20508	Bloody Tanks Wash	15060103-005off13off
Globe Wastewater Treatment Plant -- Holgate	21787	Tributary to Pinal Creek	15060103-005off15

FACILITY NAME	NPDES NUMBER	DISCHARGE LOCATION	REACH NUMBER
Globe Wastewater Treatment Plant -- Pinal Creek	20249	Pinal Creek	15060103-005
Magma Copper -- Pinto Valley	20401	Pinto Creek	1060103-018
Magma Copper -- Pinto Valley	20419	Tributary to Miami Wash	15060103-005off13
Roosevelt-Lakeside Park	21796	Roosevelt Lake	15060103-1240
Tortilla Flat Resort	22390	Tortilla Creek	15060106-014
USBR -- Roosevelt Dam	22632	Salt River	15060106-024
SAN CARLOS - SAFFORD - DUNCAN WATERSHED (UPPER GILA RIVER BASIN)			
Arizona Dept of Corrections -- Globe	22721	Tributary to Aliso Wash	15040007-012off3.5
Arizona Dept of Corrections -- Safford	22764	Bennet Wash	15040005-020off2
Phelps Dodge -- Morenci	22705	Chase Creek	15040004-001off10
		Gold Gulch	15040005-025off7
Phelps Dodge -- Safford	22331	Watson Wash	15040005-033
SAN PEDRO - WILLCOX - RIO YAQUI WATERSHED			
Arizona Electric Power Coop	23795	Willcox Playa	15050201-1892
Bisbee -- Douglas International Airport	22659	Whitewater Draw	15080301-004
Bisbee Publicly Owned Treatment Works	21810	Mule Gulch	15080301-004off0
Clark Trucking Company	22276	San Pedro River	15050203-003
Pima Co--Mt Lemmon/Summerhaven	22250	Adler Wash	15050203-008off6
Tombstone Publicly Owned Treatment Works	22080	Walnut Grove	15050202-009
SANTA CRUZ - RIO MAGDALENA - RIO SONOITA WATERSHED			
Arizona State Parks -- Patagonia Lake	21793	Patagonia Lake	15050301-013
Casa Grande Publicly Owned Treatment Works	21873	Northbranch Santa Cruz River	15050303-003off0

FACILITY NAME	NPDES NUMBER	DISCHARGE LOCATION	REACH NUMBER
Cyprus-Twin Buttes Heap Leach	23388	Santa Cruz River	15050301-006
Davis Monthan Air Force Base	23701	Tributary to Santa Cruz River	15050301-004
MSP Companies (Marana Wastewater Treatment Plant)	22373	Tributary to Gila River	15050303-006
Nogales Publicly Owned Treatment Works	20150	Santa Cruz River	15050301-010
Oracle Sanitary District	20681	Tributary to Big Wash	15050301-017
Patagonia Publicly Owned Treatment Works	21679	Sonoita Creek	15050301-013
Pima County -- Ina Road	20001	Santa Cruz River	15050301-002 on0
Pima County -- Roger Road	20923	Santa Cruz River	15050301-003
Saddlebrooke Wastewater Treatment Plant	22853	Tributary to Canada del Oro	15050301-017off7.5
Tucson -- A Mountain Swim. Fac.	22781	Tributary to Santa Cruz River	15050301-005off1
VERDE WATERSHED			
AGFD -- Page Springs Hatchery	21245	Oak Creek	15060202-017
Big Park Improvement District	23728	Jacks Canyon	15060202-008
Chaparral City Water Company	22381	Tributary to Verde River	15060203-001off
C.B. Real Estate -- Sunset Plaza	22292	Tributary to Carol Canyon	15060202-018off6
Iron Springs San Dist-B (Prescott)	20931	Willow Creek off Granite Creek	15060202-059off12
Jerome Publicly Owned Treatment Works	21804	Bitter Creek	15060202-025off16
No. Gila County Sanitary Dist.	20117	American Gulch	15060203-022off21
Sedona Venture/Sedona Mobile Home Park	21807	Dry Creek	15060202-021
USBR -- Barlett Dam		Bartlett Lake	15060203-0110
Valley Vista Estate (Sedona)	22136	Tributary to Jack's Canyon	15060202-008off1

Appendix E. Aquatic Life and Public Health Impacts

This appendix is a list of aquatic life and public health impacts of contamination in Arizona during the past two years (October 1, 1993 through September 30, 1995). The following incident categories were considered for this listing:

- Waterborne disease incident,
- Fish advisory, ban, or restriction,
- Pollution-caused fish kill or abnormality observed,
- Sediment contamination,
- Surface drinking water supply closure or advisory,
- Swimming area closure, and
- Fish or wildlife tissue contamination above Arizona's "screening level" **(Appendix A)**.

This list is not comprehensive because Arizona does not have a central reporting system for tracking this type of information and compiling data gathered from numerous agencies (i.e., county and state health departments, county and state environmental departments, Arizona Game and Fish Department, USFWS, BLM, USFS, National Parks Service, and more).

The term "elevated" was used in this table to indicate that the level of contamination was over the screening values for soil or animal tissue presented in **Appendix A**. In most cases the real impact on fish and wildlife life or humans consuming these animals is not known and will be costly to determine.

Many of these sites have been listed before, but the problems have not been resolved. The list has been greatly expanded by establishing more screening values for animal tissues and because of investigations of suspected problem sites through ADEQ's Priority Pollutant Program.

WATERBODY NAME, SEGMENT, AND WATERBODY ID(S)	AQUATIC IMPACT AND STRESSORS OF CONCERN	PROBABLE SOURCES	MILES (mi) ACRES (ac)
BILL WILLIAMS WATERSHED			
Alamo Lake 15030204-0040	Elevated levels of cadmium, chromium, copper, lead, mercury, and zinc in fish tissue (ADEQ Priority Pollutant Monitoring 1992, King et al. 1991).	Active and abandoned mining, and natural conditions. Lake acts as a sink for contaminated sediments.	5000 ac
Bill Williams River Alamo Lake-Colorado R 15030204-001, -002, -003	Aquatic life have elevated levels of boron, cadmium, chromium, copper, mercury, selenium, and zinc; mercury and selenium are high enough that they may be impacting reproduction of predator species. Arsenic is elevated in sediments. (Ruiz 1994)	Active and abandoned mining, natural conditions, cumulative impacts from activities in other states. Selenium being investigated, but maybe from uncontrollable leaching of soils at reservoirs (i.e. Lake Powell).	39 mi
Boulder Creek Wilder-Burro Creek 15030202-005	Sediment contamination at Hillside Mine (an abandoned mine) by arsenic (an ADEQ investigation in 1992).	Abandoned mine adit.	8 mi
COLORADO RIVER - GRAND CANYON WATERSHED			
Cataract Lake 15010004-0280	Elevated mercury level in fish tissue (Priority Pollutant Program 1993 monitoring).	Unknown	35 ac
Horn Creek 15010002-013OFF62	**Drinking water advisory** due to high levels of uranium and alpha counts. (National Parks Service posted in 1995).	Mining in watershed or natural.	1 mi
Pumpkin Springs, hdwt-Colorado River 15010002-003OFFX	**Drinking water advisory** due to arsenic as high as 1,180 µg/l (drinking water standard is 50 µg/l). (Chloride is also at 3920 mg/l -- SMCL is 250 mg/l). (National Parks Service 1994)	Spring naturally contaminated.	3 mi
COLORADO RIVER - LOWER GILA WATERSHED			
Colorado River, Main Canal-Mexico 15030107-001	Elevated levels of copper, DDT metabolites, dieldrin, mercury, and selenium in fish. Elevated level of arsenic in sediment.	Pesticides from agricultural crop production. Massive watershed with drainage in several states; therefore, sources may be unknown.	31 mi
Colorado River Vinegre-McAllister Wash 15030104-006, 008, 009	Elevated levels of selenium in fish and invertebrates, at a level that might interfere with reproduction in predator species (Lusk 1993, McCaulou et al. 1994).	Investigating upstream impoundments and irrigation return flows. Source may be uncontrollable leaching of metals from soils at reservoirs (Lake Powell). Massive drainage area covering several states, sources may be difficult to identify.	38 mi
Adobe Lake 15030104-0001	Elevated levels of selenium in invertebrates and birds, at a level which may be interfering with reproduction in predator species (Lusk 1993, Martinez 1994).		200 ac
Bee Lake 15030104-0002	Elevated levels of selenium, arsenic, and zinc in birds invertebrates and fish. Selenium at a level which may be interfering with reproduction in predator species (Lusk 1993, Martinez 1994).		20 ac

WATERBODY NAME, SEGMENT, AND WATERBODY ID(S)	AQUATIC IMPACT AND STRESSORS OF CONCERN	PROBABLE SOURCES	MILES (mi) ACRES (ac)
Butler Lake 15030104-0003	Elevated levels of selenium and mercury in fish, invertebrates, and birds. Selenium at a level which may be interfering with reproduction in predator species (Lusk 1993, Martinez 1994).	Investigating upstream impoundments and irrigation return flows. Source may be uncontrollable leaching of metals from soils at reservoirs (Lake Powell). Massive drainage area covering several states, sources may be difficult to identify.	50 ac
Cibola Lake 15030104-0330	Elevated levels of selenium, lead, and zinc in fish, clams, and birds. Selenium at a level which may be interfering with reproduction in predator species (Rusk 1991, King 1993, McCaulou et al. 1994, Villegas and Maughan 1994, Welsh and Maughan 1994).		15 ac
Imperial Reservoir 15030104-0670	Elevated levels of selenium in invertebrates and birds, at a level which may be interfering with reproduction in predator species (Rusk 1991, McCaulou et al. 1994).		400 ac
Island Lake 15030104-0004	Elevated levels of selenium in fish, invertebrates, and birds, at a level which may be interfering with reproduction in prey species (Lusk 1994, Martinez 1994).		130 ac
Lake Havasu 15030101-0590	1. **Beaches closed** due to high number of fecal coliform: in 1991 - 3 beaches, in 1994 - 8 beaches, and in 1995 - 6 beaches. 2. Elevated level of selenium in clams (McCaulou et al. 1994). Selenium at a level which may interfere with reproduction in predator species.	1. Wastewater treatment and disposal along with natural conditions (hot temperatures and relatively stagnant water along beaches). 2. Investigating upstream impoundments and irrigation return flows. Source may be uncontrollable leaching of metals from soils at reservoirs (Lake Powell).	150 ac
McAllister Lake 15030104-0005	Elevated levels of selenium in fish, invertebrates, and birds, at a level which may be interfering with reproduction in predator species (Lusk 1994, Martinez 1994).	Investigating upstream impoundments and irrigation return flows. Source may be uncontrollable leaching of metals from soils at reservoirs (Lake Powell). Massive drainage area covering several states, sources may be difficult to identify.	40 ac
Martinez Lake 15030104-0880	Elevated levels of selenium, copper and zinc in fish, elevated levels of selenium in sediment (King 1993). Selenium at a level which may be interfering with reproduction in predator species.		640 ac
Mittry Lake 15030107-0950	Elevated levels of selenium in invertebrates and birds, at a level which may be interfering with reproduction in predator species (Rusk 1991, McCaulou 1994).		325 ac
Painted Rock Lake (Borrow Pit) 15070201-1010	**Fish advisory.** Fish and wildlife with elevated levels of pesticides (DDT metabolites, toxaphene, chlordane, and dieldrin) and mercury.	See comments in Middle Gila for Painted Rock Reservoir and Gila River.	170 ac
Topock Marsh 15030101-1530	Elevated levels of selenium, cadmium, copper, lead, mercury, and zinc in birds, invertebrates, and fish (Rusk 1991, Baker et al. 1992, and McCaulou et al. 1994). Levels of selenium may be interfering with reproduction in predator species.	Investigating upstream impoundments and irrigation return flows. Source may be uncontrollable leaching of metals from soils at reservoirs (Lake Powell). Massive drainage area covering several states, sources may be difficult to identify.	4000 ac
Wellton-Mohawk Canal Gila Gravity Drain-split (Wellton Canal/Mohawk Canal) 15030107-003OFFWM	Elevated levels of copper, DDT metabolites, and toxaphene in fish.	Pesticides from agricultural return flows. Source of metal unknown.	15 mi

WATERBODY NAME, SEGMENT, AND WATERBODY ID(S)	AQUATIC IMPACT AND STRESSORS OF CONCERN	PROBABLE SOURCES	MILES (mi) ACRES (ac)
Yuma Main Canal, siphon-E & W Main Branch 15030108-003OFFDR	Elevated levels of chlordane, DDT metabolites, dieldrin, and toxaphene in fish, and elevated level of arsenic in sediment.	Pesticides from agricultural return flows. Arsenic may be at natural levels.	1 mi
LITTLE COLORADO - SAN JUAN WATERSHED			
Little Colorado River Puerco-Leroux 15020008-020 and Jack-Corn Creek 15020008-003	Elevated levels of arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc in fish (USFWS study - Andrews et al. 1995).	USGS report (Fisk et al. 1994) indicates that these heavy metals may be natural loading.	42 mi
MIDDLE GILA RIVER WATERSHED			
Buckeye Canal Gila River-Hassayampa River 15070103-001OFF	Elevated levels of DDT metabolites and zinc in fish (Earth Technology Corp 1993, Priority Pollutant Program monitoring in 1994).	Urban runoff, historic agricultural use.	21 mi
Chaparral Lake 15060106-0300	Elevated levels of DDT metabolites in fish (Priority Pollutant Program monitoring in 1992).	Historic agricultural use.	11 ac
Dysart Drain (canal drain to Agua Fria) 15070102-007OFFDV	**Fish advisory.** Elevated levels of DDT metabolites (up to 24 mg/kg) and zinc in fish (Priority Pollutant Program monitoring in 1994-1995).	Urban runoff, historic agricultural uses.	3 mi
French Gulch, hdwt-Hassayampa 15070103-007OFFF	Elevated levels of arsenic in sediment near Zonia Mine (Priority Pollutant Program monitoring in 1993).	Mining, or may be natural.	9 mi
Galena Gulch headwaters-Agua Fria 15070102-031OFF11	Elevated levels of lead and zinc in sediment near McCabe Mine (Hargis and Assoc. 1990).	Mining.	6 mi
Gila River Box O Wash-Queen Creek 15050100-003	Elevated levels of copper, mercury, and selenium in fish (USFWS study - King and Baker 1994).	Current and historic mining, and natural conditions.	49 mi

WATERBODY NAME, SEGMENT, AND WATERBODY ID(S)	AQUATIC IMPACT AND STRESSORS OF CONCERN	PROBABLE SOURCES	MILES (mi) ACRES (ac)
Gila River, Salt River-Painted Rock Lake 15070101-001, -003 -005, -007, -008, -009, -010, -014, -015	**Fish advisory**. Fish and wildlife with elevated levels of pesticides (DDT metabolites, toxaphene, chlordane, and dieldrin) and mercury. Elevated levels of DDT metabolites in some sediment samples (Earth Technology Corp. 1993).	Pesticides and mercuric compounds contributed by historic agricultural practices and current urban and agricultural runoff. Mercury could also have been contributed by historic wastewater discharges or historic mining in watershed.	72 mi
Salt River, 23rd Ave POTW-Gila River 15060106-001	**Fish advisory**. Fish and wildlife with elevated levels of pesticides (DDT metabolites, toxaphene, chlordane, and dieldrin) and mercury. Fish have elevated levels of heptachlor epoxide and zinc (Priority Pollutant Program monitoring in 1994).		42 mi
Painted Rock Reservoir 15070101-1020	**Fish advisory**. Fish and wildlife with elevated levels of pesticides (DDT metabolites, toxaphene, chlordane, and dieldrin) and mercury. Elevated levels of DDT metabolites in some sediment samples (Earth Technology Corp. 1993).		200 ac
Hassayampa River, Jackrabbit-Gila River 15070103-001	**Fish advisory**. Fish and wildlife with elevated levels of pesticides (DDT metabolites, toxaphene, chlordane, and dieldrin) and mercury.		15 mi
Hassayampa River, hdwt-Blind Indian 15070103-007	Elevated levels of arsenic, beryllium, cadmium, copper, lead, mercury, selenium and thallium in sediment near Senator Mine (Priority Pollutant Program monitoring in 1993).	Mining.	25 mi
Hassayampa Lake 15070103-3160	Elevated levels of arsenic, copper, and lead in sediment (Priority Pollutant Program monitoring in 1993).	Historic and current mining.	1 ac
Lake Pleasant 15070102-1100	Elevated levels of mercury and selenium in fish, and elevated levels of arsenic in sediment (Priority Pollutant Program monitoring in 1992 and 1994). Elevated levels of copper, mercury, selenium, and zinc in fish (King et al. 1991).	Historic and current mining in watershed. Lake acts as sink for contaminated sediments.	1,540 ac
Lynx Creek, headwaters-Agua Fria 15070102-033	Elevated levels of arsenic, cadmium copper, and lead in sediment (Priority Pollutant Program monitoring in 1993).	Current and historic mining.	15 mi
Lynx Lake 15070102-0860	Elevated levels of arsenic, cadmium, copper, and lead in sediment. Elevated level of lead in fish. (Priority Pollutant Program monitoring in 1992 and 1993).	Historic and current mining.	55 ac
Maricopa Lake 15070102-0001	**Fish kill** due to eutrophic conditions (high nutrients, algal bloom, low dissolved oxygen, high pH).	Recreation (i.e. feeding of ducks resulting in high population of ducks).	4 ac
McKellips Lake 15060106-0920	Elevated levels of DDT metabolites, dieldrin, and mercury in fish (Priority Pollutant Program monitoring in 1992).	Urban runoff, historic agricultural uses.	6 ac
Mineral Creek, headwaters-Gila River 15050100-012	Elevated levels of copper and zinc in sediment (King and Baker 1994).	Current and historic mining, and natural conditions.	17 mi

WATERBODY NAME, SEGMENT, AND WATERBODY ID(S)	AQUATIC IMPACT AND STRESSORS OF CONCERN	PROBABLE SOURCES	MILES (mi) ACRES (ac)
Pine Creek headwaters-Lynx Creek 15070102-033OFFP	Elevated level of arsenic in sediment near Sheldon Mine (Priority Pollutant Program monitoring in 1994).	Mining.	3 mi
Roosevelt Canal Agua Fria-Hassayampa River	Elevated levels of DDT metabolites and selenium in fish (Priority Pollutant Program monitoring in 1994).	Urban runoff, historic agricultural use.	30 mi
unnamed wash at Luke Air Force Base headwaters-Agua Fria 15070102-007OFFD	Elevated levels of chromium, lead, mercury, and zinc in fish. Elevated levels of arsenic and cadmium in sediment. (Priority Pollutant Program monitoring in 1993-1994)	Historic waste disposal practices.	3 mi
SALT RIVER WATERSHED			
Roosevelt Lake 15060103-1240	Elevated levels of copper and zinc in fish (King et al. 1991).	Mining	13,058 ac
Salt River Cherry Creek-Pinal Creek 15060103-006	Elevated levels of mercury in fish (USFWS study - King et al. 1991).	Unknown.	13.1 mi
Tonto Creek Gun Creek-Greenback 15060105-006	Elevated levels of mercury in fish (USFWS study - King et al. 1991).	Unknown.	18 mi
SAN CARLOS - SAFFORD - DUNCAN WATERSHED (UPPER GILA BASIN)			
Gila River New Mexico border-Bitter Creek 15040002-004	Elevated levels of cadmium in sediment (USFWS study - King et al. 1994).	Mining.	14 mi
Gila River Skully-San Francisco R 15040002-001	Elevated levels of cadmium and thallium in sediment, and elevated mercury in fish (USFWS study - King and Baker 1994).	Mining.	13 mi
Gila River Yuma Wash-San Carlos Reservation 15040005-020, -015, -012,	Elevated levels of cadmium and thallium in sediment; elevated levels of copper, mercury, and zinc in fish (USFWS study - King and Baker 1994).	Current and historic mining.	45 mi
San Francisco River Walnut-Padre Creek 15040004-003	Elevated level of cadmium in sediment (USFWS study - King and Baker 1994).	Historic mining.	15 mi
San Francisco River Limestone-Gila River 15040004-001	Elevated levels of copper and mercury in fish; elevated levels of beryllium cadmium and copper in sediment below Clifton mines (USFWS study - King and Baker 1994).	Current and historic mining.	11 mi

WATERBODY NAME, SEGMENT, AND WATERBODY ID(S)	AQUATIC IMPACT AND STRESSORS OF CONCERN	PROBABLE SOURCES	MILES (mi) ACRES (ac)
SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED			
Aravaipa Creek Rattlesnake-San Pedro 15050203-004	Elevated levels of lead and selenium in fish (Priority Pollutant Program monitoring in 1993).	Historic mining	31 mi
San Pedro Peppersauce-Aravaipa 15050203-003	Elevated levels of copper in sediment at San Manuel Mine (Priority Pollutant Program monitoring in 1994).	Mining	18 mi
Willcox Playa 15050201-1892	Elevated levels of cadmium, chromium, DDT metabolites, and selenium in birds; elevated levels of chromium and selenium in fish; elevated levels of arsenic in sediment (Priority Pollutant Program monitoring in 1994).	Wastewater discharge, unknown.	150 ac
SANTA CRUZ - RIO MAGDELENA - RIO SONOYTA WATERSHED			
Arivaca Lake 15050304-0080	**Fish advisory** due to elevated levels of mercury in fish. (Priority Pollutant Program monitoring in 1995).	Historic mining.	80 ac
California Gulch, hdwt-Mexico 15080200-000	Elevated levels of cadmium, lead, manganese, and zinc in sediment near Montana Mine (ADEQ investigation in 1990).	Mining	3 mi
Franklin Street Wash headwaters-Nogales Wash 15050301-011OFF	Elevated levels of arsenic and zinc in sediment (Priority Pollutant Program monitoring in 1994).	Unknown.	1 mi
Harshaw Wash, hdwt-Sonoita Creek 15050301-013OFF17S	Elevated levels of arsenic in sediment near mines (Priority Pollutant Program monitoring in 1994).	Mining	12 mi
Pena Blanc Lake 15050301-1070	**Fish advisory** due to elevated levels of mercury in fish (mean 1.44 mg/kg in largemouth bass). Elevated levels of beryllium in sediment. (Priority Pollutant Program monitoring in 1994 and 1995).	Historic mining.	45 ac
Santa Cruz River headwaters-Mexico border 15050301-012OFF	Elevated levels of chromium and zinc in fish (Priority Pollutant Program monitoring in 1994).	Historic and current mining.	11 mi
Santa Cruz River Sonoita-Sopori 15050301-009 and -008	Elevated levels of chromium, DDT metabolites, dieldrin, mercury, and zinc in fish; elevated levels of chromium in birds; elevated levels of arsenic in sediment (Priority Pollutant Program monitoring in 1993 and 1994).	Urban runoff, agricultural activities in Mexico, point source wastewater discharges.	20 mi
Santa Cruz River Canada del Oro-Guild Wash 15050301-001	Elevated levels of DDT metabolites in birds. Killdeer have a large foraging area; therefore, the elevated DDT metabolite level may not be related to this stream reach. (Priority Pollutant Program monitorng in 1993).	Urban runoff, historic agricultural activities.	8 mi
Silverbell Lake 15050301-1400	Elevated levels of lead in fish (Priority Pollutant Program monitoring in 1992).	Unknown.	18 ac

WATERBODY NAME, SEGMENT, AND WATERBODY ID(S)	AQUATIC IMPACT AND STRESSORS OF CONCERN	PROBABLE SOURCES	MILES (mi) ACRES (ac)
VERDE RIVER WATERSHED			
East Fork Sycamore, hdwt-Sycamore 15060203-002OFF	Elevated levels of lead and mercury in sediment at Duncan Mill site (ADEQ investigation in 1992).	Mine milling.	6 mi
Oak Creek West Fork-Dry Creek 15060202-018	**Swimming area closed** (Slide Rock) in 1995 due to high levels of fecal coliform.	Recreation.	21 mi
Pecks Lake 15060202-1060	Elevated levels of arsenic and beryllium in sediment.	Mine tailings.	77 ac
unnamed wash headwater-Verde River 15060202-015OFF	Sediment contaminated by diesel fuel spill (ADEQ investigation in 1994).	Above ground tank spill.	2 mi
Verde River West Clear-Fossil Creek 15060203-025	Elevated levels of copper, chromium, mercury, nickel, selenium, and zinc in fish (USFWS study - King et al. 1991).	Historic mining.	20 mi
Verde River Horseshoe Res-Alder Creek 15060203-008	Elevated levels of copper, mercury, selenium, and zinc in fish (USFWS study - King et al. 1991).	Historic mining.	12 mi
Watson Lake 15060202-1590	Elevated mercury in fish (ADEQ Priority Pollutant Program monitoring in 1994).	Historic wastewater discharge, historic mining activities, and possible agriculture.	30 ac

Appendix F. Waterbody Assessments - 1996

Individual waterbody assessments of designated uses are shown on a series of 10 tables in this appendix. Stream data are subdivided by the following watersheds (●) and sub-watersheds (-). Lake data follow all of the stream reach data in each watershed.

- Bill Williams Watershed (pages F-2 to F-5)
  Sub-watersheds: Big Sandy, Burro Creek, Santa Maria, Bill Williams.
- Colorado-Grand Canyon Watershed (pages F-6 to F-10)
  Sub-watersheds: Colorado River Main Stem, Kanab Creek, Havasu Creek, Red Lake Playa, Virgin River.
- Colorado-Lower Gila River Watershed (pages F-11 to F-15)
  Sub-watersheds: Colorado River Main Stem, Gila River.
- Little Colorado-San Juan Watershed (pages F-16 to F-25)
  Sub-watersheds: Silver Creek, Puerco, East Clear, Chevelon, and Canyon Diablo.
- Middle Gila Watershed (pages F-26 to F-36)
  Sub-watersheds: Gila River, Salt River (below Granite Reef Dam), Agua Fria River, Hassayampa River sub-watersheds.
- Salt River Watershed (pages F-37 to F-42)
  Sub-watersheds: Black River, White River, Salt River (above Granite Reef Dam), Tonto Creek.
- San Carlos-Safford-Duncan Watershed (pages F-43 to F-47)
  Sub-watersheds: Upper Gila River, San Francisco River, San Simon Creek, San Carlos.
- San Pedro River-Willcox Playa-Rio Yaqui Watershed (pages F-48 to F-52)
  Sub-watersheds: San Pedro River, Willcox Playa, Rio Yaqui.
- Santa Cruz River-Rio Magdelena-Rio Sonoita Watershed (pages F-53 to F-57)
  Sub-watersheds: Santa Cruz River, Sonoita Creek, Rillito Creek, Rios de Mexico.
- Verde River Watershed (pages F-58 to F-66)
  Sub-watersheds: Big Chino, Verde River, Oak Creek, East Verde River.

Abbreviations, Acronyms, and Terms--

A&W = Aquatic and Wildlife use
  A&Wc = coldwater fishery
  A&Ww = warmwater fishery
  A&We = ephemeral
  A&Wedw = effluent dependent water)
FC = Fish Consumption use
FBC= Full Body Contact (swimming) use
PBC = Partial Body Contact (non-swimming recreation) use
DWS = Domestic Water Source (drinking water) use
AgI = Agriculture Irrigation use
AgL = Agriculture Livestock Watering use

NPDES = National Pollutant Discharge Elimination System, a federal permit to discharge into any "water of the United States"
WWTP = Wastewater Treatment Plant

BILL WILLIAMS WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
BIG SANDY SUB-WATERSHED						
Big Sandy River, Tule-Bull Canyon 15030201-009	5.1 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	Evaluation based on downstream monitoring (15030201-006).
Big Sandy River, Bull Canyon-Stove Spring 15030201-007	1.4 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	Evaluation based on downstream monitoring (15030201-006).
Big Sandy River, Stove Spring-Sycamore 15030201-006	6.5 mi	A&Ww, FBC, FC, AgL	Monitored	Yes	Partial	ADEQ station (BS1) at highway 93 bridge: partial support of FBC, AgL, and A&Ww due to turbidity and metals (beryllium, barium, lead). Threats to fish consumption because of arsenic, beryllium, and nickel. Sources believed to be combination of natural conditions, rangeland management, and abandoned/inactive mines.
Big Sandy River, Sycamore-Burro Creek 15030201-004	9.4 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	BLM monitoring in 1992-1993 for field parameters only: partial support due to turbidity. Evaluation also based on upstream monitoring and field biologist evaluations (see comments in 15030201-006).
Big Sandy River, Burro-Groom Spring 15030201-003	7 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring and professional field evaluation (see comments in 15030201-006 and -004). BLM monitoring in 1994-1995 for field parameters only.
Big Sandy River, Groom Spring-Rupley 15030201-002	0.8 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring and field evaluation (see comments in 15030201-006 and -004).
Big Sandy River, Rupley-Alamo Lake North 15030201-001	16.2 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	Turbidity problems due to natural conditions and rangeland management. See comments for 15030201-006 and -004.
Trout Creek, Cow Creek-Knight Creek 15030201-014	27.3 mi	A&Ww, FBC, FC, AgL	Monitored	Yes	Partial	ADEQ station (TR1) 1991-1993, 13 samples: partial support of FC due to arsenic. ADEQ biocriteria site (phys/chem monitoring) 1992 & 1994, 2 samples: partial support of FC due to arsenic. Arsenic at level believed to be natural background.
Hackberry Wash, McGarrys Wash-Knight Creek 15030201-026	1.9 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Threat	Investigation by ADEQ in 1995 revealed that both facilities with NPDES permits were discharging inadequately treated wastewater to the tributary of Hackberry Wash (e.g. Blue Beacon of Kingman and Petro Stopping Center).
BURRO CREEK SUB-WATERSHED						
Burro Creek, headwaters-Pine 15030202-011	9.2 mi	A&Ww, FBC, FC, AgL (Unique Water)	Evaluated	No	Threat	Evaluation based on downstream monitoring (15030202-008) and information from BLM hydrologist.
Burro Creek, Pine-Francis Creek 15030202-009	13.3 mi	A&Ww, FBC, FC, AgL (Unique Water)	Evaluated	No	Threat	• ADEQ Biocriteria Program monitoring (phys/chem monitoring) 3 samples in 1992-94: threat due to arsenic. • BLM 1992-95, 7 samples: full support.

BILL WILLIAMS WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Burro Creek, Francis Creek-Boulder 15030202-008	10.7 mi	A&Ww, FBC, FC, AgL (Unique Water)	Monitored	Yes	Non	BLM/ADEQ cooperative monitoring at two stations (below Francis Creek and above Boulder Creek) 1989-1995, 18 samples (plus 7 field only samples): uses impaired by fecal coliform, arsenic, and turbidity. Arsenic at natural back ground level. Fecal coliform and some of the turbidity may be due to high levels of primitive camping along stream.
Burro Creek, Boulder-Black Canyon 15030202-004	14.7 mi	A&Ww, FBC, FC, AgL	Monitored	Yes	Partial	BLM/ADEQ cooperative station (BC13, just below Boulder Creek), 7 samples, 1990-94: uses impaired by lead, arsenic, turbidity, and fecal coliform. This reach and a tributary receive NPDES permits dishcarges. Sources same as above, plus historic mining practices.
Burro Creek, Black Canyon-Kaiser Spring 15030202-002	4.1 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring (15030202-004 & -008).
Burro Creek, Kaiser Spring-Big Sandy River 15030202-001	6 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	Evaluation based limited field-type parameter monitoring by BLM 1992-1994, one full parametric sample: uses impaired by arsenic and low dissolved oxygen.
Francis Creek, headwaters-Burro Creek 15030202-012	20.6 mi	A&Ww, DWS, FBC, FC, AgL (Unique Water)	Monitored	Yes	Partial	BLM/ADEQ cooperative monitoring 1989-95, 12 samples: uses imparied by fecal coliform and turbidity (threat to FC due to arsenic).
Boulder Creek, headwaters-Wilder 15030202-006	25.5 mi	A&Ww, FBC, FC, Agl, AgL	Evaluated	No	Full	ADEQ monitoring above Hillside Mine 1991-1992 (BOL 1): full support.
Boulder Creek, Wilder Creek-Burro Creek 15030202-005	7.6 mi	A&Ww, FBC, FC, Agl, AgL	Evaluated	Yes	Non	• ADEQ fixed stations (BOL1 & BOL2 near Hillside mine tailings) 1991-92, 5 samples, and ADEQ investigation 1992: impairment of stream, aquatic life (plants & bugs) killed, and sediment contamination due to heavy metals discharging from this abandoned mine. • Inadvertent release by Cyprus Bagdad Copper to Copper Creek in 1991 has been remediated, and actions taken to prevent future occurrences. • Multiple NPDES permits for Cyprus Bagdad discharges to tributaries.
SANTA MARIA SUB-WATERSHED						
Santa Maria River, *X-South Fork Santa Maria 15030203-012	14.3 mi	A&Ww, FBC, FC, Agl, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-1994, 3 samples: full support.
Santa Maria River, Date-Alamo Lake 15030203-001	3.2 mi	A&Ww, FBC, FC, Agl, AgL	Monitored	Yes	Partial	• ADEQ station 1990-1991, 10 samples: uses impaired by beryllium and turbidity. • BLM 2 stations 1988-1995, 3 samples (plus many field parameters): low DO, and high fecal coliform and turbidity. • ADEQ complaint investigation (WQMS 212.269) 1992 in tributary: uses impaired by cyanide leaking from mine pond.

BILL WILLIAMS WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Cottonwood Canyon, headwaters-Smith Canyon 15030203-024	13.8 mi	A&Ww, FBC, DWS	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1993-94, 2 samples: full support.
Sycamore Creek, headwaters-Tank Creek 15030203-021	21.2 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Full	USFS monitoring (Prescott National Forest) 1991, 2 samples: full support.
Kirkland Creek, headwaters-Skull Valley 15030203-016	21.1 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	No	Full	ADEQ station (KC1) 1992-93, 9 samples: full support.
Peeples Canyon Creek, headwaters-Santa Maria River 15030203-009OFF9	5.4 mi	A&Ww, FBC, AgL (Unique Water)	Monitored	No	Full	• BLM/ADEQ cooperative monitoring 1989-1990, 6 samples: low dissolved oxygen occurring in stagnant pools (natural low flow in summer). • ADEQ biocriteria site (phys/chem monitoring) 1992, 1 sample: full support.
BILL WILLIAMS SUB-WATERSHED						
Bill Williams River, Alamo-A 15030204-003	25.1 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	Evaluation based on Ruiz study (1994) and downstream monitoring (15030204-001).
Bill Williams River, A-B 15030204-002	2.3 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	Evaluation based on Ruiz study (1994) and downstream monitoring (15030204-001).
Bill Williams River, B-Colorado River 15030204-001	11.8 mi	A&Ww, FBC, FC, AgL	Monitored	Yes	Partial	USGS station at Planet 1991-95, 13 samples: partial support FC, A&Ww, and FBC due to arsenic, fecal coliform, low dissolved oxygen, and turbidity. Special study by University of Arizona/USFWS (Ruiz 1994) indicates that aquatic life has been contaminated by heavy metals (i.e. boron, cadmium, chromium, copper, mercury, selenium, and zinc). Source of metals is primarily believed to be inactive/abandoned mining sites. Low dissolved oxygen and some turbidity is natural. The source of the high fecal coliform and some of the turbidity is unknown, but may be recreation.

BILL WILLIAMS WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
LAKES IN THE BILL WILLIAMS WATERSHED						
Alamo Lake 15030204-0040	5000 ac	A&Ww, FBC, FC	Monitored	Yes	Partial	• US Corps of Engineers/USFWS monitoring 1991-95, 61 sampling dates at multiple sites and depths: partial support A&Ww due to sulfide and threat A&Ww due to low dissolved oxygen. • USFWS eagle prey study (King et al. 1991): cadmium, copper, mercury, and zinc elevated in fish tissue. • ADEQ Priority Pollutant Program monitoring fish and sediment samples 1992: elevated levels of chromium, copper, mercury, and lead in fish. • Upstream monitoring indicates threats due to siltation and arsenic.
Coors Lake 15030202-5000	15 ac	A&Ww, FBC, FC	Evaluated	No	Partial	ADEQ Clean Lakes Program 1992, 1 sample: slightly low dissolved oxygen a threat to A&Ww uses. AGFD reports weed harvesting (1995).

COLORADO - GRAND CANYON WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
COLORADO RIVER SUB-WATERSHED						
Colorado River, Lake Powell-Paria 14070006-001	15.9 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	• USGS (Lees Ferry) monitoring 1991-95, 30 samples: partial support of DWS due to total dissolved solids (secondary MCL). Selenium and cadmium threaten DWS and A&Wc uses. • A draft EIS by the Bureau of Reclamation (1994), federal legislation, and recent studies of Glen Canyon Dam (1992-95, reports still being prepared) all focused on potential environmental impacts of excessively fluctuating releases from the dam to meet power demands. Many impacts have been noted especially to native fish and beaches due to the changes in velocity, depth, width, temperature, erosion and deposition, and turbidity (US Bureau of Rec, 1994). • Monitoring in Lake Powell and in the Colorado River below Lake Mead indicate that selenium is bioaccumulating in fishes, particularly in lakes along the river receiving Colorado River water (see specific comments in lakes and lower reaches of the Colorado-Lower Gila Watershed.)
Paria River, Utah brdr-Colorado River 14070007-001	24.9 mi	A&Wc, DWS, FBC, FC	Monitored	Yes	Non	National Park service 1992-94, 8 samples: uses impaired by turbidity, gross alpha radiation, heavy metals (arsenic, beryllium, chromium, lead, mercury, nickel, and selenium), and high TDS and sulfate. Sources of contaminants include: natural conditions, rangeland practices, and historic mining. Sources in Utah unknown.
Bright Angel Canyon, Phantom Creek-Colorado 15010001-019	2.1 mi	A&Wc, DWS, FBC, FC	Monitored	No	Full	National Park Service monitoring 1991-95, 10 samples: full support. A facility with a NPDES wastewater permit discharges to tributary (USNPS Grand Canyon North Rim).
Phantom Creek, hdwt-Bright Angel Canyon 15010001-021	14 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Partial	National Park Service monitoring 1994, 1 sample (limited parameters): high pH (9.38), probably due to naturally low flows.
North Canyon Creek, hdwt-Colorado River 15010001-017	32.2 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Full	• USFS monitoring 1991, 3 samples: full support. • ADEQ Biocriteria Program (phys/chem samples) 1994, 1 sample: full support. • AGFD monitoring 1992, 1 sample: full support.
Vasey's Paradise (Spring) 15010001-005OFF1	0.1 mi	A&Wc, DWS, FBC, FC	Monitored	No	Full	National Park Service monitoring 1992-95, 7 samples: full support.
Nankoweap Creek, hdwt-Colorado River 15010001-003OFF9	8.5 mi	A&Wc, DWS, FBC, FC	Monitored	Yes	Partial	National Park Service monitoring 1992-95, 8 samples: uses impaired by high pH. (Note high pH during summer months with low flow is probably natural.)
Kwagunt Creek, hdwt-Colorado River 15010001-003OFF4	8 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Partial	National Park Service monitoring of Grand Canyon 1994-95, 3 samples: uses impaired by high pH, sulfate, and total dissolved solids.

COLORADO - GRAND CANYON WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Chuar Creek, hdwt-Colorado River 15010001-002OFF25	6 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Non	National Park Service monitoring 1992-95, 7 samples: uses impaired by gross alpha (between 35-51 pCi/l), arsenic, turbidity, and salts. Natural source of contaminants at springs (within Grand Canyon National Park).
Clear Creek, hdwt-Colorado River 15010001-002OFF3	6 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Full	National Park Service monitoring of Grand Canyon 1992-95, 3 samples and some limited parameter samples: full support.
Horn Creek hdwt-Colorado River 15010002-013OFF62	1.4 mi	A&Wc, DWS, FBC, FC	Evaluated	Yes	Non	• The National Park Service posted this water as unsuitable for drinking purposes based on University of Nevada at Las Vegas 1994-95 samples: excessive uranium and alpha radiation from uranium. • National Park Service monitoring 1995, 3 samples (limited parameters): low dissolved oxygen (probably natural).
Monument Creek, hdwt-Colorado River 15010002-013OFF57	2.5 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Partial	National Park Service monitoring 1992-1995, 12 samples: uses impaired by chloride, total dissolved solids, low dissolved oxygen, and high pH. All believed to be from natural sources.
Hermit Creek, hdwt-Colorado River 15010002-013OFF56	4 mi	A&Wc, DWS, FBC, FC	Monitored	Yes	Partial	National Park Service cooperative monitoring 1992-95, 8 samples: partial support of FC and DWS due to arsenic and gross alpha.
Crystal Creek, hdwt-Colorado River 15010002-013OFF51N	10.2 mi	A&Wc, DWS, FBC, FC	Monitored	Yes	Partial	National Park Service monitoring 1992-95, 8 samples: uses impaired by arsenic, chloride, turbidity and total dissolved solids.
Shinumo Creek, hdwt-Colorado River 15010002-013OFF42	13.5 mi	A&Wc, DWS, FBC, FC	Monitored	Yes	Partial	National Park Service cooperative monitoring 1992-95, 8 samples: uses impaired by turbidity and slightly elevated pH (9.01). Probably natural conditions.
Royal Arch Creek, hdwt-Colorado River 15010002-013OFF28	4.8 mi	A&Wc, DWS, FBC, FC	Monitored	Yes	Non	National Park Service cooperative 1992-95, 7 samples: uses impaired by selenium, sulfate and total dissolved solids.
Stone Creek, hdwt-Colorado River 15010002-013OFF11	3.2 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Full	National Park Service monitoring 1992-95, 8 samples: full support.
Tapeat's Creek, hdwt-Colorado River 15010002-013OFF9	7.4 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Partial	National Park Service cooperative monitoring 1992-95, 8 samples: partial support of A&Wc and FBC due to turbidity (one sample over 1000 NTU).
Thunder River, hdwt-Tapeats Creek 15010002-013OFF9OFFT	1.6 mi	A&Wc, FBC, FC, AgL	Evaluated	No	Full	National Park Service monitoring 1993-1995, 2 samples: full support.
Saddle Canyon Creek, hdwt-Tapeats Creek 15010002-013OFF9OFFS	3.5 mi	A&Wc, FBC, FC	Evaluated	No	Full	National Park Service monitoring 1992-95, 7 samples (only 1 with toxics): full support.

COLORADO - GRAND CANYON WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Deer Creek, hdwt-Colorado River 15010002-013OFF7	7 mi	A&Wc, DWS, FBC, FC	Monitored	No	Threat	National Park Service cooperative monitoring 1992-1995, 10 samples: threat to uses due to slightly elevated pH (9.08).
Pipe Creek, hdwt-Garden Creek 15010002-013OFFP	2.8 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Partial	National Park Service monitoring 1994-95 (field parameters only): one turbidity sample >1000 NTU; therefore partial support A&Ww and FBC.
Matkatamiba Cyn. Creek, hdwt-Colorado River 15010002-012OFF11	9.6 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Non	National Park Service cooperative monitoring 1992-95, 7 samples: uses impaired by selenium (median 10 µg/l), total dissolved solids, and sulfate.
National Canyon, hdwt-Colorado River 15010002-010	29.6 mi	A&Wc, DWS, FBC, FC	Monitored	No	Partial	National Park Service cooperative monitoring 1992-95, 9 samples: partial support of DWS due to sulfate (mean 1114 mg/l) and total dissolved solids (mean 1743 mg/l).
Fern Glen, hdwt-Colorado River 15010002-009OFFG	7 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Full	National Park Service monitoring: 1 sample (field parameters only) low dissolved oxygen believed natural due to spring source; therefore, full support.
Warm Springs, hdwt-Colorado River 15010002-005OFF	3.1 mi	A&Wc, DWS, FBC	Evaluated	No	Partial	National Park Service cooperative monitoring 1992-95, 6 samples: elevated total dissolved solids.
Three Springs Creek, hdwt-Colorado River 15010002-003OFF10	4.5 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Partial	National Park Service cooperative monitoring (with ADEQ) 1992-95, 5 samples: uses impaired by arsenic and fecal coliform. Source is natural or due to recreation in Grand Canyon.
Pumpkin Springs, hdwt-Colorado River 15010002-003OFFX	3.1 mi	A&Wc, DWS, FBC, FC	Monitored	Yes	Non	National Park Service cooperative monitoring 1992-95, 3 samples: uses impaired by extremely high arsenic (1,100-1,180 µg/l) and slightly elevated turbidity. National Park Service has posted this water as not suitable for drinking purposes. Source is natural from spring.
Spring Canyon Creek, hdwt-Colorado River 15010002-003OFF20	4 mi	A&Wc, DWS, FBC, FC	Monitored	Yes	Partial	National Park Service cooperative monitoring (with ADEQ) 1992-95, 8 samples: partial support of fish consumption due to arsenic.
Diamond Creek, hdwt-Colorado River 15010002-002	4 mi	A&Wc, FBC, FC	Evaluated	No	Partial	Evaluation based on limited monitoring by the National Park Service: turbidity just exceeding standard in the one sample (12 NTU).
KANAB CREEK SUB-WATERSHED						
Kanab Creek, Utah bdr-Cottonwood Creek 15010003-025	10 mi	A&Ww, DWS, FBC, FC, AgL	Evaluated	No	Partial	ADEQ Biocriteria Program (phys/chem monitoring) 1994, 1 sample: TDS and sulfate exceed secondary drinking water standards.

COLORADO - GRAND CANYON WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Kanab Creek, Jump-up Cyn.-Colorado River 15010003-001	9.3 mi	A&Ww, DWS, FBC, FC, AgL	Evaluated	No	Partial	• National Park Service monitoring 1992-1995, 9 samples: uses impaired by sulfate and total dissolved solids, and high gross alpha is a threat. Occasionally high heavy metals and turbidity. • ADEQ Priority Pollutant sediment sample 1994: no criteria exceeded.
HAVASU SUB-WATERSHED						
Havasu Creek, L. Coyote Cyn-Colorado 15010004-001	2.7 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	National Park Service cooperative monitoring 1992-95, 9 samples: uses impaired by arsenic and turbidity. Source believed primarily natural, but rangeland management may be contributing to turbidity.
RED LAKE PLAYA SUB-WATERSHED						
De La Fontaine drainage, hdwt-Truxton Wash 15010007-002OFF	15.3 mi	A&Ww, FBC	Evaluated	No	Non	ADEQ Complaint investigation (WQMS 212.243) indicated: uses impaired by zinc (total and dissolved). (Gross alpha and uranium concentrations pose a threat to groundwater use.)
American Legion drainage, hdwt-Truxton Wash 15010007-002OFFX	15.5 mi	A&Ww, FBC	Evaluated	No	Non	ADEQ complaint investigation (WQMS.212.243) 1992, 3 samples: uses impaired by copper (total and dissolved), lead (total), zinc, (total and dissolved), and pH (low). (Gross alpha is a threat to groundwater use).
Stockton Wash, hdwt-Truxton Wash 15010007-002OFFST	13 mi	A&We, PBC	Evaluated	No	Full	ADEQ complaint investigation in 1994 (SWMU 212.243.1), 1 sample: full support.
Wright Canyon, hdwt-Truxton Wash 15010007-003	13.8 mi	A&We, PBC	Monitored	No	Full	BLM station (@ Valentine) 8 samples 1992-93: full support.
VIRGIN RIVER SUB-WATERSHED						
Virgin River, Beaver Dam-Big Bend Wash 15010010-003	8.7 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	• USGS monitoring at Beaver Dam 1989, 6 samples: uses impaired by total dissolved solids (mean 2151), arsenic, and turbidity. • ADEQ Priority Pollutant sediment sample 1994: no criteria exceeded.
Virgin River, Big Bend Wash-Nevada bdr. 15010010-002	2.7 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on USGS monitoring site at Beaver Dam (see 150100010-003).
Virgin River, Black Rock Gulch-Sullivans 15010010-006	7.4 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Non	Assessment based on downstream monitoring (see comments for 15010010-003).
Virgin River, Sullivans Cyn-Beaver Dam 15010010-004	9.2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Non	Assessment based on downstream monitoring (see 15010010-003).

COLORADO - GRAND CANYON WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Beaver Dam Wash, Utah border-Virgin River 15010010-009	8 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	No	Full	ADEQ special investigation of Beaver Dam Wash in 1994: 8 sites with 4 to 8 samples per site through the year indicated full support (naturally low dissolved oxygen near spring source).
DETRITAL WASH SUB-WATERSHED						
Tennessee Wash, hdwt-Detrital Wash 15010014-005OFFT	10 mi	A&We, PBC	Evaluated	No	Non	Investigation of surface and groundwater by Roesner (1995) revealed Tennessee Wash and tributaries in the Chloride Mining District were impaired by: low pH and heavy metals (cadmium and zinc). AgL is not a designated use; however, livestock was noted grazing in the area. Waterbody would not meet livestock standards for cadmium, chromium, copper, lead, or zinc.
LAKES IN THE COLORADO-GRAND CANYON WATERSHED						
Cataract Lake 15010004-0280	35 ac	A&Wc, DWS, FC FBC, AgL	Evaluated	No	Partial	• ADEQ Priority Pollutant sediemnt and fish samples, 1993: elevated levels of mercury in fish. • ADEQ Clean Lakes Program monitoring 1993: uses impaired by turbidity and algae blooms reported.
Dogtown Reservoir 15010004-0480	50 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ Clean Lakes Program 1 sample 1993: manganese and iron exceed secondary MCL for drinking water. This is probably a natural season condition, that would make the water unattractive for consumption.
Kaibab Lake 15010004-0710	45 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ Clean Lakes Program 1993, 1 sample: uses impaired by manganese and iron, and threatened by low dissolved oxygen. Elevated manganese and iron believed to occur seasonally in Arizona's impoundments.
Santa Fe Lake (Williams Reservoir) 15010004-1340	24 ac	A&Wc, DWS, FBC, FC	Evaluated	No	Partial	ADEQ Clean Lakes Program 1993, 1 sample: partial support of uses due to manganese and iron. These parameters accumulate in reservoirs in Arizona seasonally.

COLORADO - LOWER GILA WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
COLORADO RIVER SUB-WATERSHED						
Colorado River, Hoover Dam-Lake Mohave 15030101-015	36 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	• USGS station (below Hoover Dam) 1991-1994, 21 samples: partial support DWS due to sulfate and TDS exceeding secondary public drinking water standards. • Selenium noted as threat to aquatic and wildlife in studies in Colorado River (Radke, Kepner, and Effertz 1988), backwater lakes (Lusk 1993; Martinez 1994; McCaulou, Matter, and Maughan 1994; Rusk 1991; Villegas & Maughan 1994; and Welsh & Maughan 1994) and Bill Williams River (Ruiz 1994). • One facility with a NPDES permit discharges to this reach.
Colorado River, Mohave-Piute Wash 15030101-011	26.8 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• Evaluation based on monitoring at Hoover Dam (15030101-015) and Parker Dam (15030104-020) and Lake Havasu (15030101-0590). Selenium threat based on multiple selenium studies (see comments in 15030101-015). • Two facilities with NPDES permits discharge to this reach.
Colorado River, Piute-Topock Marsh 15030101-010	18.4 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• Evaluation based on monitoring at Hoover Dam (15030101-015) and Parker Dam (15030104-020) and Lake Havasu (15030101-0590). Selenium threat based on multiple selenium studies (see comments in 15030101-015). • One facility with a NPDES permit discharges to this reach (see Appendix D).
Colorado River, Topock Marsh-Sacramento 15030101-007	0.5 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on monitoring at Hoover Dam (15030101-015) and Parker Dam (15030104-020) and Lake Havasu (15030101-0590). Selenium threat based on multiple selenium studies (see comments in 15030101-015).
Colorado River, Sacramento-Lake Havasu North 15030101-006	6.3 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on monitoring at Hoover Dam (15030101-015) and Parker Dam (15030104-020) and Lake Havasu (15030101-0590). Selenium threat based on multiple selenium studies (see comments in 15030101-015).
Colorado River, Lake Havasu No-Lake Havasu So 15030101-005	14 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on monitoring at Hoover Dam (15030101-015), Parker Dam (15030104-020), and Lake Havasu (15030101-0590).
Colorado River, Bill Williams River-Osborne Wash 15030104-020	13.3 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	USGS station (Parker Dam) 1991-1995, 42 samples: partial support DWS due to TDS and sulfate exceeding secondary drinking water standards. Selenium a threat to A&Ww, at chronic standard (also see comments in 15030104-008 and 15030101-015).
Colorado River, Ehrenberg-Mohave Wash 15030104-015	11.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	See comments for 15030104-008 and 15030104-020.

COLORADO - LOWER GILA WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Colorado River, Mohave Wash-Gould Wash 15030104-013	5.3 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	See comments for 15030104-008 and 15030104-020.
Colorado River, Gould Wash-Milpitas Wash 15030104-011	14.9 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	See comments in 15030104-008 and 15030104-020.
Colorado River, Milpitas Wash-Vinagre Wash 15030104-010	7.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	See comments for 15030104-008 and 15030104-020.
Colorado River, Vinagre-Julian Wash 15030104-009	10.2 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	Assessment based on special studies of selenium levels in aquatic life (Lusk 1993; McCaulou et al. 1994) and on monitoring at Parker Dam (15030104-020) and Imperial Dam (15030104-001).
Colorado River, Julian Wash-Yuma Wash 15030104-008	15.3 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	Assessment based on special studies of selenium levels in aquatic life (Lusk 1993; McCaulou et al. 1994) and on monitoring at Parker Dam (15030104-020) and Imperial Dam (15030104-001).
Colorado River, Yuma Wash-McCallister Wash 15030104-006	2.3 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	Assessment based on special studies of selenium levels in aquatic life (Lusk 1993; McCaulou et al. 1994) and on monitoring at Parker Dam (15030104-020) and Imperial Dam (15030104-001).
Colorado River, McCallister Wash-Indian Wash 15030104-004	0.7 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Assessment based on special studies of selenium levels in aquatic life (Lusk 1993; McCaulou et al. 1994) and on monitoring at Parker Dam (15030104-020) and Imperial Dam (15030104-001).
Colorado River, Indian Wash-Senator 15030104-002	7 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Assessment based on special studies of selenium levels in aquatic life (Lusk 1993; McCaulou et al. 1994) and on monitoring at Parker Dam (15030104-020) and Imperial Dam (15030104-001).
Colorado River, Senator-Imperial Dam 15030104-001	2.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	• Assessment based on special studies of selenium levels in aquatic life (Lusk 1993; McCaulou et al. 1994) and on monitoring at Parker Dam (15030104-020) and Imperial Dam (15030104-001). • USGS monitoring (below Imperial Dam) 1990-1992, 11 samples: partial support DWS due to sulfate and TDS exceeding secondary drinking water standards.
Colorado River, Imperial Dam-Gila River 15030107-003	15.4 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on monitoring at Morelos Dam (15030107-001) and Imperial Dam (15030104-001) and selenium studies (see comments for 15030104-006).
Colorado River, Gila-Main Canal 15030107-002	5 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• Evaluation based on monitoring upstream and downstream (see comments in 15030107-001 and 15030104-006). • One facility with a NPDES permit discharges to this reach (see Appendix D).

COLORADO - LOWER GILA WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Colorado River, Main Canal-Mexico border 15030107-001	30.5 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• USGS monitoring (Morelos Dam) 1991-95 52, samples: uses impaired by manganese, iron, TDS, sulfate, and turbidity. Threats to uses by arsenic and selenium. • Special study of Yuma Valley by USFWS (Baker et al. 1992): threats to A&Ww due to arsenic, copper, DDT, dieldrin, mercury, and selenium in fish tissue. • One facility with a NPDES permit discharges to this reach (see Appendix D).
Wellton-Mohawk Canal, Gila Gravity-Wellton/Mohawk 15030107-003OFFWM	15 mi	DWS, AgI, AgL	Monitored	No	Full	Special study of Yuma Valley by USFWS (Baker et al. 1992): threats to downstream uses and groundwater due to copper, DDT metabolites, and toxaphene in fish tissue.
Yuma Main Drain Canal, canals-Mexico border 15030108-003OFFDR	10 mi	AgI, AgL	Monitored	No	Full	Special study of Yuma Valley by USFWS (Baker et al. 1992): threats to downstream uses and groundwater due to chlordane, DDT metabolites, dieldrin, and toxaphene). Arsenic elevated in sediment.
GILA RIVER SUB-WATERSHED						
Gila River, San Cristobal-Big Eye Wash 15070201-006	28.8 mi	A&Ww, PBC, AgI, AgL	Evaluated	No	Non	Evaluation based on downstream monitoring (15070201-003) and one sample collected by ADEQ (Wellton Study) in 1994: uses impaired by boron, uses further threatened by arsenic and selenium.
Gila River, Big Eye Wash-Coyote 15070201-005	6.3 mi	A&Ww, PBC, AgI, AgL	Evaluated	No	Non	Evaluation based on monitoring in reaches: 15070201-003 & -006.
Gila River, Coyote-Fortuna 15070201-003	29.4 mi	A&Ww, PBC, AgI, AgL	Monitored	Yes	Non	• USGS monitoring station (Dome) 1991-95, 30 samples and ADEQ station (Dome) 1993-94, 11 samples: uses impaired by boron, TDS (up to 5270 mg/l), and turbidity. • ADEQ Welton Study (SWMU 301.210) in 1994 indicated boron exceeding surface water standards, and arsenic and selenium in sediment exceeding Health-based Guidance Levels.
Gila River, Fortuna-Colorado River 15070201-001	6.6 mi	A&Ww, PBC, AgI, AgL	Evaluated	No	Non	See comments for 15070201-003.
LAKES IN THE COLORADO-LOWER GILA WATERSHED						
Adobe Lake (Colorado River backwater) 15030104-0001	200 ac	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	Two studies by Arizona University, in cooperation with USFWS, (Lusk 1993, Martinez 1994) indicate that invertebrates and birds have elevated levels of selenium. The level of selenium in the birds and prey species suggests that selenium may be affecting reproduction in predatory species.

COLORADO - LOWER GILA WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Bee Lake (Colorado River backwater) 15030104-0002	20 ac	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	Two studies by Arizona University, in cooperation with USFWS, (Lusk 1993, Martinez 1994) indicate that fish, invertebrates, or birds have elevated levels of selenium. Arsenic and zinc are also elevated in some fish. The level of selenium in the birds and prey species suggests that selenium may be affecting reproduction in predatory species.
Butler Lake (Colorado River backwater) 15030104-0003	50 ac	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	Two studies by Arizona University, in cooperation with USFWS, (Lusk 1993, Martinez 1994) indicate that fish, invertebrates, or birds have elevated levels of selenium. Mercury is also elevated in some fish. The level of selenium in the birds and prey species suggests that selenium may be affecting reproduction in predatory species.
Cibola Lake 15030104-0330	15 ac	A&Ww, FBC, FC	Monitored	No	Partial	Five recent studies by the USFWS and the University of Arizona (King et al. 1993, Welsh & Maughan 1994, McCaulou et al. 1994, Villegas & Maughan 1994, and Rusk 1991) indicate that birds, fish, and other aquatic creatures have elevated levels of selenium. Zinc and lead is also elevated in some fish. Selenium is at a level that may be negatively impacting fish and bird reproduction.
Imperial Reservoir 15030104-0670	400 ac	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	• USGS station below dam 1991-92, 11 samples: partial support DWS due to TDS and sulfate. • Two special studies by the Univ. of Arizona, in conjunction with USFWS, indicated elevated levels of selenium in birds and aquatic life (Rusk 1991, McCaulou et al. 1994). Levels may be impairing reproduction in predatory species, but not a human-health concern.
Island Lake (Colorado River backwater) 15030104-0004	130 ac	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	Two studies by Univ of Arizona/USFWS (Martinez 1994, and Lusk 1993) indicate that fish, marsh birds, and invertebrates have elevated levels of selenium, to a level that is associated with reproductive impairment of predators.
Lake Havasu 15030101-0590	9920 ac	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Partial 9800 ac, Non 120 ac	• Mohave County/Havasu City/ADEQ cooperative monitoring of swimming beaches 1991-95: fecal coliform contamination occurs particularly during extremely high seasonal temperatures at beaches near London Bridge. Multiple beach closures initiated an intensive investigation to discover source/sources (See write up in this report). • ADEQ Clean Lakes Program 1991-95, multiple sites, 43 samples: uses impaired by sulfate and TDS. Turbidity at times very high. • University of Arizona study (McCaulou et al. 1994) indicates that selenium in aquatic life is at a level that it could interfere with reproduction in predator species. Multiple studies in this Colorado River area have confirmed these high levels exist in other stretches of the river and many backwater lakes (see lake assessments and comments).
Lake Mohave 15030101-0960	13250 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• Evaluation based on upstream and downstream monitoring: partial support of uses due to TDS and sulfate; threats due to selenium. • AGFD monitoring 1993-95, 49 samples (limited parameters): full support.

COLORADO - LOWER GILA WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
McAllister Lake 15030104-0005	40 ac	A&Ww, FBC, FC, AgI, AgL	Monitored	No	Partial	Two studies by Univ of Arizona/USFWS (Martinez 1994, and Lusk 1993) indicate that fish, marsh birds, and invertebrates have elevated levels of selenium, at a level that is associated with reproductive impairment of predators.
Martinez Lake 15030104-0880	640 ac	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	USFWS study on Wildlife Refuges (King et al. 1993) indicated that fish had elevated levels of copper, selenium and zinc. Selenium was at a level that can impair reproduction in fish and predators.
Mittry Lake 15030107-0950	325 ac	A&Ww, FBC, FC	Monitored	No	Partial	Two studies by the Univ. of Arizona/ USFWS indicate that clams and aquatic birds contain selenium at a level which may impair reproduction in birds and predators.
Painted Rock Borrow Pit 15070201-1010	170 ac	A&Ww, FBC, AgI, AgL	Monitored	Yes	Non	• ADEQ Clean Lakes Diagnostic/Feasibility Study 1993 concluded that lake sediments had elevated levels of DDE and metals. Prior fish and turtle tissue analysis (USFWS and ADEQ studies in 1980s and early 1990s) indicated aquatic life had elevated levels of DDT, toxaphene, other pesticides, and mercury. ADHS Health Risk Assessment for Painted Rocks and Gila River (1991) resulted in a fish advisory that is still in effect. • Corps of Engineers/USFWS monitoring 1991-95 26 samples: uses impaired by low dissolved oxygen, high pH, and turbidity (fecal coliform threat). • ADEQ Clean Lakes monitoring 1992-93, 4 samples: uses impaired by low dissolved oxygen and sulfide. • ADEQ Priority Pollutant Program samples 1992 and 1993 of fish, birds, and sediment: DDT metabolites, mercury, and selenium elevated in fish, arsenic elevated in sediment.
Topock Marsh 15030101-1530	4000 ac	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	No	Partial	• Univ of Arizona/USFWS studies (Rusk 1991, King et al. 1993, McCaulou et al. 1994): selenium level in fish at level which could impair reproductive in predators. Cadmium, copper, lead, mercury, and zinc are also elevated in some fish. • ADEQ Pesticides Program monitoring, 1 sample in 1993: full support.

LITTLE COLORADO RIVER WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
LITTLE COLORADO RIVER SUB-WATERSHED (see also page 22 AND 24)						
Little Colorado River, W.Fk.Ltl. Colorado-Water Cyn. 15020001-011	10 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-95, 4 samples: full support.
Little Colorado River, Water Canyon-Nutrioso Creek 15020001-010	3.7 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	Yes	Partial	• ADEQ complaint investigation at Springerville, 1993 (8 sites bacteria and nutrients only): uses impaired by fecal coliform. • ADEQ Biocriteria Program (1992 1 phys/chem sample): full support.
Little Colorado River, Nutrioso Creek-Carnero Creek 15020001-009	10 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Non	• ADEQ monitoring at 2 sites (Springerville and above Highway 60) 1991-95, 26 samples: uses impaired by turbidity, copper, and fecal coliform. • ADEQ Biocriteria Program site (phys/chem sample) 1992 1 sample: turbidity exceeded standard. • ADEQ investigations of a wastewater treatment plant 1992-1994 (ADEQ, 1995): contamination by fecal coliform, human enteric viruses, and coliphage.
Little Colorado River, Carnero Creek-Coyote Creek 15020001-007	3.4 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring at Springerville (15020001-009).
Little Colorado River, 15020001-021-Lyman Lake 15020001-005	1 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring at Springerville (15020001-009).
Little Colorado River, Lyman Lake-*A 15020001-001	0.7 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring at Springerville (15020001-009).
West Fork Little Colorado, hdwt-Little Colorado 15020001-013	3.7 mi	A&Wc, FBC, FC, AgI, AgL (Unique Water)	Monitored	Yes	Partial	• ADEQ stations (@ Govt. Spring, @ Sheeps Crossing) 1991-95, 31 samples: copper and cadmium occasionally exceed standards. • ADEQ Biocriteria Program 1992-95, 8 samples at 2 sites: full support. • AGFD monitoring 1993-1995, 5 samples (limited parameters): turbidity exceeded standard in one sample.
East Fork Little Colorado River, hdwt-Hall Creek 15020001-013OFF5	11 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	• ADEQ monitoring 1993, 1 samples: full support. • AGFD monitoring 1989-1990, 4 samples: full support. • ADEQ Biocriteria Program site, 1992 1 sample: full support. Naturally low dissolved oxygen at spring source.
South Fork Little Colorado, hdwt-Little Colorado River 15020001-014	6.6 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	No	Full	• ADEQ monitoring (SFLC1) 1992-93, 9 samples: full support. • ADEQ Biocriteria Program site (phys/chem) 1992-95, 4 samples: full support. • USFS 1991, 3 samples: full support.

LITTLE COLORADO RIVER WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Nutrioso Creek, hdwt-Picnic Creek 15020001-017	21.9 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Non	• ADEQ monitoring above Nelson Reservoir 1995, 6 samples: uses impaired by turbidity. • AGFD monitoring 1994-1995 (limited to field parameters): uses impaired by turbidity.
Nutrioso Creek, Picnic Creek-Little Colorado 15020001-015	3.2 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Non	ADEQ special investigations (WQMS 212.327), 17 bacteria and regular samples: uses impaired by turbidity and fecal coliform.
Paddy Creek, hdwt-Nutrioso Creek 15020001-017OFF20	5 mi	A&Wc, FBC, FC	Evaluated	No	Partial	• ADEQ biocriteria site (phys/chem monitoring) 1992-95, 3 samples: full support. • AGFD 1994-95, 3 samples (field parameters only): turbidity slightly elevated.
Rudd Creek, hdwt-Nutrioso Creek 15020001-017OFFR	11 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	• ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support. • AGFD monitoring 1994-95, 6 samples (limited to field parameters): partial support of A&Wc due to slightly elevated turbidity and occasionally low dissolved oxygen (6.5 mg/l).
Auger Creek, hdwt-Nutrioso 15020001-017OFFA	10 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	AGFD monitoring 1994-95, 4 samples (limited to field parameters): partial support of A&Wc due to turbidity. Probable source historic rangeland practices.
Colter Creek, hdwt-Nutrioso Creek 15020001-017OFFC	6 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	AGFD monitoring 1994-1995, 3 samples (limited to field parameters): partial support due to slightly elevated turbidity.
Mamie Creek, hdwt-Coyote Creek 15020001-018OFF28	9.1 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	• ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support. • AGFD fish program monitoring 1989-90 (limited to field parameters), 4 samples: full support.
Lily Creek, hdwt-Coyote Creek 15020001-019OFF	2.5 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Little Colorado River, *A-15020002-025 15020002-024	11.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	USGS monitoring at two sites (above and below Salado Springs) 1989-1991, 6 samples each site: partial support DWS and AgI due to chloride, sulfate, and TDS using SMCLs (both sites).
Little Colorado River, 15020002-025-Big Hollow 15020002-023	11.4 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• Evaluation based on upstream and downstream monitoring: (15020002-020) and (15020002-024). • NPDES permit (@ St John POTW) (see Appendix D).
Little Colorado River, Big Hollow Wash-Carrizo 15020002-021	2.6 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring: (15020002-020) and (15020008-017).

LITTLE COLORADO RIVER WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Little Colorado River, Carrizo Wash-Zion Reservoir 15020002-020	0.9 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	USGS monitoring 1991-1994, 8 samples: partial support AgI and DWS due to TDS, sulfate, chloride and manganese not meeting secondary drinking water standards.
Little Colorado River, Zion Reservoir-Concho Creek 15020002-016	7.7 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring: (15020002-020).
Little Colorado River, Concho Creek-Zuni River 15020002-014	7.2 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring: (15020002-020).
Little Colorado River, Zuni River-Beaver Dam Wash 15020002-013	4.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring: (15020002-020).
Little Colorado River, Beaver Dam Wash-Oso Wash 15020002-012	1.5 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring: (15020002-020).
Little Colorado River, Oso Wash-Cheney Draw 15020002-010	1.6 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring: (15020002-020).
Little Colorado River, Cheney Draw-Hay Hollow 15020002-008	9.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring: (15020002-020).
Little Colorado River, Hay Hollow Draw-Milky Creek 15020002-006	0.9 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring: (15020002-020).
Little Colorado River, Milky Wash-Silver Creek 15020002-005	12.2 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on downstream monitoring (see 15020002-004).
Little Colorado River, Silver Creek-Carr L Wash 15020002-004	6.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Non	• USGS monitoring (Woodruff) station and special study, 13 samples 1991-93: uses impaired by copper, zinc, gross alpha high pH, and beryllium. (See USGS study: Fisk et al. 1994.)
Little Colorado River, Carr L Wash-Washboard Wash 15020002-003	1.6 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream and downstream monitoring (see 15020002-004, and 15020008-020).
Little Colorado River, Washboard Wash-Puerco River 15020002-001	5.7 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream and downstream monitoring (see 15020002-004, and 15020008-020).

LITTLE COLORADO RIVER WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Big Hollow Wash, hdwt-Little Colorado River 15020002-022	19.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	USGS monitoring 1991-94, 8 samples: uses impaired by boron, sulfate, and TDS.
Concho Creek, hdwt-Little Colorado River 15020002-015	34.4 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Full	• USGS monitoring at Concho Springs 1991-1994, 4 samples: full support. • NPDES permit (Lake Investment Co at Concho Valley) (see Appendix D).
Mineral Creek, hdwt-Concho Creek 15020002-015OFF10	30.2 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Zuni River, New Mexico bdr-A* 15020004-004	9 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Partial	• USGS monitoring New Mexico at Black Reservoir 1991-1993, 9 samples: high suspended solids evaluated as partial support of narrative standards and probably indicate an exceedance of turbidity standards. • USGS special investigation (Wirt et al. 1994) (control site for Puerco River Study): suspended sediments exceed Health Based Guidance Levels for arsenic and beryllium, and contains high levels of gross alpha. This indicates potential groundwater problems and threats to downstream designated uses.
Zuni River, 15020004-003-Hardscrabble 15020004-002	23.9 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring (15020004-004).
Zuni River, Hardscrabble-Little Colorado 15020004-001	13.4 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring (15020004-004).
SILVER CREEK SUB-WATERSHED						
Silver Creek, Show Low Creek-Cottonwood 15020005-009	9.6 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Non	ADEQ monitoring (Snowflake) 1991-93, 13 samples: uses impaired by turbidity, copper, mercury, and zinc. Beryllium and lead also provide a threat to other uses. Probable sources include: historic rangeland practices which have lead to destruction of riparian area and bank destabilization, historic mining, sand and gravel operation, and natural conditions.
Silver Creek, Cottonwood Wash-Sevenmile 15020005-003	9.2 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Non	ADEQ station at Five-Mile Draw 1991, 1 sample: turbidity exceeds standards. Assessment also based on downstream monitoring (15020005-009).
Silver Creek, Sevenmile Dr-Little Colorado 15020005-001	9.3 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream monitoring (15020005-001 and -009).

LITTLE COLORADO RIVER WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Show Low Creek, hdwt-Linden Wash 15020005-012	34 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Non	ADEQ station at Show Low 1990-92, 16 samples: uses impaired by turbidity and low dissolved oxygen.
Show Low Creek, Linden Wash-Silver Creek 15020005-010	5.5 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream monitoring at Show Low (15020005-012).
PUERCO SUB-WATERSHED						
Puerco River, Black Creek-15020007-013 15020007-012	14.6 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Non	Evaluation based on downstream monitoring (15020007-011).
Puerco River, 15020007-013-B* 15020007-011	6.2 mi	A&Ww, FBC, AgI, AgL	Monitored	Yes	Non	• USGS monitoring 1989-91, 9 dissolved metals samples as part of a Puerco River Study: non-support of A&Ww due to dissolved lead. (Gross alpha at 1.7-1642 pCi/l indicates threats to downstream designated uses and potential groundwater contamination.)
Puerco River, B*-Crazy Creek 15020007-009	6.8 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream monitoring (15020007-011).
Puerco River, Crazy Creek-Dead Wash 15020007-008	18.2 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream monitoring (15020007-011).
Puerco River, Dead Wash-Ninemile Wash 15020007-007	0.3 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream monitoring (15020007-011).
Puerco River, Ninemile Wash-Dry Wash 15020007-005	6.6 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream monitoring(15020007-011).
Puerco River, Dry Wash-Lithodendron Wash 15020007-003	3.1 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream monitoring (15020007-011).
Puerco River, Lithodendron Wash-Carrizo 15020007-002	1.5 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream monitoring (15020007-011).
Puerco River, Carrizo Wash-Little Colorado 15020007-001	13.4 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream monitoring (15020007-011).

LITTLE COLORADO RIVER WATERSHED ASSESSMENTS - 1998						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
LITTLE COLORADO SUB-WATERSHED (see also page 17 AND 24)						
Little Colorado River, Puerco River-Leroux Wash 15020008-020	5.5 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Non	• Evaluation based on downstream monitoring at Joseph City (15020008-017), Grand Falls (15020008-001), and Cameron (15020016-008. (Results from Grand Falls and Cameron available from USGS and in their annual report). • USFWS fish and wildlife study (Andrews et al. 1994): elevated levels of arsenic, cadmium, chromium, copper, lead, mercury, mickel, and zinc. • One NPDES permit discharging in reach (see Appendix D).
Little Colorado River, Leroux Wash-Porter Tank 15020008-019	0.6 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on downstream monitoring at Joseph City (15020008-017), Grand Falls (15020008-001) and Cameron (15020016-008).
Little Colorado River, Porter Tank Dr.-McDonalds 15020008-017	18.7 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Non	• USGS monitoring (Joseph City) 1992-94, 11 samples: uses impaired by copper, zinc, arsenic, beryllium, and silver. • USGS special study of Puerco River 1989-91, 6 samples: uses impaired by gross alpha, arsenic, beryllium, and copper.
Little Colorado River, McDonalds Creek-Chevelon 15020008-015	4.6 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream and downstream monitoring at Joseph City (15020008-017) and Grand Falls (15020008-001).
Little Colorado River, Chevelon Creek-Cottonwood 15020008-014	7 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream and downstream monitoring at Joseph City (15020008-017) and Grand Falls (15020008-001).
Little Colorado River, Cottonwood Wash-Clear Creek 15020008-013	1.6 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream and downstream monitoring by USGS at Joseph City (15020008-017), and Grand Falls (15020008-001).
Little Colorado River, Clear Creek-Jacks Canyon 15020008-005	1.2 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream and downstream monitoring at Joseph City (15020008-017), Grand Falls (15020016-013) and Cameron (15020016-008).
Little Colorado River, Jacks Cyn.-Corn Creek Wash 15020008-003	36.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Threat	• Evaluation based on upstream and downstream monitoring at Woodruff (15020002-004), Joseph City (15020008-017), Grand Falls (150200008-001, and Cameron (15020016-008). • USFWS study of wildlife contamination (Andrews et al. 1995): fish tissue exceeded criteria for: chromium, copper, lead, mercury, nickel, and zinc.
EAST CLEAR CREEK SUB-WATERSHED						
East Clear Creek, hdwt-Yeager Canyon 15020008-009	18.8 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-93, 2 samples: full support.

LITTLE COLORADO RIVER WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
East Clear Creek, Yeager Canyon-Willow Creek 15020008-008	13.6 mi	A&Wc, FBC, FC, Agl, AgL	Evaluated	No	Full	• ADEQ biocriteria site (phys/chem monitoring) 1992-94, 4 samples: full support. • One NPDES permit discharges to this reach (see Appendix D).
Clear Creek, hdwt-Little Colorado 15020008-006	31.7 mi	A&Wc, FBC, FC, Agl, AgL	Evaluated	No	Partial	ADEQ station 1989, 5 samples: partial support A&Wc due to turbidity.
Barbershop Canyon Creek, hdwt-East Clear Creek 15020008-009OFF4	13.5 mi	A&Wc, FBC, FC, AgL	Evaluated	No	Full	ADEQ Biocriteria Development Program site (phys/chem monitoring) 1992-94, 6 samples at 2 sites: full support.
Buck Springs Canyon Creek, hdwt-Leonard Canyon 15020008-008OFFBUCK	6 mi	A&Wc, FBC, FC, AgL	Evaluated	No	Partial	ADEQ biocriteria monitoring site (phys/chem monitoring) 2 sites 1995: partial support A&Wc due to turbidity and low dissolved oxygen.
CHEVELON CREEK SUB-WATERSHED						
Chevelon Creek, hdwt-West Chevelon 15020010-006	30.8 mi	A&Wc, FBC, FC, Agl, AgL	Evaluated	No	Full	ADEQ station (Chevlon Crossing) 1993, 1 sample: full support. ADEQ biocriteria site (phys/chem monitoring) 1992-94, total of four sites and 7 samples: full support.
Chevelon Creek, Potatoe Wash-Black Canyon 15020010-002	7.5 mi	A&Wc, FBC, FC, Agl, AgL	Evaluated	No	Non	Evaluation based on downstream monitoring (15020010-001).
Chevelon Creek, Black Canyon-Little Colorado 15020010-001	18.3 mi	A&Wc, FBC, FC, Agl, AgL	Monitored	Yes	Non	ADEQ station CHV1 1990-91, 13 samples: uses impaired by turbidity and TDS; threats due to copper and lead. Sources believed to be forest and rangeland practices and historic mining, combined with natural conditions.
CANYON DIABLO SUB-WATERSHED						
Rio de Flag, hdwt-San Francisco Wash 15020015-004	19 mi	A&Wedw, PBC	Evaluated	No	Full	• ADEQ Priority Pollutant Program 1993 sediment sample: no criteria exceeded. • ADEQ Biocriteria Program 1994, 1 (phys/chem) sample: full support. • Three facilities with NPDES permits discharge to this reach (see Appendix D).
LITTLE COLORADO RIVER SUB-WATERSHED						
Little Colorado River, Dinnebito Wash-Deadman 15020016-012	8.3 mi	A&Ww, DWS, FBC, FC, Agl, AgL	Evaluated	No	Non	See comments in 15020016-010.

LITTLE COLORADO RIVER WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Little Colorado River, Deadman-15020016-009 15020016-010	20.2 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream and downstream monitoring by USGS at Grand Falls (15020008-001), Joseph City (15020008-017), Grand Falls (15020016-013) and Cameron (15020016-008). (Results from Cameron and Grand Falls sites are not shown here but are available in USGS annual reports.)
Little Colorado River, Lee Canyon-Colorado River 15020016-001	29.9 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• National Park Service monitoring at mouth of Little Colorado River (most of reach on Navaho reservation) 8 samples, 1991-1995: uses impaired by arsenic, chloride, turbidity, TDS. • NPDES permit discharge to tributary (Desert View) (see Appendix D).
(SAN JUAN SUB-WATERSHED ENTIRELY ON INDIAN RESERVATION)						
LAKES IN LITTLE COLORADO-SAN JUAN WATERSHED						
Ashurst Lake 15020015-0090	161 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	Turbidity, nutrients, and stagnating conditions reported by AGFD (1992). Natural conditions of a shallow, man-made lake, combined with rangeland practices in the watershed, to create eutrophic conditions.
Black Canyon Lake 15020010-0180	78 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• ADEQ Clean Lakes monitoring 1995 - 1 sample: partial support of uses due to arsenic, iron, and manganese. • AGFD and USFS report nutrient problems, algae blooms, and summer (1990) fish kills.
Bunch Reservoir 15020001-0230	20 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	USFS reports nutrient and turbidity problems.
Concho Lake 15020002-0400	60 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	Nutrient and weed problems reported by AGFD 1991-93.
Fool's Hollow Lake 15020005-0530	149 ac	A&Wc, FBC, FC, AgL	Evaluated	No	Threat	• AGFD monitoring 1993-94 3 samples (limited parameters): full support. • ADEQ investigation in 1993: analysis of white bottom deposit indicated the presence of pesticides.
Kinnickinick Lake 15020015-0730	126 ac	A&Wc, FBC, FC, AgL	Evaluated	No	Partial	ADEQ/Kleinfelder Investigations of waterbodies listed on 304(l) List 1990, 1 sample: uses imparied by low pH.
Lake Mary (lower) 15020015-0890	500 ac	A&Wc, FBC, FC, AgL	Evaluated	No	Partial	AGFD monitoring 1993, 2 samples: partial support of uses due to high pH and turbidity. AGFD reporting weed harvesting (1995).
Lake Mary (upper) 15020015-0900	450 ac	A&Wc, DWS, FBC, FC, AgL	Evaluated	No	Partial	ADEQ Clean Lakes Program monitoring 1993, 1 sample: partial support A&Wc due elevated iron (turbidity a threat based on monitoring in lower Lake Mary, no turbidity data available for this lake).

LITTLE COLORADO RIVER WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Lee Valley Reservoir 15020001-0770	35 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	AGFD (1988 report): partial support due to dissolved oxygen and turbidity, and pH as high as 9.7 during algal blooms. Old, shallow reservoir.
Long Lake (Lower) 15020008-0820	268 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	AGFD monitoring (1994): partial support due to high pH and eutrophic conditions in summer.
Lyman Reservoir 15020001-0850	1400 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	AGFD monitoring 1993-94 3 samples (limited parameters): turbidity impairing A&Wc.
Marshall Lake 15020015-0870	35 ac	A&Wc, FBC, FC, AgL	Evaluated	No	Partial	AGFD monitoring (limited parameters) 1993, 2 samples: partial support of uses due to turbidity and high pH.
Mormon Lake 15020015-0970	600 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Non	ADEQ Clean Lakes monitoring 1995 1 sample: partial support due to turbidity and high pH. AGFD 1993, 1 sample (limited parameters): partial support due to low dissolved oxygen, iron, manganese, and turbidity.
Nelson Reservoir 15020001-1000	60 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	AGFD reports weed harvesting 1991-93: partial support FBC, threat A&Wc.
Pintail Lake 15020005-5000	12 ac	A&Wedw, PBC	Evaluated	No	Partial	Pintail Pond is part of a series of lakes which act as wetlands to provide natural/biological treatment of effluent. ADEQ Priority Pollutant monitoring of water and sediment in 1994 indicated a high pH was the only parameter not meeting standards.
Rainbow Lake 15020005-1170	80 ac	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Partial	ADEQ Clean Lakes Program completed a Diagnostic Feasiblity Study 1996. 15 samples on 3 dates: partial support of uses due to high pH. Mercury threat to Fish Consumption use (measured two times at standard). Phase one TMDL analysis completed in this watershed (Silver Creek) in 1992 by Limno Tech.
River Reservoir 15020001-1220	50 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	Nutrient and algae bloom problems reported by USFS, weeds reported by AGFD.
Scotts Reservoir 15020005-1360	80 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	AGFD monitoring 1993-94 2 samples (limited parameters): full support.
Show Low Lake 15020005-1380	100 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	AGFD 1993, 2 samples (limited parameters): partial support A&Wc due to turbidity.
Sponseller Lake 15020005-5001	20 ac	A&Ww, FBC	Evaluated	No	Partial	AGFD monitoring 1994 1 sample (limited parameters): high pH, natural conditions for this ephemeral lake.
Telephone Lake 15020005-1500	12 ac	A&Wedw, PBC	Evaluated	No	Partial	Telephone Lake is part of a series of lakes which act as wetlands to provide natural/biological treatment of effluent (see Pintail above). ADEQ Priority Pollutant Program monitoring 1994 of water, sediment and birds revealed mercury elevated over screening levels in birds (0.26-0.3 mg/kg).

LITTLE COLORADO RIVER WATERSHED ASSESSMENTS - 1998						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Willow Springs Lake 15020010-1670	158 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ Clean Lakes Program monitoring 1994 1 sample: full support.
Woodland Reservoir 15020005-1690	10 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ Clean Lakes Program 1992-93, 4 samples, and AGFD monitoring in 1993 2 samples (limited parameters): partial support due to high pH.
Woods Canyon Lake 15020010-1700	52 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Threat	ADEQ Clean Lakes monitoring 1995 1 sample: DWS use is threatened by elevated levels of iron and manganese. This occurs in many lakes in Arizona when they stratify.

MIDDLE GILA WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
GILA RIVER SUB-WATERSHED (see also 15070101)						
Gila River, San Carlos-Dripping Spring 15050100-010	16.4 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	• Evaluation based on upstream monitoring (USFWS monitoring in San Carlos Reservoir indicated high TDS and arsenic) and downstream monitoring (see 15050100-003). • NPDES permit at Coolidge Dam (see Appendix D).
Gila River, Dripping Spring-San Pedro 15050100-009	10.6 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	• Evaluation based on upstream monitoring (USFWS monitoring in San Carlos Reservoir indicated high TDS and arsenic) and downstream monitoring (see 15050100-003). • NPDES permit discharges to this reach (see Appendix D).
Gila River, San Pedro-Mineral Creek 15050100-008	18.2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	Yes	Partial	• Evaluation based on upstream monitoring (USFWS monitoring in San Carlos Reservoir indicated high TDS and arsenic) and downstream monitoring (see 15050100-003). • One NPDES permitted facility discharges to this reach (see Appendix D) • EPA monitoring, 1 sample in 1993: turbidity exceeded standard.
Gila River, Mineral Creek-Donnelly Wash 15050100-007	14.3 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	Yes	Partial	• Evaluation based on upstream monitoring (USFWS monitoring in San Carlos Reservoir indicated high TDS and arsenic) and downstream monitoring (see 15050100-003). • USFWS sediment monitoring 1991-92: elevated copper.
Gila River, Donnelly Wash-Box O Wash 15050100-005	2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	• Evaluation based on upstream monitoring (USFWS monitoring in San Carlos Reservoir indicated high TDS and arsenic) and downstream monitoring (see 15050100-003).
Gila River, Box O Wash-Queen Creek 15050100-003	49.5 mi	Varies, see comments	Evaluated	No	Partial	• Reach has 4 sets of designated uses: Box-O Wash to Ashurst-Hayden Dam (2.3 miles A&Ww, FBC, FC, AgI, AgL); Ashurst-Hayden Dam to Florence POTW (2.4 miles-drop AgI); Florence POTW to Felix Rd (approx 5 miles A&Wedw, PBC, AgL); below EDW to Queen Creek (44.8 miles A&Ww, PBC, AgL). • ADEQ sample 1990, 1 sample: arsenic and TDS exceed standards. • USFWS studies sediment and fish in the Upper and Middle Gila (Baker & King, 1994; Baker & King 1995): uses threatened by copper, mercury, and selenium. • Two facilities with NPDES permits discharge to this reach (see Appendix D).
Queen Creek, hdwt-Witlow Canyon 15050100-014	17.1 mi	A&Ww, PBC, AgL	Evaluated	No	Threat	• Will Graf (professor at the Arizona State University) has been studying the transport of sediments and their heavy metal contaminants in Queen Creek many years (Graf et al. 1991, Graf et al. 1989). Heavy metals being transported and deposited behind dams pose a threat to designated uses. • 3 NPDES permits discharge to this reach (see Appendix D).

MIDDLE GILA WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Queen Creek, Witlow Canyon-Gila River 15050100-013	43.2 mi	A&Ww, PBC, AgL	Evaluated	No	Threat	• See comments in 15050100-014 concerning Will Graf studies. • ADEQ investigation 1993, 2 sites: full support. • 3 NPDES permits discharge to this reach (see Appendix D).
Mineral Creek, hdwt-Gila River 15050100-012	17.3 mi	A&Ww, FBC, FC, AgL	Monitored	Yes	Non	• ADEQ monitoring 1993, 11 samples: uses impaired by beryllium, copper, and turbidity. • ADEQ complaint investigation (WQMS 212.251 and 212.147) 1991-94, multiple sites sampled around Ray Mine and Gibson Mine: uses impaired by arsenic, beryllium, copper, low pH, and zinc. • EPA Copper Mine Studies (1992), 2 sites: uses impaired by dissolved and total copper, and low pH. • USFWS (Baker & King 1995): elevated levels of copper and zinc in sediment. • ASARCO Inc. Ray Mine has a NPDES permit to discharge to Mineral Creek, and has been in compliance with its discharge limits (see Appendix D).
Mescal Creek 15050100-010OFF9	8.5 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	BLM monitoring 1990-93, 3 samples: uses impaired by fecal coliform and slightly elevated pH.
SALT RIVER SUB-WATERSHED (below Granite Reef Dam diversions)						
Salt River, Granite Reef-Gila River 15060106-001	41.9 mi	Varies, see comments	Monitored	Yes	Partial 8.5 Non 33.4	• This reach flows through the Phoenix metro area and has four sets of designated uses: A&Ww, FBC, DWS, FC, AgI, AgL for 2 kilometers below Granite Reef Dam; A&We and PBC from this spot to the Interstate-10 bridge in Phoenix, A&Ww and PBC from I-10 bridge to 23rd Avenue wastewater treatment plant discharge, and A&Wedw, PBC, FC, AgI, AgL below the 23rd Avenue WWTP. • The last 12.5 miles of this reach has a fishing advisory due to pesticides (DDT, toxaphene, dieldrin, and chlordane) and mercury contamination. • ADEQ monitoring (@ 107th Ave) 1990-91, 12 routine samples: uses impaired by low pH and high TDS. • ADEQ Priority Pollutant Program fish and sediment samples in 1994: elevated levels of heptachlor epoxide and zinc. • Phoenix/USGS stormwater related studies in 1991-93 (Lopes et al. 1995 and information available from Maricopa County Flood Control): stormwater a threat to uses due to grease and oil, chemical and biological oxygen demand, fecal coliform, nitrogen, DDT metabolites in some areas, and occasionally high levels of semi-volatile organics and lead. • During the 1991 and 1993 floods, a portion of the Tri-City Landfill eroded into Salt River (upstream of Phoenix on the Salt River Indian Reservation) dumping tons of debris into the river channel. Although there has been an extensive effort to clean up this debris, some debris still remains. • There are ten facilities with NPDES permits which discharge into this reach (or unassessed tributaries) (see Appendix D).

MIDDLE GILA WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Arizona Canal, Granite Reef-Skunk Creek 15060106-001OFFAZ	38.2 mi	DWS, AgI, AgL	Monitored	No	Full	• SRP monitoring 1991-94, four sites with up to 40 samples: full support (TDS, chloride, manganese, and iron sometime exceed levels above which there may be objectionable tastes (i.e. SMCLs)). • ADEQ Priority Pollutant Monitoring in 1992 (fish and sediment): no criteria were exceeded.
Consolidated Canal, Southern Canal-Superstition 15060106-001OFFCONS	17 mi	DWS, AgI, AgL	Evaluated	No	Full	SRP monitoring 1990-91, 8 samples (few parameters): full support (chloride and TDS exceed secondary drinking water standards - for taste and odor - some of the time).
Eastern Canal, Southern Canal-Santan Rd 15060106-001OFFE	16.3 mi	DWS, AgI, AgL	Monitored	No	Full	SRP monitoring 1991-94, two sites and up to 36 samples per site: full support. One facility with a NPDES permit discharges to this (see Appendix D).
Grand Canal, Crosscut Canal-New River 15060106-001OFFGRAND	21.6 mi	AgI, AgL	Monitored	No	Full	SRP monitoring at lateral 23, 12 samples in 1992: full support.
Southern Canal, Granite Reef-Consolidated 15060106-001OFFS	6.7 mi	DWS, AgI, AgL	Monitored	No	Full	SRP monitoring 1991-94, two sites with up to 36 samples: full support (chloride and TDS exceeds SMCL for taste and odor problems some times).
Tempe Drain, hdwt-Salt River 15060106-001OFFTD	3 mi	AgI, AgL	Evaluated	No	Full	ADEQ Priority Pollutant Program sediment samples: full support.
Tempe/Tempe X-cut Canal, Consolidated-Western 15060106-001OFFTMPX	9.2 mi	DWS, AgI, AgL	Monitored	No	Full	SRP monitoring 1992-94, 36 samples: full support (TDS and chloride sometimes exceed SMCL standards for taste and odor).
Western Canal, Consolidated Canal-27th Ave 15060106-001OFFW	21.9 mi	AgI, AgL	Monitored	No	Full	• SRP monitoring 1991-94, 40 samples: full support. • Two facilities with NPDES permits discharge to this canal; see Appendix D.
Cave Creek, hdwt-Arizona Canal 15060106-026	70.1 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	No	Full 60.1 Threat 10	• ADEQ fixed station 1992-93, 6 samples: full support. • USFS 1991, 3 samples: full support. • ADEQ/Kleinfelder investigation @ Maricopa Mine: sediment contamination by lead and zinc which threatens uses. • One NPDES permit discharges to this reach (see Appendix D).

MIDDLE GILA WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
GILA RIVER SUB-WATERSHED (see also 15050100 page 28)						
Gila River, Salt River-Aqua Fria River 15070101-015	3.6 mi	A&Wedw, FC, PBC, AgI, AgL	Monitored	Yes	Non	• Fish Advisory based on USFWS/ADEQ monitoring 1980-1990 that indicated fish, turtle, and/or sediment contamination by pesticides and mercury. • ADEQ fixed station 1990-91, 14 samples: uses impaired by mercury, threats by arsenic and beryllium. • See comment about Tri-City Landfill and stormwater monitoring in 15060106-001 (Salt River).
Gila River, Agua Fria River-Waterman 15070101-014	12.2 mi	A&Wedw, FC, PBC, AgI, AgL	Evaluated	Yes	Non	• Assessment based on fish advisory and upstream and downstream monitoring and assessments (see 15070101-007 and -015). • One facility with a NPDES permit discharges to a tributary (see Appendix D).
Gila River, Waterman Wash-Hassayampa 15070101-010	12.4 mi	A&Wedw, FC, PBC, AgI, AgL	Evaluated	Yes	Non	• Assessment based on fish advisory and upstream and downstream monitoring (15070101-007 and -015). • ADEQ Clean Lakes Program 1992, 1 sample: sediment contaminated with DDT metabolite. • One facility with a NPDES permit discharges to the Arlington Canal, which discharges to this reach. See Appendix D.
Gila River, Hassayampa-15070101-016 15070101-009	0.6 mi	A&Wedw, FC, PBC, AgI, AgL	Evaluated	Yes	Non	Assessment based on fish advisory and upstream and downstream monitoring and assessments (see 15070101-007 and -015).
Gila River, 15070101-016-Centennial 15070101-008	9.9 mi	A&Wedw, FC, PBC, AgI, AgL	Evaluated	Yes	Non	• Assessment based on fish advisory and upstream and downstream monitoring and assessments (see 15070101-007 and -015). • ADEQ Clean Lakes Program 1992 sediment samples: DDT metabolites detected in sediment.
Gila River, Centennial-15070101-006 15070101-007	5.9 mi	A&Wedw, FC, PBC, AgI, AgL	Monitored	Yes	Non	• Fish advisory due to pesticides and mercury. • USGS monitoring (Gillespie Dam) 1991-95, 54 samples: uses impaired by fecal coliform, arsenic, boron, TDS, and turbidity. • USFWS/ADEQ monitoring water, fish, and sediment 1980-1990 revealed fish, turtle, and/or sediment contamination by DDT metabolites, toxaphene, other pesticides, and mercury. • ADEQ Clean Lakes Program sediment borings in 1992 also detected DDT metabolites. • See comments in 15060106-001 concerning Tri-City Landfill and stormwater.

MIDDLE GILA WATERSHED ASSESSMENT - 1998						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Gila River, 15070101-006-Sand Tank 15070101-005	13.5 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	Yes	Non	• Assessment based on fish advisory and upstream monitoring (see comments in 15070101-007). • ADEQ Clean Lakes Program sediment borings in 1992: neither pesticides nor metals were detected. • One facility with a NPDES permit discharges to this reach (see Appendix D).
Gila River, Sand Tank-Sauceda Wash 15070101-003	5.2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	Yes	Non	• Assessment based on fish advisory and upstream monitoring (15070101-007). • One facility with a NPDES permit discharges to this reach; see record of compliance with discharge limits in Appendix D of this report. (Gila Bend WWTP was several feet under water during the 1993 floods; however, monitoring data is not available to determine whether flooding of this infrastructure impaired water quality.)
Gila River, Sauceda Wash-Painted Rock 15070101-001	19.2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	Yes	Non	• Assessment based on fish advisory and upstream monitoring (15070101-007). • ADEQ Clean Lakes program sediment borings in 1992 indicated DDT metabolites contamination at or below detection limit. • See comments in 15060106-001 concerning Tri-City Landfill and stormwater.
AGUA FRIA SUB-WATERSHED						
Agua Fria River hdwt-Lynx Creek 15070102-032	13.2 mi	A&We, PBC, AgI, AgL	Evaluated	No	Threat	Assessment based on non-compliance with NPDES permit discharge levels at a new wastewater treatment plant (Prescott Valley POTW) which discharges to this reach. See Appendix D.
Agua Fria River, Sycamore-Big Bug Creek 15070102-023	10 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	BLM monitoring 1992-95, 2 sites (18 and 26 samples): partial support of uses due to fecal coliform, turbidity, and low dissolved oxygen. Probable source is grazing practices on the open range.
Agua Fria River, Big Bug Creek-Squaw Creek 15070102-022	11.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• BLM monitoring 1992-95 26 samples (mostly limited parameters): uses impaired by arsenic, fecal coliform, and turbidity. • ADEQ biocriteria development monitoring (phys/chem parameters) 1992-95 4 samples: full support.
Agua Fria River, Squaw-Black Canyon Creek 15070102-020	3.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15070102-019 and -022).
Agua Fria River, Blk Cyn.-Little Squaw Creek 15070102-019	4.1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• USGS monitoring (Rock Springs) 1991-95, 60 samples: uses impaired by arsenic (from natural sources). • BLM monitoring 1992-95, 43 field samples (limited parameters): partial support of uses due to fecal coliform (from grazing). • One facility with a NPDES permit discharges to this reach. See Appendix D.

MIDDLE GILA WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Agua Fria River, Ltl Squaw-Cottonwood Creek 15070102-017	5.5 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15070102-008 and 15070102-019).
Agua Fria River, Cottonwood Creek-Humbug 15070102-016	5.9 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15070102-008 and 15070102-019).
Agua Fria River, Top L Pleasant-Humbug Creek 15070102-015	1 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15070102-008) and (15070102-019).
Agua Fria River, Humbug Creek-Lake Pleasant 15070102-014	1.3 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15070102-019) and (15070102-008).
Agua Fria River, Lake Pleasant-Beardsly Canal 15070102-008	5.3 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• USGS monitoring 1991-95, 32 samples: partial support FC due to arsenic. Arsenic believed due to be natural background level. • One facility with a NPDES permit discharges into this reach (see Appendix D).
Agua Fria River, Beardsly Canal-New River 15070102-007	20 mi	A&Ww, PBC, AgI, AgL	Evaluated	No	Threat	• Three NPDES permit discharges to this reach (see Appendix D). • ADEQ Priority Pollutant Program discovered DDT metabolites at extremely high levels in the agriculture drainway known as Dysart Drain, which drains to this reach. Dysart Drain has been posted with a fish advisory. Fish also contained elevated levels of zinc.
Agua Fria River, New River-Gila River 15070102-001	8.1 mi	A&Wedw, PBC	Evaluated	No	Threat	Evaluation based on non-compliance with discharge limits by facilities with NPDES permits. See Appendix D.
Lynx Creek, hdwt-Agua Fria River 15070102-033	15.4 mi	A&Ww, PBC, AgL	Evaluated	No	Non	• ADEQ Priority Pollutant Program monitoring of fish and sediment in 1993: sediment contamination with arsenic, lead, and beryllium. • ADEQ monitoring above Lynx Lake 1993 (3 samples): dissolved copper and zinc impairing A&Ww use. • Other monitoring (8 samples): full support. • Four facilities with NPDES permits discharge into this reach (see Appendix D).
Knapp Gulch, hdwt-Lynx Creek 15070102-033OFFK	2 mi	A&Ww, PBC, AgL	Evaluated	No	Threat	Prescott National Forest abandoned mines survey 1990: full support.
Pine Creek, hdwt-Lynx Creek 15070102-033OFFP	3 mi	A&Ww, PBC, AgL	Evaluated	No	Threat	ADEQ Priority Pollutant Program sediment samples in 1994: arsenic contamination of sediment (9 times Arizona's normal background levels used as assessment screening levels -- Appendix A).

MIDDLE GILA WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Galena Gulch, hdwt-Agua Fria River 15070102-031OFF11	5.8 mi	A&Ww, PBC, AgL	Monitored	Yes	Non	• Magma Copper Co monitoring (Hargis & Assoc) 1990-93: sediments contaminated with chromium, lead and zinc. Water samples in cistern and below tailings ponds indicate non-support of A&Ww and AgL due to lead and cyanide. • Magma Copper has a NPDES permit for MaCabe, which has been in compliance (however, mine has reportedly not been operating for several years). See Appendix D.
Ash Creek, hdwt-Yellow Jacket 15070102-028	24.7 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	• ADEQ biocriteria site (phys/chem monitoring) 1992-94, 2 samples: full support. • BLM monitoring 1992-95, 20 samples (limited parameters): partial support FBC due to fecal coliform. Source believed to be grazing practices in watershed.
Ash Creek, Yellow Jacket-Agua Fria River 15070102-026	1 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring (15070102-028).
Little Ash Creek, hdwt-Ash Creek 15070102-026OFF1	15 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Full	• ADEQ biocriteria site (phys/chem monitoring) 1992-95, 4 samples: full support. • BLM monitoring 1992-95, 22 samples (limited parameters): full support. (Occasional low dissolved oxygen at spring source).
Sycamore Creek, hdwt-Agua Fria River 15070102-024	15.7 mi	A&Wc, FBC, FC, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-93, 2 samples: full support.
Big Bug Creek, hdwt-Agua Fria River 15070102-034	27.5 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	BLM monitoring 1992-95, 25 samples (limited parameters): partial support of uses due to very high fecal coliform. Source believed to be grazing practices within the watershed.
Silver Creek, hdwt-Agua Fria 15070102-022OFFS	14 mi	A&Ww, DWS, FBC, FC, AgI,	Evaluated	No	Partial	BLM monitoring 1992-95, 10 samples: partial support FBC due to fecal coliform. Source believed to be grazing practices within the watershed.
Larry Creek, hdwt-Agua Fria 15070102-022OFFLAR	5.5 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	BLM monitoring 1992-95, 10 samples (limited parameters): partial support FBC due to fecal coliform. Source believed to be grazing practices in the watershed.
Lousy Canyon, hdwt-Agua Fria 15070102-022OFFL	5 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	BLM monitoring 1992-95, 12 sample (limited parameters): partial support of uses due to fecal coliform. Source believed to be grazing practices in watershed.
Indian Creek, hdwt-Agua Fria 15070102-022OFFI	12 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	BLM monitoring 1992-95 12 samples (limited parameters): partial support of designated uses due to fecal coliform. Source believed to be grazing practices in the watershed.

MIDDLE GILA WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Black Canyon Creek, hdwt-Agua Fria River 15070102-035	15.1 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Full	• ADEQ monitoring 1993, 2 samples: full support. • BLM monitoring 1992-95, 40 samples (all except one limited to field parameters): full support. • Prescott Mining Project (US Bureau of Mines/ADEQ) 1994-1995 2 samples: full support.
Antelope Creek, hdwt-Bumble Bee Creek 15070102-035OFFA	5 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Partial	BLM monitoring 7 samples (limited parameters): partial support of uses due to fecal coliforms.
Crazy Basin Creek, hdwt-Poland Creek 15070102-035OFFCB	9 mi	A&Ww, FBC, AgI, AgL	Monitored	No	Full	Bureau of Mines and ADEQ Prescott Mining Project monitoring 1994-1995 11 samples: full support. (Note samples during snow melt runoff in headwaters, and do not include runoff from tailings piles.)
Dripping Spring, hdwt-Black Canyon 15070102-035OFFD	3 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Non	BLM monitoring 1992-95, 7 samples (limited parameters): A&Ww and FBC uses impaired by fecal coliform and low dissolved oxygen. Source believed to be grazing practices in watershed.
Rock Springs Creek, hdwt-Black Canyon 15070102-035OFFR	3 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Full	ADEQ complaint investigation (WQMS 212.283) 1993, 2 samples: full support.
Poland Creek, hdwt-Black Canyon 15070102-037	8.4 mi	A&Ww, FBC, AgI, AgL	Evaluated	No	Full	• Bureau of Mines and ADEQ Prescott Mining Project monitoring 1994-95 4 samples: full support (but does not include runoff from tailings areas). • ADEQ biocriteria site (phys/chem monitoring) 1992, 1 sample: full support. • USFS/ADEQ cooperative monitoring 1991, 2 samples: full support. • One facility with a NPDES permit discharges to a tributary of this reach (see Appendix D).
Turkey Creek, hdwt-Poland Creek 15070102-036	18 mi	A&Ww, FBC, AgI, AgL	Monitored	Yes	Partial	• US Bureau of Mines/ADEQ Prescott Mining Project 1994-95, 28 samples: partial support of AgI due to high total dissolved solids (does not include runoff from tailings). • Prescott National Forest/Labat-Anderson 1990 monitoring, 3 sites (total of 7 samples): uses impaired by arsenic, cadmium, copper, cyanide, lead, zinc, and antimony (includes runoff from tailings). • USFS/ADEQ monitoring 1991, 3 samples: full support.
Tule Creek, hdwt-Agua Fria 15070102-016OFFT	8.3 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• BLM monitoring 1993, 1 sample: full support. • ADEQ biocriteria site (phys/chem monitoring), 1 sample: partial support FC due to arsenic (Arsenic at 41 μg/l).
Dale Creek, hdwt-Agua Fria 15070102-007OFFD	4 mi	A&Ww, PBC, AgI, AgL	Evaluated	No	Partial	• ADEQ Priority Pollutant Program monitoring 1993-94: sediment contaminated by arsenic and cadmium, and fish contaminated by chromium. • ADEQ complaint investigation 1994, 1 water sample: uses impaired by high pH and turbidity.

MIDDLE GILA WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Skunk Creek, hdwt-New River 15070102-003	30.5 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Threat	Investigation of fire (Telephone Pole Fire) on tributary (Scatter Wash) indicated that soil contamination may present a threat to uses if sediments or contaminants are transported into this stream.
HASSAYAMPA SUB-WATERSHED						
Hassayampa River, hdwt-Blind Indian Creek 15070103-007	25.1 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	• ADEQ fixed stations above and below Senator Mine, 1992: above: impaired by cadmium, copper, and zinc. below: impaired by arsenic, cadmium, copper, lead, zinc, turbidity and low pH. • ADEQ biocriteria site above mine (phys/chem monitoring) 1992-94, 3 samples: full support. • USFS site 1991, 3 samples (above mines): full support. • ADEQ Priority Pollutant Program 1993 sediment sample: elevated levels of arsenic, beryllium, cadmium, copper, lead, mercury, selenium, and thallium. • ADEQ monitoring 1990-93 (near Wagoner) 1991-95, 21 samples: threats due to beryllium and mercury. • ADEQ monitoring on tributaries also show non-support due to heavy metal contamination and low pH (Cash Mine, McCleur Mine). • Prescott National Forest (abandoned mines study) in 1990, set of three samples: uses impaired by arsenic, copper, mercury, and low pH.
Hassayampa River, Blind Indian-Cottonwood 15070103-005	1.2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring (15070103-007) and downstream monitoring (15070103-004).
Hassayampa River, Cottonwood Creek-Martinez 15070103-004	25.9 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• ADEQ station 1990-93, 16 samples: uses impaired by turbidity. • ADEQ WQARF investigation of Wickenburg Mill 1991 set of 2 samples: full support. • BLM 1994, 1 sample: full support.
Hassayampa River, Martinez Wash-Sols Wash 15070103-003	1.2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ special investigation at Vulture Mill site (1992): uses impaired by turbidity and threatened by seeps and puddles heavily contaminated with heavy metals.
Hassayampa River, Sols Wash-Jackrabbit Wash 15070103-002	39.5 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	• ADEQ 1990-91, 9 samples: uses impaired by low dissolved oxygen and turbidity. • ADEQ biocriteria site (phys/chem monitoring) 1993-94, 2 samples: full support. • ADEQ Priority Pollutants Program monitoring of fish: no criteria exceeded. • Three facilities with NPDES permits discharge to this reach (see Appendix D).
Hassayampa River, Jackrabbit Wash-Gila River 15070103-001	14.7 mi	A&We, PBC	Evaluated	Yes	Non	• Fish advisory due to pesticides and mercury (see 15060106-001). • ADEQ Clean Lakes Program sediment samples as part of the Painted Rocks Area study in 1992: DDT metabolites detected.

MIDDLE GILA WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
French Gulch, hdwt-Hassayampa 15070103-007OFFF	9 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	• ADEQ Zonia Mine investigations (WQMS 212.068) 1989-93, 22 samples: uses impaired by heavy metals, low pH, TDS, and turbidity. • ADEQ Priority Pollutant Program 1993 sediment sample: arsenic level high.
Antelope Creek, hdwt-Martinez Creek 15070103-010	16.8 mi	A&Ww, PBC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-93, 2 samples: full support.
Lion Canyon Creek, hdwt-Weaver 15070103-010OFFL	2 mi	A&Ww, PBC, AgI, AgL	Evaluated	No	Threat	ADEQ biocriteria site (phys/chem monitoring) 1992-93 2 samples: full support (low dissolved oxygen presents a threat to A&Ww).
Buckeye Canal, Gila River-Hassayampa 15070103-001OFFB	21 mi	AgI, AgL	Evaluated	No	Full	Clean Lake Program sediment monitoring (1992) and ADEQ Priority Pollutant program monitoring (1994) both indicated DDT contamination. Zinc was also detected well above the nationally accepted background level in fish. FC & A&W are not designated uses on canals in Arizona; therefore, it is assessed in full support. However, these levels pose threats to downstream uses and groundwater.
Roosevelt Canal, Agua Fria-Hassayampa 15070103-001OFFR	30 mi	AgI, AgL	Evaluated	No	Full	ADEQ Priority Pollutant monitoring 1994: fish contaminated with DDT metabolites and selenium. Arizona canals are not protected for A&W or FC uses; therefore, this waterbody is assessed in full support. However, these levels pose threats to downstream uses and groundwater.
LAKES IN THE MIDDLE GILA WATERSHED						
Alvord Park Lake 15060106-0050	25 ac	A&Ww, FC, PBC	Evaluated	No	Threat	• ADEQ Priority Pollutant Program fish and sediment monitoring 1992: full support. • AGFD monitoring 1988-92, 3 samples: turbidity threat to uses.
Chaparral Park Lake 15060106-0300	10.5 ac	A&Ww, FC, PBC, AgI	Evaluated	No	Threat	• ADEQ Priority Pollutant Program monitoring 1992, fish and sediment: DDT elevated in fish over screening value for human health and fish protection (threat). Source believed to be urban runoff. • AGFD monitoring 1992 1 sample (limited parameters): full support.
Hassayampa Lake 15070103-3160	1 ac	A&Wc, DWS, FBC	Evaluated	No	Threat	ADEQ Priority Pollutant monitoring 1993, fish and sediment: arsenic, copper, and lead elevated in sediment.
Horsethief Basin Lake 15070102-0630	2 ac	A&Wc, DWS, FBC, FC, AgL	Evaluated	No	Non	ADEQ Clean Lakes monitoring 1994, 1 sample: uses impaired by arsenic, low dissolved oxygen, and high iron and mercury. Arsenic extremely high (1,760 µg/l) - possibly abandoned mine runoff.
Kiwanis Park Lake 15060106-0740	14 ac	A&Ww, FC, PBC, AgI	Evaluated	No	Full	• ADEQ priority pollutant program 1992 sediment: no elevated levels. • AGFD (limited parameters) 1989-91, 3 samples: full support.

MIDDLE GILA WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Lake Pleasant 15070102-1100	1540 ac	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	• ADEQ Clean Lakes Program 1992, 2 samples 1992: FC use impaired by arsenic. • USFWS Bald Eagle Prey Study (King et al 1991): elevated levels of mercury, copper, selenium, and zinc in fish. • ADEQ Priority Pollutant Program 1992, fish and sediment: elevated levels of mercury and selenium in fish, and elevated level of arsenic in sediment. • USGS station at Lake Pleasant 1991, 1 sample: FC use impaired by arsenic.
Lynx Lake 15070102-0860	55 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• Assessment based on excessive weed growth - weed harvesting by AGFD reported. • ADEQ Clean Lakes Program 1992, 4 samples: full support. • ADEQ Priority Pollutant Program 1992 sediment and 1993 sediment & fish: arsenic, copper, cadmium and lead elevated in sediment, and lead elevated in fish (threat to uses).
McKellips Park Lake 15060106-0920	6 ac	A&Ww, FC, PBC, AgI	Evaluated	No	Threat	• ADEQ Priority Pollutant Program 1992 fish and sediment samples: fish have elevated levels of DDT metabolites, dieldrin, and mercury. Urban runoff is believed to be the source of these contaminants. • AGFD monitoring 1992 (limited parameters): full support.
Painted Rock Reservoir 15070101-1020	200 ac	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	• Fish advisory due to pesticides and mercury. • ADEQ monitoring 1992-95, 27 samples plus field measures: uses impaired by high pH, turbidity, and TDS. • ADEQ Clean Lakes Diagnostic/Feasibility Study 1993 concluded that reservoir sediments had elevated levels of DDE and metals. Extensive fish and turtle tissue analysis (USFWS and ADEQ studies in 1980s) indicated that DDE, toxaphene, dieldrin, and other pesticides and mercury were bioaccumulating at levels of concern for wildlife. ADHS Health Risk Assessment for Painted Rocks and Gila River (1991) resulted in a fish advisory. • Monitoring by Corps of Engineers and USFWS 1992-93 18 samples: partial support A&Ww due to low dissolved oxygen (no metals or organics tested). • Erosion of Tri-City Landfill in January 1992 and 1993 floods resulted in further impairment of uses due to debris in water and accumulating on stream banks.

SALT RIVER WATERSHED ASSESSMENTS						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
BLACK RIVER SUB-WATERSHED						
Black River, Beaver Creek-Reservation Creek 15060101-007	10.4 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	USFS/ADEQ monitoring 1991, 3 samples: partial support A&Wc due to nitrogen.
Conklin Creek, hdwt-Black River 15060101-007OFF1	7 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	• ADEQ biocriteria site (phys/chem monitoring) 1992-93, 2 samples: full support. • AGFD monitoring (few parameters): full support.
Reservation Creek, hdwt-Black River 15060101-010	14.5 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	• ADEQ biocriteria development reference site (phys/chem monitoring 1992-95), 4 samples: full support. • AGFD monitoring 1990, 3 samples: full support. (Most of this stream is on Indian Reservation.)
East Fork Black River, hdwt-Black River 15060101-009	25.2 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• ADEQ station 1992-93, 4 samples: A&Wc impaired by turbidity. Sources of turbidity believed to be: recreation, forestry practices (including forest roads), grazing, and natural conditions. • ADEQ biocriteria site (phys/chem monitoring) 1992-95, 4 samples: iron impairing DWS use. • USFS/ADEQ 1991, 3 samples: full support.
West Fork Black River, hdwt-E.Fk.Black River 15060101-009OFF1	15.5 mi	A&Wc, FBC, FC, DWS, AgI, AgL	Monitored	Yes	Partial	• ADEQ monitoring 1992-93, 4 samples: A&Wc impaired by turbidity. • ADEQ biocriteria site (phys/chem monitoring) 1992-95, 4 samples: high iron impairing water quality. • AGFD monitoring 1989, 5 samples: copper impairing A&Wc (2 samples). AGFD fish management report on the West Fork of Black River (AGFD, 1991): Habitat Condition Index, riparian scorecard ratings, and trout standing stock indicate stream only in fair condition (partial support). Substandard in meadow reaches impacted by livestock and lower stream due to habitat modification and recreation. • USFS 1991, 3 samples: full support.
Hayground (Hay) Creek, hdwt-W.Fk.Black River 15060101-009OFF1OFF5	1.6 mi	A&Wc, FBC, FC	Evaluated	No	Full	AGFD monitoring 1990, 3 samples: full support.
Stinky Creek, hdwt-W.Fk. Black River 15060101-009OFF1OFF6	4.3 mi	A&Wc, FBC, FC	Evaluated	No	Full	AGFD 1990, 2 samples (few parameters): full support.
Home Creek, hdwt-W.Fk. Black River 15060101-009OFF1OFF1	8.3 mi	A&Wc, FBC, FC	Evaluated	No	Full	AGFD 1990, 2 samples (few parameters): full support (high copper in 1988 but not sampled for copper since).

SALT RIVER WATERSHED ASSESSMENTS						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Beaver Creek, hdwt-Black River 15060101-008	11.9 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Non	ADEQ fixed Station 1992, 4 samples: A&Wc use impaired by turbidity and phosphorus.
Hannagan Creek, hdwt-Beaver Creek 15060101-008OFF8	7.5 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	AGFD 1990, 3 samples (limited parameters): full compliance.
Horton Creek, hdwt-Tonto Creek 15060101-008OFFH	4.2 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria phys/chem monitoring 1992-93, 2 samples: full support.
North Fork Bear Wallow Creek, hdwt-Bear Wallow 15060101-006OFF44OFF15N	5 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-95, 4 samples: full support.
SALT RIVER SUB-WATERSHED (see also page 44)						
Salt River, Cherry Creek-Pinal Creek 15060103-006	13.1 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Threat	USFWS study of eagle prey (King et al 1991) indicated that fish had elevated mercury levels in 1988 at Redmond. Source of mercury is believed to be historic mining (however, much of the watershed is on Indian reservations and little information is available concerning potential sources).
Salt River, Pinal Creek-Roosevelt Lake 15060103-004	3.5 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	USGS (above Roosevelt Lake, below Pinal Creek) 1991-95, 54 samples: partial support of uses due to turbidity and arsenic; uses threatened by fecal coliform, TDS, nitrogen, manganese, and copper. Fecal coliform exceedance routinely in August (during monsoon rains). See comments in Pinal Creek (15060103-005).
Cherry Creek, hdwt-Salt River 15060103-015	51.7 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	No	Full	• ADEQ station 1991-92, 10 samples: full support. • ADEQ biocriteria site (phys/chem monitoring) 1992-94, 2 sites, 6 samples combined: full support.
Devil's Chasm Creek, hdwt-Cherry Creek 15060103-015OFFDC	2.5 mi	A&Wc, FBC, FC	Evaluated	No	Full	ADEQ Biocriteria Development site (phys/chem monitoring), 1 sample 1993: full support.
Canyon Creek, hdwt-Oak Creek 15060103-014	19.4 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• ADEQ monitoring 1991-93, 17 samples: uses impaired by turbidity. • ADEQ Biocriteria Development Program (phys/chem monitoring) 3 samples 1992-94: full support. • AGFD 1991-92, 10 samples (limited parameters): full support. • One facility with a NPDES permit discharges to this reach (see Appendix D).

SALT RIVER WATERSHED ASSESSMENTS						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Coon Creek, hdwt-Salt River 15060103-006OFF7	12.5 mi	A&Ww, FBC	Evaluated	No	Full	ADEQ monitoring (above Forest Road 203), 6 samples 1995: full support.
Pinal Creek, hdwt-Salt River 15060103-005	17.6 mi	Varies, see comments	Monitored	Yes	Non	• There are 3 sets of designated uses on this reach: A&We, PBC, AgI, AgL from headwaters to intermittent flow beginning at Setka Ranch, (except below the Globe WWTP discharge to Radium where it is A&Wedw, and PBC); and A&Ww, FBC, FC, AgI, and AgL below Setka Ranch. • USGS monitoring (Inspiration Dam) 1991-95, 30 samples: uses impaired by TDS, manganese, and nickel. • ADEQ Biocriteria Development Program site (above Radium in effluent dependent water), 1 sample in 1994: uses impaired by pH at 10. • ADEQ complaint investigations in 1991 and 1993: uses impaired by beryllium, copper, manganese, nickel, low pH, and TDS. • Five facilities have NPDES permits to discharge to this stream or its tributaries (see Appendix D). • Efforts to reduce contamination through the Superfund/WQARF Program have been successful at mitigating groundwater contamination (Lewis and Burraychak 1979; Brown 1990; Longsworth and Taylor 1992; Ham 1995).
Miami Wash, hdwt-Bloody Tanks Wash 15060103-005OFF13	2.7 mi	A&We, PBC, AgL	Evaluated	No	Non	Evaluation based on monitoring on Bloody Tanks Wash and Pinal Creek.
Bloody Tanks Wash, hdwt-Miami Wash 15060103-005OFF13OFF1	7.6 mi	A&We, PBC, AgL	Evaluated	Yes	Non	EPA monitoring at two sites (Oxhide and Triple Nickel) in 1993: dissolved copper exceeded standard by a factor of 10.
Pinto Creek, hdwt-Spring Creek 15060103-018	25.4 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	• Magma Copper Company instream monitoring (for NPDES permit) indicate that dissolved copper exceeds standards above their discharge point, but not below. • ADEQ/EPA monitoring in 1992 (4 sites): dissolved copper exceeded standards below tributary discharge from Gibson Mine. • ADEQ 1990-92 Gibson Mine Investigation on tributary: opper, manganese, zinc and pH impair unnamed tributary from Gibson Mine. • Other investigations during tailings spills: narrative violations and dissolve copper impairing uses. • One facility with a NPDES permit discharges to this stream (see Appendix D).
Pinto Creek, Spring Creek-Roosevelt Lake 15060103-017	2.6 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	No	Threat	ADEQ monitoring (Henderson Ranch) 1991-95, 30 samples: threats to A&Ww due to selenium (occasionally high) and copper (up-stream monitoring).

SALT RIVER WATERSHED ASSESSMENTS						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Salome Creek, hdwt-Roosevelt Lake 15060103-022	26.3 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Reynolds Creek, hdwt-Salome Creek 15060103-022OFF9	11 mi	A&Wc, FBC, FC, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Workman Creek, hdwt-Salome Creek 15060103-022OFF8	12 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Campaign Creek, hdwt-Pinto Creek 15060103-017OFFC	16 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992 and 1994, 2 samples: full support.
TONTO CREEK SUB-WATERSHED						
Tonto Creek, hdwt-Haigler Creek 15060105-013	14.5 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Full 6 Partial 8.5	• ADEQ intensive survey of upper Tonto Creek (1995) indicated that nitrogen below the AGFD hatchery exceeding standards. • AGFD hatchery monitoring (18 samples 1991-92) - indicated excess phosphorus at the discharge point. This facility has a NPDES permit to discharge (see Appendix D).
Tonto Creek, Haigler Creek-Spring Creek 15060105-011	8 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated		Full	Biocriteria reference site (phys/chem monitoring), 2 samples 1993-94: full support.
Tonto Creek, Spring Creek-Rye Creek 15060105-009	15.5 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Threat	Evaluation based on upstream and downstream monitoring (15060105-006, -008, -013). Biocriteria site (phys/chem monitoring) 1992, 1 sample: full support.
Tonto Creek Rye Creek-Gun Creek 15060105-008	2.4 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Partial	ADEQ monitoring (above Gun Creek), 1991-95, 30 samples: uses impaired by trubidity.
Tonto Creek, Gun Creek-Greenback Creek 15060105-006	18.3 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Threat	• USFWS study of Eagle prey (King et al 1991): elevated mercury levels in fish. • USFS monitoring 1991, 3 samples: full support.
Tonto Creek, Greenback Creek-Roosevelt Lake 15060105-004	2.5 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Threat	Evaluation based on upstream monitoring (15060105-006 & -008).
Rye Creek, hdwt-Tonto Creek 15060105-014	15.4 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Full	USFS/ADEQ cooperative monitoring 1991, 3 samples: full support.

SALT RIVER WATERSHED ASSESSMENTS						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Deer Creek, hdwt-Rye Creek 15060105-014OFF6	7 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Christopher Creek, hdwt-Tonto Creek 15060105-013OFF8	7.2 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	• USFS/ADEQ monitoring 1991, 3 samples: full support. • ADEQ special investigation 1993 (WQMS 212.357) because of illegal wastewater discharge: uses impaired by TDS and nutrients.
Haigler Creek, Haigler Creek-Tonto Creek 15060105-012	17.1 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	No	Full	• ADEQ station 1992-93, 12 samples: full support. • ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support. • USFS/ADEQ monitoring 1991, 3 samples: full support.
Gordon Canyon Creek, hdwt-Haigler Creek 15060105-012OFF3	10 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• ADEQ station 1993, 5 samples: full support. • ADEQ biocriteria site (phys/chem monitoring) 1993-94, 2 samples: partial support of A&Wc due to turbidity.
Spring Creek, hdwt-Tonto Creek 15060105-010	19.4 mi	A&Wc, FBC, FC, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Greenback Creek, hdwt-Tonto Creek 15060105-005	9.2 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992, 1 sample: full support.
SALT RIVER SUB-WATERSHED (above Granite Reef Dam) (see also page 41)						
Salt River, Stewart Mtn. Dam-Verde River 15060106-003	9 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Monitored	No	Threat	USGS monitoring (Stewart Mtn Dam) 1991-92, 12 samples: partial support DWS due to chloride and TDS exceeding secondary drinking water standards. However, more recent downstream monitoring indicates TDS and chloride levels have dropped (more flow); therefore, assessed in full support but threatened.
Salt River, Verde River-Granite Reef 15060106-002	4 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Threat	Evaluation based on upstream monitoring (15060106-003). • USFS/Maricopa Co/ADEQ cooperative study of bacterial contamination in the tubing area of stream (5 sets of 5 at 5 locations taken on Sundays during summer 1991): fecal coliform remained well below all standards.
LAKES IN THE SALT RIVER WATERSHED						
Big Lake 15060101-0160	450 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ Clean Lakes Program monitoring 1995, 1 sample: uses impaired by arsenic and iron, both probably due to natural sources.
Crescent Lake 15060101-0420	100 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	Blooms of blue-green algae and weed harvesting (AGFD 1988-93). Problem in part due to grazing practices.

SALT RIVER WATERSHED ASSESSMENTS						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Roosevelt Lake 15060103-1240	13058 ac	A&Ww, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• ADEQ/USGS Clean Lakes Phase-I Diagnostic Feasibility Study (Hem 1995) 1991-92, 44 samples: uses impaired by beryllium, TDS and chloride. • USFWS 1988 eagle study of prey (King et al 1991): copper and zinc exceed criteria for fish. • One facility with a NPDES permit discharges to this lake (see Appendix D).
Saguaro Lake 15060106-1290	1195 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ monitoring 1995, 1 sample: TDS exceeds secondary maximum contaminant level for drinking water.

SAN CARLOS - SAFFORD - DUNCAN WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
GILA RIVER SUB-WATERSHED (see also 15040005 page 47)						
Gila River, Border-Bitter Creek 15040002-004	14.2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	Yes	Non	• USGS station (Redrock) 1991-93, 36 samples: uses impaired by turbidity. • USFWS monitoring at border (Baker & King 1994): arsenic impaires water uses, and cadmium is elevated in sediment.
Gila River, Bitter Creek-Apache Creek 15040002-003	2.2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15040002-004) and (15040002-001).
Gila River, Apache Creek-Skully Creek 15040002-002	6 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15040002-001) and (15040002-004).
Gila River, Skully Creek-San Francisco 15040002-001	13.1 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	• BLM monitoring 1993, 2 samples: uses impaired by turbidity. • USFWS study (Baker and King 1994): arsenic impairing uses in water, elevated levels of cadmium and thallium in sediment, and elevated mercury in fish.
SAN FRANCISCO RIVER WATERSHED						
San Francisco River, hdwt-New Mexico bdr. 15040004-023	9 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Non	• ADEQ bacteria monitoring 1992: threats due to fecal coliform. • ADEQ station 1992-95 (2 sites), 8 samples: uses impaired by fecal coliform and turbidity. Watershed is heavily grazed in the summer. Population growth, land development, and wastewater treatment have been identified as water quality concerns in this subwatershed. • ADEQ biocriteria site (phys/chem monitoring), limited parameters, 1993, 1 sample: full support.
San Francisco River, Blue River-Limestone Gulch 15040004-003	15 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	• ADEQ biocriteria site (phys/chem monitoring) 1992, 1 sample: full support (no dissolved metals analysis). • USFWS study (Baker and King 1994) monitoring water and sediment: arsenic impairing FC use, cadmium elevated in sediment.
San Francisco River, Limestone Gulch-Gila River 15040004-001	10.7 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	• ADEQ monitoring (@ Clifton) 1994-95, 12 samples: non-support A&Ww due to dissolved copper. • USGS monitoring (Clifton) 1991-93, 18 samples: uses impaired by turbidity, copper, and fecal coliform (mercury a threat). • USFWS study of water, sediment, and fish (Baker and King 1994): arsenic and TDS impair water; cadmium and copper elevated in sediments, and copper and mercury elevated in fish. • Other studies indicate turbidity and arsenic problems. • Possible sources of pollutants include: current and past mining, natural conditions, grazing practices, forestry management, and insufficient riparian vegetation.

SAN CARLOS - SAFFORD - DUNCAN WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Blue River, hdwt-Campbell Blue Creek 15040004-027	8.1 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: A&Wc impaired by turbidity.
Blue River, Campbell Blue-KP Creek 15040004-026	18.8 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream, downstream, and tributary monitoring (15040004-025) and (15040004-028).
Blue River, KP Creek-San Francisco 15040004-025	27.1 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Non	• USGS fixed station 1991-93, 17 samples: uses impaired by turbidity. • ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Campbell Blue Creek, hdwt-Blue River 15040004-028	17.4 mi	A&Wc, FBC, FC	Evaluated	No	Threat	• USFS/ADEQ monitoring in Apache Sitgreaves Nat'l Forest 1991, 3 samples: full support. • ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support (slightly low dissolved oxygen near spring source). • AGFD monitoring 1991-93, 3 samples (limited parameters): elevated pH (believed related to low flows) is a threat to designated uses.
Coleman Creek, hdwt-Campbell Blue 15040004-028OFFC	7 mi	A&Wc, FBC, FC	Evaluated	No	Full	• ADEQ biocriteria development reference site (phys/chem monitoring) 3 samples 1992-94: full support. • AGFD 1991-93, 5 samples (limited parameters): full support.
Pigeon Creek, hdwt-Blue Creek 15040004-025OFFP	10.5 mi	A&Ww, FBC, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1993, 1 sample: full support.
Lanphier Creek, hdwt-Blue River 15040004-026OFFL	6.6 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Grant Creek, hdwt-Blue River 15040004-026OFFA	10.2 mi	A&Wc,FBC, FC	Evaluated	No	Full	• ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support. • AGFD monitoring (few parameters): all meet standards.
GILA RIVER SUB-WATERSHED (see also 15040002 page 46)						
Gila River, San Francisco River-Eagle 15040005-024	3 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15040005-022) and (15040002-004).
Gila River, Eagle Creek-Bonita Creek 15040005-023	9 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Non	Evaluation based on upstream and downstream monitoring (15040005-022) and (15040002-004).
Gila River, Bonita Creek-Yuma Wash 15040005-022	6 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	USGS monitoring site (Solomon) 1991-95, 30 samples: uses impaired by turbidity, dissolved copper, and fecal coliform; threats due to arsenic and mercury.

SAN CARLOS - SAFFORD - DUNCAN WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Gila River, Yuma Wash-San Simon 15040005-020	7.7 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	• USFWS study of fish, water, and sediment contamination (Baker and King 1994): arsenic impairing uses in water, cadmium elevated in sediment, mercury elevated in fish. • One facility with a NPDES permit discharges to a tributary of this reach (Az Dept of Corrections/Safford into Bennet Wash) (see Appendix D).
Gila River, San Simon Creek-Stockton 15040005-019	2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15040005-011, -015, -020, -022).
Gila River, Stockton-Watson Wash 15040005-017	6.6 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15040005-011, -015, -020, and -022).
Gila River, Watson Wash-Coyote Wash 15040005-016	0.4 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15040005-011 and -022).
Gila River, Coyote Wash-Peck Wash 15040005-015	3.6 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	USFWS study of sediment, fish, and water contamination (Baker & King 1994): water impaired by arsenic, and sediment has elevated cadmium and thallium, and fish has elevated copper and zinc.
Gila River, Peck Wash-Underwood 15040005-014	3.8 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15040005-011, -012, -015, 022).
Gila River, Underwood-Bylas Salt 15040005-012	21.4 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	USFWS study of water, fish, and sediment contamination (Baker and King 1994): TDS and arsenic impair water uses, thallium is elevated in sediment, and copper, mercury, and zinc are elevated in fish tissue.
Watson Wash, hdwt-Gila River 15040005-033	10.1 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Non	• BLM monitoring 1993, 1 sample at artesian well (spring): uses impaired by zinc, TDS, and arsenic. • One facility with a NPDES permit discharges to this reach (see Appendix D).
Bonita Creek, Park Creek-Gila River 15040005-030	23 mi	A&Ww, DWS, FBC, FC, AgI, AgL (Unique Water)	Monitored	Yes	Partial	• BLM monitoring 1991-93, 6 samples: uses impaired by high pH and dissolved zinc. (Older samples also indicate exceedance of zinc and copper.) (BLM believes contaminants natural conditions.) • ADEQ biocriteria site (phys/chem monitoring) 1993-94, 2 samples: full support. (Note headwaters on Indian lands.)
Eagle Creek, hdwt-Willow Creek 15040005-028	13.2 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Eagle Creek, Willow Creek-Sheep Wash 15040005-027	4.6 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Full	Evaluation based on upstream and downstream monitoring (15040005-025) and (15040005-028).

SAN CARLOS - SAFFORD - DUNCAN WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Eagle Creek, Sheep Wash-Gila River 15040005-025	33 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Part	• ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: partial support. • One facility with a NPDES permit discharges to this reach (see Appendix D).
Frye Creek, hdwt-Highline Canal 15040005-020OFFA	11 mi	A&Wc, FBC, FC, AgL	Evaluated	No	Full	ADEQ biocriteria chem/phys monitoring 1992-94, 3 samples: full support.
Marijilda Creek, hdwt-Stockton Wash 15040005-018OFF1	14 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	• AGFD 1994, 1 sample: uses impaired by arsenic and TDS. • ADEQ biocriteria site (phys/chem monitoring) 1992-93, 2 samples: full support.
Ash Creek, hdwt-Gila River 15040005-015OFF1	15 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	ADEQ station 1992, 1 sample: partial support of uses due to low pH.
Markham Creek, hdwt-Gila River 15040005-014OFF1	11 mi	A&Ww, FBC, AgL	Evaluated	No	Full	BLM monitoring 1991-1993, 3 samples: full support.
Black Rock Canyon, hdwt-Gila River 15040005-012OFFB	24 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Full	BLM monitoring 1991, 1 sample: full support.
Fishhook Canyon, hdwt-McKinney Canyon 15040005-012OFFF	3.4 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Full	BLM monitoring 1991-93, 2 samples: full support.
SAN SIMON CREEK SUB-WATERSHED						
Cave Creek (& Ponds), hdwt-New Mexico bdr. 15040006-000	16 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) in South Fork Cave Creek 1992-95, 4 samples: full support.
East Turkey Creek, hdwt-San Simon 15040006-006OFFT	14.5 mi	A&Ww, PBC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria chem/phys monitoring 1992-95, 4 samples: full support.
SAN CARLOS RIVER SUB-WATERSHED (entirely on Indian Reservation)						
LAKES IN THE SAN CARLOS-SAFFORD-DUNCAN WATERSHED						
Cluff Ranch Pond #3 15040005-0370	10 ac	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	AGFD monitoring 1990, 1 sample: too few parameters to assess. Weed problems reported by AGFD.

SAN CARLOS - SAFFORD - DUNCAN WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Luna Lake 15040004-0840	75 ac	A&Wc, FBC, FC, AgL	Evaluated	No	Partial	ADEQ Clean Lakes Program monitoring 1995, 1 sample: uses impaired by high pH and algal bloom at time of monitoring. AGFD reports weed harvesting 1991-95. USFS letter (1991) to Clean Lakes Program states that this lake has a algal bloom problem which reduces recreation and fisheries potential.
Roper Lake 15040006-1250	32 ac	A&Ww, FBC, FC	Evaluated	No	Partial	AGFD monitoring 1989-91, 8 samples: partial support of uses due too high pH and low dissolved oxygen. Hot springs source of water and possibly naturally high pH and low DO.

SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
WILLCOX PLAYA SUB-WATERSHED						
Post Creek, hdwt-Grant Creek 15050201-001OFFP	1.3 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Non	ADEQ monitoring 1991-92, 2 samples: impaired uses due to dissolved chromium and low pH.
Grant Creek, hdwt-High Creek 15050201-001OFF10	15 mi	A&Wc, DWS, FBC, FC, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Goudy Creek, hdwt-Grant Creek 15050201-001OFFG	8 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-93, 2 samples: full support.
Ward Canyon, hdwt-Turkey Creek 15050201-002OFFW	3 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-95, 4 samples: full support.
SAN PEDRO SUB-WATERSHED						
San Pedro River, Mexico border-Charleston 15050202-008	27.3 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• ADEQ 3 stations (Lewis Springs, Charleston, and Palominas) for a total of 67 samples 1991-95: uses impaired by turbidity, low dissolved oxygen, beryllium, and fecal coliforms; threats due to heavy metals. • ADEQ Priority Pollutant Program monitoring of fish and sediment 1992: full support.
San Pedro River, Charleston-Walnut Gulch 15050202-006	7.4 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• USGS station 1991-93, 29 samples: uses impaired by turbidity, threats due to heavy metals (copper, arsenic, and lead) and fecal coliform. • ADEQ biocriteria site (phys/chem monitoring) 1992-95, 4 samples: full support.
San Pedro River, Walnut Gulch-Babocomari 15050202-005	0.5 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring (15050202-006 @ Charleston).
San Pedro River, Babocomari Creek-Dragoon 15050202-003	14.9 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• ADEQ 2 stations (Fairbanks, Curtis Siding) total 1991-93, 31 samples: uses impaired by fecal coliform and turbidity; threats due to arsenic and beryllium (lead and mercury occasionally exceed standards). • ADEQ 2 sites at St David, 1991-95, 34 samples: uses impaired by nitrate, fecal coliform, and turbidity, threats due to arsenic, beryllium, copper, lead, and mercury. • Superfund site at St David (excessive nitrates) impacting this waterbody through groundwater contamination upwelling at springs along stream. Probable sources include: historic mining, historic manufacturing and waste disposal practices, grazing practices, reduced riparian area, and natural conditions.

SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
San Pedro River, Dragoon-Tres Alomos 15050202-002	13.2 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring (15050202-003).
San Pedro River, Tres Alomos-15050203 15050202-001	6.2 mi	A&Ww, PBC, AgL	Evaluated	No	Partial	Evaluation based on upstream monitoring (15050102-003) and evaluation of riparian condition (AGFD 1993).
Miller Canyon Creek, hdwt-San Pedro 15050202-008OFF16W	11.5 mi	A&Wc, FBC, FC, AgL	Evaluated	No	Full	ADEQ Biocriteria Development Program monitoring (phys/chem samples) 1995, 1 sample: full support.
Carr Canyon Creek, hdwt-San Pedro 15050202-008OFF15	10.8 mi	A&Wc, FBC, FC, AgL	Evaluated	No	Full	ADEQ Biocriteria Development Program monitoring (phys/chem samples), 1 sample in 1995: full support.
Ramsey Canyon Creek, hdwt-San Pedro 15050202-008OFF14	14.5 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring), 4 samples 1991-1995: full support.
Banning Creek, hdwt-San Pedro 15050202-008OFF16	12 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Full	ADEQ 1990, 1 sample: full support.
Babocomari River, Banning Creek-San Pedro 15050202-004	30 mi	A&Ww, FBC, FC, AgL	Monitored	No	Threat	• ADEQ 4 stations 1990-93, 16 samples: naturally low dissolved oxygen near spring source, full support. • ADEQ Priority Pollutant Program analysis of fish and sediment: full support. • BLM monitoring 1991-93, 3 locations 7 samples: barium was 3 times the standard in one sample, threat to FBC when added to other samples.
Walnut Gulch, hdwt-San Pedro 15050202-009	13.7 mi	A&Wedw, PBC	Evaluated	No	Threat	Reach evaluated as threatened due to Tombstone publicly owned treatment plant discharges (see Appendix D).
San Pedro River, 15050203-Hot Springs 15050203-012	13.5 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on downstream monitoring (15050203-011).
San Pedro River, Hot Springs Creek-Redfield 15050203-011	13.2 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	No	Full	ADEQ monitoring at 2 sites (Cascabel and Redington) 1991-92, 5 samples: full support.
San Pedro River, Redfield Canyon-Buehman 15050203-009	4.6 mi	A&Ww, FBC, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15050203-011) and (15050203-008).

SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
San Pedro River, Buehman-Peppersauce 15050203-008	11.8 mi	A&Ww, FBC, AgL	Evaluated	No	Partial	• EPA Copper Mine Initiative monitoring 1993, 1 sample: uses impaired by turbidity. • Pima County Mt. Lemmon Summerhaven facility has a NPDES permit to discharge to Alder Wash tributary (see Appendix D).
San Pedro River, Peppersauce-Aravaipa 15050203-003	18.4 mi	A&Ww, FBC, AgL	Evaluated	No	Partial	• ADEQ Priority Pollutant Program monitoring of sediment in 1994: copper elevated in sediment. • EPA/Magma Copper Company Mine Initiative monitoring: turbidity impairs uses in higher flows. • One facility with a NPDES permit discharges to this reach (see Appendix D).
San Pedro River, Aravaipa Creek-Gila River 15050203-001	11.1 mi	A&Ww, FBC, AgL	Monitored	Yes	Non	• USGS monitoring suspended solids 1990-93: flows over 30 cfs results in excessive suspended solids. • ADEQ fixed station 1993-94 5 samples: uses impaired by turbidity. • USFWS study (King and Baker 1995) of sediment: no elevated metals.
Redfield Canyon, hdwt-San Pedro 15050203-014	18.7 mi	A&Ww, FBC, FC, AgL	Monitored	Yes	Non	• ADEQ station 1991-93, 6 samples: uses impaired by low dissolved oxygen and arsenic. • ADEQ biocriteria site (phys/chem monitoring): full support (lab detection level for arsenic above standard). • BLM monitoring 1990-93 4 samples: chromium IV and zinc impairing uses.
Hot Springs Canyon Creek, hdwt-San Pedro 15050203-013	23.3 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	• BLM monitoring 1990-93, 5 samples: uses impaired by fecal coliform and dissolved chromium. • ADEQ station @ Cascabel 1991-92, 5 samples: arsenic threat to FC. • ADEQ biocriteria site (phys/chem monitoring) 1992-93, 2 samples: full support.
Wildcat Canyon, hdwt-Hot Springs 15050203-013OFFW	2.8 mi	A&Ww, FBC, FC, AgL	Evaluated	No	Partial	BLM monitoring 2 samples 1991-93: partial support of FC due to arsenic.
Bass Canyon, hdwt-Hotsprings 15050203-013OFFB	11.7 mi	A&Ww, FBC, AgL	Evaluated	No	Non	• BLM (Safford) monitoring 1990-93, 6 samples: uses impaired by copper and chromium. • ADEQ biocriteria site (phys/chem monitoring) 1992-93, 2 samples: full support.
Buehman Canyon, hdwt-San Pedro 15050203-010	11.3 mi	A&Ww, FBC, AgL	Evaluated	No	Full	ADEQ monitoring 1991, 3 samples: full support.
Geesaman Wash, hdwt-Alder Wash 15050203-008OFFG	10.7 mi	A&Ww, FBC, AgL	Evaluated	No	Non	ADEQ Oracle Ridge Mine Investigation (WQMS 212.245) 1992-93 (7 sites): copper from mining activities impairing uses.

SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Gibbs Wash, hdwt-San Pedro 15050203-008OFFGIB	3.6 mi	A&Ww, FBC, AgL	Evaluated	No	Partial	ADEQ investigation of effects of mining activities in Oracle Ridge mining area 1993, 8 water samples and 10 pairs (20) sediment/streambank samples: uses impaired by copper and turbidity, and narrative violations of bottom deposits.
Copper Creek, hdwt-San Pedro 15050203-003OFF12	15.2 mi	A&Ww, PBC, AgI, AgL	Evaluated	No	Non	• EPA Copper Mines Initiative Study 1993, 1 sample: uses impaired by dissolved copper and turbidity. Sources believed to be historic mining and grazing practices. • BLM monitoring 1993, 1 sample: full support.
Mulberry Creek, hdwt-San Pedro 15050203-003OFFM	8 mi	A&Ww, FBC, AgL	Evaluated	No	Non	BLM monitoring 1993, 1 sample: uses impaired by copper, cadmium, and low pH. Source believed to be historic mining.
Aravaipa Creek, hdwt-Rattlesnake 15050203-006	24.8 mi	A&Ww, DWS, FBC, FC, AgL	Monitored	No	Threat	BLM monitoring 1991-93, 4 samples: uses threatened by naturally high pH and manganese, and occassional lead and cyanide from historic mining.
Aravaipa Creek, Rattlesnake-San Pedro 15050203-004	31.3 mi	A&Ww, DWS, FBC, FC, AgL	Monitored	No	Threat	• ADEQ biocriteria development monitoring site (phys/chem monitoring) 1992-94, 2 sites 3 samples each: full support. • ADEQ monitoring (Woods Ranch) 1992-94, 9 samples: 1 sample exceeded turbidity standards. • ADEQ Priority Pollutant Program monitoring of fish: lead and selenium elevated in fish. • BLM monitoring 1990-93, 3 samples: dissolved zinc impairing uses. Klondike Mine Investigation by ADEQ in 1993: elevated heavy metals in sediment. • BLM monitoring on 2 tributaries: Javalina Canyon (full support) & Oak Grove Canyon (partial support due to high pH).
RIO YAQUI SUB-WATERSHED						
Rucker Canyon Creek, headwaters-Whitewater 15080301-004OFFA	33 mi	A&Wc, DWS, FBC, FC, AgL	Evaluated	No	Full 28 Partial 5	• ADEQ complaint investigation (WQMS-212.108): uses impaired by arsenic and beryllium. • ADEQ biocriteria site (phys/chem monitoring) 1992-95, 4 samples: full support.
Whitewater Draw, Mexican Border-Mule Gulch 15080301-002	12.7 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	ADEQ 2 monitoring sites 1992, 2 samples each (@ Highway 80 and @ International border): uses impaired by arsenic, beryllium, fecal coliform, low dissolved oxygen, turbidity, and zinc.
Whitewater Draw, Mule Gulch-Elfrida 15080301-004	21.4 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Non	• Evaluation based on monitoring downstream and on tributaries. • One facility has a NPDES permit to discharge to this reach (see Appendix D).

SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Mule Gulch, hdwt-Whitewater Draw 15080301-004OFF6	9.2 mi	Varies, see comments	Monitored	Yes	Non	• This reach has sets of designated uses: A&Ww, PBC, AgI, AgL from headwaters to Bisbee WWTP; and A&Wedw, PBC, AgL below the WWTP. • ADEQ monitoring 1990-93, 2 sites: uses impaired by copper, zinc, and low pH due to current and historic mining in the immediate watershed. Turbidity exceeds standards occasionally. • One facility has a permit to discharge to this reach (see Appendix D).
Guadalupe Canyon, New Mexico-Mexico border 15080302-002	10 mi	A&Ww, PBC	Evaluated	No	Full	BLM (Safford Dist) monitoring 1991, 1 sample: full support.
LAKES IN THE SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED						
Willcox Playa 15050201-1892	29440 ac	A&Ww, FBC, AgL	Evaluated	No	Non	• ADEQ monitoring near Willcox AZ, 1995 1 sample: uses impaired by arsenic, beryllium, and turbidity. • ADEQ Priority Pollutant Program monitoring of sediment and wildlife in 1994: arsenic elevated in sediment, cadmium, chromium, selenium, and DDT metabolites elevated in wildlife. • One facility has a NPDES permit to discharge to this waterbody (see Appendix D). (Note this is a playa, a waterbody lacking discharge; therefore, any pollutants must naturally degenerate or they will continue to accumulate in the water, sediment or biota.)

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
SANTA CRUZ SUB-WATERSHED (see also 15050303)						
Santa Cruz River, hdwt-Mexico 15050301-012OFFL	11 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	No	Threat	• ADEQ station 1990-93, 11 samples: full support. • ADEQ Biocriteria site (phys/chem monitoring) 1992, 1 sample: full support. • ADEQ Priority Pollutant Program monitoring of sediemnt, fish, and birds, 1994: chromium and zinc over screening values in fish.
Santa Cruz River, Mexico bdr-Nogales Wash 15050301-012	16.4 mi	A&Ww, DWS, FBC, AgI, AgL	Monitored	Yes	Partial	ADEQ 2 stations: 1) At Mexico border (34 samples 1991-95) 2) at Guevavi Ranch (14 samples 1993-95): partial support of A&Ww and FBC due to turbidity; threats due to fecal coliform and low dissolved oxygen.
Santa Cruz River, Nogales Wash-Sonoita 15050301-010	3 mi	Varies, see comments	Evaluated	Yes	Partial	• This waterbody has two sets of designated uses: A&Ww, DWS, FBC, AgI, and AgL above the WWTP discharge, and A&Wedw and PBC below the discharge. • International Boundary Water Commission monitored 1991, 2 samples: full compliance. See comments in 15050301-009. • Nogales International WWTP discharges to this reach (see Appendix D).
Santa Cruz River, Sonoita Creek-Josephine 15050301-009	6.3 mi	A&Wedw, PBC	Monitored	Yes	Partial	• ADEQ/Volunteer monitoring (Rio Rico) 1991-95, 40 samples below Nogalas WWTP discharge (ADEQ 1995). Also a cooperative study (ADEQ, Santa Cruz County, City of Nogales, and the International Boundary Water Commission) of impacts of Nogales Wash @ Calabasas Road 1991, 8 samples and 20 bacteriological samples. Together this monitoring reveals: uses impaired by cyanide, fecal coliform, and turbidity. • ADEQ Priority Pollutant monitoring in 1993 and 1994 of sediment, fish, and birds: elevated arsenic in sediment, elevated chromium, DDT, dieldrin, mercury and zinc in fish, and elevated chromium in birds.
Santa Cruz River, Josephine Canyon-Sopori 15050301-008	13.6 mi	Varies, see comments	Monitored	Yes	Partial	• This reach has two sets of designated uses: A&Wedw and PBC for the first 5 miles and A&We, PBC, AgL for the last 8.6 miles. • ADEQ monitored 3 stations 1992-93, total 14 samples: partial support due to turbidity, copper, and cyanide. • ADEQ Priority Pollutant Program monitoring of sediment, fish, and birds 1994: elevated levels of chromium, DDT metabolites, and zinc in fish.
Santa Cruz River, W.Branch S.Cruz-Airport 15050301-005	1.5 mi	A&We, PBC	Evaluated	No	Partial	• Evaluation based on upstream and downstream monitoring (15050301-001 and -008). • One facility with a NPDES permit discharges to a tributary; see Appendix D.

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Santa Cruz River, Airport W.-Rillito Creek 15050301-003	9 mi	Varies, see comments	Evaluated	No	Partial	A&W ephemeral and PBC down to discharge from Rorger Road wastewater treatment facility, the A&W effluent dependent water and PBC. • Evaluation based upstream & downstream monitoring (15050301-001 and -008). • One facility with a NPDES permit discharges into this reach (see Appendix D).
Santa Cruz River, Rillito-Canada del Oro 15050301-002	1.1 mi	A&Wedw, PBC	Evaluated	No	Threat	Evaluation based on downstream monitoring (15050301-001).
Santa Cruz River, Canada del Oro-Guild 15050301-001	8 mi	A&Wedw, PBC	Monitored	Yes	Threat	• ADEQ station (Cortero) 1990-93, 20 samples: turbidity threatens uses. • ADEQ Priority Pollutant monitoring birds and sediment in 1993: killdeer contaminated by DDT metabolites (source of DDT may not be this reach because of the feeding range of killdeer). Ina Road WWTP discharges to this reach (see Appendix D).
Washington Gulch, hdwt-Duquesnew 15050301-012OFFW	3.5 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	ADEQ investigation of Washington Camp Mine (WQSM 212.358) 1992, 6 sites: non-support A&Ww, AgL due to copper and zinc; partial support AgL & AgI due to copper, lead, TDS, and zinc.
Providencia Canyon, hdwt-Santa Cruz 15050301-012OFFP	6.5 mi	A&Ww, DWS, FBC, AgI, AgL	Evaluated	No	Full	USFS/ADEQ cooperative monitoring 1991, 1 sample: full support.
Nogales Wash, Mexico bdr-Santa Cruz 15050301-011	4.9 mi	A&Ww, PBC, AgI, AgL	Monitored	Yes	Non	• This wash has received untreated sewage effluent from Mexico. • ADEQ 1990-93, 23 samples: uses impaired by fecal coliform, ammonia, and turbidity. • 1991 cooperative monitoring (ADEQ/IBWC/Santa Cruz County Health Dept) on Nogales wash and several tributaries: fecal coliform exceeds standards.
Peck Canyon Creek, hdwt-Santa Cruz 15050301-009OFFP	12 mi	A&We, PBC, AgL	Evaluated	No	Full	ADEQ monitoring 1991, 1 sample: full support.
Madera Canyon Creek, hdwt-Santa Cruz 15050301-006OFF4	11 mi	A&Ww, FBC, FC	Evaluated	No	Full	• ADEQ 1990 (@ Roundup and Whitehorse) 2 samples: full support. • ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support.
Demetrie Wash, hdwt-Santa Cruz 15050301-006OFFD	15 mi	A&Ww, FBC, FC	Evaluated	No	Non	EPA/Cyprus monitoring at Sierrita Mine 1993, 1 sample: non-support due to copper; partial support due to low pH. Source appears to be mining activities.

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Canada del Oro, hdwt-Big Wash 15050301-017	15.4 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Threat	• ADEQ biocriteria site (phys/chem monitoring) 1992-94, 3 samples: full support. • Two facilities have NPDES permits to discharge to this reach or a tributary (Big Wash (see Appendix D).
Romero Canyon Creek, hdwt-Canada del Oro 15050301-017OFF1	5 mi	A&Wc, FBC, FC	Evaluated	No	Full	ADEQ monitoring 1 sample 1993 and USFS/ADEQ cooperative monitoring 1991 3 samples: full support.
SONOITA CREEK SUB-WATERSHED						
Sonoita Creek, hdwt-Santa Cruz River 15050301-013	30.2 mi	Varies, see comments	Monitored	Yes	Partial 15.1 mi., Non 15.1 mi.	• Designated uses for this reach change at Patagonia: A&Ww, PBC, AgI, AgL above Patagonia, and A&Ww, FBC, FC, AgI, AgL below. • ADEQ 5 monitoring sites with 38 samples 1991-93: partial support of uses due to low dissolved oxygen and heavy metals. • Two facilities have NPDES permits to discharge to this reach (see Appendix D).
Alum Gulch, hdwt-Sonoita Creek 15050301-013OFF13	7 mi	A&We, PBC	Monitored	Yes	Non	• ADEQ monitoring 1992, 1 sample: full support. • ADEQ investigation of mining in 1995 at 7 sites: non-support of uses because of heavy metals and low pH.
Harshaw Wash, hdwt-Sonoita Creek 15050301-013OFF17S	12 mi	A&Ww, PBC, AgL	Monitored	Yes	Non	• ADEQ 1993 monitoring Endless Chain Mine 3 sites: non-support A&Ww, AgL, and PBC due to copper, pH, and zinc. • ADEQ Priority Pollutant monitoring, 1994: arsenic elevated in sediment. • ADEQ monitoring @ Trench Camp Mine, 2 sites: full support.
Redrock Canyon, hdwt-Harshaw Creek 15050301-013off17SoffR	10 mi	A&Ww, FBC, FC	Evaluated	No	Full	ADEQ Biocriteria Development monitoring site (phys/chem monitoring) 1 sample 1993: full support.
Temporal Gulch, hdwt-Sonoita Creek 15050301-013OFFT	12 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ monitoring 1992, 1 sample: full support.
Three-R Canyon, hdwt-Sonoita Creek 15050301-013OFFR	2 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Non	• ADEQ Three-R Mine investigation (WQMS 212.261) 3 stream samples (including radiochemicals): uses impaired by arsenic, beryllium, cadmium, copper, low pH, zinc.
RILLITO CREEK SUB-WATERSHED						
Rillito Creek, hdwt-*A 15050302-003	2 mi	A&We, PBC, AgL	Evaluated	No	Full	ADEQ monitoring 1991, 1 sample: full support.

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE** miles/acres	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Rillito Creek, *A-Santa Cruz River 15050302-001	10.9 mi	A&We, PBC, AgL	Evaluated	No	Partial	Stormwater monitoring at two sites indicates that stormwater is contaminated by chromium, grease and oil, and a low pH.
Tanque Verde Creek, hdwt-Rillito Creek 15050302-009	23 mi	A&Ww, FBC, AgL	Evaluated	No	Full	• ADEQ monitoring 1989, 1 sample: full support. • USFS 1991, 3 samples: full support.
Agua Caliente Wash, hdwt-Tanque Verde River 15050302-009OFF7	9 mi	A&Ww, FBC, AgL	Evaluated	No	Full	ADEQ biocriteria development site (phys/chem monitoring), 1 sample 1995: full support.
Sabino Canyon Creek, hdwt-Tanque Verde River 15050302-009OFF3	17.1 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Monitored	No	Threat	• ADEQ (Summerhaven) 1990-95, 10 samples: full support. • USFS 1 sample at 2 locations 1991: full support. • ADEQ biocriteria development site (phys/chem monitoring) 1992-94, 3 samples: full support, but threat due to iron above secondary MCL.
Cienega Creek, hdwt-Pantano Wash 15050302-006	32.2 mi	A&Ww, FBC, AgL, (Unique Water)	Monitored	No	Full	• ADEQ 3 stations 1991-95, a total of 26 samples: full support. • ADEQ biocriteria site (phys/chem monitoring) 1992, 1 sample: full support. • BLM monitoring 1993, 2 sites: full support.
Cave Creek, hdwt-Cienega Creek 15050302-006OFFC	3 mi	A&Ww, FBC, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992, 1 sample: full support.
Gardner Canyon Creek, hdwt-Cienega Creek 15050302-006OFF17	15.5 mi	A&Ww, FBC, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992, 1 sample: full support.
SANTA CRUZ SUB-WATERSHED (see also 15050301 page 56)						
Arivaca Wash, hdwt-Puertocito/Altar Wash 15050304-008	18.9 mi	A&Ww, FBC, AgL	Monitored	Yes	Partial	ADEQ 3 stations 1990-93 with a total of 56 samples: partial support of A&Ww due to low dissolved oxygen.
El Tiro, hdwt-Aguirre Wash 15050305-001OFFT	11 mi	A&We, PBC	Evaluated	No	Non	ADEQ investigation at ASARCO Silver Bell mine in 1993, 2 sites: uses impaired by copper, selenium, cadmium, low pH, and zinc.
RIOS MAGDELENA AND SONOYTA SUB-WATERSHED						
California Gulch hdwt-Mexico 15080200-000	16 mi	A&We, PBC, AgL	Evaluated	No	Threat	ADEQ investigation in 1990, 4 sediment samples: sediment contaminated by cadmium, lead, manganese, and zinc.

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED ASSESSMENTS - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Sycamore Creek hdwt-Mexico 15080200-002	7 mi	A&Ww, FBC, AgL	Evaluated	No	Full	ADEQ Biocriteria Monitoring 1992-94, 3 samples: full support.
LAKES IN THE SANTA CRUZ - RIO MAGDELENA - RIO SONITA WATERSHED						
Arivaca Lake 15050304-0080	80 ac	A&Ww, FBC, FC, AgI, AgL	Evaluated	Yes	Non	ADEQ and AGFD fish samples in 1995 revealed elevated levels of mercury in some species and sizes of fish, subsequently a fish advisory was posted on this lake. AGFD reports weed harvesting (1995).
Kennedy Park Lake 15050301-0720	11.2 ac	None established		No	Not applicable	• Lake is man-made, does not have designated uses, and was not assessed. However, it is a public lake, and has been stocked by AGFD. • ADEQ Clean Lakes Program and AGFD monitoring 1991-94, 6 samples: pH exceeds standards for A&Ww and PBC. • ADEQ Priority Pollutant Program monitored fish and sediment in 1992: full support.
Lakeside Park Lake 15050302-0760	12 ac	A&Ww, PBC	Evaluated	No	Non	• ADEQ Clean Lakes Program 1992-93, 3 samples: uses impaired by pH, ammonia, arsenic, lead, and mercury. • AGFD monitoring 1994-95, 6 samples (limited parameters): uses impaired by low dissolved oxygen. • ADEQ Priority Pollutant Program fish and sediment samples 1992: full support.
Parker Canyon Lake 15050301-1040	125 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ Clean Lakes Program monitoring 1992, 1 sample: full support. AGFD reports weed harvesting (1995).
Patagonia Lake 15050301-1050	260 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• ADEQ Clean Lakes Program 1992, 1 sample: full support. • AGFD 1993 (few parameters) 1 sample: manganese exceeded secondary MCL for drinking water use. Noted excessive weed growth. • ADEQ Priority Pollutant Program fish sample 1993: elevated mercury in fish.
Pena Blanca Lake 15050301-1070	45 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	Yes	Non	• ADEQ and AGFD fish samples revealed elevated levels of mercury in some species and sizes of fish, subsequently a fish advisory was posted on this lake. • ADEQ Clean Lakes Program 1992, 1 sample: uses threatened by turbidity and high pH. AGFD reports weed harvesting (1995).
Silverbell Park Lake 15050301-1400	17.5 ac	None established		No	Not applicable	• This lake is man-made, lacks designated uses, and was not assessed. However, it is a public lake, that has been stocked by AGFD. • ADEQ Clean Lakes Program monitoring 1992-93, 2 samples: arsenic and high pH impair water. • ADEQ Priority Pollutant monitoring of fish and sediment in 1992: lead elevated in fish.

VERDE RIVER WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
BIG CHINO SUB-WATERSHED						
Apache Creek, hdwt-Walnut Creek 15060201-019	8.5 mi	A&Ww, DWS, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ Biocriteria Development Program monitoring site (phys/chem samples) 1995 1 sample: full support.
Walnut Creek, hdwt-Big Chino Wash 15060201-002OFFW	24 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Full	• ADEQ monitoring 1993, 5 samples: full support. • ADEQ Biocriteria Development Program monitoring site 1995 1 sample: full support.
Pine Creek, hdwt-Big Chino Wash 15060201-016	10.9 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ investigation in 1992 (Nonpoint Source Program) indicated substantial evidence of bank erosion, accelerated down cutting, vegetation degradation, and accumulative sedimentation. Gabion structures have been installed in this stream channel to slow erosion; however, unnatural islands have been created in this stream channel due to Off Highway Vehicle use in this watershed.
VERDE RIVER SUB-WATERSHED (see also 15060203 page 65)						
Verde River, Big Chino-Sullivan Lake 15060202-054	3 mi	A&Ww, FC, FBC, AgI, AgL	Evaluated	No	Partial	Evaluation based on downstream monitoring (15060202-052) and (15060202-038).
Verde River, Sullivan Lake-Granite Creek 15060202-053	1.4 mi	A&Ww, FC, FBC, AgI, AgL	Evaluated	No	Partial	See comments for 15060202-052.
Verde River, Granite Creek-Hell Canyon 15060202-052	15.6 mi	A&Ww, FC, FBC, AgI, AgL	Monitored	Yes	Partial	• ADEQ station (Pauldin) 1990-91, 6 samples: partial support FC due to arsenic. • ADEQ Biocriteria Monitoring site in 1995, 1 sample: partial support of FC due to arsenic.
Verde River, Hell Cyn.-15060202-065 15060202-038	5.5 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15060202-037 and -052)
Verde River, 15060202-065-Railroad Dr. 15060202-037	9.6 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• ADEQ station (Perkinsville) 1990-93, 24 samples: uses impaired by arsenic and phosphorus. Threats to uses due to beryllium and turbidity. • ADEQ Biocriteria Development monitoring site (phys/chem monitoring) 1992-95, 5 samples: partial support FC due to arsenic.
Verde River, Railroad Draw-Sycamore 15060202-035	2.2 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15060202-025) and (15060202-037).

VERDE RIVER WATERSHED ASSESSMENT - 1998						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Verde River, Sycamore Creek-Oak Creek 15060202-025	24 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• USGS station (Clarkdale) and 4 other ADEQ monitoring sites, 1991-95, 72 samples: uses impaired by arsenic and turbidity. • The Verde Formation, a natural alluvial deposit in the middle Verde River, is the major source of high arsenic. Anthropogenic activities (mining, manufacturing) do not appear to be a source at ambient (lower) flows (Baker et al, 1994).
Verde River, Oak Creek-Beaver Creek 15060202-015	11.5 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• ADEQ 2 monitoring stations (1000 Trails, Interstate 17) 1990-91 - 32 samples (limited parameters): uses impaired by turbidity. • ADEQ Biocriteria Development Program monitoring site (below Oak Creek) 1995 - 1 sample - fulll support.
Verde River, Wet Beaver Creek-*A 15060202-001	2.4 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15060202-015 and 15060203-027) and a watershed study of the Verde River between Tapco to Beasley Flat (Cook et al 1991). This study identified that the primary water quality concern along this stream segment is due to streambank destabilization and removal of riparian vegetation. Grazing and recreational activities (including roads) have combined with sand and gravel operations, mill tailings, and construction to impair uses due to turbidity.
Hell Canyon, hdwt-15060202-050 15060202-049	18.1 mi	A&Ww, FC, FBC, AgL	Evaluated	No	Full	USFS/ADEQ cooperative monitoring 1991, 1 sample: full support.
Tule Tank Wash, hdwt-Sycamore Creek 15060202-033	13.4 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	USFS/ADEQ cooperative monitoring 1991, 1 sample: full support.
JD Wash, hdwt-Tule Wash 15060202-033OFFJD	5.5 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	USFS/ADEQ cooperative monitoring 1991, 1 sample: full support.
Volunteer Wash, hdwt-Sycamore Creek 15060202-028OFFV	16 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Threat	Volunteer Wash receives drainage from the U.S. Army Navajo Depot Hazardous Waste Disposal Facility. In 1993, ADEQ's Priority Pollutant Program took a set of sediment samples from the wash as it exited the military base: only arsenic was found to be elevated in the wash sediment, but at background levels found in Arizona.
Sycamore Creek, Cedar Creek-Verde River 15060202-025OFFB	9.3 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	No	Full	• ADEQ Biocriteria Development monitoring site (summer/spring) 1992-95, 5 samples: full support. • USFS monitoring 1991, 3 samples: full support.
Big Springs, hdwt-Sycamore Creek 15060202-032	11.6 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	USFS/ADEQ cooperative monitoring 1991, 3 samples: full support.

VERDE RIVER WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Bitter Creek, hdwt-Verde River 15060202-025OFF16	5.5 mi	Varies, see comment	Monitored	Yes	Threat	• Bitter Creek has three sets of designated uses: A&Ww, PBC, AgL from headwaters to Jerome WWTP; A&Wedw & PBC for 2.5 miles downstream of Jerome WWTP; and A&Ww, FBC, Agl, AgL below the effluent dependent water. • ADEQ WQARF/Superfund monitoring 1990-95, 4 sets (multiple sample sites per set): uses impaired by low pH, cadmium, copper, and zinc at springs in watershed. These springs threaten uses on this waterbody. • ADEQ station (Clarkdale) 1990-93, 20 samples: threat to uses due to copper and lead. • One facility has a NPDES permit to discharge to Bitter Creek (Jerome) (see Appendix D).
Black Canyon, hdwt-Verde River 15060202-025OFFB	10 mi	A&Ww, FBC, FC, Agl, AgL	Evaluated	No	Full	ADEQ Biocriteria Development monitoring site (phys/chem monitoring) 1992-95, 6 samples: full support.
Dry Beaver Creek, hdwt-Rattlesnake 15060202-013	8.9 mi	A&Ww, FBC, FC, Agl, AgL	Evaluated	No	Full	Evaluation based on downstream monitoring (15060202-010 and -011).
Dry Beaver Creek, Rattlesnake-Jack Canyon 15060202-011	3.3 mi	A&Ww, FBC, FC, Agl, AgL	Evaluated	No	Full	• USFS/ADEQ cooperative monitoring 1991, 3 samples: full support. • ADEQ Biocriteria Development monitoring site (phys/chem samples) 1 sample in 1995: full support.
Dry Beaver Creek, Jack Canyon-Wet Beaver 15060202-010	13 mi	A&Ww, FBC, FC, Agl, AgL	Monitored	No	Full	ADEQ monitoring 1991-93, 8 samples: full support. ADEQ complaint investigation at a sand and gravel operation: full support.
Wet Beaver Creek, hdwt-Long Canyon 15060202-006	9.9 mi	A&Wc, FBC, FC, Agl, AgL	Evaluated	No	Partial	Evaluation based on downstream monitoring (15060202-002) and (15060202-004).
Wet Beaver Creek, Long Canyon-Rarick 15060202-004	7.1 mi	A&Wc, FBC, FC, Agl, AgL	Monitored	Yes	Partial	• ADEQ station 1990-91, 13 samples: uses impaired by arsenic and turbidity. • ADEQ biocriteria development monitoring site (phys/chem monitoring) 1992-95, 8 samples: paritial support due to turbidity.
Wet Beaver Creek, Rarick-Dry Beaver Creek 15060202-003	6.4 mi	A&Wc, FBC, FC, Agl, AgL	Evaluated	No	Partial	• Evaluation based limited monitoring in reach and on upstream and downstream monitoring (15060202-002 and -004). • ADEQ Biocriteria Development Program collected at 2 sites in 1995: turbidity slightly over standard at one site.

VERDE RIVER WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Wet Beaver Creek, Dry Beaver Creek-Verde 15060202-002	8.1 mi	A&Wc, FBC, FC, AgI, AgL	Monitored	Yes	Non	• ADEQ monitoring (@ Camp Verde) 1990-91, 13 samples: impaired uses due to turbidity, low dissolved oxygen, and arsenic. Arsenic is at natural background level. High turbidity and low dissolved oxygen believed to be primarily natural; however, a sand and gravel operation, grazing, recreational activities, and silviculture activities in the watershed may be adding to the turbidity. • ADEQ biocriteria development site (physical/chemical monitoring) 1993 and 1995, 2 samples: uses impaired by turbidity and arsenic.
Jacks Canyon Creek, hdwt-Dry Beaver Creek 15060202-008	11.1 mi	Varies, see comment	Evaluated	No	Partial	• There are two sets of designated uses on this waterbody: A&Wc, FBC, FC, AgI, and AgL above Big Park WWTP discharge, and A&Wedw and PBC below the discharge. • Evaluation based on report and concern by US Forest Service District Ranger in letter to ADEQ/EPA concerning algal blooms downstream of Big Park Improvement District discharge (correspondence dated June 8, 1993). Two facilities discharge to this reach, but only one has had a permit to discharge (as of Jan 1, 1996) (see Appendix D).
OAK CREEK SUB-WATERSHED						
Oak Creek, hdwt-West Fork 15060202-019	17.7 mi	A&Wc, DWS, FBC, FC, AgI, AgL, (Unique Water)	Evaluated	No	Partial	ADEQ monitoring (above West Fork) 1988-91, 8 samples: full support. ADEQ Biocriteria Development Program monitoring sites at Cave Spring Camp and Pine Flat (phys/chem monitoring) 1992-93, 9 samples: partial support due to low dissolved oxygen and high turbidity.
Oak Creek, West Fork-Dry Creek 15060202-018	21.7 mi	A&Wc, DWS, FBC, FC, AgI, AgL, (Unique Water)	Monitored	Yes	Non	• Monitoring at Slide Rock Park has resulted in occasional closing of the swimming area due to high fecal coliform counts in the water. Sediments also high in fecal coliform. • USGS (Red Rock) station 1991-94, 37 samples: partial support of uses due to arsenic and turbidity. • ADEQ has 2 monitoring sites (Lomacasi Resort, Red Rock Crossing) 1992-95, 18 samples: partial support due to turbidity. • ADEQ Biocriteria Development sites 1992-95, 4 sites with 6 samples 1992-95: partial support due to turbidity.
Oak Creek, Dry Creek-Spring 15060202-017	9 mi	A&Wc, DWS, FBC, FC, AgI, AgL, (Unique Water)	Monitored	Yes	Partial	• ADEQ Biocriteria Development monitoring site, and ADEQ Complaint investigation - 3 samples 1992-95: uses impaired by turbidity, iron and arsenic. Iron and arsenic level may be natural; however turbidity is due to natural conditions combined with construction activities, grazing, recreational activities, urban runoff, and other activities occurring within the watershed which increase erosion or deteriorate riparian conditions. • The AGFD hatchery has a permit to discharge to this reach (see Appendix D).

VERDE RIVER WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Oak Creek, Spring-Verde River 15060202-016	10.4 mi	A&Ww, DWS, FBC, FC, AgI, AgL (Unique Water)	Monitored	Yes	Non	ADEQ fixed site 6 samples and special investigation of lower Oak Creek (6 other sites) all in 1992: uses impaired by turbidity, arsenic, iron, and low dissolved oxygen. Arsenic at a natural level (Baker 1994). High turbidity and low dissolved oxygen are due to a combination of natural conditions and multiple activities within this watershed (intensive recreation, construction activities, urban runoff, and grazing).
Spring Creek, hdwt-Oak Creek 15060202-022	4.8 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria development site (phys/chem monitoring) 1995, 1 sample: full support.
West Fork Oak Creek, hdwt-Oak Creek 15060202-020	11 mi	A&Wc, FBC, FC, AgL, (Unique Water)	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-95, 7 samples: full support.
Pumphouse Wash, hdwt-Oak Creek 15060202-019OFFP	11 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Non	ADEQ station 1990-93, 9 samples: uses impaired by turbidity, dissolved copper, iron, and low dissolved oxygen. Stream bank destabilization has been noted by ADEQ field personnel.
Munds Creek, hdwt-Oak Creek 15060202-018OFFM	7 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Monitored	Yes	Non	• ADEQ 2 fixed stations and 2 special investigations (WQMS 212-020 & 212.355) 1990-93, a total of 46 samples: uses impaired by turbidity, fecal coliform, nutrients, iron, manganese, and low dissolved solids. • Special investigation also indicated that the west tributary did not support its uses due to high fecal coliform and nutrients. Reuse wastewater (applied to golf course) has been found to be the primary source of fecal coliform and nutrients.
Carroll Canyon Wash, hdwt-Oak Creek 15060202-018OFFC	4 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• ADEQ special investigation of Shelby WWTP (WQMS 212-226), 2 sites in 1992: partial support of uses due to turbidity and fecal coliform. • One facility has a NPDES permit to discharge to this reach (see Appendix D).
Dry Creek, hdwt-Oak Creek 15060202-021	10.3 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Threat	• ADEQ complaint investigation (WQMS 212.337) in 1993 of a discharge from a wastewater package plant discharge into tributary. • One facility (Sedona Venture/Sedona Mobile Home Park) has a NPDES permit to discharge to this reach (see Appendix D).
VERDE RIVER SUB-WATERSHED (see also 15060202 page 61)						
Verde River, 15060203-West Clear 15060203-027	6.2 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• USGS station (Camp Verde) 1992-95, 35 samples: uses impaired by arsenic and turbidity. • ADEQ Biocriteria Development monitoring 1993-1995, 2 samples: turbidity impairing uses. • Multiple activities in the watershed impacting riparian condition and contributing to turbidity (Brock 1987).

VERDE RIVER WATERSHED ASSESSMENT - 1998						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Verde River, West Clear-Fossil Creek 15060203-025	20.5 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• ADEQ station (Beasley Flat) 1990-91, 15 samples; and ADEQ Biocriteria Development monitoring (phys/chem), 1 sample in 1995: uses are impaired by elevated arsenic and turbidity. • USFWS study of Eagle Prey (King et al 1991): copper, chromium, and selenium elevated in fish and may be negatively impacting aquatic life (values are below screening level for human consumption).
Verde River, Fossil Creek-East Verde 15060203-023	7.7 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15060203-025 and -018).
Verde River, E. Verde-Wet Bottom Mesa 15060203-021	16.3 mi	A&Ww, FC, PBC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (see 15060203-018 and -025).
Verde River, Wet Bottom Mesa-Tangle 15060203-019	7.9 mi	A&Ww, FC, FBC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15060203-018) and (15060203-021).
Verde River, Tangle Creek-Ister Flat 15060203-018	4.1 mi	A&Ww, FC, FBC, AgI, AgL	Monitored	Yes	Partial	USGS station (Tangle Creek) 1991-95, 47 samples: uses impaired by arsenic (at natural background level) and turbidity. Turbidity is caused by natural conditions compbined with multiple activities in watershed (e.g. grazing, recreation, silviculture) which have impacted riparian vegetation and compressed soils along the streams.
Verde River, Horseshoe Dam-Alder Creek 15060203-008	11.7 mi	A&Ww, FC, FBC, AgI, AgL	Evaluated	No	Partial	Evaluation based on upstream and downstream monitoring (15060203-004) and (15060203-018), and fish tissue study by USFWS (King et al 1991). Fish sampled in 1988 had elevated levels of copper, mercury, selenium, and zinc which may be impacting fish populations (levels below screening values for human consumption).
Verde River, Bartlett Dam-Camp Creek 15060203-004	5.6 mi	A&Ww, DWS, FC, FBC, AgI, AgL	Monitored	Yes	Partial	USGS station 1991-92, 12 samples: partial support FC due to arsenic.
Lime Creek, hdwt-Horseshoe Reservoir 15060203-030	15.6 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ Biocriteria Monitoring site (phys/chem monitoring) 1995 1 sample: arsenic exceeded FC standard (at natural background level).
Tangle Creek, hdwt-Verde River 15060203-028	14.8 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ Biocriteria Development monitoring site 1 sample 1995: arsenic exceeded FC standard (at natural background level).
Roundtree Creek, hdwt-Tangle Creek 15060203-028OFFR	4.4 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ Biocriteria Development site (phys/chem monitoring) 1992-95, 7 samples: full support.

VERDE RIVER WATERSHED ASSESSMENT - 1998						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
West Clear Creek, hdwt-Verde River 15060203-026	54.3 mi	A&Wc, FBC, FC, AgL	Monitored	No	Full	• ADEQ Biocriteria Development monitoring sites (phys/chem monitoring) 1992-95, 20 samples: full support. • USFS monitoring 3 sites, 9 samples 1991: full support.
Fossil Creek, hdwt-Verde River 15060203-024	19.3 mi	A&Ww, FBC, FC, AgI, AgL	Monitored	No	Full	ADEQ station (Strawberry) 1990-91, 12 samples: full support (nickel exceeded a FC standard once).
Houston Creek, hdwt-Verde River 15060203-021offH	7.5 mi	A&Ww, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ Biocriteria Development monitoring site (phys/chem monitoring) 1995, 1 sample: partial support due to arsenic.
Wet Bottom Creek, hdwt-Verde River 15060203-020	7.4 mi	A&Ww, FC, FBC, AgI, AgL	Monitored	Yes	Partial	USGS station (Childs) 1991-95, 20 samples: partial support due to arsenic and beryllium. Both contaminants are probably at natural levels, but exceed standards.
Red Creek, hdwt-Verde River 15060203-019OFFR	11 mi	A&Ww, FC, FBC, AgI, AgL	Evaluated	No	Partial	ADEQ Biocriteria Development monitoring site (phys/chem monitoring) 1 sample 1995: arsenic exceeding FC standard. Recent studies indicate arsenic from natural sources (Baker et al. 1994).
Sycamore Creek, hdwt-Verde River 15060203-018OFFS	6 mi	A&Ww, FC, FBC, AgI, AgL	Evaluated	No	Partial	ADEQ biocriteria site (phys/chem monitoring) 1992-95, 4 samples: partial support due to arsenic. Arsenic at natural background levels based on recent studies (Baker et al. 1994).
Sycamore Creek, hdwt-Verde (Tonto NF) 15060203-002	36 mi	A&Ww, FC, FBC, AgI, AgL	Monitored	Yes	Partial	• ADEQ monitoring (Sheep Bridge) 5 samples in 1992: partial support FC due to arsenic. • ADEQ Biocriteria Development monitoring site (phys/chem monitoring) 1992-95, 6 samples: full support. • ADEQ/USFS cooperative monitoring 1991, 3 samples: full support. • ADEQ Priority Pollutant Program sediment samples: arsenic elevated, but probably at normal background in this watershed.
East Fork Sycamore, hdwt-Sycamore Creek 15060203-002OFFE	5.5 mi	A&Ww, FC, FBC, AgI, AgL	Monitored	Yes	Partial	ADEQ special investigation at Duncan Mill 1992, 5 water samples and 1 soil sample: partial support of FC due to arsenic (at natural background level); elevated levels of lead and mercury in the soil.
EAST VERDE RIVER SUB-WATERSHED						
East Verde River, hdwt-Verde River 15060203-022	41.5 mi	A&Ww, DWS, FC, FBC, AgI, AgL	Monitored	Yes	Partial	• USGS station (Childs) 1991-93, 17 samples; ADEQ station (above highway 89) 1990-91, 12 samples; and two ADEQ Biocriteria Monitoring sites (phys/chem monitoring) 1992-93, total 3 samples: uses impaired by turbidity and arsenic (mercury, iron, and manganese occasionally exceed standards). • Arsenic at natural background level (Baker et al. 1994). • Turbidity due to multiple activities in watershed and only fair riparian condition (Brock 1987).

VERDE RIVER WATERSHED ASSESSMENT - 1996						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
American Gulch, hdwt-East Verde River 15060203-022OFF21	4 mi	Varies, see comment	Evaluated	No	Threat	• This waterbody has two sets of designated uses: A&Ww, FBC, FC, AgI, AgL from headwaters to WWTP discharge in Payson; and A&Wedw and PBC below the WWTP discharge. • Evaluation based on ADEQ Biocriteria Development monitoring 1994 1 sample, and compliance with discharge monitoring requirements. • Uses threatened by the facility with a NPDES permit to discharge to this reach (see Appendix D).
Bonita Creek, hdwt-EastVerde River 15060203-022OFFA	2.9 mi	A&Wc, DWS, FBC, FC	Evaluated	No	Full	USFS/ADEQ cooperative monitoring 1991, 2 sites: full support.
Dude Creek, hdwt-East Verde River 15060203-022OFFD	4.6 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	USFS/ADEQ cooperative monitoring 1991, 3 samples: full support.
Ellison Creek, hdwt-East Verde River 15060203-022OFFE	11 mi	A&Wc, FBC, FC, AgL	Monitored	Yes	Partial	• ADEQ station (near Tonto Village) (Dude Fire area in 1990) 1991-93, 18 samples: uses impaired by turbidity. Threat due to high beryllium. • USFS/ADEQ cooperative monitoring Tonto National Forest 1991, 3 samples: full support. • ADEQ Biocriteria Development monitoring, 2 sites 1995: full support.
Gap Creek, hdwt- East Verde River 15060203-022OFFGAP	5.6 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	ADEQ Biocriteria Development monitoring site, 1 sample 1995: arsenic exceeded standard for FC (natural source).
Perley Creek, hdwt-Ellison 15060203-022OFFP	1 mi	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Full	USFS/ADEQ cooperative monitoring 1991, 1 sample: full support.
Pine Creek, hdwt-EastVerde River 15060203-022OFFF	16 mi	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Full	ADEQ biocriteria site (phys/chem monitoring) 1992-95, 2 sites, total 7 samples: full support.
Webber Creek, hdwt-East Verde River 15060203-022OFFG	9.5 mi	A&Wc, FC, FBC, AgL	Evaluated	No	Full	ADEQ Biocriteria Development Program site (phys/chem monitoring) 1992-95, 7 samples: full support.
LAKES IN THE VERDE WATERSHED						
Bartlett Lake 15060203-0110	2015 ac	A&Ww, DWS, FBC FC, AgI, AgL	Monitored	Yes	Partial	ADEQ Clean Lakes Program 1992-95, 10 samples: partial support FC due to arsenic (natural sources).
Goldwater Lake 15060202-0570	25 ac	A&Wc, DWS, FBC, FC	Evaluated	No	Partial	Weed harvesting reported by AGFD (1995).

VERDE RIVER WATERSHED ASSESSMENT - 1998						
WATERBODY NAME LOCATION REACH OR LAKE NUMBER	**WATERBODY SIZE miles/acres**	**DESIGNATED USES**	**ASSESSMENT CATEGORY**	**WATER QUALITY LIMITED**	**USE SUPPORT**	**ASSESSMENT COMMENTS**
Granite Basin Lake 15060202-0580	5 ac	A&Ww, FBC FC, AgI, AgL	Evaluated	No	Partial	• AGFD monitoring 1990, 2 samples: partial support due to high pH. • ADEQ Clean Lakes Program 1992-93, 2 samples: partial support due to high pH. Lake subject to periodic influx of granite sand material during floods which rapidly settles and deposits, thereby reducing lake capacity.
J.D. Dam Lake 15060202-0700	6 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Partial	• ADEQ Priority Pollutant Program monitoring 1994 of water, sediment and birds: mercury elevated over screening levels in birds. • Nutrient problems from effluent disposal reported by USFS. AGFD monitoring 1990-93, 3 samples: partial support of uses due to high pH and turbidity.
Peck's Lake 15060202-1060	77 ac	A&Ww, FBC, FC, AgI, AgL	Monitored	Yes	Partial	• CERCLA preliminary investigation of surface water, groundwater, sediment, and tailings from 1993-1995 indicates that: surface water exceeds arsenic standards for FC; and soil and sediment high in metals. • AGFD indicates sediment, nutrient, and weed problems.
Stoneman Lake 15060202-1490	170 ac	A&Wc, FBC, FC, AgI, AgL	Evaluated	No	Non	• ADEQ monitoring 1995, 1 sample: non-support due to fish kill, high pH, and low dissolved oxygen. Complaint 1991 to ADEQ that lake is stagnating and showing symptoms of eutrophication in summer. • AGFD monitoring (1985-87) 7 samples: uses impaired by high pH and low dissolved oxygen. AGFD has on-going weed control on lake.
Watson Lake 15060202-1590	30 ac	A&Ww, FC, FBC AgI, AgL	Evaluated	No	Threat	ADEQ Priority Pollutant Program monitoring of fish in 1994: mercury elevated in fish. Source of mercury unknown.
Whitehorse Lake 15060202-1630	30 ac	A&Wc, DWS, FBC, FC, AgI, AgL	Evaluated	No	Partial	• AGFD monitoring 1993, 2 samples: partial support of DWS and A&Wc due to turbidity, iron and manganese. • ADEQ Clean Lakes Program 1993, 1 sample: full support.

Appendix G. Groundwater Contaminant Sites

This appendix provides two lists groundwater contamination sites in Arizona as of October 1995 -- Groundwater Contaminant Sites, and Leaking Underground Storage Tanks. The data are presented in tables separated by watershed, and subdivided by groundwater basin.

Remediation programs--The Groundwater Contaminant Sites list includes sites with natural contaminants and sites under investigation or remediation by the following programs:

The Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), including
- Sites on the National Priorities List,
- Department of Defense remediation sites,
- Department of Energy remediation sites,

The Water Quality Assurance Revolving Fund (WQARF), a state funded remediation program, and

The Resource Conservation and Recovery Act (RCRA) Program.

Maps--These sites are given an identification number and their approximate location is illustrated on watershed maps that accompany each table **(Maps G-1 to G-9)**. Natural contamination sites are included on this list. However, not all of the sites that exceed standards for fluoride, arsenic, or nitrate due to natural contamination are listed because there are a very large number of sites (see discussion in groundwater assessment section of this report).

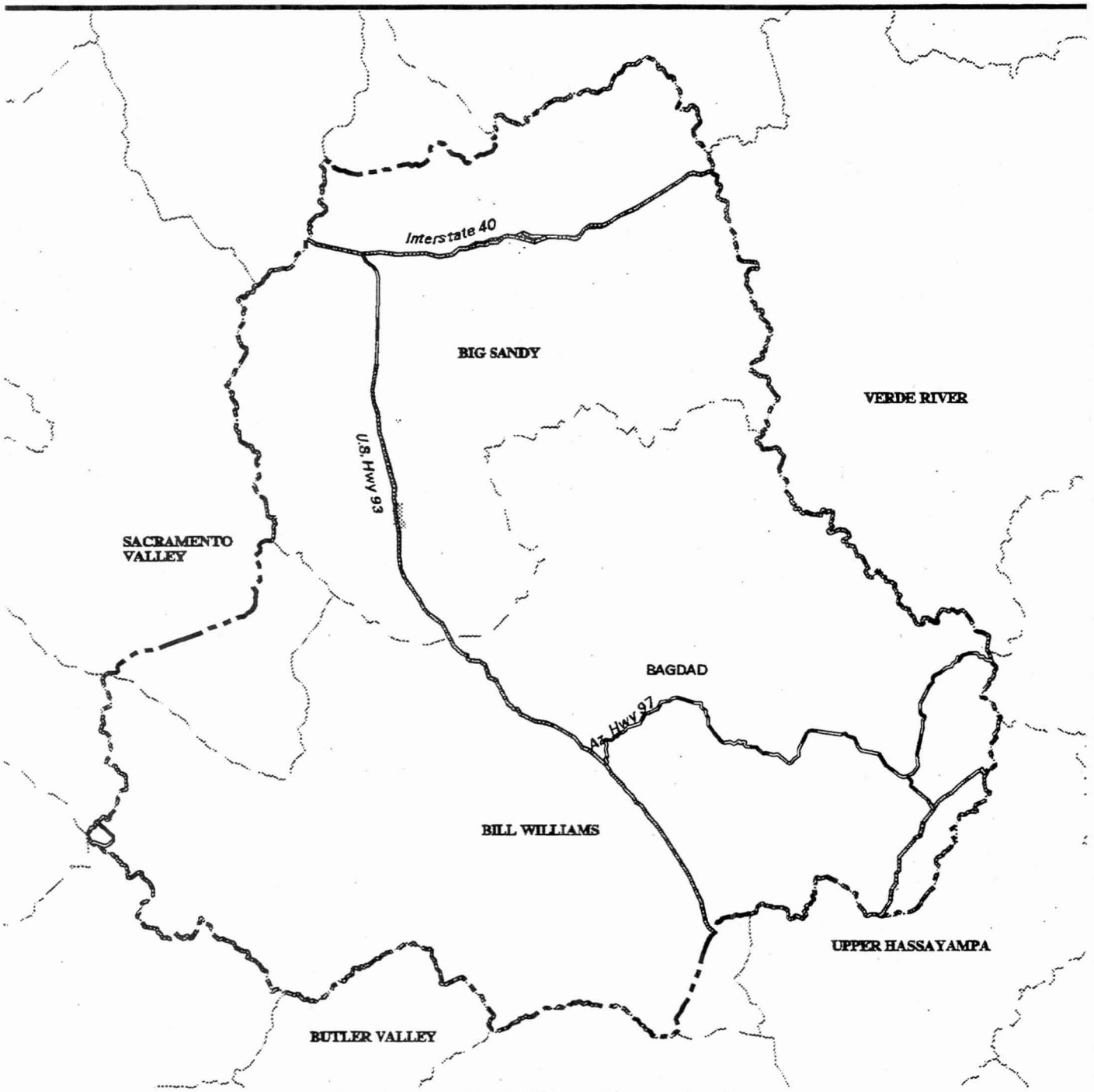
Leaking Underground Storage Tank sites--The Leaking Underground Storage Tank (LUST) site list in this appendix is limited to those that may be contaminating groundwater as of October 1995. The exact location of many of these sites has not been documented; therefore, only the number of sites within an area (a zip code area) is provided in this list and shown on the accompanying map **(Map G-10)**. The chemical contaminant that has leaked is not available for these sites. The type of facility or source is provided for each site, and a statewide summary is provided at the end of the table.

Abbreviation, Acronyms, and Terms--See Appendix A for standards and chemical abbreviations used in this table.

ADEQ	Arizona Department of Environmental Quality
HBGL	Health Based Guidance Level
LUST	Leaking Underground Storage Tank
MCL	Maximum Contaminant Level as defined by Arizona's Aquifer Water Quality Standards.
SRP	Salt River Project
CFU	Colony Forming Unit
µg/l	microgram per liter = parts per billion
mg/l	milligrams per liter = parts per million
pCi/l	picocuries per liter

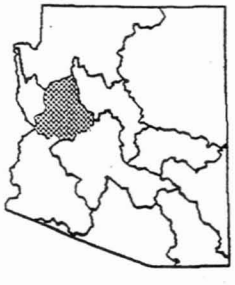
Appendix G-1. Groundwater Contaminant Sites

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
BILLWILLIAMS WATERSHED				
NO KNOWN GROUNDWATER CONTAMINANT SITES IN THIS WATERSHED				



Map G - 1. Bill Williams Watershed Groundwater Contamination Sites

- Indian Reservation
- Watershed Boundary
- Primary Highway
- Secondary Highway
- Groundwater Basin
- WS/GW Boundary



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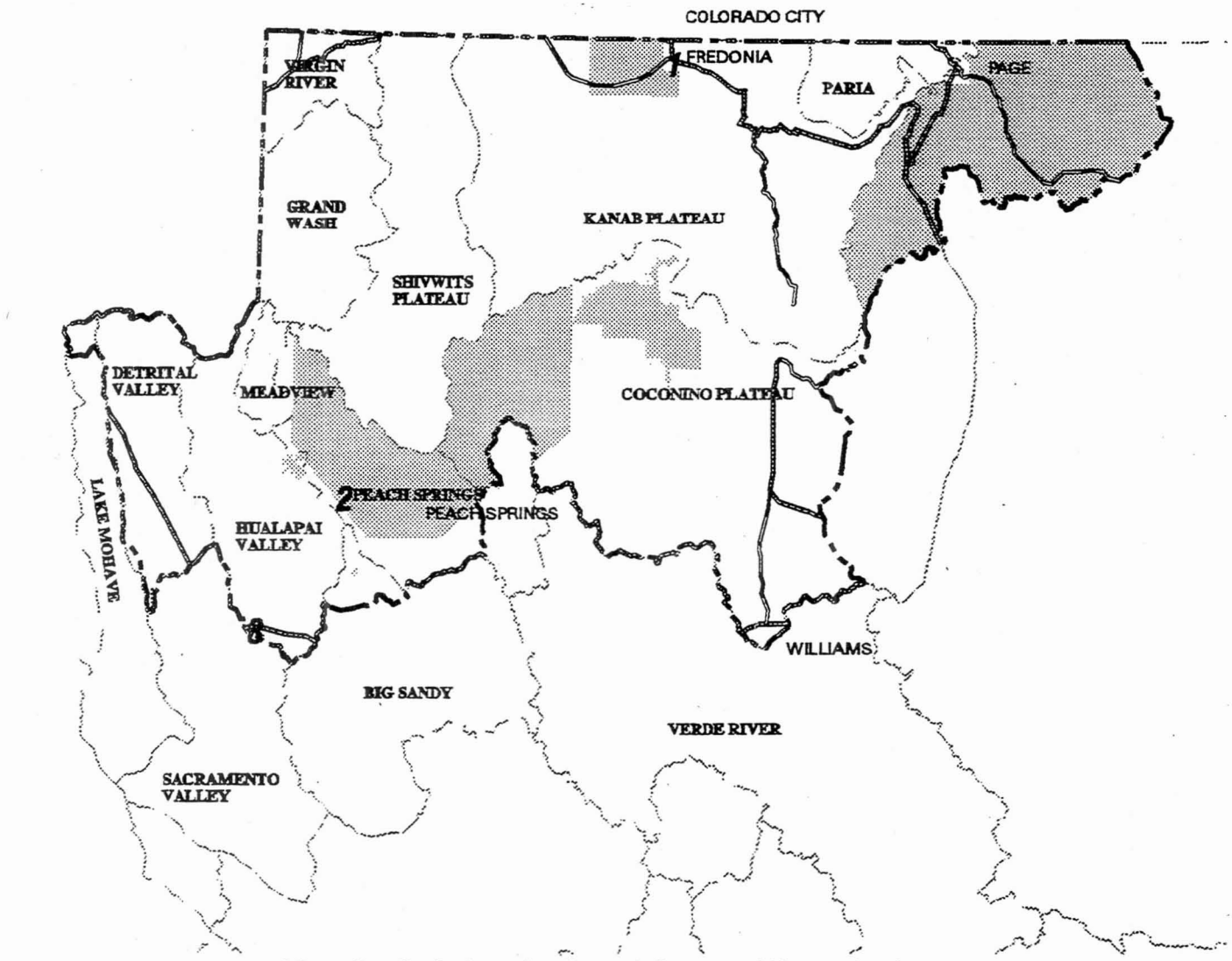
ADEQ 1996

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
COLORADO RIVER - GRAND CANYON WATERSHED				
KANAB PLATEAU GROUNDWATER BASIN				
1	Intermountain Refinery, Fredonia	Soil and groundwater contaminated with benzene, toluene, ethyl benzene, xylene, chrysene, benzo-a-pyrene, chromium, and lead. Degree and extent of contamination unknown but deeper than 10 feet.	Disposal to impoundments on site, spills, and releases.	RCRA file AZT000613406 Hazardous waste inspection 1992. Multimedia site inspection initiated 1995.
PEACH SPRINGS GROUNDWATER BASIN				
2	Peach Springs	Mercury at 3.8 µg/l exceeds the standard in one well.	Naturally occurring.	
HUALAPAI VALLEY				
3	Kingman	Chromium from 60-140 µg/l exceeds MCL.	Naturally occurring.	(Data from ADEQ groundwater database)
		Radon from 657-945 pCi/l.	Natually occurring.	(Data from ADEQ groundwater database)



Map G - 2. Colorado-Grand Canyon Watershed Groundwater Contamination Sites

- Indian Reservation
- Watershed Boundary
- Primary Highway
- Secondary Highway
- Groundwater Basin
- WS/GW Boundary

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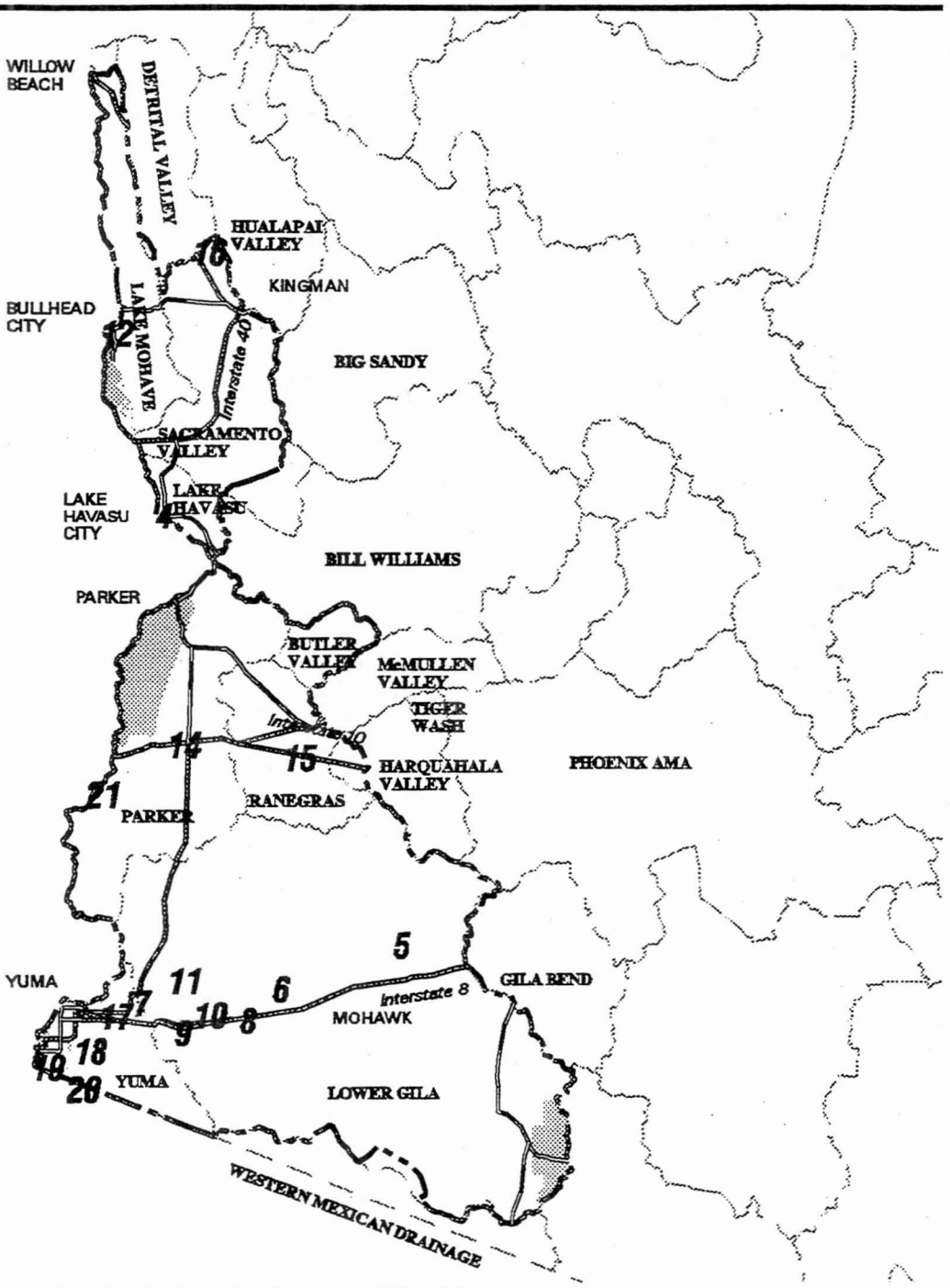
N W E S

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
COLORADO RIVER - LOWER GILA WATERSHED				
LAKE HAVASU GROUNDWATER BASIN				
4	Lake Havasu City	Out of 147 samples taken from 19 wells, the following results were found: Chloride - exceeded the SMCL of 250 mg/l 99 times from 250-1000 mg/l, Flouride - exceeded the SMCL of 2 mg/l 25 times from 2-4, but did not exceed the MCL of 4 mg/l, Nitrate - exceeded the MCL of 10 mg/l 19 times from 10-30 mg/l Sulfate - exceeded the SMCL of 250 mg/l 133 times from 250-1000 mg/l, TDS - exceeded the SMCL of 500 mg/l 145 times from 500-5000 mg/l.	Non-point source pollution from wastewater treatment plants, irrigation, and septic systems.	
LOWER GILA GROUNDWATER BASIN				
5	Agua Caliente	Major cations and anions with TDS from 3,000 to 5,000 mg/l.	Naturally occurring.	
6	Growler	Major cations and anions with TDS from 3,000 to 5,000 mg/l.	Naturally occurring.	
7	Kinter	Major cations and anions with TDS from 3,000 to 5,000 mg/l.	Naturally occurring.	
8	Tacna	Major cations and anions with TDS from 3,000 to over 10,000 mg/l.	Naturally occurring.	
9	Wellton	Major cations and anions with TDS from 3,000 to over 10,000 mg/l.	Naturally occurring.	
10	Mohawk Valley near Yuma	Groundwater contaminated by methomyl at 1.4 µg/l and dacthal (DCPA) at 2.1 µg/l.	Agricultural activities.	ADEQ Pesticide Program site number W-494 and W059A. Ongoing investigation.
11	Yuma Army Proving Ground Yuma	Groundwater contaminated with petroleum products. Potential contamination by pesticides and solvents being investigated	Military testing of fueling devices. Fire training and disposal of pesticides are potential sources.	Department of Defense Installation Restoration Program site number E4271.1.10. Ongoing investigation and assessment. Removed pesticides which had been improperly buried.

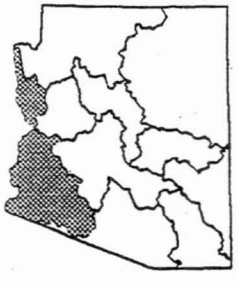
ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
COLORADO RIVER - LOWER GILA WATERSHED				
MOHAVE LAKE GROUNDWATER BASIN				
12	Bullhead City	In wells sampled on two occasions (June, Nov/Dec 1994), Nitrate/Nitrite as (N) exceeded the MCL of 10 mg/l in three out of 53 wells and exceeded the 3 mg/l limit for suitable drinking water in fifteen out of 53 wells. The nitrate levels ranged from 3.1-18.1 mg/l. Areas to note for high nitrate levels are the Riviera area west of highway 95, Bullhead City, and north mesa (Tuve & Giannelli, 1995).	The concentrations of >3 mg/l nitrate as (N) are usually the result of improper disposal of human wastes mainly from septic tanks. Wells 00324 and 21610 indicate that areas of high density population coincide with groundwater nitrate values especially in areas where on-site septic tanks are still operating (Tuve & Giannelli, 1995).	
		TDS level at 3800 mg/l in one well.	Discharge from septic systems.	
PARKER GROUNDWATER BASIN				
13	Parker	Fluoride (5.2 mg/l) exceeds standards.	Naturally occurring.	
14	Quartzsite	Nitrate (57 mg/l).	Discharging septic systems.	
RANEGRAS PLAIN GROUNDWATER BASIN				
15	Ranegras Basin	Barium at 8.1 exceeds the standard in one well.	Naturally occurring.	
		Hexavalent chromium (3.0 mg/l) exceeds standards in 13 wells.		
		Fluoride (up to 21.0 mg/l) exceeds standards in 37 of 48 wells.		
SACRAMENTO VALLEY GROUNDWATER BASIN				
16	Chloride	Radium levels up to 11.3 pCi/l.	Naturally occurring.	
YUMA GROUNDWATER BASIN				
17	South Gila Valley	Major cations and anions with TDS from 3,000 to 5,000 mg/l.	Naturally occurring.	
18	Yuma Marine Corps Air Station Yuma.	Soil and groundwater contamination at several areas by fuels, solvents, oils, battery acid, contaminated ash, oils, paints, acids, caustics, detergents, photographic chemicals, and more.	Spills and improper disposal of vehicle maintenance products, industrial wastes, and ordinances. Hazardous waste disposal into lagoons drywells, landfills, and septic systems.	Department of Defense Installation Restoration Program site number E-4210.1.11. Remedial Investigation Report completed 1995. Remedial actions still to be determined.

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
COLORADO RIVER - LOWER GILA WATERSHED				
19	Yuma monitoring wells Yuma	Groundwater contaminated by: banvel (sold as dicamba) at 0.21-7.4 µg/l, bromacil at 3.8-20 µg/l, cloropropham at 1.7-7.4 µg/l, dacthal (DCPA) at 0.22-2.41 µg/l, dibromochloropropane (DBCP) at 0.080-0.20 µg/l, endosulfane alpha at 0.05-1.6 µg/l, endosulfane beta at 1.2-2.8 µg/l, endosulfane sulfate at 0.29-5.4 µg/l, linuron at 0.47-3.5 µg/l, methomyl at 0.17-50.0 µg/l, neburon 1.4-3.4 µg/l, oxamyl at 1.2-24 µg/l, propoxur (sold as baygon) at 7.0-150 µg/l, and 2,4-D at 0.21-6.0 µg/l.	Agriculture pesticide application.	ADEQ Pesticide Program site numbers: W-28, W-221, W-537, W-471, W-472, W-474, W-479, W-480, W-481, W-482, W-485, W-487, W-488, W-489. Ongoing investigations.
20	Yuma	Uranium from 60.5-74 pCi/l.	Naturally occurring.	
21	Residential well in Yuma	Well contaminated with DBCP at 0.000144 µg/l.	Historic pesticide application	ADEQ Pesticide program site number P-res. Pesticide has been banned.



Map G - 3. Colorado-Lower Gila Watershed Groundwater Contamination Sites

- Indian Reservation
- Watershed Boundary
- Primary Highway
- Secondary Highway
- Groundwater Basin
- WS/GW Boundary



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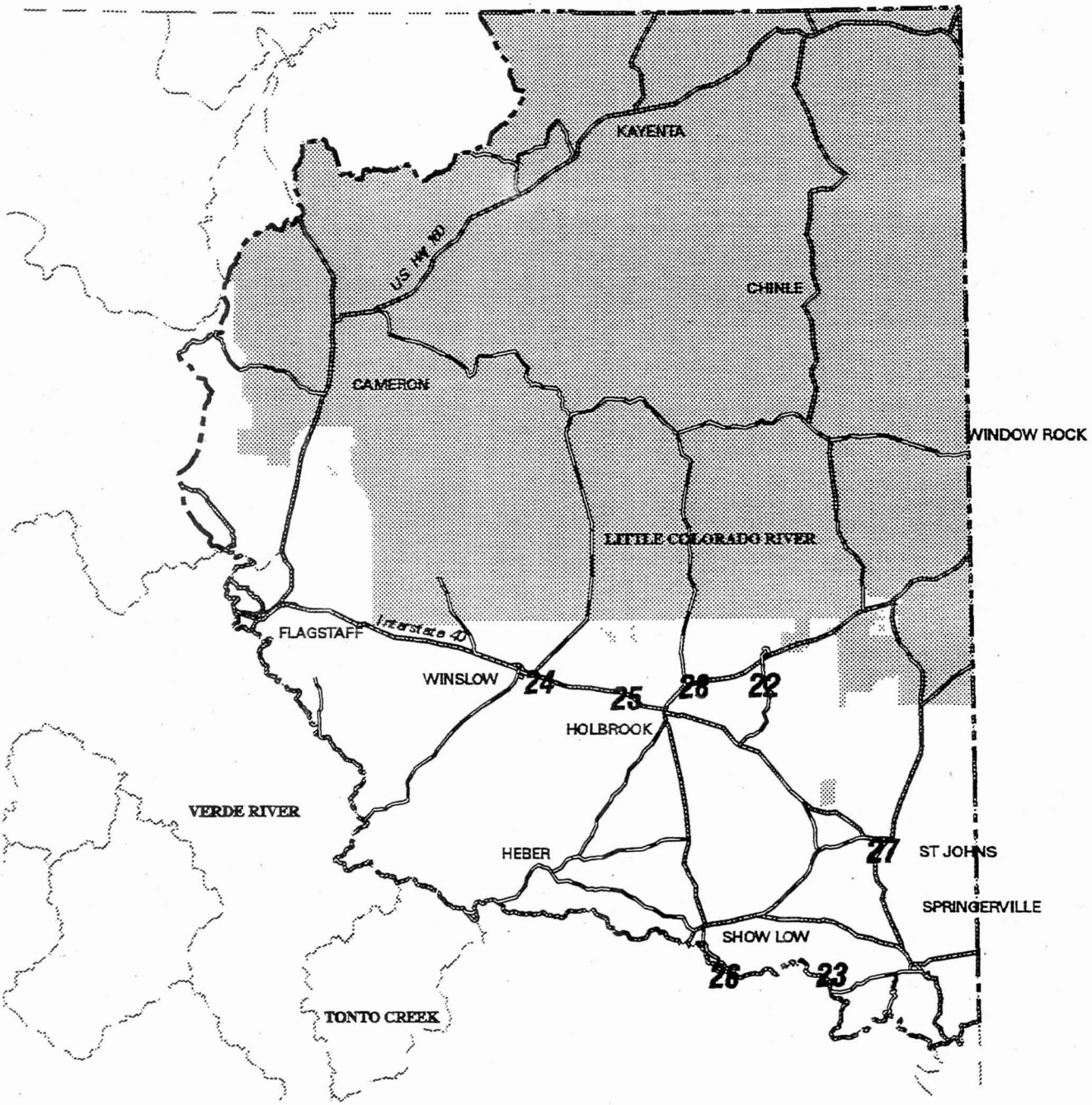
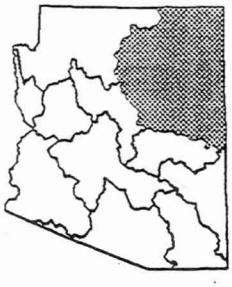
ADEQ 1996

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
LITTLE COLORADO - SAN JUAN WATERSHED				
LITTLE COLORADO RIVER GROUNDWATER BASIN				
22	Adamana	Major cations and anions with TDS over 10,000 mg/l.	Naturally occurring.	
23	Concho	Radium levels up to 6.2 pCi/l.	Naturally occurring.	
24	Hibbard	Major cations and anions with TDS from 3,000 to 5,000 mg/l.	Naturally occurring.	
25	Joseph City	Major cations and anions with TDS from 3,00 to 5,000 mg/l.	Naturally occurring.	
26	Pinetop/Lakeside	Total coliform (50 CFU) contamination.	Discharges from septic systems.	
27	St. Johns	Fluoride levels >2.4 mg/l.	Naturally occurring.	
		Radium from 5.67-34.6 pCi/l.	Naturally occurring.	
28	Sun Valley	Major cations and anions with TDS over 10,000 mg/l.	Naturally occurring.	



Map G - 4. Little Colorado-San Juan Watershed Groundwater Contamination Sites

- Indian Reservation
- Watershed Boundary
- Primary Highway
- Secondary Highway
- Groundwater Basin
- WS/GW Boundary



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ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
MIDDLE GILA WATERSHED				
AGUA FRIA GROUNDWATER BASIN				
30	Black Canyon City	MCL for arsenic exceeded (76 µg/l).	Naturally occurring.	
GILA BEND GROUNDWATER BASIN				
29	Painted Rock Dam	Major cations and anions with TDS from 3,000 to over 10,000 mg/l.	Naturally occurring	
31	Gila Bend	Major cations and anions, with TDS from 3,000 to 5,000 mg/l.	Naturally occurring.	
LOWER SAN PEDRO BASIN				
32	Winkelman	Major cations and anions with TDS up to 10,000 mg/l.	Naturally occurring.	
MCMULLEN VALLEY GROUNDWATER BASIN				
33	Wendon/Salome	Fluoride (7.6 mg/l) exceeding standard.	Naturally occurring.	
PHOENIX ACTIVE MANAGEMENT AREA				
34	Allenville (Gila River)	Major cations and anions with TDS from 3,000 to 10,000 mg/l.	Naturally occurring.	
35	Arlington (Gila River)	Major cations and anions with TDS from 3,000 to 10,000 mg/l.	Naturally occurring.	
36	Buckeye	Elevated levels of Boron in areas around Buckeye. Nitrate (up to 29 mg/l).	Naturally occurring.	
37	Chandler	Major cations and anions with TDS from 3,000 to 10,000 mg/l.	Naturally occurring.	
38	Chandler/Gilbert	Nitrate (up to 30 mg/l).	Agriculture.	
39	Glendale	Nitrate (up to 29 mg/l).	Agriculture.	
40	Komatke	Sulfate levels up to 500 mg/l.	Naturally occurring.	
41	Liberty	Major cations and anions with TDS from 3,000 to 5,000 mg/l.	Naturally occurring.	
42	Mesa	Nitrate (up to 16 mg/l).	Naturally occurring.	
43	New River/Cave Creek	Radon of 260 to 5,800 pCi/l in 27 wells. Radon from 381-8151.3 pCi/l. Arsenic (50 to 200 µg/l) exceeded standards in four wells.	Naturally occurring.	
44	Paradise Valley	Chromium at or above the standard (greater than 0.05 mg/l).	Naturally occurring.	
45	Peoria	Nitrate (up to 18 mg/l).	Naturally occurring.	

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
		MIDDLE GILA WATERSHED		
46	Phoenix	Radon from 390-8150 pCi/l.	Naturally occurring.	
47	West Phoenix	Nitrate (up to 30 µg/l).	Agriculture.	
48	Air National Guard Refueling Group Phoenix	Groundwater contamination by benzene, ethylbenzene, PCE, TCE, DCE, and DCA.	Petroleum products storage area. Historic hazardous waste disposal practices.	Department of Defense Remediation site number E-5161.16. Ongoing investigation of extent of contamination.
49	Allen's Cleaners, Phoenix	Soil and groundwater contamination by Tetrachloroethene (PCE)	Dry cleaning waste disposal.	WQARF Superfund site number AZD981968399. Soil remediation has been completed. See East Central Phoenix for ongoing assessment for groundwater contamination.
50	(Former) Arizona Cleaners, Phoenix.	PCE in soil ranging from 200 to 18,000 µg/l. Possible groundwater contamination. Approximately 18,000 square feet contaminated.	Dry cleaning waste disposal.	RCRA Hazardous Waste inspection 1991. Ongoing site assessment.
51	A to Z Equipment Rentals, Phoenix	Benzene, ethylbenzene, toluene, xylene, and trichlorofluoromethane contaminating soil. Groundwater contamination being investigated.	Waste discharge from rental facility.	RCRA investigation site number AZD000543488. Contamination discovered 1994. Site assessment 1995.
52	Buckeye Valley, Buckeye	Groundwater contaminated with diuron at 44-52 µg/l.	Agricultural pesticide application.	ADEQ Pesticide Program site number W-499. Possible future sampling.
53	Buckeye Valley, Buckeye	Groundwater contaminated with DBCP at 0.0115 µg/l.	Historic agricultural pesticide application.	ADEQ Pesticide Program site number W-08-05-92. Pesticide has been banned since use.
54	Budget Cleaners, Tempe.	PCE in groundwater at 330 µg/l beneath the site and up to 3300 µg/l downgradient. Groundwater at 70 depth.	Dry cleaning waste disposal.	RCRA investigation site number AZD981998073. Three groundwater monitoring wells have been installed at the property. Soil vapor extraction well is proposed to remove PCE from the soil.
55	Chandler, AZ	Groundwater contaminated by dibromochloropropane (DBCP).	Historic agricultural pesticide application.	ADEQ Pesticide Program site number W-06-24-93. Product banned since use.
56	ChemResearch, Phoenix.	MCLs exceeded for chromium and PCE. Vertical contamination extends to groundwater (52 feet below ground surface). Lateral extent of contamination is yet to be determined.	Releases from plating lines.	RCRA assessment and remediation site number AZD980085420: soil excavation and several monitoring wells being installed. Other options after full assessment complete.
57	Collins Metal Finishing, Phoenix.	Soil contamination more than 14 feet below ground surface: cadmium 3.8 - 184 mg/kg, chromium 20.5 - 761 mg/kg, lead 9.2 - 133 mg/kg, cyanide 0.04 - 153.8 mg/kg. Possible groundwater contamination.	Septic system receiving metal finishing sludge.	RCRA site number AZD050539675. Assessment in progress.

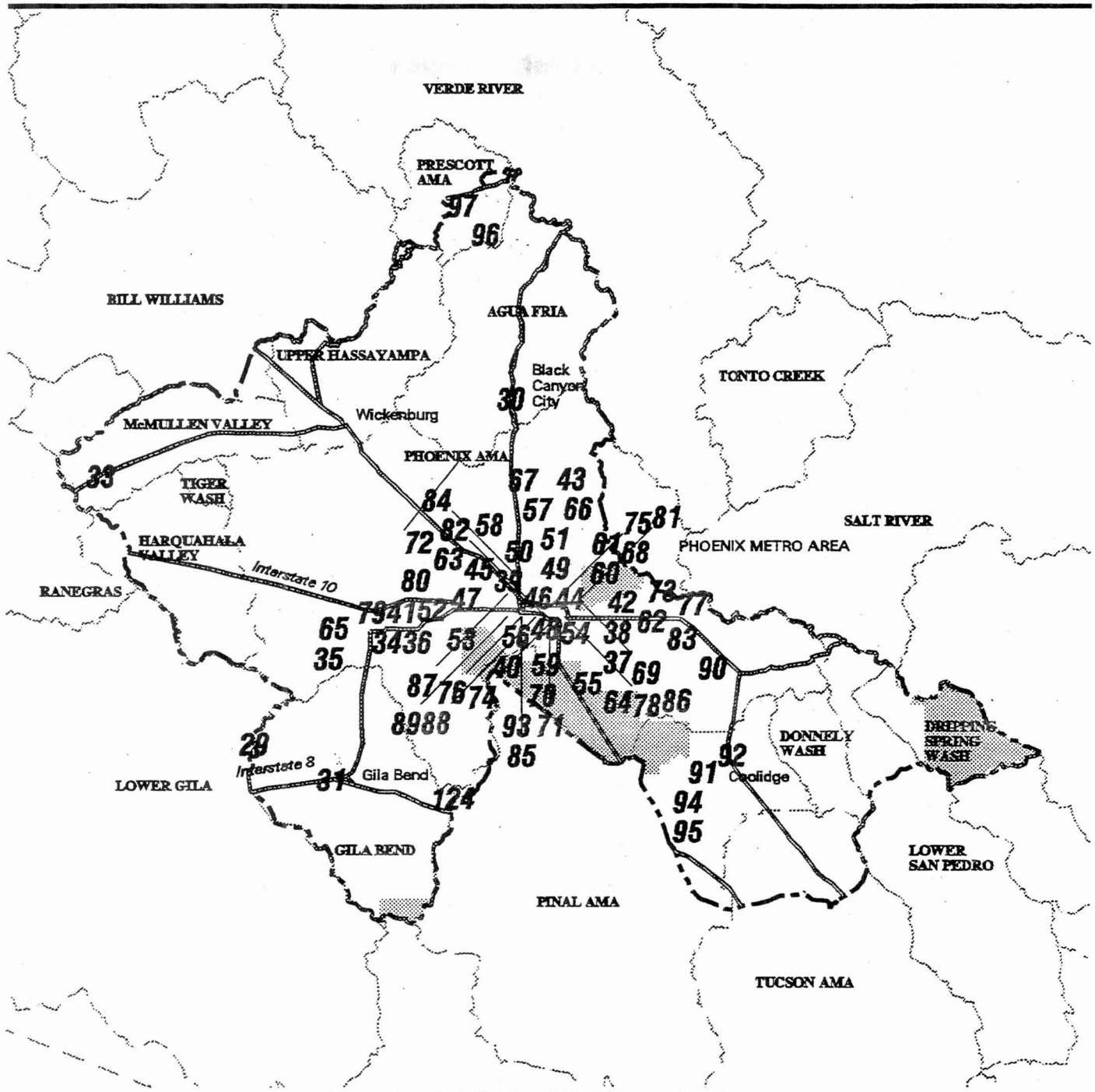
ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
		MIDDLE GILA WATERSHED		
58	Deer Valley Computer Park, Phoenix	Groundwater contaminated with TCE (1.5-1,250 µg/l), above the MCL (5 µg/l).	Disposal of industrial wastes into drywells and unlined evaporation pond prior to 1970.	WQARF superfund site E-5380.3.5.2. 1994 Honeywell purchased 5 City of Phoenix wells. Pilot groundwater treatment by exposing water to ultraviolet light and hydrogen peroxide, then discharged to city sewer. Ongoing monitoring.
59	Dolphin, Inc, Phoenix	Chromium and chlorinated solvents (PCE and TCE) contaminating groundwater and soil.	Chromic acid spills in acid etch area of facility.	RCRA Hazardous waste inspection 1992, site number AZD058787086. Site assessment currently ongoing.
60	East Central Phoenix (The Cleaners, Allen's Cleaners, Sandy's Magic Tough, Arcadia Cleaners, Rose Formal Wear, Star Cleaners, Kachina Cleaners) Phoenix	Groundwater (and soil) contaminated with PCE (up to 34,000 µg/l), TCE, and TCA up to 14 µg/l.	Dry cleaners disposal.	WQARF Superfund site number 5-5150. Ongoing site investigation. Three irrigation wells have been shut down. (No drinking water wells within boundary.)
61	East Washington Site, (Tiernay Turbines, Arvin Industries, FMC Corporation, and Allied Signal) Phoenix	VOCs in groundwater. Motorola's 52nd Street Superfund site's plume extends into this 24 square mile area and mingle with discharges from other sources.	Sources unknown but believed to be manufacturing and disposal practices.	WQARF Superfund site number 5-5160.2.1. Ongoing remedial investigation of extent and sources of contaminants.
62	Estes Landfill, Phoenix	Groundwater contamination by vinyl chloride, isomer of DCE, and TCE. Total VOCs up to 13,057 µg/l.	Inundation when Salt River flows of old landfill (which received hazardous wastes 1953-1972).	WQARF Superfund site number E-5161.01.11.1. Ongoing remedial investigation to determine extent and potential remedial actions.
63	Glendale Ave Landfill, Glendale	Possible contamination of groundwater. Arsenic, nitrate, and chromium above the MCL in groundwater samples.	May be due to spalling of steel casings in the monitoring well, or leaching from landfill.	WQARF remediation site number E-5610. Groundwater contamination detected in 1993. City of Glendale conducting quarterly monitoring to determine extent and nature of problem.
64	G.W. Silicones, Chandler	PCE at 17.8 µg/l exceeding MCLs in groundwater. DCE at 2.6 µg/l and freon-113 at 41.5µg/l. Soil was contaminated by PCE near dry well.	Dry wells for chemical waste disposal.	RCRA site inspection number E-4030. GE has been pumping and air stripping groundwater to remediate the aquifer; however, may be pumping from a less contaminate lower aquifer. Treated water used for irrigation. Dry well removed and soil vapor extraction used to remove VOCs from soil (completed).
65	Hassayampa Landfill, Maricopa County	VOCs contaminating groundwater: isomers of DCE, TCA, Freon, PCE, and DCA. Total VOC concentration as high as 1359 µg/l.	Hazardous and industrial wastes disposal.	National Priority List Superfund site number E-4110.13. Remediation to include groundwater extraction, air stripping with vapor phase carbon absorption, and re-injection of treated water. To install a cap over the hazardous waste disposal area and conduct soil vapor extraction. Design and construction to be completed in 1996.

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
		MIDDLE GILA WATERSHED		
66	Honeywell Inc, Ind. Automation and Control Div., Phoenix	Groundwater and soil contaminated by hazardous wastes (paints, solvents, metal plating solutions, acids, and more). Groundwater in lower aquifer not exceeding MCLs. VOCs in soil ranged from 1,430 mg/kg to 84,720 mg/kg. VOCs in water at 55 µg/l to 59,000 µg/l. Contaminated groundwater is 300 feet below ground surface.	Disposal of chemical wastes into drywells.	WQARF Superfund site number E-5370. Feasibility Study 1994. Honeywell plans to close facility and relocate operations. Proposed groundwater extraction, treatment, and either reinjection or discharge into an SRP canal.
67	Houston International, Ltd., Phoenix.	PCE in groundwater from 5,000 to 27,000 µg/l, which exceeds both MCL (5 µg/l) and HBGL (0.7 µg/l). Soil contamination very limited.	Disposal of wastewater containing degreasers to ground (no sewer connection at facility).	RCRA hazardous waste site number AZD983480963. Ongoing site assessment.
68	Indian Bend Wash-North, Scottsdale	Groundwater contamination by VOCs (TCE, PCE, TCA, DCE). Soils contaminated by heavy metals.	Improper use, storage and disposal of hazardous wastes (degreasing agents and solvents).	National Priority List Superfund site number E-4080. Air stripping groundwater for water distribution system in Scottsdale. Constructing a soil vapor extraction system. Ongoing investigation of extent and sources of contamination, and remediation options.
69	Indian Bend Wash-South, Tempe	Groundwater contamination by VOCs (TCE, PCE, TCA, DCE), xylene, benzene, and ethylbenzene. Nitrates, chlorides, manganese, TDS, chromium, and iron exceeded primary or secondary drinking water standards (some metals, TDS, and chlorides may be naturally high).	Historic improper disposal of hazardous materials in landfills along the Salt River.	National Priority List Superfund site number E-4090.10.6. Contaminated public water wells removed from service in early 1980s (Scottsdale, Tempe, Phoenix). Contaminated soils removed from some sites. Soil vapor extraction to be conducted. Ongoing site evaluation.
70	Intel Corporation, Chandler	Perched aquifer contaminated by benzene, isomers of DCA, DCE, TCE and freon. Freon has also been detected in the single regional monitoring well. Only DCE and TCE have exceeded MCLs.	Overfill/spill of underground waste solvent tank.	WQARF superfund site number E-5510.1.1. Removed the solvent tank and excavated surround soils in 1985. Abandoned seven perched aquifer wells. Added other monitoring wells. Soil gas survey in 1993 to determine extent of possible soil contamination. Ongoing investigation to determine other sources and better remediation.
71	Laundry & Cleaners Supply, Phoenix.	PCE contaminating soil. Possible groundwater contamination	Dry cleaning waste discharge to an on-site drywell.	RCRA hazardous waste site. A soil vapor extraction to remediate the drywell in operation - 1995.
72	Litchfield Park	Four wells contaminated with DBCP at 1.0-10.4 µg/l.	Historic agriculture pesticide application.	ADEQ Pesticide Program site numbers: W-558, W-559, W-560. DBCP has been banned since use.
73	Mesa DBCP Project, Mesa	Groundwater contaminated with dibromochloropropane (DBCP) at 0.05-0.93 µg/l (AZ HBGL in water 0.02 µg/l).	Pesticide use on orchard (banned in 1980 after contamination).	WQARF Superfund site number E-5230. Treatment: activated carbon process since 1991. Treated water used in City of Mesa's potable water system.

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
		MIDDLE GILA WATERSHED		
74	(Former) Motorola, Raymond Street Plant Phoenix	Groundwater contaminated with isomers of TCA up to 676 µg/l, DCE up to 18 µg/l, PCE at 1.3 µg/l, TCE at 93 µg/l, DCA at 72.4-87.5 µg/l, and dichloropropane at 20 µg/l. Soil contamination also occurring.	Underground waste and product storage tank leaks and spills.	WQARF Superfund site number E-5450. Two of the tanks have been removed and two have been closed and filled with granular material. Ongoing assessment and investigation of further remediation.
75	Motorola, 52nd Street Plant Phoenix	Soil and groundwater contamination by VOCs: TCE, trichlorothrifluoromethane, exlene, and tCA. TCA at 5100 µg/l.	Leaking underground solvent tank. On-site spills, tank and pipe leaks, and disposal of over 300,000 gallons of solvents into dry wells and leaching fields.	National Priority List Superfund Site number E-4070.6.4.15 (since 1989). To install a soil vapor extraction and air sparging treatment system. Existing on-site and off-site treatment to contain and extract contaminants from soil and groundwater.
76	19th Avenue Landfill, Phoenix	Groundwater contamination above MCLs by vinyl chloride, TCE, DCE, and PCE.	Inundation of landfill by Salt River during 1970's.	National Priority List Superfund site number E-4010.12.5 (since 1983). Remediation action includes: levee and bank protection, stream grade control, storm drain channel, soil cap over part of landfill, surface water drainage on site, groundwater monitoring program, fencing and landscaping site, and methane gas control.
77	Northeast Mesa (Talley Defense Systems Plant)	Groundwater contaminated with VOCs: TCE (up to 70 µg/l), isomers of DCE (7 µg/l).	Source unknown. Believed to be solvents used in manufacturing.	WQARF Superfund site number E-5260 (since 1987). Water use restricted to irrigating citrus orchard.
78	Northwest Tempe (Garret/Allied Signal, Litton, Tempe Meat Packing) Tempe	Groundwater contamination by an isomer of DCE. Groundwater at 50-60 below land surface.	Possibly: illegal dumping in a storm drain, spillage in a chemical drum storage area, underground waste storage tanks. Source investigation ongoing.	WQARF Superfund site number E-5390.0.6.2. Ongoing monitoring, assessment, and remediation. Old storage tanks removed and removal or remediation of contaminated soils.
79	Palo Verde, AZ	Groundwater contaminated with DBCP at 0.086 µg/l.	Historic agricultural pesticide use.	ADEQ Pesticide Program site number W-08-05-92. Product has been banned since usage.
80	Phoenix-Goodyear Airport, (City of Phoenix, Unidynamics, and Loral) Goodyear	Groundwater contaminated with VOCs (TCE, DCE, MEK) and chromium. TCE up to 40 µg/l. Soils also contaminate by cadmium.	Historic disposal of hazardous wastes into sludge ponds.	National Priority List Superfund site number E-4120.12.1. Soil and groundwater remediation (and removing free product petroleum) using a soil vapor extraction system, thermal oxidation, and air stripping. Plan to use liquid phase granular activated carbon to treat groundwater.
		Six wells contaminated with TDS from 3350-3940 mg/l.	Naturally occurring.	
		Groundwater contaminated with petroleum hydrocarbons	Underground storage of aviation fuels.	
81	Scottsdale TCE, Scottsdale	Groundwater contamination by Trichloroethylene at 300 µg/l (MCL = 5 µg/l).	Underground storage waste tanks leaking at industrial site.	WQARF Superfund site number E-5290. City of Scottsdale well taken out of service after discovery in 1981. Air stripping treatment system was successful for many years; however, City now upgrading system due to recent increase in influent TCE. concentration

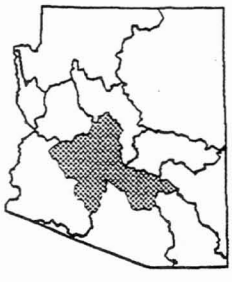
ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
		MIDDLE GILA WATERSHED		
82	Sky Harbor International Airport, Phoenix	Contamination of groundwater by VOCs: PCE, TCE, and isomers of TCA and DCE.	Potential sources include: Allied Signal (manufacturing), ITT Cannon (manufacturing), and others in the airport area.	WQARF Superfund site number E-5161.17.1.2.1 (discovered in 1983). Remediating petroleum contaminated soils. Ongoing assessments and monitoring at various sites to determine extent of contamination.
		Petroleum hydrocarbons, benzene, and ethylbenzene contaminate soils.	Phoenix International Airport.	
83	South Mesa Applied Metalics Mesa, Chandler, and Gilbert	Groundwater within this 9 square mile area exceeds MCL for PCE.	Manufacturing solvent disposal.	WQARF Superfund site number E-53000III2.3. Two SRP irrigations wells shut down since discovery in 1983. Interim remedy is treatment by air stripping/resin absorption system. The PCE is then recycled, and the water is used for irrigation.
84	Schultz Auto Shredder Fluff Dump Site Glendale	Contamination of groundwater vadose zone and perched aquifer beneath fluff piles. Fluff contaminants include: arsenic, cadmium, chromium, lead, nickel, and PCBs. Potential for contaminating New River when flowing.	Illegal disposal of auto-shredder fluff (non-metallic waste).	WQARF Superfund site number E-5660. Discovery 1990. Fluff piles have been removed from lands owned by Arizona State Land Department and US Bureau of Land Management. Ongoing monitoring and assessment.
85	The 27th Avenue Landfill, Phoenix	Groundwater and soil have been impacted by volatile organic compounds, benzene, and methylene chloride.	Landfill in floodplain.	WQARF Superfund site number E-5570. Landfill to be closed in 1995. Monitoring wells installed.
86	Unichem International, Gilbert.	PCE in groundwater beneath and down gradient of the site ranging from 200 to 5800 μg/l, which exceeds MCL (5μg/l) and HBGL (0.7 μg/l).	Industrial disposal to drywell.	RCRA hazardous waste inspection 1989. Monitoring wells installation 1994. Installation of soil vapor extraction system 1995. Additional site assessment 1995.
87	West Central Phoenix (W. Osborn Complex, Layke, ARCO, Osborn Products, Precise Metal Products, City of Phoenix Glenrosa Service Center, F&B Manufact, Rinchem Chem) Phoenix	Groundwater and soil contaminated with VOCs (TCE, PCE, TCA, and three isomers of DCE) from multiple sources.	Multiple sources including manufacturing processes, drywells for wastes, underground storage of liquid wastes, and more.	WQARF Superfund site number E-4180. Ongoing investigations of sources and extent of contamination. Several enforcement actions are also in progress.
88	Western Automatic Machining, Phoenix.	Soil contamination by lead, cadmium, chromium and VOCs such as: TCA, TCE, PCE, and trichlorophenol. Possible groundwater contamination.	On-site releases from machining operations.	RCRA hazardous waste assessment site number AZD982007528. Initial site assessment ongoing.

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
MIDDLE GILA WATERSHED				
89	West Van Buren (American Linen Supply and Maroneys Cleaners Inc., Chemresearch, Dolphin, Maricopa County, Reynolds Metals, and Van Waters and Rogers) Phoenix	Groundwater contamination plume (1.5 miles long) of VOC and heavy metal contaminants. TCA, TCE, PCE and chromium in soil.	Multiple sources: dry cleaners and chemical solvents disposal.	WQARF Superfund site number E-5350.0.0. Interim remediation proposed to prevent further migration. Final remediation plan to be established after full site evaluation completed.
		Petroleum free product in groundwater.	Petroleum tank farm leaks/spills. Leaking rail car	Petroleum free product being skimmed off groundwater and soil vapor extraction systems installed to remove hydrocarbon contamination from the soils.
		PCE and TCE in soils and maybe contributing to groundwater.	Not identified but maybe leaking rail car.	Ongoing groundwater monitoring.
90	Williams Air Force Base, Mesa	Groundwater contaminated by petroleum products.	Leakage of stored jet fuel.	Department of Defense Installation Restoration site number E-4230.1.10. Ongoing site investigation to determine extent of contamination and appropriate remediation.
		Groundwater contaminated by petroleum products, VOCs, semi-volatile organic compounds (SOCs), and metals.	Landfill	
PINAL ACTIVE MANAGEMENT AREA				
91	Coolidge	Major cations and anions with TDS from 3,000 to 10,000 mg/l.	Naturally occurring.	
		Sulfate levels up to 800 mg/l.		
92	Florence	Nitrate from 10-90 mg/l.	Naturally occurring.	
93	Komatke (East of)	Major cations and anions with TDS from 3,000 to 10,000 mg/l.	Naturally occurring.	
94	Randolph	Selenium over 0.01 mg/l (near or over the standard).	Naturally occurring.	
95	La Palma	Nitrate up to 90 mg/l.	Agriculture.	
PRESCOTT ACTIVE MANAGEMENT AREA				
96	Dewey	Elevated levels of arsenic (65 µg/l).	Naturally occurring.	
		Total coliform above standard.	Discharges from septic systems.	
97	Prescott Valley	Radon 2,730 pCi/l.	Naturally occurring.	



Map G - 5. Middle Gila Watershed Groundwater Contamination Sites

- Indian Reservation
- Watershed Boundary
- Primary Highway
- Secondary Highway
- Groundwater Basin
- WS/GW Boundary



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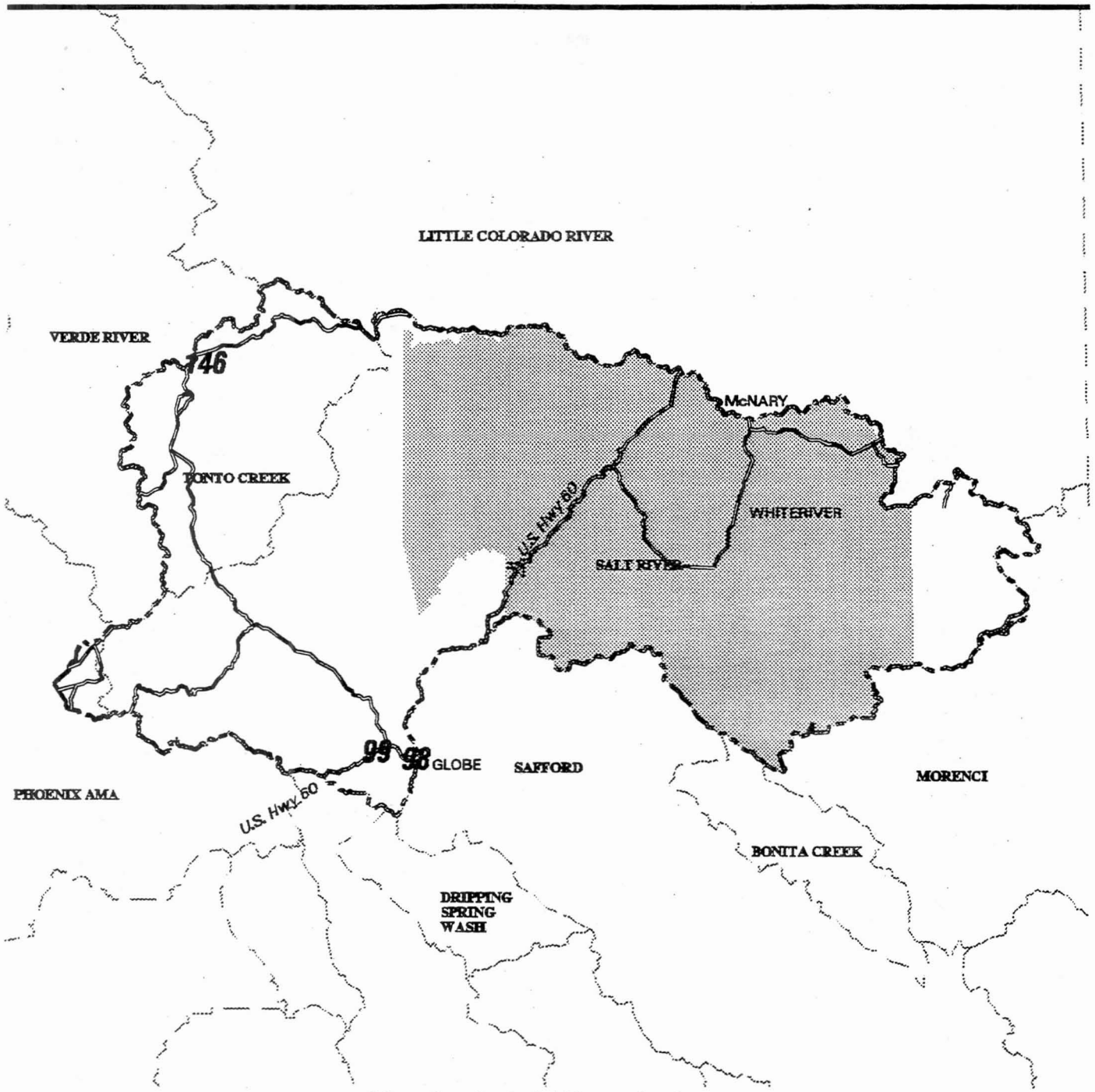
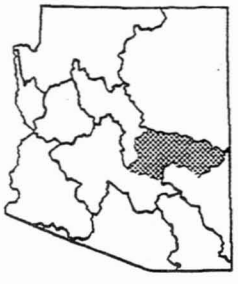
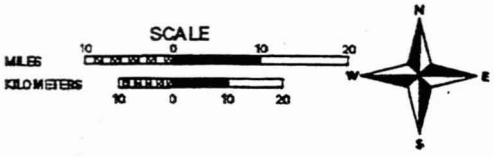
ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
SALT RIVER WATERSHED				
SAFFORD BASIN				
98	Globe/Miami	Elevated TDS levels and sulfate up to 4600 mg/l.	Mining.	
SALT RIVER GROUNDWATER BASIN				
99	Pinal Creek Globe-Miami	Groundwater is contaminated with heavy metals, high total dissolved solids (TDS), and is acidic. Groundwater contamination threatens Pinal Creek. USGS study (Longsworth and Taylor 1992) indicates groundwater contamination by: Aluminum (up to 190,000 µg/l), Beryllium (up to 110 µg/l), Cadmium (up to 700 µg/l), Chloride (up to 260 mg/l), Chromium (up to 300 µg/l), Fluoride (up to 31 mg/l), Iron (up to 2,000 mg/l), Lead (up to 650 µg/l), Manganese (up to 120 mg/l), Nickel (up to 2,600 µg/l), Sulfate (up to 7,900 mg/l), and Zinc (up to 17,600 µg/l).	Historic mining practices.	WQARF Superfund site number E-5280.1.4. EPA's NPDES program is also involved in an enforcement action (since 1986) to ensure cleanup of the creek and tributaries. Contaminated groundwater has been pumped up gradient to reduce acidity of the plume and prevent surface water contamination.



Map G - 6. Salt Watershed Groundwater Contamination Sites

- Indian Reservation
- Watershed Boundary
- Primary Highway
- Secondary Highway
- Groundwater Basin
- WS/GW Boundary





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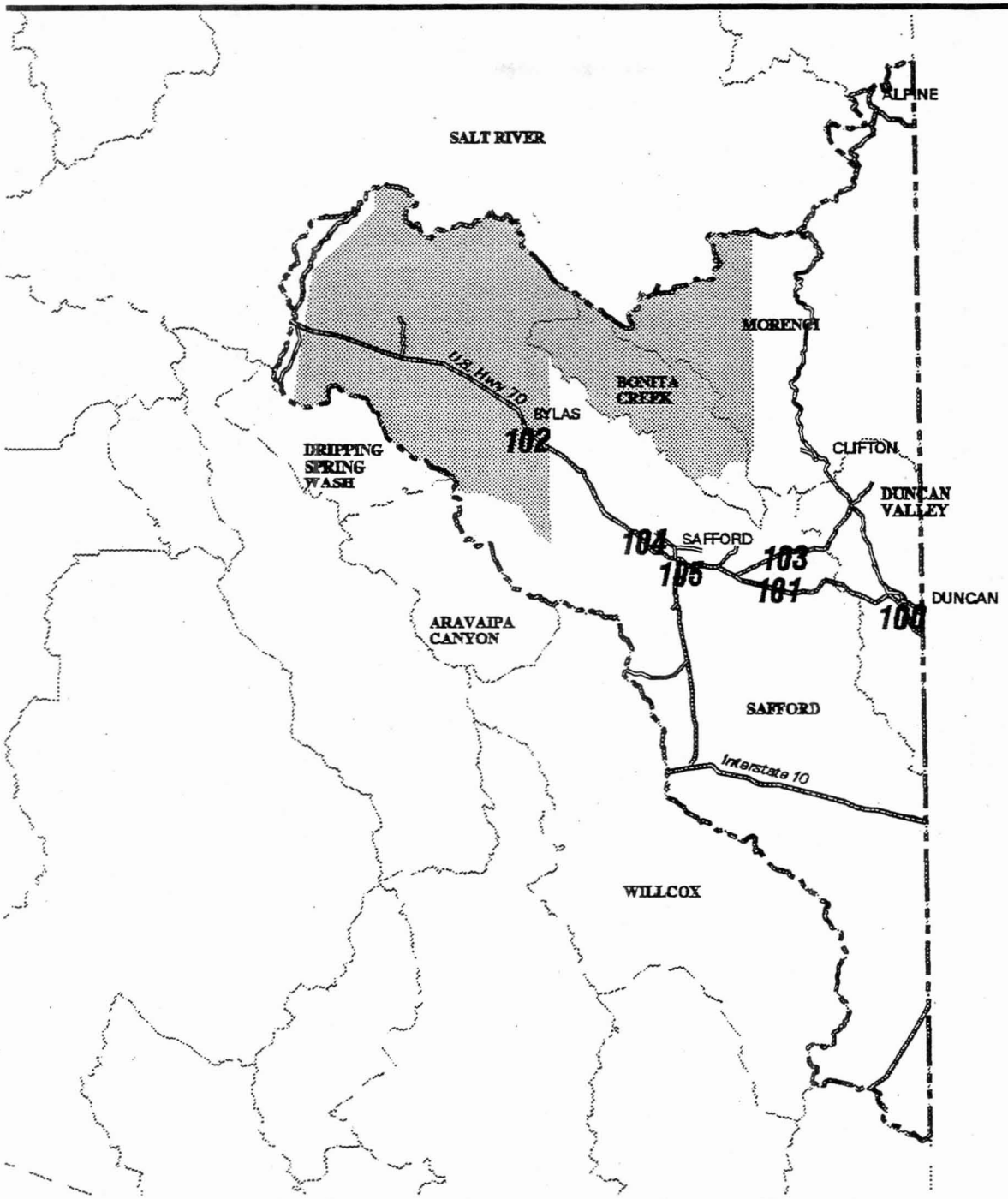
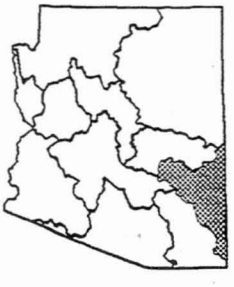
ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
SAN CARLOS - SAFFORD - DUNCAN WATERSHED				
DUNCAN VALLEY GROUNDWATER BASIN				
100	Duncan	Major cations and anions with TDS from 3,000 to 10,000 mg/l.	Naturally occurring.	
101	Duncan/Safford/ San Carlos Mgt. Zone	High levels of salinity in groundwater with one well containing 3,600 mg/L TDS.	Naturally occurring highly mineralized subsurface deposits.	Nonpoint Source Mgt. Zone Committee is investigating application of BMPs to prevent buildup of salinity in soils.
SAFFORD GROUNDWATER BASIN				
102	Bylas	Major cations and anions with TDS from 3,000 to 10,000 mg/l.	Naturally occurring.	
103	Duncan/Safford/ San Carlos Mgt. Zone	High levels of salinity in groundwater with one well in Eden containing 3,700 mg/L TDS and a well in Artesia containing 3,000 mg/L TDS.	Naturally occurring highly mineralized subsurface deposits.	Mgt. Zone Committee is investigating application of BMPs to prevent buildup of salinity in soils.
104	Pima	Major cations and anions with TDS from 3,000 to 10,000 mg/l.	Naturally occurring.	
105	Safford	Major cations and anions with TDS from 3,000 to 10,000 mg/l.	Naturally occurring.	
		Radon from 461-1020 pCi/l.	Naturally occurring.	



Map G - 7. San Carlos-Safford-Duncan Watershed Groundwater Contamination Sites

- Indian Reservation
- Watershed Boundary
- Primary Highway
- Secondary Highway
- Groundwater Basin
- WS/GW Boundary



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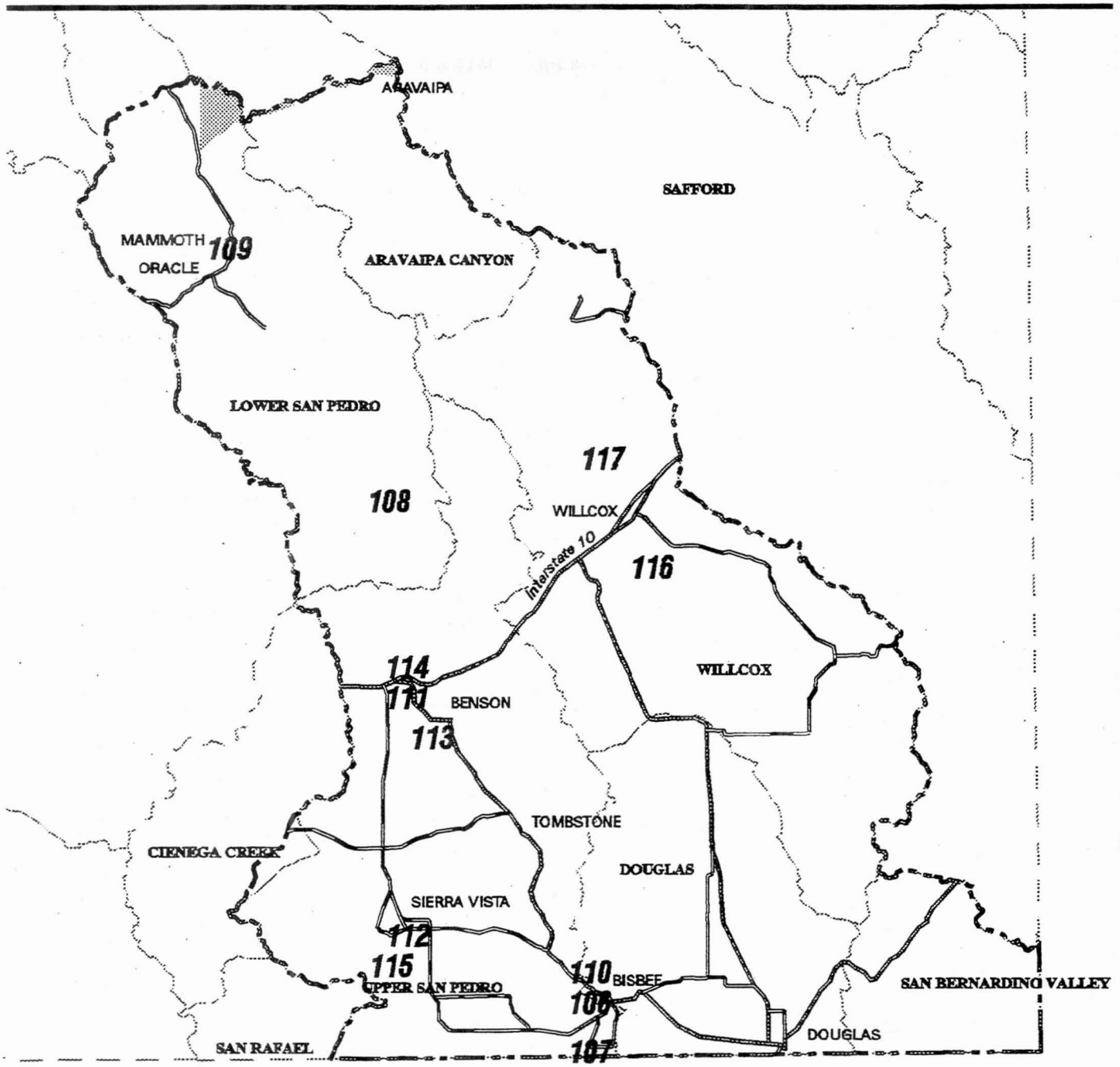
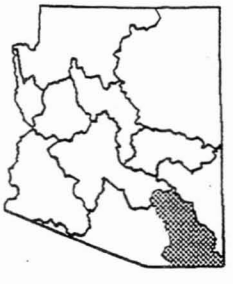
ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
SAN PEDRO - WILLCOX PLAYA - RIO YAQUI WATERSHED				
DOUGLAS GROUNDWATER BASIN				
106	Bisbee-Warren	Sulfate over 650 mg/l.	Naturally occurring.	
107	Naco (Northeast of)	Sulfate over 650 mg/l.	Naturally occurring.	
LOWER SAN PEDRO GROUNDWATER BASIN				
108	Cascabel (East of)	Major cations and anions with TDS from 3,000 to 10,000 mg/l.	Naturally occurring.	
109	Mammoth	Fluoride levels (>30 mg/l).	Naturally occurring.	
UPPER SAN PEDRO GROUNDWATER BASIN				
110	Bisbee	Uranium levels up to 94.5 pCi/l.	Naturally occurring.	
111	Benson	TDS in one well up to 3330 mg/l.	Naturally occurring.	
112	Sierra Vista	Radon from 777-1220 pCi/l.	Naturally occurring.	
113	St. David	Fluoride 6.4 mg/l.	Naturally occurring.	
114	Apache Powder at St. David	Nitrate contamination: • Perched aquifer > 1000 mg/l, • Shallow aquifer 400 mg/l, • San Pedro River up to 200 mg/l. Soil contaminants include: metals, nitrate, spent catalyst material, and dinitrotoluene. (NO3 standard = 10 mg/l.)	Industrial waste disposal.	National Priority List Superfund site number E-4100.10.6 (since 1990). Consent Decree (ADEQ) 1994 and Unilateral Administrative Order (EPA) 1994. Remedial actions include: inactive waste ponds capped with clay, contaminated soils removed from site, brine concentrator to treat waste stream and remediate perched aquifer, and shallow aquifer to be pumped and treated in a constructed wetland or used to irrigate crops.
115	Fort Huachuca Sierra Vista	Perched groundwater contamination as leachate from landfill exceeds HBGLs for dieldrin, DDD, cadmium, and lead. Also detectable levels of metals, VOCs, base-neutral acids, and other pesticides. Soil contamination confirmed at several sites.	Landfill, and aircraft wash area.	Department of Defense Installation Restoration Program site number E4250.0.1. Ongoing investigation and assessment of extent of contamination.
WILLCOX GROUNDWATER BASIN				
116	Willcox Playa	Major cations and anions with TDS over 10,000 mg/l.	Naturally occurring.	
117	Willcox, AZ	Well contaminated by 2,4-D at 0.8 µg/l.	Agriculture activities.	ADEQ Pesticide Program site number W-547. Possible future sampling.



Map G - 8. San Pedro-Willcox Playa-Rio Yaqui Watershed Groundwater Contamination Sites

- Indian Reservation
- Watershed Boundary
- Primary Highway
- Secondary Highway
- Groundwater Basin
- WS/GW Boundary



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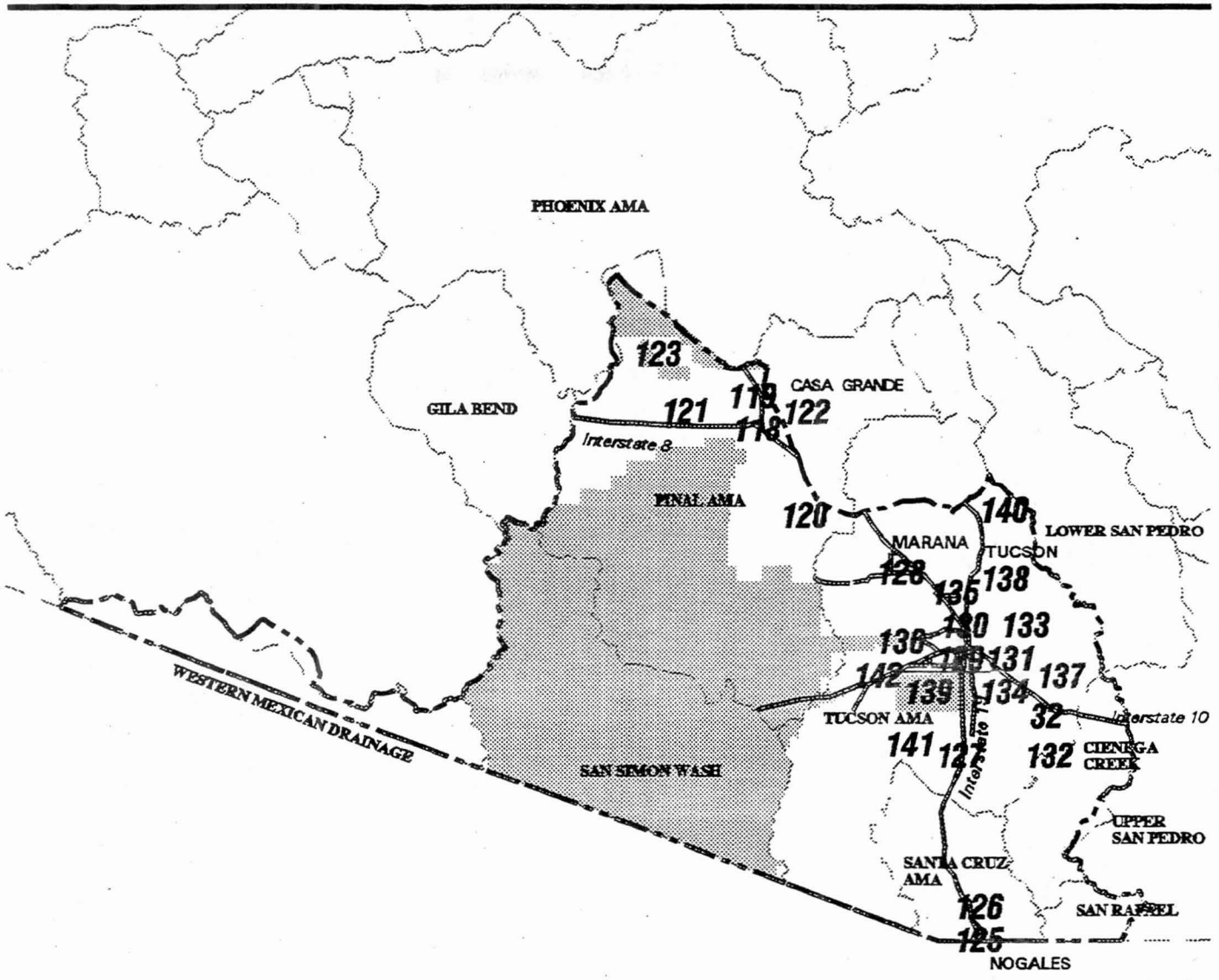
ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
SANTA CRUZ - RIO MAGDELENA - RIO SONOYTA WATERSHED				
PINAL ACTIVE MANAGEMENT AREA				
118	Arizola	Nitrate up to 28 mg/l.	Naturally occurring.	
119	Casa Grande	Major cations and anions with TDS from 3,000 to 5,000 mg/l.	Naturally occurring.	
		Nitrate (up to 28 mg/l).	Agriculture.	
		High levels of nitrate in groundwater, with one well containing 70.9 mg/L (as N) in an area north of Casa Grande.	High concentration of septic systems.	Data from this study has been forwarded to ADEQ's Surface Water Section for review.
		Highly mineralized water around the Sacaton mine area. TDS exceed 4,000 mg/l, nitrate up to 200 mg/l, fluoride up to 2.6 mg/l, sodium as high as 1,470 mg/l, sulfate as high as 2,350 mg/l, chromium 0.08 mg/l. Arsenic and selenium also naturally exceed the drinking water MCL.	Naturally occurring.	Natural groundwater conditions studied as part of the WQARF Superfund site: Hexcel Chromium Deposal (E-5400.1.0).
		Sulfate level up to 800 mg/l.	Naturally occurring.	
		Uranium up to 40.5 pCi/l.	Naturally occurring.	
120	Friendly Corners	Nitrate up to 29 mg/l.	Naturally occurring.	
121	Stanfield	Uranium from 65.1-73.7 pCi/l.	Naturally occurring.	
122	Griffin/Kocide Chemical, Casa Grande	Soil contaminated with arsenic, barium, cadmium, chromium, lead, mercury, selenium, thallium, and copper (from 10 to 200,000 mg/l). Groundwater, surface water, and air contamination problems. Other contaminants include: total dissolved solids and volatile organic chemicals (VOCs).	Storage of manufacturing wastes.	Hazardous waste site number AZD098039902. Inspection in 1986. Site assessments began 1993.
123	Maricopa	Sulfate level up to 500 mg/l.	Naturally occurring.	
		Major cations and anions with TDS over 10,000 mg/l.		
SAN SIMON WASH BASIN				
124	San Simon (Tohono O'Odham Reservation)	Arsenic (200 µg/l) exceeds standard.	Naturally occurring.	
SANTA CRUZ ACTIVE MANAGEMENT AREA				
125	Nogales Wash, Nogales	Groundwater contamination by VOCs: PCE above the MCL, and 18 other VOCs detected but below MCLs.	Source(s) may be large U.C corporations operating twin plants on both sides of the border.	WQARF Superfund site number E-5250.1.2 (since 1987). Ongoing studies to determine source(s), extent, and severity of contamination. Drinking water wells containing PCE above the MCL have been taken out of service.

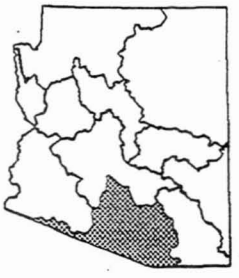
ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
SANTA CRUZ - RIO MAGDELENA - RIO SONOYTA WATERSHED				
126	United Musical Instruments, Nogales.	Groundwater contaminated by VOCs (isomers of DCE, DCA, TCE, and chloroform.). The area of contamination is approximately 20 acres and depth to groundwater is 90-160 feet. MCL of 5 µg/l exceeded at facility.	Waste disposal into surface impoundment.	Site number AZD89304216. Remediation should start by the end of 1995. (Treated water to be used for golf course).
TUCSON ACTIVE MANAGEMENT AREA				
127	Green Valley	Nitrate (greater than 10 mg/l).	Naturally occurring.	
		Sulfate over 1200 mg/l.	Mining activity.	
128	Marana	Nitrate up to 41 mg/l.	Agriculture and infiltration of sewage plant effluent.	
129	Tucson	Radon up to 1400 pCi/l. 71 of 157 wells exceeded a proposed radon standard of 300 pCi/l. No radon standards have been adopted.	Uranium-rich lacustrine limestone.	(Smith 1988.)
130	Tucson (Santa Cruz River)	Nitrate exceeds standard (>10 mg/l).	Histoic or current agricultural practices.	
131	Ansell, Tucson	Total chromium in groundwater beneath and downgradient of the site from 0.1 to 0.4 mg/l (MCL = 0.05 mg/l). Estimated area of the plume is 500,000 square feet.	Disposal of manufacturing wastes containing chromium to unlined ponds.	Hazardous Waste site number AZT050010255. Inspection 1991. Installation of monitoring wells 1992.
132	Arizona State Land Department @ Fagan Lake	Soil and surface water contaminated by lead. Possible lake sediment contamination.	Illegal wire burning site.	Discovery of site 1988. First removal of contaminated soils in 1988 and additional removal completed 1990.
133	Broadway Landfill Tucson	Groundwater contaminated with PCE and TCE.	Source unknown.	WQARF Superfund site number E-5460.1.8. Site assessment ongoing.
134	Davis-Monthan Air Force Base, Tucson	Petroleum contamination of groundwater. (Soil contamination by heavy metals associated with dross piles)	Fuel tank leaks at air base. (Dross is solid wastes from salvaging airplanes.)	Department of Defense Installation Restoration Program site number E-4240.1.0. Groundwater extracted and treated with activated carbon treatment system. Soil vapor extraction used to prevent migration.
135	El Camino Del Cerro Landfill, Tucson	Contamination of groundwater by 23 different VOCs and several trace metals. Several public drinking water wells are threatened.	County landfill (operated 1973-1978).	Potential WQARF site number E-5600.1.0. 1994 Pima County deepened bank protection along Santa Cruz River. Ten more monitoring wells installed in 1994.
136	ESCO Tucson	Potential contamination of soils and groundwater with volatile organic chemicals (VOCs) or metals. Within floodplain, although groundwater thought to be 400 feet below ground.	Hazardous waste storage, disposal, recycling, and transportation site.	WQARF remediation site number E-5590.10.6. Hazardous substance storage drums removed from site by ADEQ in 1990. Ongoing investigation.

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
SANTA CRUZ - RIO MAGDELENA - RIO SONOYTA WATERSHED				
137	Los Reales Landfill Tucson	VOCs have been detected in monitoring wells: PCE, TCE, DCA, trichlorofluoromethane, dichlorofluoromethane, chloroethane, dichloroethene, and methylene chloride. Only PCE exceeds an MCL.	Landfill with 5 acre hazardous waste disposal site active 1977-1980.	WQARF Superfund site number E-5440.1.10. Site investigation and risk assessment completed. Remediation strategies being proposed.
138	Miracle Mile Interchange, Silverbell Jail Annex Landfill, Tucson	VOCs above MCLs in groundwater: TCE, PCE, Freon 12, Freon 11, DCE, methyl tertiary butyl ether (MTBE), and benzene. PCE up to 480 µg/l.	TCE, PCE, and vinyl chloride are probably from landfill leachate. Old gas station suspected of source of benzene.	WQARF Superfund site number E-II-5240.2.5. Interim remediation has been suspended due to decline in contaminant levels.
139	Mission Linen, Tucson	Groundwater contamination with diesel product, PCE (up to 82,700 µg/l), TCE (at 15 µg/l), an isomer of DCE (at 0.62 µg/l), and other volatile organic compounds. In both perched and regional aquifers.	Historic use and storage of dry cleaning chemicals. Leaking underground storage tank from another site.	WQARF Superfund site number E-5340.2.1. Removal of PCE-contaminated diesel fuel in 1994. Currently monitoring and designing a soil vapor extraction system.
140	Page-Trowbridge Ranch Landfill, Oracle.	Soil and groundwater contaminated by: organic solvents, acids and caustics, heavy metals, pesticides, reactives, photographic chemicals, and more.	Hazardous waste disposal site.	Hazardous Waste Program site number AZD980665814. Closure plan approved by ADEQ in August 1995, Closure activities to be completed by early 1996.
141	Tucson International Airport, (General Dynamics Corp, McDonnel Douglas, US Air Force, National Guard) Tucson	Plume A: Groundwater contamination by TCE and chromium in a seven mile long plume.	Solvent use and disposal in aircraft industry.	National Priority List Superfund site number E-4130.5.1. Ongoing investigation.
		Plume B: Groundwater contaminated by TCE up to 47 µg/l (MCL = 5 µg/l).	Use and disposal of solvents and other hazardous substances at this air base.	Department of Defense Installation Restoration Program. 1994 air-stripping treatment facility began operation. Treated water for City of Tucson's drinking water system. Ongoing investigation.
142	US Air Force Plant 44 (Hughes) Tucson	Perched groundwater contains chromium, manganese, iron, zinc, and isotopes of TCA, TCE, and DCE. In upper regional aquifer chromium exceeds MCL. Manganese, zinc, and arsenic, TCE, TCA, and DCE > background levels.	Historic waste disposal practices.	Department of Defense Installation Restoration Program site number E-4130.2.0.3. Groundwater treatment to remove VOCs and chromium since 1987. Treated water reinjected. Contaminated soils removed. Well casings sealed to minimize migration between aquifers.



Map G - 9. Santa Cruz-Rio Magdelana-Rio Sonoyta Watershed Groundwater Contamination Sites

- Indian Reservation
- Watershed Boundary
- Primary Highway
- Secondary Highway
- Groundwater Basin
- WS/GW Boundary



SCALE

MILES 10 0 10 20 30 40

KILOMETERS 10 0 10 20 30 40 50

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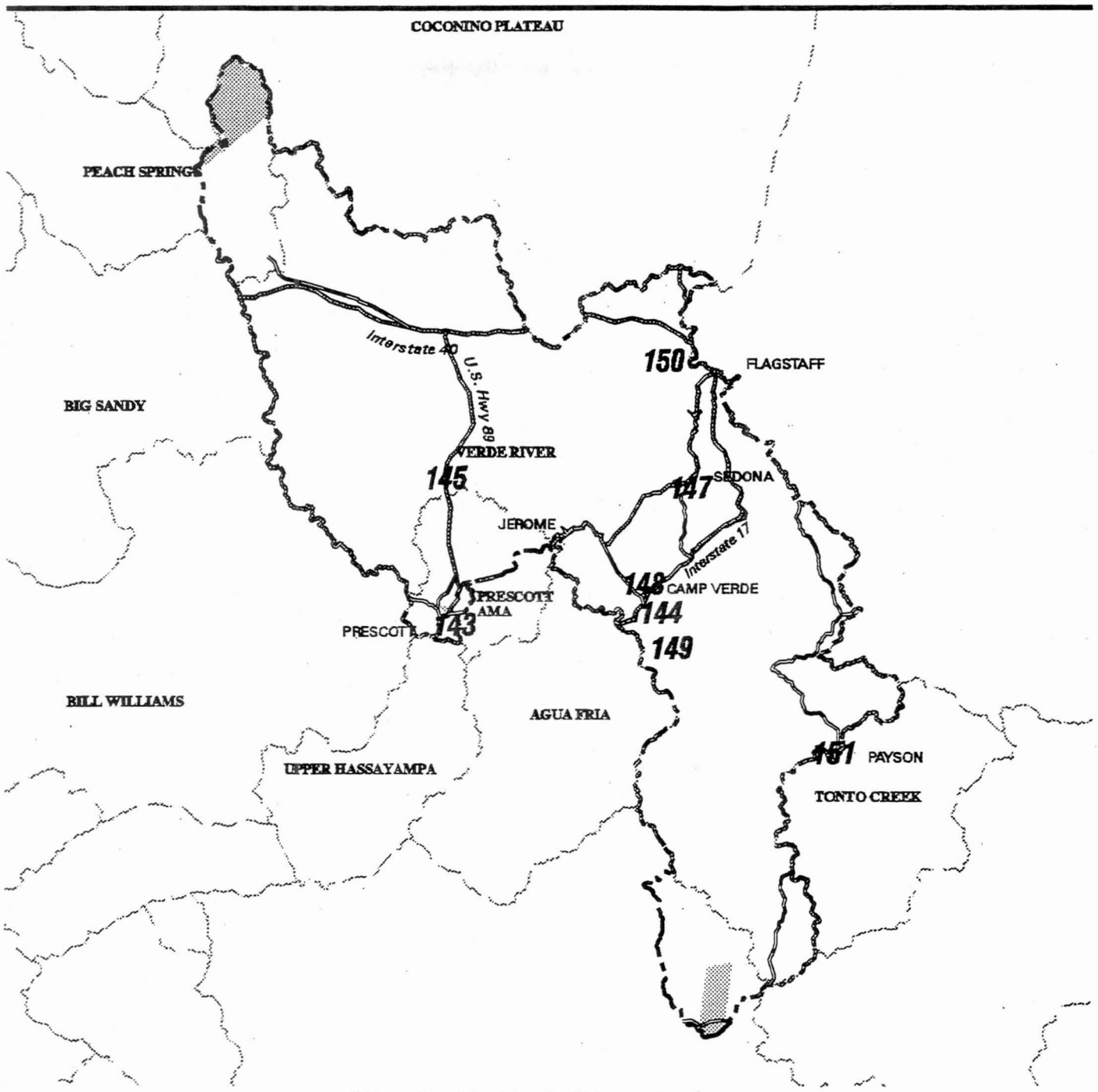
ADEQ 1996

ID NUMBER	SITE NAME AND LOCATION	CONTAMINANT PROBLEM	PROBABLE SOURCE	STATUS
VERDE WATERSHED				
PRESCOTT ACTIVE MANAGEMENT AREA				
143	Prescott	Radon 2,120 - 22,300 pCi/l. Uranium from 45.36 - 79 pCi/l	Naturally occurring.	
VERDE RIVER GROUNDWATER BASIN				
144	Camp Verde	Major cations and anions with TDS 3,000 to 10,000 mg/l.	Naturally occurring.	
145	Paulden	Radon from 885-937 pCi/l.	Naturally occurring.	
146	Payson	Radon from 1750-6310 pCi/l.	Naturally occurring.	
147	Sedona	Fecal coliform (10 CFU).	Discharges from septic systems.	
148	Verde Valley	MCL for arsenic exceeded in over 30% of wells sampled (1000-240,000 µg/l). Radon up to 2560 pCi/l.	Naturally occurring.	
149	West Clear Creek	Major cations and anions with TDS over 10,000 mg/l. (SMCL = 500 mg/l).	Naturally occurring.	
150	Camp Navajo (formerly Navajo Depot) U.S. Army, Bellemont	Known contamination of shallow perched aquifers by petroleum, explosive compounds, nitrates and sulfates, nutrient-related compounds, and metals. Potential contamination of deep aquifers. Known historic releases to surface water, but testing has shown no residual contamination.	Site established as a military storage and disposal site for ammunition, pesticides and other hazardous materials and wastes. Leaking underground storage tank, landfill leachate, ammunition workshop.	Department of Defense Installation Restoration Program site number E-4260.1.1. Excavated petroleum contaminated initiated to be used as a landfill cap. Site closed. Ongoing assessments.
151	Payson Site Payson	Groundwater contaminated by PCE up to 25,000 µg/l (MCL = 5 µg/l).	Historic disposal of dry cleaning solvents.	WQARF Superfund site number E-5490.3.1. Septic tank and contaminated fluids in the tank and soils have been removed. Owners of wells affected have been advised. Finishing assessment before implementing treatment of groundwater.



Map G - 10. Verde Watershed Groundwater Contamination Sites

Indian Reservation

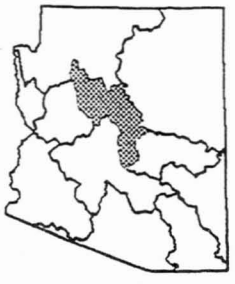
Watershed Boundary

Primary Highway

Secondary Highway

Groundwater Basin

WS/GW Boundary



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Appendix G-2. Leaking Underground Storage Tanks - 1995

ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
COLORADO-GRAND CANYON WATERSHED			
BIG SANDY GROUNDWATER BASIN			
85360	1 tank. Score 185	At a vehicle maintenance yard.	Remediation completed February 1994.
COCONINO PLATEAU GROUNDWATER BASIN			
86046 - Williams	2 tanks. Score 191-198.	At a gas station, a railroad site.	Remediation initiated at both sites.
KANAB PLATEAU GROUNDWATER BASIN			
86022 - Fredonia	1 tank. Score 178.	At an industrial site.	Remediation to soil.
VIRGIN RIVER GROUNDWATER BASIN			
86432 - Littlefield	1 tank. Score 112.	At a vehicle maintenance site.	Remediation to soil.
COLORADO-LOWER GILA WATERSHED			
LAKE HAVASU GROUNDWATER BASIN			
86403 - Lake Havasu City	6 tanks. Scores between 172-213.	5 gas/service stations, 2 industrial site.	Initiated - 4 sites, Not initiated - 2 sites.
LOWER GILA GROUNDWATER BASIN			
85333 - Dateland	1 tank. Score 203.	At a farm.	Remediation to soil .
85356 - Wellton	1 tank. Score 175.	At a railroad site.	Remediation to soil and groundwater.
MOHAVE LAKE GROUNDWATER BASIN			
86427 - Fort Mohave	1 tank. Score 172.	At a gas station.	Remediation to soil.
86430 - Bullhead City	2 tanks. Scores 192-198.	At a gas station, 1 vehicle maintenance area.	Initiated - 1 site, Not initiated - 1 site.
86436 - Topock	2 tanks. Scores 160-193.	At a gas station. 1 commercial site.	Initiated - 2 sites,
86440 - Mohave Valley	2 tanks. Scores 171-220.	At a gas station, 1 commercial site.	Initiated - 1 site, Not initiated - 1 site.
86442 - Bullhead City	1 tank. Score 215.	At a commercial site.	Remediation to soil.

ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
PARKER GROUNDWATER BASIN			
85334 - Ehrenberg	3 tanks. Scores 163-228.	1 gas station, 1 industrial site.	Initiated - 3 sites.
85344 - Parker	6 tanks. Scores between 103-239.	3 gas/service stations, 2 commercial sites, 1 farm.	Initiated - 5 sites, Not initiated - 1 site.
85346 - Quartzsite	1 tank. Score 206.	At a vehicle maintenance yard.	Remediation to soil and groundwater.
85359 - Quartzsite	2 tanks. Scores 185-245.	At 2 gas stations.	No remediation initiated.
SACRAMENTO VALLEY GROUNDWATER BASIN			
85438 - Yucca	1 tank. Score 235.	At a commercial site.	No remediation initiated.
LAKE HAVASU GROUNDWATER BASIN			
85350 - Yuma	6 tanks. Scores between 171-195.	5 gas/service stations, 1 farm.	Initiated at all 6 sites.
85364 - Yuma	31 tanks. Scores between 77-208.	26 vehicle service stations, 2 commercial sites, 1 utility site, 1 railroad site, 1 hospital.	Initiated - 19 sites, Not initiated - 12 sites.
85365 - Yuma	9 tanks. Scores between 122-234.	7 gas/vehicle service stations, 1 commercial sites, 1 farm.	Initiated - 6 sites, Not initiated - 3 sites.
85369 - Yuma	6 tanks. Scores between 174-206.	All at military base.	Initiated - 6 sites, Not initiated - 1 site.
LITTLE COLORADO-SAN JUAN WATERSHED			
LITTLE COLORADO RIVER GROUNDWATER BASIN			
85901 - Show Low	2 tanks. Scores 176-224.	1 gas station, 1 contractor	No remediation initiated.
85925 - Eagar	3 tanks. Scores 162-191.	2 gas stations, 1 industrial site.	Initiated - 2 sites Not initiated 1 site.
85929 - Lakeside	2 tanks. Scores 85-219	2 utility sites.	Initiated at both sites.
85931 - Forest Lakes	1 tank. Score 202.	At a fish hatchery.	Remediation to soil.

ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
85935 - Pinetop	2 tanks. Scores 188-195.	At a gas station, 1 commercial site.	Remediation initiated at both sites.
85936 - St. Johns	7 tanks. Scores between 186-250.	All at vehicle maintenance or gas stations.	Initiated at 5 sites, Not initiated at 2 sites.
85937 - Snowflake	1 tank. Score 198.	At a gas station.	Not initiated.
85938 - Springerville	6 tanks. Score 154-214.	2 gas stations, 1 petroleum distributor.	Initiated at 3 sites, Not initiated at 3 sites.
85939 - Taylor	1 tank. Score 158.	At a vehicle maintenance yard.	Not initiated.
86001 - Flagstaff	13 tanks. Scores 143-266.	11 gas/service stations, 1 commercial site, 1 utility site.	Initiated at 5 sites Not initiated at 8 sites.
86025 - Holbrook	8 tanks. Scores 1-217.	7 gas/service stations, 1 commercial site.	Initiated at 2 sites, Not initiated at 6 sites.
86032 - Joseph City	1 tank. Score 188.	At a utility site.	Not initiated.
86040 - Page	7 tanks. Scores 133-278.	5 gas/service stations, 2 commercial sites.	Initiated - 3 sites. Not initiated - 4 sites.
86047 - Winslow	11 tanks. Scores 144-240.	8 gas/service stations, 2 commercial sites, 1 railroad.	Initiated at 6 sites. Not initiated at 5 sites.
MIDDLE GILA WATERSHED			
AGUA FRIA GROUNDWATER BASIN			
85324 - Black Canyon City and Rock Springs	5 tanks. Scores 174-231.	4 gas stations, 1 contractor.	Initiated - 2 sites, Not initiated - 3 sites.
86333 - Mayer	2 tanks. Scores 154-196.	At 2 gas stations.	No remediation initiated.
GILA BEND GROUNDWATER BASIN			
85337 - Gila Bend	2 tanks. Scores 97-182.	1 farm, 1 vehicle maintenance yard.	Remediation initiated at both sites.
MCMULLEN VALLEY GROUNDWATER BASIN			
85357 - Wendon	1 tank. Score 180	At a railroad site.	No remediation initiated.

ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
PHOENIX ACTIVE MANAGEMENT AREA			
85003 - Phoenix	2 tanks. Scores 181-207.	2 vehicle service/gas stations.	No remediation initiated.
85004 - Phoenix	14 tanks. Scores range from 91-204.	7 commercial sites, 5 vehicle service/gas stations, 1 industrial facility, 1 utility company.	Initiated - 8 sites, Not initiated - 6 sites.
85007 - Phoenix	18 tanks. Scores between 48-192.	9 vehicle service/gas stations, 3 industrial facilities, 1 gasoline distributor, 5 misc. commercial facilities.	Initiated - 11 sites, Not initiated - 7 sites.
85008 - Phoenix	21 tanks. Scores between 69-220	13 vehicle service/gas stations, 5 commercial sites, 2 military sites, 1 utility.	Initiated - 10 sites, Not initiated - 11 sites.
85009 - Phoenix	51 tanks. Scores from 85 to 209.	30 vehicle service/gas stations, 9 commercial sites, 4 industrial sites, 3 petroleum distributors, 2 contractor sites. 1 railroad site, 1 landfill, 1 fire training center.	Initiated - 28 sites, Not initiated - 23 sites.
85012 - Phoenix	5 tanks. Scores ranged from 59 to 199.	2 vehicle service/gas stations, 2 commercial sites, 1 industrial site.	Initiated - 2 sites, Not initiated - 3 sites.
85013 - Phoenix	8 tanks. Scores from 177 to 202.	All 8 are service/gas stations.	Initiated - 4 sites, Not initiated 4 sites.
85014 - Phoenix	7 tanks. Scores between 173-198.	All 7 are service/gas stations.	Initiated - 6 sites, Not initiated 1 site.
85015 - Phoenix	6 tanks. Scores ranged from 96-205.	All 6 are service/gas stations.	Initiated - 5 sites, Not initiated 1 site.
85016 - Phoenix	6 tanks. Scores between 56-194.	5 gas stations, 1 medical center.	Cleanup complete - 1 site. Initiated - 3 sites, and Not initiated - 2 sites.
85017 - Phoenix	7 tanks. Scores from 139 to 201.	4 gas stations, 2 commercial sites, 1 contractor.	Initiated - 5 sites. Not initiated - 2 sites.

ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
85018 - Phoenix	15 tanks. Scores between 120-202.	All 15 are service/gas stations.	Initiated - 9 sites, Not initiated 6 sites.
85019 - Phoenix	5 tanks. Scores: 61-182.	3 vehicle service/gas stations, 1 contractor, 1 utility company.	Initiated - 4 sites, Not initiated 1 site.
85022 - Phoenix	1 tank. Score is 189.	At a gas station.	Remediation to soil.
85028 - Phoenix	1 tank. Score is 188.	At a gas station.	Remediation to soil.
85031 - Phoenix	1 tank. Score is 179.	At a gas station.	Remediation to soil.
85032 - Phoenix	1 tank. Score is 71.	At a gas station.	No remediation initiated.
85033 - Phoenix	2 tanks. Scores 176-179.	At 2 gas stations.	Initiated - 1 site, Not initiated - 1 site.
85034 - Phoenix	36 tanks. Scores from 77 to 214.	10 vehicle service/gas stations. 10 commercial sites, 7 industrial sites, 4 contractors, 3 airport sites, 2 utility sites.	Initiated - 19 sites, and Not initiated - 17 sites.
85037 - Phoenix	1 tank. Score is 181.	At a gas station.	Remediation to soil.
85040 - Phoenix	16 tanks. Scores from 121 to 240.	10 vehicle service/gas stations, 4 commercial sites, 2 industrial sites.	Initiated - 11 sites, Not initiated - 5 sites.
85041 - Phoenix	3 tanks. Scores from 189-228.	1 gas station, 1 commercial site, 1 contractor.	Initiated - 2 sites, Not initiated - 1 site.
85043 - Phoenix	8 tanks. Scores range from 71-197.	5 vehicle service/gas stations, 1 industrial site, 1 commercial site, 1 petroleum distributor.	Initiated - 5 sites, Not initiated - 3 sites.
85072 - Phoenix	1 tank. Score is 205.	At a contractor site.	Remediation to soil.
85201 - Mesa	4 tanks. Scores between 189-207.	All 4 at service/gas stations.	Initiated - 2 sites, Not initiated - 2 sites.
85210 - Mesa	1 tank. Score is 158.	At a contractor site.	Remediation to soil.
85220 - Apache Junction	1 tank. Score is 235.	At a vehicle maintenance yard.	No remediation initiated.
85224 - Chandler	4 tanks. Scores from 180-195.	3 vehicle gas/service stations, 1 commercial site.	Initiated - 3 sites, Not initiated - 1 site.

ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
85225 - Chandler	1 tank. Score is 186.	At a commercial site.	Remediation to soil.
85226 - Chandler	1 tank. Score is 137.	At a commercial site.	No remediation initiated.
85228 - Coolidge	3 tanks. Scores between 185-193.	All 3 are service/gas stations.	Remediation initiated at all sites.
85231 - Eloy	1 tank. Score is 182.	At a gas station.	No remediation initiated.
85234 - Gilbert	1 tank. Score is 195.	At a contractor site.	Remediation to soil.
85235 - Hayden	1 tank. Score 210.	At an industrial site.	Remediation to soil and groundwater.
85237 - Kearny	2 tanks. Scores 191-197.	1 vehicle service area, 1 industrial site.	No remediation initiated.
85240 - Chandler	3 tanks. Scores from 184-194.	All 3 at a military base.	Initiated - 1 site. Not initiated - 2 sites.
85249 - Chandler	1 tank. Score is 184.	At a municipal airport.	No remediation initiated.
85251 - Scottsdale	2 tanks. Scores 191-210.	At 2 gas stations.	Initiated 1 site, Not initiated.
85257 - Scottsdale	1 tank. Score is 114.	At a vehicle maintenance yard.	Remediation to soil.
85258 - Scottsdale	1 tank. Score is 108.	At a gas station.	No remediation initiated.
85268 - Fountain Hills	1 tank. Score is 188.	At a gas station.	No remediation initiated.
85281 - Tempe	16 tanks. Scores range from 102 to 216.	6 vehicle service/gas stations. 4 contractor sites, 3 commercial sites, 3 utility sites.	Initiated - 13 sites. Not initiated 3 sites.
85282 - Tempe	4 tanks. Scores from 173 to 210.	2 gas stations, 2 commercial sites.	Initiated - 2 sites. Not initiated - 2 sites.
85283 - Tempe	2 tanks. Scores 202-215.	1 gas station, 1 commercial site.	Initiated - 1 site. Not initiated 1 site.
85285 - Tempe	1 tank. Score 191.	At a gas station.	Remediation to soil.
85301 - Glendale	3 tanks. Scores 176-200.	At 3 gas stations.	Remediation initiated at all 3 sites.
85302 - Glendale	1 tank. Score 189.	At a gas station.	Remediation to soil.
85322 - Arlington	1 tank. Score 205.	At a vehicle maintenance yard.	Remediation to soil and groundwater.
85323 - Avondale	3 tanks. Scores from 80 to 203.	3 gas stations, 1 contractor site.	Remediation initiated at all 3 sites.

ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
85326 - Buckeye	8 tanks. Scores ranges from 173 to 200.	5 vehicle service/gas stations, 1 commercial site, 1 contractor site, 1 industrial site.	Initiated - 2 sites. Not Initiated - 6 sites.
85329 - Cashion	3 tanks. Scores from 183-226.	2 vehicle service/gas stations, 1 commercial site.	Initiated - 2 sites. Not initiated - 1 site.
85338 - Goodyear	8 tanks. Scores ranged from 133-186.	3 vehicle service/gas stations, 2 airports, 1 farm, 1 utility, 1 industry.	Initiated - 4 sites. Not initiated - 4 sites.
85339 - Laveen	4 tanks. Scores between 185-196.	3 farms, 1 gas station.	Initiated - 3 sites. Not initiated - 1 site.
85353 - Tolleson	5 tanks. Scores between 109-202.	2 commercial sites, 2 vehicle service areas, 1 unknown.	Initiated - 2 sites. Not initiated 3 sites.
85354 - Tonopah	2 tanks. Scores 55-201.	1 gas station, 1 utility site.	Remediation initiated at both sites.
PINAL ACTIVE MANAGEMENT AREA			
85222 - Casa Grande	15 tanks. Scores from 164 to 198.	11 service/gas stations, 3 utilities, 1 commercial site	Initiated - 7 sites. Not Initiated - 8 sites.
85228 - Coolidge	3 tanks. Scores from 185 to 193.	3 gas station/vehicle maintenance yard.	Remediation initiated at all 3 sites.
85231 - Eloy	1 tank. Score 182.	At a gas station.	Remediation not initiated.
UPPER HASSAYAMPA GROUNDWATER BASIN			
85358 - Wickenburg	1 tank. Score 193.	At a vehicle maintenance yard.	Remediation to soil.
85362 - Yarnell	2 tanks. Scores 195-237.	1 vehicle maintenance yard.	Initiated - 1 site. Not initiated - 1 site.
UPPER SAN PEDRO GROUNDWATER BASIN			
85235 - Hayden	1 tank. Score 201.	At an industrial site.	Remediation to soil and groundwater.
85237 - Kearny	2 tanks. Scores 191-197.	1 industrial site, 1 vehicle maintenance yard.	No remediation initiated.

ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
SALT WATERSHED			
PHOENIX ACTIVE MANAGEMENT AREA			
85273 - Superior	1 tank. Score 136.	At a vehicle maintenance yard.	Remediation to soil.
SALT RIVER GROUNDWATER BASIN			
85501 - Globe	3 tanks. Scores from 140 to 158.	2 vehicle service areas, 1 commercial site.	Initiated - 2 sites. Not initiated - 1 site.
85502 - Globe	1 tank. Score 217.	At a gas station.	Remediation to soil.
85539 - Globe	3 tanks. Scores from 112 to 201.	2 industrial sites, 1 commercial site.	Initiated - 2 sites. Not initiated - 1 site.
85545 - Roosevelt	2 tanks. Scores 220-238.	At 2 gas stations.	Initiated - 1 site. Not initiated - 1 site.
85554 - Young	1 tank. Score 175.	At a vehicle maintenance yard.	Remediation to soil.
SAN CARLOS-SAFFORD-DUNCAN WATERSHED			
DUNCAN VALLEY GROUNDWATER BASIN			
85534 - Duncan	1 tank. Score 172.	At a utility site.	No remediation initiated.
MORENCI GROUNDWATER BASIN			
85539 - Miami	1 tank. Score 181.	At a vehicle maintenance site.	Remediation to soil.
SAFFORD GROUNDWATER BASIN			
85546 - Safford	6 tanks. Scores from 165 to 218.	5 service/gas stations, 1 petroleum distributor.	Initiated - 4 sites. Not initiated 2 sites.
85548 - Safford	2 tanks. Scores 176-205.	1 federal work center, 1 utility site.	No remediation initiated.
85551 - Solomon	1 tank. Score 141.	At a vehicle maintenance yard.	Remediation to soil.
85552 - Thatcher	1 tank. Score 198.	At a gas station.	Remediation to soil.
85605 - Bowie	1 tank. Score 183.	At a railroad site.	Remediation to soil.
85632 - San Simon	1 tank. Score 197.	At a railroad site.	Remediation to soil.
SAN PEDRO-WILLCOX PLAYA-RIO YAQUI WATERSHED			
DOUGLAS GROUNDWATER BASIN			
85603 - Bisbee	1 tank. Score 178.	At a contractor site.	Remediation to soil.
85607 - Douglas	3 tanks. Scores between 122-201.	1 service station, 1 utility site.	Initiated - 1 site. Not initiated - 2 sites.

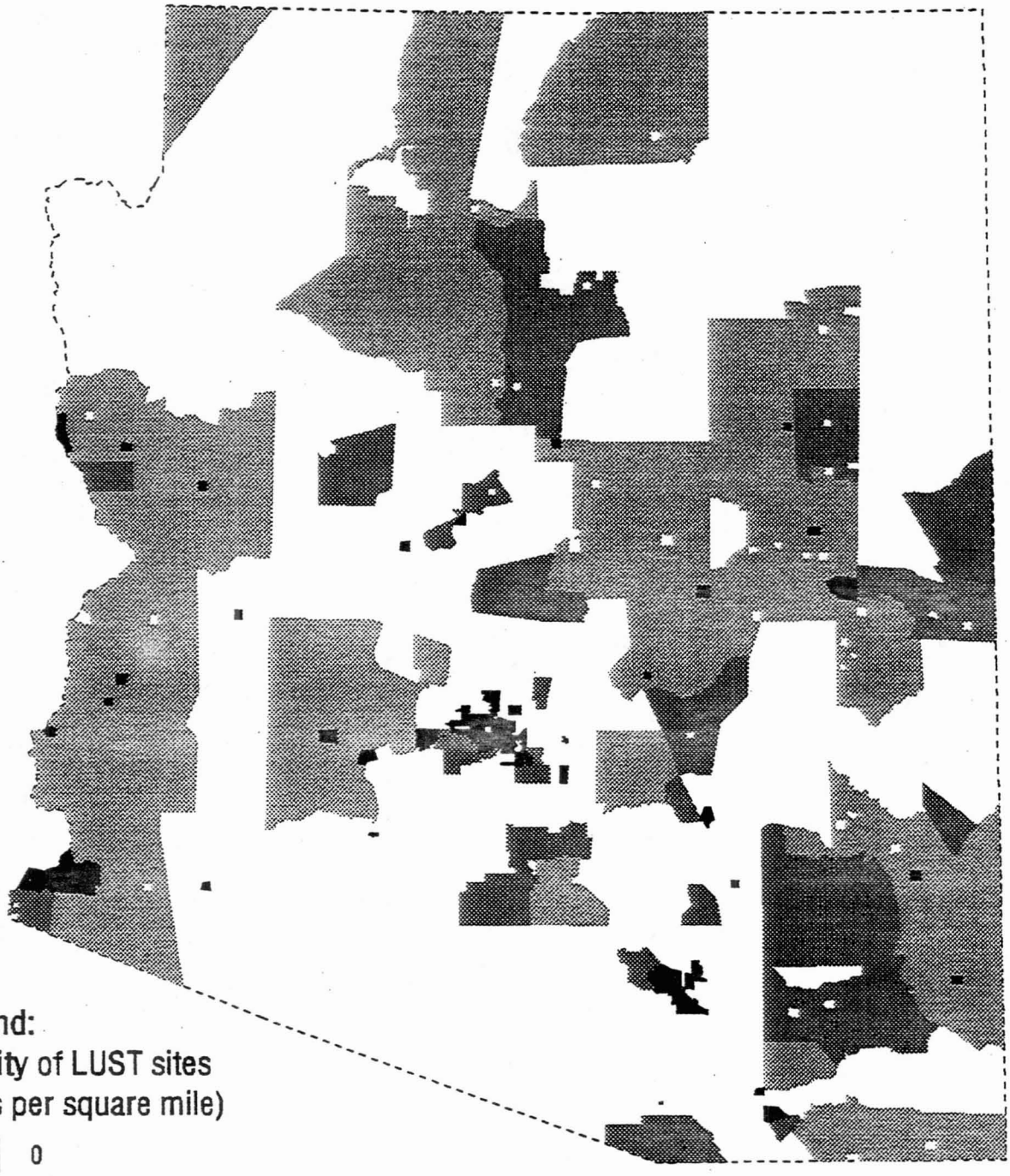
ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
UPPER SAN PEDRO GROUNDWATER BASIN			
85618 - Mammoth	1 tank. Score 204.	At a gas station.	Remediation to soil.
85623 - Oracle	1 tank. Score 188.	At a gas station.	Remediation to soil.
LOWER SAN PEDRO GROUNDWATER BASIN			
85602 - Benson	5 tanks. Scores from 24 to 205.	4 service/gas stations, 1 commercial site.	Initiated - 2 sites. Not initiated - 3 sites.
85613 - Fort Huachuca	8 tanks. Scores range from 119 to 204.	All at a military base.	Initiated - 5 sites. Not initiated - 3 sites.
85630 - St David	1 tank. Score 183.	At a service station.	Remediation to soil.
85635 - Sierra Vista	1 tank. Score 189.	At a service station.	No remediation initiated.
WILLCOX GROUNDWATER BASIN			
85643 - Willcox	14 tanks. Scores ranged from 182 to 216.	All at service/gas stations.	Initiated - 2 sites. Not initiated - 12 sites.
SANTA CRUZ-RIO MAGDELENA-RIO SONOYTA WATERSHED			
CIENEGA CREEK GROUNDWATER BASIN			
85611 - Elgin	1 tank. Score 110.	At ranger station.	Remediation to soil and groundwater.
PINAL ACTIVE MANAGEMENT AREA			
85543 - Pima	1 tank. Score 196.	At a gas station.	No remediation initiated.
SANTA CRUZ ACTIVE MANAGEMENT AREA			
85621 - Nogales	6 tanks. Scores ranged from 166 to 207.	All as service/gas stations.	Initiated - 2 sites. Not initiated - 4 sites.
TUCSON ACTIVE MANAGEMENT AREA			
85619 - Summerhaven	1 tank. Score 243.	At treatment plant.	No remediation initiated.
85622 - Green Valley	1 tank. Score 101.	At an industrial site.	Remediation to soil.
85640 - Amado	1 tank. Score 197.	At a gas station.	Remediation to soil.
85701 - Tucson	3 tanks. Scores between 194-249.	1 truck hauling company, 1 commercial site, 1 railroad site.	Initiated - 1 site. Not initiated - 2 sites.
85705 - Tucson	6 tanks. Scores from 130 to 206.	4 commercial sites, 2 gas/service stations.	Initiated - 5 sites. Not initiated - 1 sites.

ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
85706 - Tucson	5 tanks. Scores from 158 to 201.	2 gas stations, 2 commercial sites, 1 utility site.	Initiated - 1 site. Not initiated - 4 sites.
85711 - Tucson	1 tank. Score 110.	An auto dealer.	Remediation to soil.
85712 - Tucson	1 tank. Score 178.	At a gas station.	No remediation initiated.
85713 - Tucson	7 tanks. Scores between 180-230.	All at service/gas stations.	Initiated - 5 sites. Not initiated - 2 sites.
85714 - Tucson	4 tanks. Scores between 180-199.	2 gas stations, 1 commercial site, 1 industrial site.	Initiated - 3 sites. Not initiated - 2 sites.
85715 - Tucson	1 tank. Score 183.	At a gas station.	No remediation initiated.
85719 - Tucson	2 tanks. Scores 167-187.	1 truck hauling company, 1 petroleum distributor.	Initiated - 2 sites.
85743 - Tucson	3 tanks. Scores between 119-208.	2 service/gas station, 1 commercial site.	Initiated - 1 site. Not initiated - 2 sites.
VERDE WATERSHED			
PRESCOTT ACTIVE MANAGEMENT AREA			
86301 - Prescott	22 tanks. Scores ranged from 126 to 238.	14 service/gas stations, 5 commercial sites, 2 petroleum distributors, 1 utility.	Initiated - 19 sites. Not initiated - 3 sites.
86329 - Humboldt	1 tank. Score 196.	At a gas station.	No remediation initiated.

ZIP CODE AREA LOCATION	TANKS CONTAMINATING GROUNDWATER HAZARD RANKING SCORE (out of 300 points)	PROBABLE SOURCE OR TYPE OF UNDERGROUND STORAGE TANK	ADEQ STATUS OF REMEDIATION
VERDE RIVER GROUNDWATER BASIN			
85545 - Payson	10 tanks. Scores ranged form 131 to 220.	7 service/gas stations, 2 commercial sites, 1 utility.	Initiated - 7 sites. Not initiated - 4 sites.
85547 - Payson	1 tank. Score 198.	At a commercial site.	No remediation initiated.
86015 - Bellemont	2 tanks. Scores 185-231.	At a military site.	Remediation to soil.
86017 - Munds Park	2 tanks. Scores 189-197.	1 commercial site, 1 gas station.	Initiated - 2 sites.
86326 - Cottonwood	2 tanks. Scores 192-207.	1 gas station, 1 petroleum distributor.	Initiated - 1 site. Not initiated - 1 site.
86336 - Sedona	3 tanks. Scores from 182 to 230.	2 gas stations, 1 commercial site.	Initiated at all 3 sites.

Records reflect status in October 1995. Statewide summary by sources:

389	Service/gas stations
102	Commercial sites
34	Industrial sites
24	Utility sites
21	Contractor sites
20	Military sites
17	Vehicle maintenance yards
11	Petroleum distributor sites
9	Farm sites
9	Railroad sites
6	Airport sites
12	Miscellaneous other sites



Legend:
Density of LUST sites
(sites per square mile)

- 0
- >0 to 0.005
- >0.005 to 0.04
- >0.04 to 0.4
- >0.4 to 6.3

Map G-11. Leaking Underground Storage Tanks
By Zipcode Area (1995)

SCALE
MILES 10 0 10 20 30 40
KILOMETERS 10 0 10 30 50

N
W E
S

ADEQ 1996

Appendix H. 1996 Water Quality Limited Waterbodies List and Ranking

Table Format and Explanation--The list of Water Quality Limited Waters is organized by watershed, and each waterbody (lake or stream reach) has been assigned an identification number, using the Hydrologic Unit Code number (assigned by U.S. Geological Survey for the drainage area), and a Reach Number for a stream segment (assigned by the U.S. Environmental Protection Agency) or a lake number (assigned by Arizona Game and Fish Department). This unique identification number minimizes confusion caused by giving many streams the same name (e.g. Sycamore Creek). "Reach" maps are available upon request through ADEQ or EPA.

Additions to the table since the last listing are indicated with an "*." Both new waterbodies and new stressors have been added to this table.

RANK:

- STRESSOR - 1 point per cause or stressor listed as impaired,
- NON-SUPPORT - 1 point per use assessed in "non-support" (0 points for uses in partial support),

  uses: A&W = Aquatic and Wildlife (warm water fish, coldwater fish, ephemeral, or effluent dominated waters).
  FC = Fish Consumption
  FBC/PBC = Full Body Contact/Partial Body Contact
  AgI = Agriculture Irrigation
  AgL = Agriculture Livestock Watering
  DWS = Domestic Water Source

- SPECIAL STATUS - 2 points if any (or all) of the following special status applies.

  UNIQUE - waters designated or proposed as Unique Water under Arizona's surface water quality rules;
  WILDER - waters within a designated Wilderness, Primitive area, or Wildlife Refuge;
  W&S - waters designated or proposed as Wild and Scenic Rivers designation (W&S);
  NPS - water is part of a U.S. National Park, National Monument, or National Recreational Area.
  RIP - waters within a designated Riparian Protection Area;
  ADVISORY - fish advisory, swimming advisory, or drinking advisory during the past two years.

- APPROPRIATENESS OF TMDL: Scores were adjusted for appropriateness. Factors considered included: apparent risk to human health or aquatic life, degree of public interest and support, how well existing ADEQ programs and initiatives could support completion of this analysis, and other mechanisms available to bring uses into full support (i.e. standards development, enforcement actions, use attainability analysis).

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
BILL WILLIAMS WATERSHED							
Burro Creek, Francis-Boulder Creek 15030202-008	11	3 arsenic, fecal coli, turbidity	3 FBC, A&Ww, AgL	2 UNIQUE WILDER W&S	8	Arsenic and bacteriologic standards change (1996 adoption). Turbidity standard under review.	MEDIUM
Burro Creek, Boulder-Black Canyon 15030202-004	15	5 arsenic, fecal coliform, dissolved oxygen, lead, *turbidity	0		7		MEDIUM
Big Sandy Wash, Stove Spring-Sycamore 15030201-006	7	5 *beryllium, *barium, *dissolved oxygen, *lead, turbidity	0	2 WILDER W&S	7	Turbidity standard under review.	MEDIUM
Boulder Creek, Wilder Creek-Burro Creek 15030202-005	8	6 arsenic, beryllium, copper, lead, manganese, zinc,	2 A&Ww, FBC	0	8	Single source known -- adit at Hillside mine -- TMDL not useful.	LOW
Alamo Lake (confluence of Big Sandy and Santa Maria rivers) 15030204-0040	5000	3 sulfide*, turbidity, low dissolved oxygen	1 A&Ww	2 W&S	6	Turbidity standard under review.	MEDIUM
Bill Williams River, B (11.8 miles)-Colorado 15030204-001	12	4 arsenic, dissolved oxygen*, fecal coli, turbidity*	0	2 WILDLIFE	6	Arsenic and bacteriologic standards change (adoption 1996). Turbidity standard under review.	MEDIUM
Francis Creek, headwaters-Burro Creek 15030202-012	21	2 fecal coli, turbidity	0	2 UNIQUE W&S	4	Bacteriologic standards change (adoption 1996). Turbidity standard under review.	MEDIUM
Santa Maria River, Date-Alamo Lake 15030203-001	3	2 beryllium, fecal coliform*	0	2 WILDER W&S	4	Bacteriologic standards change (adoption 1996).	MEDIUM
Trout Creek Cow Creek-Knight Creek 15030201-014	27	1 arsenic	0	0	1	Arsenic standard change (1996).	LOW
COLORADO RIVER-GRAND CANYON WATERSHED							
Paria River Utah border-Colorado River 14070007-001	25	5 arsenic, beryllium, gross alpha, pH, turbidity	2 A&Wc, FBC	2 NPS	9	Most of watershed in Utah. Arsenic standard change (1996). Turbidity standard under review.	MEDIUM

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
Virgin River Beaver Dam-Big Ben 15010010-003	9	2 arsenic, turbidity	2 A&Ww, FBC	0	4	Most of watershed in Utah. Arsenic standard change (1996). Turbidity standard under review.	MEDIUM
Pumpkin Spring headwater-Colorado River 15010002-003off	3	2 arsenic, turbidity	4 A&Wc, FC, FBC, DWS	2 NPS ADVISORY	8	Spring source in Grand Canyon National Park - all natural contamination. TMDL not needed.	LOW
*Royal Arch Creek headwater-Colorado River 15010002-013OFF	5	1 selenium	1 A&Wc	2 NPS	4		
*Horn Creek headwater-Colorado River 15010002-013OFF62	1	2 uranium, gross alpha	1 DWS	2 NPS ADVISORY	5		
*Shinumo Creek headwaters-Colorado River 15010002-013OFF	14	2 pH, turbidity	0	2 NPS	4		
*Hermit Creek headwater-Colorado River 15010002-013OFF	4	2 arsenic, gross alpha	0	2 NPS	4		
*Crystal Creek headwater-Colorado River 15010002-013OFF	10	1 arsenic	0	2 NPS	3		
*Nankoweap Creek headwater-Colorado River 15010001-003OFF	9	1 pH	0	2 NPS	3		
*Spring Canyon Creek headwater-Colorado River 15010002-003OFF	4	1 arsenic	0	2 NPS	3		
COLORADO RIVER-LOWER GILA WATERSHED							
*Colorado River Main Canal-Mexico 15030107-001	31	1 turbidity	0	0	1	Turbidity standard under review.	LOW
*Lake Havasu on Colorado River 15030101-0590	120	1 fecal coliform	1 FBC	2 WILDER ADVISORY	4	On-going investigation has identified sources. TMDL not necessary at this time.	MEDIUM

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
Painted Rock Lake (Borrow Pit) on Gila River below dam 15070201-1010	350	8 chlordane, DDT metabolites, dieldrin, low dissolved oxygen, mercury, *pH, toxaphene, *turbidity	1 A&Ww	2 ADVISORY	11	See comments for Painted Rock Reservoir, Gila River, Salt River, and Hassayampa River in Middle Gila Watershed	MEDIUM
Gila River, Coyote-Fortuna 15070201-003	29	2 boron, turbidity	1 AgI	0	3	Turbidity standard under review.	MEDIUM
LITTLE COLORADO-SAN JUAN WATERSHED							
Little Colorado, Silver Creek-Carr Wash 15020002-004	6	8 arsenic, beryllium, copper, lead, pH, gross alpha, turbidity, zinc*	2 A&Ww, DWS	0	10	USGS study in the Puerco indicates that these heavy metals and radiochemicals may be at natural background level. Arsenic standard change (1996). Turbidity standard under review. Note that heavy metals being deleted were in suspended solids and are no longer attributed to water column contamination.	MEDIUM
Little Colorado, Porter Tank-McDonalds 15020008-017	19	7 arsenic, beryllium, copper, gross alpha, silver*, turbidity, zinc	2 A&Ww, DWS	0	9		MEDIUM
Puerco River, (around Chambers) 15020007-011	6	1 lead	1 A&Ww	0	2		LOW
Rainbow Lake on Silver Creek 15020005-1170	80	2 pH, narrative (nutrient) standards	4 A&Wc, FBC, AgI, AgL	0	6	Nutrient loading study completed by Clean Lakes Program (1996) can be the basis for a preliminary TMDL.	MEDIUM
Silver Creek, Show Low-Cottonwood 15020005-009	10	4 copper*, mercury*, turbidity, zinc*	2 A&Wc, FBC	0	6	Turbidity standard under review.	MEDIUM
Little Colorado River Nutrioso-Carnero 15020001-009	10	3 turbidity, fecal coli, copper*	1 A&Wc	0	4	Bacteriologic standards change (1996). Turbidity standard under review.	MEDIUM
Nutrioso Creek Picnic-Little Colorado 15020001-015	3	2 fecal coli, turbidity	2 A&Wc, FBC	0	4	Bacteriologic standards change (1996). Turbidity standard under review.	MEDIUM
*Nutrioso Creek headwaters-Picnic Creek 15020001-017	22	1 turbidity	1 A&Wc		2		LOW
West Fork Little Colorado headwater-Little Colorado 15020001-013	4	1 cadmium	1 A&Wc	2 UNIQUE W&S	4	Contaminant believed natural. TMDL not appropriate.	LOW

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
*Little Colorado River @ Colorado confluence 15020016-001	1	2 arsenic, turbidity*	0	2 NPS	4	Contaminants at natural background levels. TMDL not appropriate.	LOW
Show Low Creek headwaters-Linden Wash 15020005-012	34	2 turbidity, low dissolved oxygen	1 A&Wc	0	3	Turbidity standard under review.	LOW
Chevelon Creek, Black Canyon-Little Colorado 15020010-001	18	2 dissolved oxygen, turbidity	1 A&Wc	0	3	Turbidity standard under review.	MEDIUM
Little Colorado River Water Canyon-Nutrioso 15020001-010	4	1 fecal coli	0	0	1	Bacteriologic standard change (1996).	LOW
MIDDLE GILA WATERSHED							
Gila River, Centennial-Gillespie Dam 15070101-007	6	8 arsenic, boron, chlordane, mercury, DDT metabolites, dieldrin, fecal coli, toxaphene, turbidity	2 A&Wedw, FC	2 Advisory	12	Gila River from Salt to Painted Rocks Lake, lower Salt River, and lower Hassayampa River have fish advisory due to pesticides and mercury. It is believed that the majority of these contaminants are the result of historic pesticide applications to fields. A TMDL could be used as a tool to determine contributions from different sources (e.g. stormwater or canal return flows). Once sources are identified it may be possible to implement Best Management Practices to minimize future impacts from these chemicals. Boron exceeds standards in some reaches, and a TMDL could again be used as a tool to determine primary sources and the need for Best Management Practices to minimize inputs to surface waters. The turbidity standard is currently under review. These waterbodies will be targeted when the Middle Gila watershed becomes active under the watershed framework.	MEDIUM
Gila River, A*-Centennial Wash 15070101-008	10				13		MEDIUM
Gila River, Sauceda-Painted Rock 15070101-001	19	8 *arsenic, *boron, chlordane, DDT metabolites, dieldrin, mercury, toxaphene, *turbidity	2 A&Ww, FC		12		MEDIUM
Gila River, Sand Tank-Sauceda 15070101-003	5				12		MEDIUM
Gila River, B-Sand Tank 15070101-005	14				12		MEDIUM
Salt River Granite Reef-Gila 15060106-001	42	7 chlordane, DDT metabolites, dieldrin, mercury, pH, toxaphene, turbidity*	2 A&Wedw, FC		12		MEDIUM
Painted Rock Reservoir on Gila River 15070101-1020	250	7 chlordane, DDT metabolites, dieldrin, mercury, *pH, toxaphene, *turbidity	2 A&Ww, FC		11		MEDIUM

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
Gila River, Hassayampa-A 15070101-009	1	5 chlordane, DDT metabolites, dieldrin, mercury, toxaphene	2 A&Wedw, FC		9		MEDIUM
Gila River, Waterman-Hassayampa 15070101-010	12				9		MEDIUM
Gila River, Agua Fria-Waterman 15070101-014	12				9		MEDIUM
Gila River, Salt-Agua Fria 15070101-015	4				9		MEDIUM
Hassayampa River, Jackrabbit-Gila 15070103-001	15	2 DDT, toxaphene	1 A&Ww		5		MEDIUM
French Gulch, headwaters-Hassayampa 15070103-007off	9	7 beryllium, cadmium, copper, manganese, pH, turbidity, *zinc	4 A&Ww, FBC, AgI, AgL	0	11	Known source -- Zonia Mine -- abatement actions on-going. TMDL not needed.	LOW
Hassayampa River, headwaters-Blind Indian 15070103-007	25	7 cadmium, copper, low dissolved oxygen, lead, pH, zinc, turbidity	4 A&Ww, FBC, AgI, AgL	0	11	This waterbody will be targeted for TMDL completion when the watershed becomes active under the watershed framework.	MEDIUM
Mineral Creek, headwaters-Gila River 15050100-012	17	6 arsenic, beryllium, copper, pH (low), sulfide, zinc	3 A&Ww, FBC, AgL	0	9	Sources of contaminants largely known. Mitigation actions being developed. TMDL may not be appropriate.	MEDIUM
Turkey Creek, headwaters-Poland Creek 15070102-036	18	7 antimony, arsenic, cadmium, copper, cyanide, lead, zinc	0	0	7	Arsenic standard change (1996). Numerous abandoned mines in watershed. Lack monitoring data during runoff events needed to determine contributions from specific mines.	MEDIUM
*Agua Fria River, Big Bug-Squaw Creek 15070102-022	11	3 arsenic, fecal coliform, turbidity	0	0	3	Arsenic and bacteriologic standards change (1996). Turbidity standard under review.	MEDIUM
Hassayampa River, Sols Wash-Jackrabbit 15070103-002	15	2 low dissolved oxygen, *turbidity	1 A&Ww	0	3	Turbidity standard under review.	MEDIUM

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
Hassayampa River, Cottonwood-Martinez 15070103-004	26	1 turbidity	0	0	1	Turbidity standard under review.	LOW
Gila River San Pedro-Mineral Creek 15050100-008	18	3 arsenic, copper, turbidity	0	0	3	Arsenic standard change (1996). Turbidity standard under review.	LOW
Gila River Mineral Creek-Donnelly 15050100-007	14	3 arsenic, copper, turbidity	0	0	3	Arsenic standard change (1996). Turbidity standard under review.	LOW
Galena Gulch headwaters-Agua Fria 15070102-031off	6	1 cyanide	2 A&Ww, AgL	0	3	Single source known -- Magma Copper Co mine -- TMDL not needed.	LOW
Agua Fria River, Black Canyon-Little Squaw 15070102-019	4	1 arsenic	0	0	1	Arsenic standard change (1996).	LOW
Agua Fria River, Lake Pleasant-Beardsly 15070102-008	5	1 arsenic	0	0	1	Arsenic standard change (1996).	LOW
SALT WATERSHED							
Pinal Creek, headwaters-Salt River 15060103-005	18	7 beryllium, copper, low dissolved oxygen, manganese, nickel, pH, turbidity	4 A&Ww, FBC, AgI, AgL	0	11	These waterbodies will be targeted when the watershed becomes active under the watershed framework.	MEDIUM
Bloody Tanks Wash, headwaters-Miami Wash 15060103-005off	8	1 copper	1 A&Ww	0	2		LOW
*Lake Roosevelt on Salt River 15060103-1240	13058	1 beryllium	0	0	1	Beryllium level may be natural.	LOW
Pinto Creek, headwaters-Spring Creek 15060103-018	25	1 copper	1 A&Ww	2 W&S	4	Lack of information as to merits of doing a TMDL.	MEDIUM
Canyon Creek, headwaters-Oak Creek 15060103-014	19	1 turbidity	0	2 W&S	3	Turbidity standard under review.	LOW

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
*Tonto Creek headwaters-Haigler Creek 15060105-013	15	1 nitrogen	0	2 W&S WILDER	3	On-going intensive studies to identify sources.	LOW
Tonto Creek, Rye Creek-Gun Creek 15060105-008	2	1 turbidity	0	2 W&S WILDER	3	Turbidity standard under review.	LOW
West Fork Black River headwaters-Black River 15060101-009off	16	1 turbidity	1 A&Wc	2 W&S	4	Turbidity standard under review.	MEDIUM
Salt River, Pinal Cr-Roosevelt Lake 15060103-004	4	2 arsenic, turbidity	0	0	2	Arsenic standard change (1996). Turbidity standard under review.	LOW
*Gordon Creek hdwt-Haigler Creek 15060105-012	10	1 turbidity	0	0	1	Turbidity standard under review.	Low
Beaver Creek, headwaters-Black River 15060101-008	12	2 turbidity, phosphates	1 A&Wc	0	3	Turbidity standard under review.	LOW
SAN CARLOS-SAFFORD-DUNCAN WATERSHED (UPPER GILA RIVER BASIN)							
Gila River, New Mexico-Bitter Creek 15040002-004	14	2 *arsenic, turbidity	2 A&Ww, FBC	2 W&S	6	Part of the watershed is in New Mexico and on Indian Reservation. On-going watershed participation. Arsenic and bacteriologic standards change (1996). Turbidity standard under review.	HIGH
San Francisco River, Limestone-Gila River 15040004-001	11	4 *arsenic, copper, fecal coli, turbidity	2 A&Ww, FBC,	0	6		HIGH
Gila River, Bonita Creek-Yuma Wash 15040005-022	6	3 copper, fecal coliform*, turbidity	2 A&Ww, FBC	2 W&S	7		HIGH
Blue River, KP Creek-San Francisco 15040004-025	27	1 turbidity	1 A&Wc	2 W&S WILDER	4		HIGH
Bonita Creek, Park Creek-Gila River 15040005-030	23	4 arsenic, copper, pH*, zinc	1 A&Ww	2 W&S UNIQUE WILDER	7	Part of the Bonita Creek watershed is on Indian Reservation. All stressors believed to be natural.	LOW

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
SAN PEDRO-WILLCOX PLAYA-RIO YAQUI WATERSHED							
Whitewater Draw Mule Gulch-Mexico 15080301-002	13	9 arsenic, beryllium, copper, low dissolved oxygen, fecal coli, lead, manganese, turbidity, zinc	2 A&Ww, FBC,	0	11	Arsenic and bacteriologic standards change (1996). Turbidity standard under review.	MEDIUM
Mule Gulch, headwaters-Whitewater Dr 15080301-004off	9	4 copper, pH, *turbidity, zinc	3 A&Ww/A&Wedw, AgI, AgL	0	7		MEDIUM
San Pedro River, Babocomari-Dragoon 15050202-003	15	3 fecal coli, nitrate, turbidity	1 A&Ww	0	4	Nitrate source known -- Apache Powder -- TMDL not needed. Bacteriologic standards change (1996). Turbidity standard under review.	MEDIUM
San Pedro River, Mexico-Charleston 15050202-008	27	4 beryllium, low dissolved oxygen, fecal coli, turbidity	0	0	4		MEDIUM
Redfield Canyon Creek, headwaters-San Pedro 15050203-014	19	4 arsenic, low dissolved oxygen, *chromium VI, zinc	1 A&Ww	0	5	Arsenic standard change (1996)	MEDIUM
*San Pedro River Aravaipa Creek-Gila River 15050203-001	11	1 turbidity	2 A&Ww, FBC	0	3	Turbidity standard under review.	MEDIUM
San Pedro River, Walnut-Babocomari 15050202-006	1	1 turbidity	0		1	Turbidity standard under review.	LOW
SANTA CRUZ - RIO MAGDELENA - RIO SONOITA WATERSHED							
Sonoita Creek, headwaters-Santa Cruz 15050301-013	30	5 arsenic*, beryllium, low dissolved oxygen, lead*	1 A&Ww	0	6	Many abandoned mines on tributaries to Sonoita Creek, most are located on federally owned land. BLM and USFS making inventory of mines and ranking by risk to impact water quality or safety. Arsenic standard change (1996).	MEDIUM
Three-R Canyon Creek, headwaters-Sonoita 15050301-013offR	2	5 cadmium, copper, pH, radium 228, zinc	4 A&Ww, FBC, AgI, AgL	0	9		MEDIUM
Harshaw Wash, headwaters-Sonoita 15050301-013off17S	12	3 copper, pH, zinc	3 A&Ww, PBC, AgL	0	6		MEDIUM
Alum Gulch headwaters-Sonoita Creek 15050301-013off13	7	4 cadmium, copper, pH, zinc	2 A&We, PBC	0	6		MEDIUM

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
Nogales Wash, headwaters-Santa Cruz 15050301-011	5	2 chlorine*, turbidity	1 A&Ww	0	3	Chlorine being added due to fecal contamination problems in Mexico. Major border studies in progress. TMDL not appropriate at this time.	LOW
Santa Cruz River, Mexico bdr-Nogales Wash 15050301-012	16	2 low dissolved oxygen, turbidity	1 A&Ww	0	3	Part of the watershed is in Mexico. Reaches above and below Nogales International Wastewater Treatment Plant. Turbidity standard under review.	LOW
Santa Cruz River, Nogales-Sonoita 15050301-010	3	2 cadmium, copper	0	0	2		LOW
Santa Cruz River, Sonoita-Josephine 15050301-009	6	2 cyanide*, turbidity	0	0	2		LOW
Santa Cruz River, Josephine-Sopori 15050301-008	14	2 copper, turbidity	0	0	2		LOW
Washington Gulch, headwaters-Duquesnew Wash 15050301-012off	4	3 copper, lead, zinc	2 A&Ww, AgL	0	5	Single source known -- Washington Camp Mine -- TMDL not appropriate.	LOW
Arivaca Wash, headwaters-Puertocito 15050304-008	19	1 low dissolved oxygen	1 A&Ww	0	2	Low dissolved oxygen believed natural. TMDL not needed.	LOW
Santa Cruz River, Canada del Oro-Guild 15050301-001	8	1 turbidity	0	0	1	Turbidity standard under review.	LOW
*Pena Blanca Lake 15050301-1070	45	1 mercury	1 FC	2 ADVISORY	4	TMDL might assist in identifying and remediation of sources.	MEDIUM
*Arivaca Lake 15050304-0080	80	1 mercury	1 FC	2 ADVISORY	4	TMDL might assist in identifying and remediation of sources.	MEDIUM
VERDE WATERSHED							
Bitter Creek, headwaters-Verde River 15060202-025off	5	4 cadmium, copper, pH, zinc	3 A&Ww, PBC, AgL	0	7	Known source of contaminants -- TMDL not appropriate.	LOW

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
Oak Creek, West Fork-Dry Creek 15060202-018	22	2 arsenic, *fecal coliform, turbidity	1 A&Wc	2 UNIQUE W&S ADVISORY	5	The Verde River watershed is active within the watershed framework. Any needed TMDLs in this basin have been targeted for completion within the next two years. ADEQ is reevaluating the existing nutrient TMDL on Oak Creek at the request of local stakeholders. The reevaluation will include a look at the existing nutrient TMDL on the Verde River. Also, ADEQ may look at a loading capacity for turbidity for entire watershed. Arsenic and bacteriologic standards change (1996). Turbidity standard under review. Natural levels of beryllium.	HIGH
Oak Creek, Dry Creek-Spring Creek 15060202-017	9	2 arsenic, turbidity	1 A&Wc	2 UNIQUE W&S	5		HIGH
Oak Creek, Spring-Verde River 15060202-016	10	2 arsenic, turbidity	1 A&Wc	2 UNIQUE W&S	5		HIGH
Verde River, Granite Creek-Hell Canyon 15060202-052	16	2 arsenic, *nutrients	0	0	2		HIGH
Verde River, B-Railroad Draw 15060202-037	10	3 arsenic, *nutrients, turbidity	0	2 W&S	5		HIGH
Verde River, Sycamore-Oak Creek 15060202-025	24	2 arsenic, turbidity	0	2 W&S	4		HIGH
Verde River, Oak Creek-Beaver Creek 15060202-015	16	2 arsenic, turbidity	0	0	2		HIGH
Verde River, *A-West Clear Creek 15060203-027	6	2 arsenic, turbidity	0	0	2		HIGH
Verde River, West Clear-Fossil Creek 15060203-025	21	2 arsenic, turbidity	0	0	2		HIGH
Verde River, Tangle Creek-Ister Flat 15060203-018	4	2 arsenic, turbidity	0	0	2		HIGH
Wet Beaver Creek, Long Canyon-Rarick 15060202-004	7	2 arsenic, turbidity	0	2 WILDER W&S	4		HIGH

WATERBODY NAME REACH DESCRIPTION WATERBODY ID	MILES OR ACRES	RANKING CRITERIA			RANKING SCORE	APPROPRIATENESS OF TOTAL MAXIMUM DAILY LOAD (TMDL) ANALYSIS	RANK
		STRESSOR	USE NON-SUPPORT	SPECIAL STATUS			
Wet Beaver Creek, Dry Beaver-Verde River 15060202-002	8	3 arsenic, low dissolved oxygen, turbidity	1 A&WC	2 WILDER W&S	6		HIGH
Munds Creek, headwaters-Oak Creek 15060202-018off	13	3 fecal coliform, nutrients, turbidity	1 A&Wc	0	4		HIGH
Pumphouse Wash, headwaters-Oak Creek 15060202-019off	11	2 copper, turbidity	1 A&Wc	0	3		HIGH
Wet Bottom Creek, headwaters-Verde River 15060203-020	7	2 arsenic, beryllium	0	0	2		HIGH
East Verde River, headwaters-Verde River 15060203-022	42	3 arsenic, low dissolved oxygen, turbidity	0	2 W&S	5		HIGH
Ellison Creek, headwaters-East Verde 15060203-022off	11	1 turbidity	0	0	1		HIGH
Verde River, Bartlett Dam-Camp Verde 15060203-004	6	1 arsenic	0	0	1	New arsenic standards (adopted in 1996 after assessment) will bring these waters into full support of their designated uses.	LOW
Sycamore Creek (Tonto), headwater-Verde River 15060203-002	36	1 arsenic	0	0	1		LOW
East Fork Sycamore Creek, headwaters-Sycamore 15060203-002off	6	1 arsenic	0	0	1		LOW
*Pecks Lake 15060202-1060	77	1 arsenic	0	0	1		LOW
*Bartlett Lake on Verde River 15060203-0110	2015	1 arsenic	0	0	1		LOW

Appendix I. Abbreviations and Acronyms

ACERP	Arizona Comparative Risk Assessment Project
ADEQ	Arizona Department of Environmental Quality
ADHS	Arizona Department of Health Services
AGFD	Arizona Game and Fish Department
ADWR	Arizona Department of Water Resources
AgI	Agriculture Irrigation (surface water designated use)
AgL	Agriculture Livestock Watering (surface water designated use)
AMA	Active Management Areas
A&W	Aquatic and Wildlife (a set of surface water designated uses) A&Wc - coldwater fisheries A&Ww - warmwater fisheries A&We - ephemeral water A&Wedw - effluent dependent water
BADCT	Best Available Demonstrated Control Technologies
BMP	Best Management Practices
BLM	Bureau of Land Management
BOR	Bureau of Reclamation
CAP	Central Arizona Project (a Colorado River canal that terminates in Tucson)
CERCLA	Comprehensive Environmental Response Compensation and Liability Act (federal Superfund)
cfs	Cubic feet per second
COE	U.S. Army Corps of Engineers
DWS	Domestic Water Source (a surface water designated use)
EIS	Environmental Impact Statement (required for federal actions)
EPA	U.S. Environmental Protection Agency
FBC	Full Body Contact (surface water designated use)
FC	Fish Consumption (surface water designated use)
HBGL	Health Based Guidance Levels (established by ADHS)
ITFM	Intergovernmental Task Force on Monitoring Water Quality
LUST	Leaking underground storage tanks (UST Program)
MCL	Maximum contaminant levels (standards for Public Water Supplies and aquifer water quality protection)
MRL	Minimum reporting levels
NPL	National Priority List (federal cleanup sites under CERCLA)
NPS	National Parks Service
NRCS	Natural Resources Conservation Service
PBC	Partial Body Contact (surface water designated use)
PDEQ	Pima County Department of Environmental Quality
QA/QC	Quality assurance/quality control
RASA	Regional Aquifer Systems Analysis Program
RCRA	Resource Conservation and Recovery Act (hazardous waste program)
SMCL	Secondary maximum contaminant levels (guidance levels established by EPA for drinking water)
SOC	Semi-volatile organic chemicals
SRP	Salt River Project (Phoenix metro. water and energy)
STORET	Storage and retrieval database (EPA's water quality database)
TDS	Total dissolved solids (mixture of salts in water)
TPH	Total petroleum hydrocarbons
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	Underground Storage Tank Program
VOC	Volatile organic compounds
WQARF	Water Quality Assurance Revolving Fund (Arizona Superfunds)