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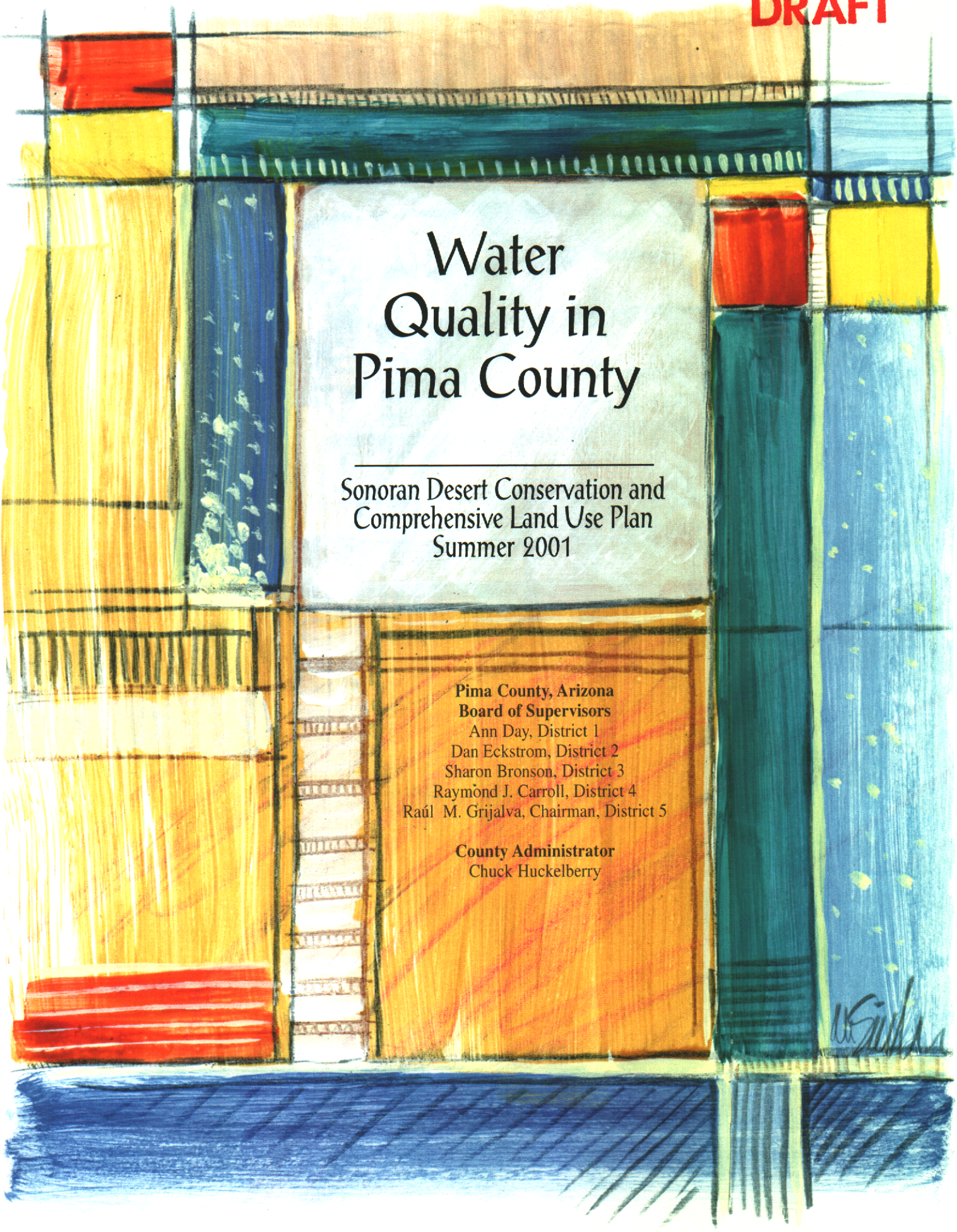

Water Quality in Pima County

Sonoran Desert Conservation and Comprehensive Land Use Plan Summer 2001

Pima County, Arizona
Board of Supervisors
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County Administrator
Chuck Huckelberry

MEMORANDUM

Date: September 6, 2001

To: The Honorable Chair and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: **Water Quality Analysis**

Background

Water quality is an important issue in the alternatives analysis of the Sonoran Desert Conservation Plan and as a component of the Environmental Planning Element of the Comprehensive Plan. The state law that defines the Comprehensive Plan requires "analysis, policies and strategies to address anticipated effects, if any, of plan elements on air quality, water quality and natural resources associated with proposed development under the comprehensive plan." The Pima Association of Governments is working with Pima County to address water quality under these planning initiatives. As the state-designated Water Quality Planning Agency for Pima County under Section 208 of the Clean Water Act, and a partner with Pima County in the Sonoran Desert Conservation Plan study process, Pima Association of Governments is particularly suited for this role. The workplan includes the following tasks:

- Overview of the quality of various water sources in Pima County
- Review and summarize existing state and federal regulations
- Review and compile existing data on water quality requirements of aquatic species
- Identify the highest priority watersheds for water quality monitoring and restoration
- Compile water quality data for the highest priority watersheds
- Assess land uses and potential pollution sources that might impact the water quality of the highest priority aquatic habitats
- Review planning alternatives and identify potential impacts on water quality
- Propose mitigation measures to ensure that water quality of priority aquatic habitats is maintained or improved, and propose a water quality monitoring program for the highest priority aquatic habitats
- Draft a water quality report for the Environmental Planning Element

The attached reports represent (1) an overview of the quality of various water sources in Pima County, and (2) a review and summary of existing state and federal regulations.

Overview of the Quality of Various Water Sources in Pima County

The first study submitted by Pima Association of Governments provides a descriptive overview of the quality of the principal water sources in Pima County, including groundwater, surface waterbodies, stormwater runoff, Central Arizona Project water, and treated wastewater. Highlights include:

1. Groundwater

- "In general, groundwater in the Tucson Active Management Area is of acceptable quality for most uses. Most of the groundwater resources meet federal and state drinking water standards, though contaminant levels exceed primary safe drinking water in a few areas. Groundwater withdrawals from wells within these identified areas have been discontinued or are in the process of remediation. Other areas of known contamination not currently under remediation are monitored to ensure that contaminants do not spread."

- "Land uses that have reportedly led to historic groundwater contamination in eastern Pima County include: landfills and disturbed area, abandoned wells, irrigated agriculture, animal impoundments, underground storage tanks, surface impoundments, wastewater treatment facilities, mines, industry and commerce. Common groundwater contaminants in the Tucson area groundwater include volatile organic compounds (VOC), nitrates, petroleum hydrocarbons, and heavy metals. "

- "There are ten known areas of contamination in eastern Pima County. They include: (1) Broadway-Pantano site; (2) Davis Monthan Air Force Base; (3) Downtown Tucson; (4) El Camino Del Cerro Site; (5) Tucson Airport Area Remediation Project (TARP); (6) Air Force Plant 44; (7) Los Reales Site; (8) Price Service Center; (9) Silverbell Jail Annex Landfill / Miracle Mile Site; and the (10) Shannon Road-Rillito Creek Site."

2. Surface Waterbodies

- "Although it is relatively scarce, naturally occurring surface water in perennial and intermittent streams provides very important habitat for Pima County. Most of the streams that have been monitored are of a quality sufficient for their intended use or habitat. However, monitoring is very limited compared to the other sources."

3. Stormwater Runoff

- "This water is not widely used as a resource. However, it is extensively monitored under existing regulations."

4. Central Arizona Project Water

- "The quality of this water is extensively monitored, and its quality is sufficient for its intended uses, which include drinking water, aquifer recharge, irrigation and industry."

5. Treated Wastewater

- "Treated wastewater is also being used in increasing quantities. It is extensively monitored, and its quality meets standards for its intended uses, which include reuse for turf irrigation, agriculture and discharge to an effluent dependent stream. The effluent discharges currently support valuable riparian habitat subject to major stormwater events."

Review and Summary of Existing state and federal regulations

The second study submitted by the Pima Association of Governments provides a good summary of the laws that address water quality at the federal, state and local level, demonstrating that some water sources are under nine different regulatory regimes. The study concludes that:

- The various water sources are amply regulated by a wide range of existing water quality laws and rules;

- Unforeseen pollutant discharges can never be entirely prevented by regulations, and surface waterbodies are probably more at risk than other water sources; and

- Additional protection of some surface waterbodies, through land use planning and emergency response plans, could be warranted.

Conclusion

In the next months we will see additional studies from the Pima Association of Governments on the topic of water quality that contribute to the Comprehensive Plan and the alternatives analysis of the Sonoran Desert Conservation Plan.

These will allow us to identify the highest priority watersheds for water quality monitoring and restoration, assess land uses and potential pollution sources that might impact the water quality of the highest priority aquatic habitats, and propose mitigation measures to ensure that water quality of priority aquatic habitats is maintained or improved.

The final water quality report for the Environmental Planning Element will provide the Board with the option of implementing a water quality monitoring program for the highest priority aquatic habitats.

Attachments

Water Quality in Pima County

Prepared for the Pima County Comprehensive Plan and Sonoran Desert Conservation Plan

Draft

August 2001

Prepared by

Pima Association of Governments

Acknowledgments

PAG would like to thank Maeveen Beham and Julia Fonseca at Pima County for including this project in PAG 's work program and the Pima County's Administrators Office for providing the funding to make this project possible.

In addition PAG would like to thank the following people who graciously provided information and input in this project: Glen Peterson at Pima County Wastewater Management Department; Karen Dotson at Tucson Water; Catesby Knight at the City of Tucson Transportation Department; Jean Melillo at Tucson Water; and Eric Shepp and Adam Amante at Pima County Department of Environmental Quality.

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Introduction

Background

Since 1998, Pima County has been developing the Sonoran Desert Conservation Plan. Development of this plan has been prompted in part by the federal Endangered Species Act. In addition, the County is updating its Comprehensive Plan as required by the state's recently adopted Growing Smarter legislation. The two plans are to be integrated into the *Sonoran Desert Conservation and Comprehensive Land Use Plan*. This combined plan will contain a water quality element in order to meet the requirements of the Growing Smarter legislation, and to ensure the preservation of species dependent on surface water or shallow groundwater in Pima County.

Pima Association of Governments (PAG) is helping with the preparation of the Plan's water quality element at the County's request. This request was prompted in part by the fact that PAG is the state-designated Water Quality Planning Agency for Pima County under Section 208 of the Clean Water Act.

PAG's Section 208 Water Quality Management Plan consists of a document written in 1978 and all of the subsequent amendments and updates to that document. The 208 Plan addresses one of the major water quality concerns associated with growth, which is the disposition of waste. The original PAG 208 Plan and several amendments also identified various point- and non-point sources of pollutants. However, the 208 Plan has not had a recent comprehensive, countywide update and it does not include site-specific programs for unique aquatic habitats identified in the Sonoran Desert Conservation Plan. Therefore, reliance on the existing 208 Plan would probably not meet the County's needs, and development of additional planning materials is warranted.

Purpose

The purpose of this report is to provide, using existing literature to the extent possible, a brief, descriptive overview of the quality of various water sources found in Pima County. By identifying high-quality water sources as well as areas with potential water quality problems, it will be possible to prioritize regional water quality planning efforts. These plans could include additional monitoring, assigning appropriate uses for some water sources, improving the quality of some sources where necessary, and protecting the water quality of other sources. This report, along with a separate report summarizing existing regulations, plans and programs related to water quality management and protection, will provide a foundation on which the water quality element of the County plan can be developed.

Information and Data Sources

Much of the information in this report comes from previously published documents containing information about water quality in Pima County. In particular, this report relies heavily on the following: *Water Quality State of the Region Report* (PAG, 1994); *Tucson Active Management Area Third Management Plan* (ADWR, 1999); *The Status of Water Quality in Arizona - Clean Water Act Section 305b Report* (ADEQ, 2000); *Water Quality Assessment for the Tucson Active Management Area Northwest Replenishment Program Feasibility Study* (PAG, 1996), City of Tucson's *Municipal Stormwater Annual Report for Fiscal year 1998-1999* and *Pima County NPDES Stormwater Discharge Permit (No. AZS000002) Third Annual Report, September 2000.*

Scope and Limitations

This report is the first deliverable under PAG's contract with Pima County to provide assistance with developing the water quality element of the *Sonoran Desert Conservation and Comprehensive Land Use Plan*. The study area is all of Pima County, excluding Indian reservations. However, the emphasis is on eastern Pima County.

This report, in accordance with the PAG-Pima County contract, relied primarily on data that were readily available in existing literature. No original data were collected for this project, and PAG did not attempt to verify the accuracy of the data contained in the sources used. In addition, the time and budget available for this project did not permit an exhaustive search for all literature that might be available on water quality in Pima County. Additional data, including monitoring results more current than the data used for this report, are probably available. However, it is assumed that the data used for this report are adequate to provide a general, descriptive overview of water quality in the county. PAG only used data from previously published, peer-reviewed literature, or data provided by organizations with an extensive history of water quality monitoring and data reporting, for this project.

An important consideration when reviewing water quality data for different water sources is that different water sources are used for different purposes, regulated under different programs, and monitored for different reasons, for different constituents and at different frequencies. Also, the data in this report represent sampling and analyses that were completed by different people, agencies and organizations, and at different times, and PAG did not verify that consistent protocols and QA/QC standards were followed. For these reasons, the user of this report is cautioned against using it for a detailed, quantitative comparison of the different water sources, or for concluding that one water source is "better" or "worse" than another. A more appropriate use of this report is to review the information for the individual water sources, and use the information as the basis for discussions of: (1) adequacy of the quality of each source for its current or intended use; (2) potential suitable uses for each water source in the future; (3) data gaps and regional priorities for additional monitoring; and (4) regional priorities for water quality protection and/or improvements. In this way, the report should be a useful starting point for an update to existing countywide water quality plans.

Study Area Description

Pima County is large and diverse. It is 9,240 square miles in area and within its boundaries are some of the most pristine, unfrequented landscapes in the United States, as well as one of the nation's fastest growing metropolitan areas. It includes the second largest Indian reservation in the country, irrigated farmlands, open pit copper mines, military facilities, National Parks and Monuments, National Forests, National Wildlife Refuges, County-managed natural preserves, major corporate and university research facilities, world-class tourist resorts, urban districts, suburbs, and commercial areas.

Based on 2000 Census data, the population of Pima County is approximately 840,000; the population of Tucson, the largest incorporated city, is approximately 490,000. The towns of Marana and Oro Valley were the fastest and second-fastest growing towns in Arizona in the 1990s.

Natural Setting

Pima County is in the Basin and Range physiographic province, which is characterized by northwest-trending mountain ranges separated by alluvial basins. Land surface elevations in Pima County range from less than 2,000 feet above sea level on the basin floors to more than 9,000 feet above sea level in the mountains. Most of the Tucson metropolitan area lies within the Tucson basin, a gently sloping plain between 2,000 and 3,000 feet in elevation, which is ringed by eight mountain ranges. The highest of these are the Santa Rita, Santa Catalina and Rincon ranges, all of which reach elevations above 8,000 feet.

A large portion of eastern Pima County lies in two alluvial basins: Avra Valley in the west and the Tucson basin in the east. The basins are separated by the Tucson Mountains. Land use in Avra Valley consists mostly of open space and agriculture. Much of the Tucson basin is urbanized, but outside the Tucson metropolitan area, the predominant land uses are agriculture, mining, and open space.

The Santa Cruz River and its tributaries form eastern Pima County's regional drainage network. The Santa Cruz River is a tributary of the Gila River, which in turn flows into the Colorado River.

Climate

The climate is arid to semi-arid in the basins, with summertime temperatures often exceeding 100 degrees Fahrenheit. Precipitation in the Tucson basin averages 12 inches per year (NOAA, 1998). Most of the precipitation occurs in the form of intense, localized thunderstorms during the summer and gentle, regional rains during the winter. Natural vegetation in the basins is sparse, ranging from Lower Sonoran Desert shrubs and cacti to Upper Sonoran Desert grasslands. Lower temperatures and increased precipitation in the mountains support mid-elevation oak and juniper woodlands, and at the highest elevations, coniferous forests.

Principal Water Sources of Pima County

Five principal categories of water sources are present in Pima County:

- Groundwater pumped from wells;
- Naturally occurring perennial and intermittent surface waterbodies, such as streams, springs, and spring-fed ponds and pools;
- Stormwater runoff;
- Imported Central Arizona Project (CAP) water that consists primarily of Colorado River water; and
- Treated wastewater.

These water sources are closely linked in many ways. Therefore, in many aspects of planning, they should not be treated entirely separately. For example, springs and many perennial and intermittent streams are directly fed by groundwater. Wastewater is also primarily derived from groundwater that is used for domestic, commercial and industrial purposes. Therefore, the quality of wastewater and many surface waters can be influenced by the quality of local groundwater. Also, stormwater, CAP water, and wastewater recharge groundwater in many locations of the County, either naturally or artificially. The quality of these sources can therefore affect the quality of local groundwater.

Each of these water source categories is described briefly below. A detailed report on water resources is being prepared by the Water Resources Research Center.

Groundwater

Historically, groundwater has been the most widely used water resource in Pima County. Throughout most of the County, groundwater is drawn from wells that tap deep aquifers found in the alluvial basins. These aquifers consist of unconsolidated to semi-consolidated silts, sands, gravels, and clays derived from the mountain ranges surrounding the basins. Elsewhere, groundwater is drawn from shallow wells tapping comparatively localized sources, such as fractured bedrock, flood plain aquifers, or perched aquifers.

Most of the groundwater development has occurred in eastern Pima County, in the Upper Santa Cruz Basin and Avra Valley. Groundwater in these areas is used for public drinking water supply, landscape and crop irrigation, and industry. Pumpage of groundwater for these uses totals more than 300,000 acre-feet per year in the Tucson Active Management Area, which includes most of eastern Pima County and part of Pinal County (ADWR, 1999). This greatly exceeds the volume of groundwater recharge, resulting in water-table declines of over 200 feet (Tucson Water, 1998). Depths to groundwater in eastern Pima County currently range from less than 50 feet to greater than 700 feet below land surface (Tucson Water, 2000a). In general, water level declines can lead to lower well productivity, increased pumping costs, declining water quality, and land subsidence (Water Resources Research Center, 1999). For these and

other reasons, there is widespread interest in developing and using other water sources instead of relying entirely on groundwater pumpage.

Surface Waterbodies

According to the Arizona Department of Water Resources, in its Third Management Plan for the Tucson Active Management Area (TAMA), the main surface water drainage in the TAMA is the Santa Cruz River. The river, which is about 60 miles long within the AMA, flows north through the Upper Santa Cruz Valley Subbasin and then northwest into the Avra Valley subbasin. The nine mile reach of the Santa Cruz that flows north of the two regional wastewater treatment plants in Tucson is perennial due to treated effluent discharged into the channel at Roger Road and Ina Road. The remainder of the Santa Cruz within the TAMA is ephemeral (ADWR, 1999).

Major tributaries of the Santa Cruz River in the Upper Santa Cruz Valley Subbasin include the Canada del Oro, which drains the northern part of the Upper Santa Cruz Valley Subbasin, and Rillito Creek and its tributaries, which drain the area north and east of Tucson. Tributaries to Rillito Creek include the Pantano Wash and Tanque Verde Creek, which in turn receive flow from Sabino Creek, Rincon Creek, and Cienega Creek. In the Avra Valley Subbasin, Altar Wash originates in the southern portion and flows north to become Brawley Wash. Brawley Wash flows to the north and northwest through Avra Valley to its confluence with the Santa Cruz River southwest of Red Rock.

The San Pedro River is a tributary of the Gila River and drains 4485 square miles of Arizona and Mexico. The San Pedro River enters Pima County in the northeastern corner, in what is considered the Lower San Pedro Basin. The river is fed by flow from the northeast side of the Santa Catalina Mountains and by two significant drainages from the Galiuro Mountains. Most of the stream reaches on the San Pedro are intermittent but in the area around Bingham Cienega there is both perennial and intermittent flow (Royayne, M.J. and T. Maddock III,1996).

The vast majority of the watercourses in Pima County are ephemeral, and do not represent a significant water source, except for stormwater runoff. In contrast, the number of perennial and intermittent watercourses is relatively small, but the surface water in these waterbodies is very important habitat for aquatic species.

Prior to the initiation of research for the Sonoran Desert Conservation Plan (SDCP), a comprehensive assessment of perennial and intermittent streams in Pima County was not available. In January 2000, however, a county-wide assessment of these watercourses was completed, and a GIS coverage showing the locations of perennial and intermittent streams was created for the SDCP. Fifty-five perennial stream reaches and eighty-two intermittent stream reaches from a total of seventy-four different streams were identified (PAG, 2000a).

The identified perennial and intermittent streams of Pima County are in a variety of locations and environments, and most are located in eastern Pima County. This is likely due to the presence of higher land elevations and greater precipitation. Thirty-eight streams that had perennial or intermittent reaches had flows that originated in the Coronado National Forest or Saguaro National Park in the Santa Catalina, Rincon or Santa Rita Mountains (PAG, 2000a).

The identified natural perennial and intermittent streams flowing in eastern Pima County are shown on the following tables. Some of the streams are listed on both tables because they contain both perennial and intermittent reaches.

Table 1. Perennial Streams in Pima County (PAG, 2000a).

Apache Spring	Montosa Creek
Arivaca Creek *	Nogales Spring
Bingham Cienega	Posta Quemada
Buehman Canyon (three reaches) *	Quitobaquito (Pond and Spring)
Bullock Canyon	Romero Canyon
Canada Del Oro	Ruelas Canyon
Cienega Creek (nine reaches) *	Sabino Creek (3 reaches) *
Cinco Canyon	San Pedro River (2 reaches) *
Davidson Canyon	Santa Cruz River (effluent dependent) *
Edgar Canyon *	Scholefield Spring
Empire Gulch (two reaches)	Simpson Spring
Espiritu Canyon	Tanque Verde
Honey Bee Canyon	Wakefield Canyon (4 reaches)
Lemmon Creek	Wild Burro Canyon (5 reaches)
Little Nogales Spring	Wild Cow Spring
Mattie Canyon	Youtcy Canyon (2 reaches)

*- Indicates water quality data are available on these streams and are included in this report.

Table 2. Intermittent Streams in Pima County (PAG, 2000a)

Agua Verde Creek	Madera Canyon *
Alder Canyon	Madrona Canyon
Arivaca Creek*	Mattie Canyon
Ash Creek	Miller Creek
Atchley Canyon	Molino Canyon
Barrel Canyon	Mud Spring Canyon
Bear Canyon (2 reaches)	Paige Creek (2 reaches)
Bear Creek	Palisade Canyon Creek (2 reaches)
Bootlegger Spring	Peck Basin
Box Canyon	Pima Canyon
Brown Canyon	Rincon Creek
Buehman Canyon (2 reaches)*	Romero Canyon (2 reaches)
Bullock Canyon (3 reaches)	Rose Canyon Creek
Canada Agua	Sabino Canyon
Canada del Oro	San Pedro River (3 reaches)
Cargodera Canyon	Santa Cruz River
Chiminea Creek	Smitty Spring
Chimney Canyon	Soldier Creek
Cienega Creek (8 reaches)*	Sutherland Wash
Davidson Canyon (3 reaches)	Sycamore Canyon
Deer Creek	Tanque Verde Creek (5 reaches)
Distillery Canyon	Thomas Canyon
East Fork Sabino Canyon	Unnamed tributary to Ash Creek
Espiritu Canyon	Unnamed Spring
Finger Rock Canyon	Unnamed Tributary to Ash Creek
Florida Canyon	Ventana Canyon (3 reaches)
Gardner Canyon	Wakefield Canyon
Geesaman Wash	West Fork Sabino Creek
La Milagrosa Canyon	Youtcy Canyon (2 reaches)

*- Indicates water quality data are available on these streams and are included in this report.

Many of the streams in Pima County are located, totally or partially, in areas protected by the National Park Service, National Forest Service or Pima County Parks and Recreation. However, a number of important stream reaches are outside protected areas. These include Davidson Canyon south of Interstate 10, the San Pedro River, portions of Arivaca Creek, several streams draining the northeast side of the Santa Catalina Mountains, Agua Verde Creek, Wakefield Canyon, Rincon Creek, Tanque Verde Creek, and others.

One of the perennial streams, Cienega Creek, is an important water, recreation and wildlife resource located southeast of Tucson in the Santa Cruz watershed. It is one of the few low-elevation streams in Pima County that exhibits significant perennial flow. The section of Cienega Creek that flows from Interstate 10 to the Del Lago dam has been designated by the Arizona Department of Environmental Quality (ADEQ) as a "Unique Water", which means it has been classified as an "outstanding state resource water". Buehman Canyon, another perennial stream in Pima County has also been designated a "Unique Water" by the State.

Stormwater Runoff

Because stormwater runoff is typically short-term and occurs in response to precipitation events, the direct use of this surface water has been limited. However, surface water flow is an important source of recharge to the aquifer in the Tucson AMA. Groundwater conditions can be greatly affected by occasionally large surface water flows in the Santa Cruz River and its tributaries. Surface water flows recharge the groundwater system in the vicinity of the stream as water infiltrates through the stream channel sediments to the underlying aquifer. Stream channel recharge in the Upper Santa Cruz Valley Subbasin is estimated at 30,960 acre-feet per year and in the Avra Valley Subbasin at around 6695 acre-feet per year (ADWR, 1999).

Stormwater runoff in major urbanized areas is regulated by the USEPA, and these urban areas are required to obtain stormwater permits. The intent of the permit program is to improve the quality of the stormwater runoff and its subsequent impact, if any, on surface water. Regulated municipalities must develop a plan with mechanisms designed to locate and eliminate discharge into storm sewers from sources other than stormwater. They must also have a mechanism for erosion and sediment control for preventing and reducing other pollutants associated with construction activity. In addition, they must also inspect industrial facilities to ensure that measures are in place to prevent stormwater contamination. Finally, they must have an operation and maintenance program to prevent or reduce pollutant runoff from all municipal operations. (City of Tucson, 1999). Stormwater NPDES permits have been issued to Pima County and the City of Tucson. Both entities conduct stormwater monitoring and implement programs to reduce pollutant runoff.

Although the use of stormwater is currently very limited, it is an important resource that should be considered in water-related planning efforts. Stormwater runoff supports riparian vegetation along washes, and it can create aquatic habitats at retention basins. In addition, stormwater has been considered as a potential source water for artificial groundwater recharge projects in Pima County. In particular, Rillito Creek has been proposed as a site for artificial recharge of stormwater (Pima County Department of Transportation and Flood Control District, 1986). However, CH2M Hill (1988) and others reported in a recharge feasibility assessment for the Tucson area that the potential for artificial recharge using stormwater is limited to 17,000 acre-feet annually.

CAP Water

To address groundwater depletion throughout the state, the Central Arizona Project (CAP) aqueduct was constructed. The CAP aqueduct is 326 miles long and transports water from the Colorado River to southern Arizona. Tucson Water has the largest allocation of CAP water in the area with approximately 139,000 acre-feet per year. Other jurisdictions, water companies, and public and private entities also have CAP water allocations. These include: Metropolitan Domestic Water Improvement District, Spanish Trail Water Company, Community Water Company of Green Valley, Green Valley Water Company, the Town of Oro Valley and others (ADWR, 1999).

Tucson Water began direct delivery of CAP water in November of 1992 but ended it in October of 1994 due to persistent problems of corrosion in the public and private water lines. In April of 1996 Tucson Water began a recharge and recovery pilot project in Avra Valley called the Central Avra Valley Storage and Recovery Project (CAVSARP). Recharge operations began in the summer of 1996. In June of 1999 Tucson Water began delivering recovered water to the first of four neighborhoods in its service area as a demonstration that the recovered water would be acceptable to area residences and that it would not cause the same corrosion problems as before. (PAG, 1999a). The demonstration projects were successful and Tucson Water began system-wide delivery of the blended groundwater/CAP recharge water in May of 2001.

Permits from the Arizona Department of Water Resources (ADWR) are required whenever water is intentionally added to an aquifer. As of 1998 there were three Underground Storage Facilities (USF) for CAP water in the TAMA. They include: CAVSARP, Pima Mine Road Recharge Project (PMRRP) and Avra Valley Airport. (ADWR, 1999).

Clearwater is a water supply project in Avra Valley designed to recharge Colorado River water to blend with native groundwater in the aquifer. The blend is then piped to the greater Tucson area and distributed to Tucson Water's customers. CAVSARP is the primary structural element of the larger Clearwater Project. The CAVSARP project provides the means to take water from the CAP canal, recharge the water in basins in Avra Valley, and then recover and pump the water as far as the Hayden-Udall Water Treatment Plant. The Clearwater Project also includes blending of the recovered water with waters from other wellfields, delivery of the blended water to water customers, and ultimately the shut-down of many wells in the central wellfield (Tucson Water, 2000b).

The PMRRP is a constructed facility located approximately 15 miles south of Tucson. The pilot testing was conducted from March 1997- March 1999. A full-scale underground storage facility permit was issued in September of 2000. As of December 31, 2000, the total net recharge volume for the project was 25,185.29 acre feet. (CAWCD, 2001).

The Avra Valley Airport USF-CAP consists of four off-channel constructed shallow spreading basins which have a combined area of about 11.4 acres (PAG, 1999a). The facility is located northeast of the airport. The permit for the pilot project allowed for 8,300 acre-feet maximum volume and the full-scale facility permit allows for 11,000 acre-feet annually (ADWR, 1999).

Additional uses for CAP water include agriculture and industry. Many potential agricultural users in the Tucson AMA declined their CAP water allocations mainly due to the high cost of the water and infrastructure. In 1997 agriculture use of CAP was approximately 25,000 acre feet. Industrial uses of CAP water are limited due to costs and water quality concerns. The mines are the largest volume industrial water users in the TAMA. The lack of delivery infrastructure, costs associated with CAP water quality as it affects operations, and the cost of the water may preclude direct CAP use. (ADWR, 1999).

Treated Wastewater

For purposes of this report, treated wastewater is defined as water that has been used for domestic, commercial or industrial purposes, conveyed via sewer lines to either the Ina Road or Roger Road wastewater treatment facility, and either reused directly, discharged to the Santa Cruz River, or used in the City's reclaimed water system. Additional wastewater treatment facilities are located throughout Pima County, but effluent from these plants is not addressed in this report. The capacities of the Ina Road and Roger treatment facilities are 25 mgd and 41 mgd, respectively (PAG, 1999a). These two plants treated approximately 68,664 acre-feet of wastewater during fiscal year, 1999-2000 (PCWMD, 2001). The discharges support an effluent dependent stream flow and a diverse riparian habitat, subject to flood events, along a river channel that would otherwise be ephemeral. Pima County also supplies approximately 500 acre-feet per year of treated effluent to the Arthur Pack Golf Course for irrigation.

The reclaimed water treatment process begins at Pima County's Roger Road Treatment Facility. The County treats the wastewater to standards required by state and federal agencies. This treated wastewater is piped into Tucson Water's filtration plant. After it is delivered to the plant, the water is filtered through pressure filters containing anthracite coal and sand, disinfected and tested to ensure quality control. The treated reclaimed water is gravity-fed to a 3-million-gallon reservoir on-site, ready for distribution to customers (Malcolm Pirnie, 1999). The delivery system includes more than 85 miles of separate piping and five separate reservoirs with a combined storage capacity of 15 million gallons.

According to Tucson Water (2001a), in 1999 more than 3 billion gallons of reclaimed water were delivered to customers. Currently, over eight percent of Tucson Water's total demand for water is met with reclaimed water. There are over 250 reclaimed water customers including 14 golf courses, 34 schools and 30 parks. It is anticipated that in the future 15 percent of total water demand will be met by the use of reclaimed water.

Some of the water treated at the Roger Road Facility is piped to Tucson Water's recharge basins where it is naturally filtered through the earth and stored underground for future use. The filtered water is recovered through wells and piped to the chlorine contact chamber where it is chlorinated and mixed with the filtered water produced at the plant (Tucson Water, 2001a).

Tucson Water operates the Sweetwater Wetlands on the east side of the Santa Cruz River. The constructed wetlands occupy 17 acres and consist of two settling ponds and two polishing ponds. The backwash water from the filtration plant is piped to the Sweetwater Wetlands where it is naturally treated before it is released into the recharge basin (Tucson Water, 2001; PAG, 1999a).

Water Quality in Pima County

Groundwater Quality

Natural factors and human activities affect groundwater quality. Natural factors that have the most effect in the basins of south-central Arizona are depth in the aquifer and distance from major faults. Groundwater temperatures and pH significantly increase with well depth. In a United States Geological Survey (USGS) study, concentrations of dissolved solids, alkalinity, calcium, potassium, chloride and sulfate were significantly higher in samples collected from wells less than 2 kilometers from major fault lines. Groundwater quality was not significantly different among the various basin-fill units; between parts of the basin fill that differ in thickness, lateral extent and composition north to south of an inferred fault; or among areas that differ in distance from stream alluvium (USGS, 1999).

Most existing groundwater quality data for Pima County is representative of eastern Pima County, because more groundwater development has occurred there. Monitoring data in this area are abundant, due to a variety of regulatory requirements. In general, groundwater in the Tucson AMA is of acceptable quality for most uses. Most of the groundwater resources meet federal and state drinking water standards, though contaminant levels exceed primary safe drinking water standards in a few areas. Groundwater withdrawals from wells within these identified areas have been discontinued or are in the process of remediation. Other areas of known contamination not currently under remediation are monitored to ensure that contaminants do not spread (ADWR, 1999).

Groundwater is the main drinking water source for Pima County. For this report general water quality data from various drinking water providers in the County were reviewed. Drinking water providers are required to sample the water that is delivered to their customers and report those constituents that were detected during the required monitoring. A detected result means a concentration that is above the minimum value that can be measured by a laboratory. In most cases, the minimum detectable level of a constituent is well below the USEPA's regulatory limit for that constituent (Tucson Water, 2000). A review of water quality data from Pima County drinking water providers for the 1998-2000 sampling years indicated the most common regulated constituents detected were nitrate, fluoride, arsenic, and chromium. Though these constituents were detected in the drinking water supplies none were seen at levels that exceeded the established drinking water maximum contaminant levels (MCLs).

Concentrations of selected constituents in Tucson-area groundwater are shown on Table 3. The data are from Tucson Water's wellfields, which encompass large areas of the Tucson basin and Avra Valley in eastern Pima County.

Table 3. Concentrations of Selected Constituents In Tucson-Area Groundwater (PAG, 1994b)

Constituent (mg/l)	Tucson Water Production Wells[1]
TDS (range)	259 (107-752)
Hardness as $CaCO_3$ (range)	119 (24-378)
Sodium	39.6
Chloride	17.4
Calcium	39.2
Magnesium	4.99
Sulfate	45.1
Alkalinity	126

[1]Average drinking water quality for Tucson Water production wells, 1991 data supplied by Tucson Water and reported by PAG (1994b).

Land uses that have reportedly led to historic groundwater contamination in eastern Pima County include: landfills and disturbed areas, abandoned wells (wells no longer in service that have not been capped), irrigated agriculture, animal impoundments, underground storage tanks, surface impoundments, wastewater treatment facilities, mines, and industry and commerce (PAG, 1994). Common groundwater contaminants in the Tucson area groundwater include volatile organic compounds (VOC), nitrates, petroleum hydrocarbons, and heavy metals.

There are ten known areas of contamination in eastern Pima County. They include: Broadway-Pantano WQARF Site, Davis Monthan Air Force Base, Downtown Tucson, El Camino Del Cerro WQARF Site, Tucson Airport Area Remediation Project (TARP), Air Force Plant 44, Los Reales WQARF Site, Price Service Center, Silverbell Jail Annex Landfill/Miracle Mile WQARF Site and Shannon Road-Rillito Creek WQARF Site. The groundwater is usually considered contaminated if the most recent well sample data available indicated an MCL exceedance (PAG, 1994).

Broadway-Pantano WQARF Site

The Broadway landfill was closed in 1971 and since that time a groundwater plume has developed beneath the site, extending toward the northwest. Four public drinking water wells have been removed from service due to the PCE contamination at this site. Contaminant levels near the edge of the plume are 5ppb. The highest concentration measured was 100 ppb directly adjacent to the landfill. An activated carbon adsorption system has been selected to treat the contaminated groundwater. Treatment will focus on pumping the aquifer and re-injecting the water to achieve hydraulic containment (PAG, 2000b).

Davis Monthan Air Force Base

In 1985 groundwater contaminated with jet fuel was found on the base in the area of the air strip called the J-3 pump house. A soil vapor extraction system was used to remove jet fuel from the soil and reduce the groundwater contamination. This system has been in operation since the early 1990's and the contamination remains localized on the air force base. (PAG, 1994).

Downtown Tucson

Groundwater in the vicinity of downtown Tucson contains petroleum products and VOCs at various locations. Diesel fuel is the most widespread contaminant. Chlorinated VOCs such as TCE and PCE are present in more localized areas, including the Mission Linen site, where PCE concentrations have been reported at levels as high as 11,000 µg/l (ADWR, 1999). The 7th Street and Arizona Avenue and Park-Euclid WQARF sites are located within the downtown Tucson area (ADEQ web site, 2001).

El Camino del Cerro WQARF Site

The El Camino del Cerro WQARF site is located in northwest Tucson. The primary contaminants of concern include PCE, TCE, vinyl chloride, and benzene (ADEQ web site, 2001). Nitrate contamination is also present (PAG, 1994). Pima County is operating a landfill gas extraction system at the closed El Camino del Cerro landfill. VOCs have been removed at a rate of 30 to 40 pounds per week (PAG, 2000b).

Tucson Airport Area Remediation Project (TARP)

This is a federal Superfund site. Groundwater in the area is contaminated with TCE, and a pump and treat remediation system has been in operation since 1994. Contaminants are being removed using three air stripping towers. The design rate was 5,800 gpm and the average expected TCE concentration was approximately 15-35 µg/l. By the end of 1999 the system had treated approximately 13.4 billion gallons of water and had removed 1,400 pounds of TCE. This plant supplies almost 9% of Tucson's total drinking water supply (PAG, 2000b).

Air Force Plant 44

This location is part of the Tucson Area Superfund Site plume, south of Los Reales Road in the Tucson metropolitan area. The groundwater contamination plume beneath the site contains chromium and TCE. Remediation at this site began in 1987 and uses air strippers with carbon adsorption and a re-injection system (PAG, 1994).

Los Reales WQARF Site

Groundwater downstream of the Los Reales Landfill is contaminated with TCE and PCE in a plume that measured approximately ½ mile wide by ½ mile long. No public water supply wells have been impacted by this contamination, which is trapped in the upper aquifer. An air stripper remediation system was installed to contain the groundwater plumes. The average concentration of TCE in the groundwater entering the treatment system is approximately 7 ppb (PAG, 1994, 2000b).

Price Service Center

Petroleum contaminated groundwater is present in the area of the City of Tucson's Price Service Center. This contamination resulted from leaks and damage to several underground storage tanks. The shallow groundwater has had benzene detected at concentrations as high as 30,000 ppb. No public water wells have been impacted by this contamination (PAG, 1994).

Silverbell Jail Annex/Miracle Mile WQARF Site

TCE and PCE have been found at concentrations of 13.5 ppb and 154 ppb respectively. In addition, the inorganic groundwater quality of the area is naturally poor with high TDS, sulfate, and chloride concentrations. High nitrate concentrations have also been present since the 1950's. This contamination has impacted two public-supply wells serving mobile home parks in the area. (PAG, 1994). A pilot remediation project using a re-circulation well system at Silverbell Landfill has been in use for several years (PAG, 2000b).

Shannon Road-Rillito Creek WQARF Site

PCE was detected in the groundwater at this site in 1993. Metro Water installed a well head treatment system on the South Shannon well. Two public supply wells have been impacted. One owned by the City of Tucson has been shut down and the other, owned by a mobile home park, has been equipped with a carbon treatment system since July 1997 (PAG, 2000b).

Other Sites

In addition to the above listed sites, there are a number of former landfill sites and underground storage tank sites that may have impacted the local groundwater. Also, an area encompassing 42 square miles in the south Santa Cruz area, which extends from two miles south of the Tucson City limit to just north of Green Valley, contains seven public supply wells that have exceeded the MCL for nitrate. Historical data indicate the high nitrate concentrations in this area developed between the late 1940's and the mid-1960's. The nitrate contamination in this area

appears to be a result of a combination of irrigated agriculture, sewage effluent, septic tanks and animal feed lots (PAG, 1992).

Surface Waterbodies Water Quality

Stream water quality in the higher elevations of Pima County is primarily determined by natural factors. Processes such as chemical weathering of bedrock and soils, biological activity in soils, groundwater discharge to streams, and runoff determine the water quality of these streams. Locally, stream water quality may be affected by agriculture, mining and urban land use. Nutrient and dissolved-solids concentrations fluctuate seasonally in these streams. The patterns of rainfall and snowmelt account for the seasonal fluctuations in concentrations of nutrients. Concentrations increase in streams during times of rainfall and snowmelt runoff because the runoff carries nutrients washed off the land surface into the streams. Seasonal patterns of dissolved solids are opposite to those of nutrients. During periods of runoff, flow in streams is diluted and the dissolved-solids concentrations are lower. Streams affected by human activities may have elevated concentrations of dissolved solids from a variety of activities including urban and agricultural runoff. Man made compounds such as pesticides and volatile organic compounds (VOC) in streams are a direct result of human activities (USGS, 2000).

ADEQ Monitoring

Arizona Department of Environmental Quality (ADEQ) assessed 281 miles of streams and six lakes in the Santa Cruz-Rio Magdalena-Rio Sonoyta Watershed, which includes Santa Cruz County and a large portion of eastern Pima County. This watershed is 11,096 square miles and makes up about 10% of the state's land. The watershed is a composite of two surface water basins: the Santa Cruz which flows north to the Gila River, and the Rio Magdalena and Rio Sonoyta drainages which flow south into Mexico. In its report, *The Status of Water Quality in Arizona, Clean Water Act Section 305(b) Report 2000*, ADEQ tabulated the results of the stream assessments. The data for streams and lakes in Pima County are included in Appendix A.

Three lakes, Arivaca Lake, Kennedy Lake and Lakeside Lake, in Pima County were assessed by ADEQ. Though none were found to be in full support of their designated uses, ADEQ recognized that smaller lakes were more likely to be in the partial support or non-support category. Through its monitored assessment ADEQ found Arivaca Lake to be non-supporting of its designated use due to high pH, low dissolved oxygen and mercury.

ADEQ performs two types of assessments: "monitored" and "evaluated." Monitored assessments are based on current data that are less than five years old and normally there are at least four monitoring events within a year. Evaluated assessments are based on less data and information. Assessment reliability generally increases with increased quantity and diversity of data.

The following area streams were monitored or evaluated by ADEQ and determined to be in full support of their designated uses: Arivaca Creek (headwaters to Altar Wash), Canada del Oro

(headwaters to Big Wash), Cienega Creek (headwaters to Del Lago dam), Sabino Canyon Creek (headwaters to the Tanque Verde Creek), Tanque Verde Creek, and Madera Canyon Creek (headwaters to the Santa Cruz River). Only the Santa Cruz River (Canada del Oro to Guild Wash) was found to be non-supporting due to some of the samples indicating low dissolved oxygen, but this reach is in full support with regard to turbidity.

The State is required to develop water quality improvement plans for any streams and lakes that have been identified as impaired. The TMDL Program (Total Maximum Daily Load) is a separate but closely related effort to the Water Quality Assessment Program. The purpose of the program is to identify the sources and quantities of pollutants being delivered to a waterbody and to identify the maximum quantities of the pollutant that the waterbody can assimilate and still meet water quality standards. The goal is to develop a plan which identifies how all the various contributors of pollutants can work together to reduce pollutant loading and help get the water body back into compliance with the water quality standard. Waterbodies that are scheduled for development of TMDLs are identified on the state's "water quality limited waters" list, which is commonly referred to as the "303(d) list"(ADEQ, 2000).

Only one water in Pima County was on the state's 1998 303(d) list. Arivaca Lake was listed with mercury as the primary stressor, along with a fish consumption advisory. Arivaca Creek was de-listed in 1998 for dissolved oxygen, which was determined to be a natural condition.

ADEQ has additional water quality monitoring data for area streams. The following table includes selected data from ADEQ's surface water quality database.

Table 4. Selected Stream Water Quality Data, 1989-2000, From ADEQ Database

Site	Ca Total (mg/l)	Mg Total (mg/l)	Na Total (mg/l)	K Total (mg/l)	Bicarbonate Total (mg/l)	SO4 Total (mg/l)	Cl Total (mg/l)	F Total (mg/l)	Arsenic Total (mg/l)	TDS (mg/l)
Arivaca Creek at Ruby Rd 3/23/93	70.7	9.9	16.2	1.88	265	ND	9.8	0.23	ND	287
Madera at Whitehouse, 12/19/90	71.3	12.6	17.7	1.1	141	100	6.9	0.36	<.005	320
Tanque Verde Creek 8/1/89	11.2	1.8	6.6	2.1	32	13	3.7	0.12	<.005	90
Sabino Creek 5/13/91	11.0	1.8	2.3	0.5	31*	5.55*	2.1	0.13	<.005	60
San Pedro River 8/31/91	57.4	12.9	46.0	4.4	183	87	15	0.82	<0.005	340
Buehman Canyon 5/18/00	71	8.2	20	2.5	260	21	8	0.68	ND	295

Notes: Sabino Creek below Summerhaven; Buehman Canyon 2 miles below confluence with Bullock Canyon; Tanque Verde at Sabino Canyon Road and San Pedro at Redington. ND= not detected, *- average of two sample results, mg/l= milligrams per liter.

Sonoran Desert Conservation Plan Studies

In addition to ADEQ's monitoring, several waterbodies that are potentially very important aquatic habitat in Pima County have been sampled for studies conducted by PAG and Pima County Flood Control District as part of the Sonoran Desert Conservation Plan. These include Cienega Creek, Bingham Cienega, and the San Pedro River.

A portion of Cienega Creek has been designated by the state as a "unique water" which means it qualifies for site-specific water quality standards established to maintain and protect the existing water quality. The water quality of Cienega Creek was described in the Unique Waters Final Nomination Report submitted to the state. This report concluded that the water quality of base flows in the reach nominated for Unique Water status met standards designed for designated uses, including aquatic and wildlife (warm-water). The lowermost reaches of Cienega Creek were sampled more recently (in the late 1990s) as part of a two-year study by PAG and Pima County Flood Control District to determine the source of the water. The results are summarized on Table 5.

Bingham Cienega is a rare, perennial wetland located approximately 2000 feet west of the lower San Pedro River, and ¼ mile north of the settlement of Redington. PAG and the Pima County Flood Control District sampled Bingham Cienega, the San Pedro River, and Edgar Canyon (a tributary to the San Pedro) in the late 1990s, in order to identify the water source of the cienega. The results are summarized on Table 5.

Table 5. Average Values, Water Quality Data for Selected Streams in Pima County September 1998-June 2000. From PAG studies: *Lower Cienega Basin Source Water Study, October 2000* and *Bingham Cienega Source Water Study, February 2001.*

Site	Ca dissolved (mg/l)	Mg dissolved (mg/l)	Na dissolved (mg/l)	K dissolved (mg/l)	Alkalinity CaCO3 (mg/l)	SO4 dissolved (mg/l)	Cl dissolved (mg/l)	F dissolved (mg/l)	Arsenic dissolved (mg/l)	TDS (mg/l)
Cienega Creek	109	32	61	5.9	252	257	14	0.57	0.0006	737
Bingham Cienega	64	12	40	1.7	219	55.8	11	1.14	.0043	280
San Pedro River	64	16	55	2	222	90.2	18	0.92	0.0022	344
Edgar Canyon	64	15	24	1.1	238	18.6	6.9	0.39	0	287

Notes: 0 = constituent was not detected at the Practical Quantitation Limit (PQL).
mg/l= milligrams per liter

Aside from the monitoring conducted by ADEQ and the studies noted above, PAG is unaware of any extensive water quality monitoring of the 74 streams in Pima County with one or more reaches of perennial and/or intermittent flow. Although it is likely that additional studies and monitoring data are available for some streams, it appears that the vast majority of the aquatic habitats in Pima County have not been adequately monitored for water quality.

Stormwater Runoff Water Quality

For the purpose of this report PAG reviewed historical stormwater quality data from the 1996 *Water Quality Assessment for the Tucson Active Management Area Northwest Replenishment Program Feasibility Study*, and NPDES stormwater monitoring reports submitted by the City of Tucson and Pima County to the EPA.

Historical Data

The Lower Santa Cruz River

For the Lower Santa Cruz River, PAG (1991) reported water quality data for a sample collected by ADEQ on October 6, 1989, from the Santa Cruz River and Congress Street Bridge. Concentrations of the major constituents are shown on the following table.

Table 6. Stormwater Quality Data for the Santa Cruz River at Congress Street Bridge Collected by ADEQ October 6, 1989.

Parameter	Concentration (mg/l) milligrams per liter
Calcium	17.6
Magnesium	2.32
Sodium	9.1
Potassium	9.3
Bicarbonate	75
Chloride	1.1
Sulfate	10
NO2+NO3	0.61
TDS (total dissolved solids)	90
TSS (total suspended solids)	10,600

In addition Harding Lawson Associates (1987) reported water quality data from a Santa Cruz River sample collected upstream of the Roger Road treatment plant in 1985. The results were as follows: Bicarbonate 104 mg/l, TDS 230 mg/l, and TSS 11,724 mg/l. No other data for this sample were reported.

The Rillito Creek Basin

Water Quality data (PAG, 1996) for the Rillito Creek basin included concentrations of major ions, nutrients, trace metals, suspended sediments and organics reported by the USGS for the years 1986-1993. Slightly less than two thirds of the samples were collected automatically. Automatic samplers were programmed to activate when the flow stage exceeded a threshold value of 0.2 feet in 2 minutes. A sample was collected every 5 minutes during a rising stage, and every 10 minutes during a falling stage. The samples were composited. Samples were not collected on a regular basis (e.g. once a month), or at a consistent time of day, presumably because the frequency of runoff events in the Tucson area is highly irregular. However, the data represented nearly equal numbers of winter and summer storms. (PAG, 1996). The data are shown on Tables 7 and 8.

Table 7. 1986-1993 Stormwater Quality Data for Tanque Verde Creek at Sabino Canyon Road (USGS, 1995a; USGS, 1994)

Constituent	Average (mg/l)*	Minimum (mg/l)	Maximum (mg/l)
Calcium	10.4	4.3	25
Magnesium	1.6	0.98	4.6
Sodium	6.0	4.1	10
Potassium	2.2	0.7	6.5
Aluminum (total)	117	0.47	410
Bicarbonate	34	14	68
Chloride	4.0	2.1	7.2
Sulfate	9.9	4.5	16
Nitrate	0.3	0.07	0.81
TDS	93	41	205
TOC	84	8.8	240
TSS	2891	22	10300

*mg/l= milligrams per liter.

Table 8. 1986-1993 Stormwater Quality Data for Rillito Creek at Dodge Boulevard (USGS, 1995a;USGS 1994)

Constituent	Average (mg/l)*	Minimum (mg/l)	Maximum (mg/l)
Calcium	15	8.2	46
Magnesium	1.9	0.8	5.9
Sodium	6.6	1.9	15
Potassium	2.5	0.8	5.1
Aluminum (total)	195	44	550
Bicarbonate	53	28	121
Chloride	3.8	1.5	12
Sulfate	13	4.6	52
Nitrate	0.5	0.18	1.3
TDS	100	19	243
TOC	117	19	210
TSS	12089	21	36700

*mg/l= milligrams per liter

Brown and Caldwell (1984) and CH2M Hill (1988) have reported that stormwater runoff can contain elevated levels of trace metals. Some of the undissolved metals in the stormwater samples (particularly aluminum, which is abundant in clays) may be naturally occurring in sediments that are eroded during storm events. These sediments are carried downstream in suspension, and metals contained in (or sorbed onto) these sediments are included in the analysis of total metals (PAG, 1996).

Municipal NPDES Monitoring Data

The City of Tucson's Municipal Stormwater Permit stipulates that the City will implement the stormwater monitoring program as described in the City's October 1996 permit application. EPA amended the monitoring program slightly by adding the chemical DDE to the list of pollutants for which sampling and analysis was to be conducted. The purpose of the monitoring program was to develop a substantial local database of land-use-specific stormwater quality data, and to develop a focused management program (City of Tucson, 1999).

Analysis of 15 constituents is required under the monitoring program approved for the City's NPDES Municipal Stormwater permit (permit # AZS000001) and includes the following constituents: Arsenic (As), copper (Cu), lead (Pb), zinc (Zn), biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrogen as nitrite, nitrogen as nitrate, total dissolved solids (TDS), total suspended solids (TSS), total kjeldahl nitrogen (TKN), DDE, oil and grease, total phenols and total phosphorous. Under the approved monitoring program each sampling site was automated in 1999 to allow better response to storm events with the goal of sampling each site once during the winter rainy season and once during the summer rainy season. Because the automated units were not yet operating according to EPA protocol manual, samples were manually collected for the 1998-99 reporting period (City of Tucson, 1999).

Stormwater was monitored at five locations representing different land uses typical to Tucson. They include: single family residential site, multi-family residential site, commercial site, industrial site and a mixed-use site. Table 9 summarizes the analyses results for the events sampled during the 1998-99 fiscal year.

Table 9. Fiscal Year 1998-99 Monitoring Results. Municipal Stormwater Annual Report City of Tucson.

DATE	7/22/98	7/31/98	4/01/99	8/05/98	9/16/98	10/21/98	MAX	MIN
Facility	Mfr	Sfr	Sfr	Mxu	Ind	Com		
Rainfall (in)	0.55	0.50	1.20	0.15	0.10	0.10	1.20	0.10
Duration (hours)	3 hours	2 hours 20 min	16 hours	3 hours	2 hours	1 hour 20 min.	16 hour	1 hour 20 min
Last Rain (days)	4	9	115	3	12	47	115	3
Temperature	25.9	27.1	N/T	N/T	27.5	18.2	27.5	18.2
pH	7.1	7.4	7.2	6.7	6.7	6.5	7.4	6.5
Total Flow (gal)	151,814	92,111	356,823	269,451	148,672	21,790	356,823	21,790
As (mg/l)	<0.005	<0.005	<0.003	<0.005	0.006	<0.005	0.006	ND
Cu (mg/l)	<0.015	0.026	0.056	<0.016	0.063	<0.005	0.063	ND
Pb (mg/l)	<0.005	0.026	0.036	0.043	0.022	0.010	0.043	ND
Zn (mg/l)	0.07	0.16	0.32	0.44	0.34	0.35	0.44	0.07
BOD (mg/l)	10	20	N/A	35	48	98	98	10
COD (mg/l)	89	209	334	285	371	582	582	89
Nitrate+nitrite (mg/l)	0.5	1.0	1.5	1.7	2.2	1.3	2.2	0.5
Total Phosphorus (mg/l)	0.89	4.3	0.83	2.55	6.96	1.60	6.96	0.83
TDS (mg/l)	53	116	236	118	233	383	383	53
TSS (mg/l)	71	160	136	186	16	29	186	16
TKN (mg/l)	0.50	1.70	5.92	1.70	1.10	2.30	5.92	0.50
DDE (µg/l)	<1.0	<1.0	<0.02	<1.0	N/A	N/A	ND	ND
Oil & Grease (mg/l)	<5.0	<5.0	N/A	<5.0	<5.0	<5.0	ND	ND
Phenols (µg/l)	<5.0	<5.0	N/A	<5.0	<10	<5.0	ND	ND

Sf r= Single family residential-Grant Road and Wilson Ave
Mfr = Mutli-family residential- Greenlee Road
Com = Commercial El Con Mall- Randolf Way
Mxu = Mixed use-First Ave at Limberlost
Ind = Industrial 17th Street
N/T = Not Taken- Due to Equipment Failure
N/A = Lab Quality Control Failure, No data available
ND = Non-detected

The 1998-99 sampling results, similar to the results submitted in the previous annual report, indicated that Tucson stormwater was essentially free of the man-made contaminants included in the monitoring program. The results were variable, with no definite trends identified.

Similar to the City of Tucson, Pima County has an NPDES stormwater permit, no. AZS000002. The permit stipulates that a summary of the required monitoring data, accumulated throughout

the reporting period, be submitted to the USEPA in the form of an annual report. Wet weather monitoring is conducted in accordance to permit requirements with samples collected biannually at five monitoring stations, once during the winter rainy season and once during the summer rainy season. Those results are shown on Table 10.

Table 10. Monitoring Results for Pima County Stormwater, Second Reporting Period, September 2000. From the Third Annual Report, Pima County NPDES Stormwater Discharge Permit.

Facility	Site 1	Site 1	Site 1	Site2A	Site 3	Site 3	Site 3	Site 4	Site 4	Site 4	Site 5	Site 5
Date	7/14/99	3/6/00	6/22/00	7/6/99	7/14/99	3/6/00	6/22/00	7/14/99	3/6/00	6/22/00	7/5/99	6/19/00
H2O Temperature on arrival °C	29.3	9.6	23.0	24.0	31.3	10.5	24.5	30.0	10.4	26.4	27.2	22.2
H2O Temperature + 1 hour °C	-	9.0	-	23.9	-	10.1	27.1	-	11.1	25.7	27.8	25.1
H2O Temperature +2 hours °C	-	-	-	-	-	9.7	-	-	11.5	25.8	27.9	29.8
H2O Temperature + 3 hours °C	30.7	9.2	23.3	24.6	29.6	9.7	25.6	28.4	11.6	25.6	-	30.7
pH at arrival s.u.	9.07	6.97	8.03	7.94	6.58	7.43	7.79	7.32	7.39	7.76	8.03	8.65
pH + 1 hour s.u.	-	7.45	-	7.91	-	7.55	7.05	-	7.44	7.67	7.84	8.06
pH+ 2 hours s.u.	-	-	-	-	-	7.51	-	-	7.54	7.81	7.94	7.90
pH + 3 hours s.u.	8.16	7.5	7.42	7.25	7.72	7.45	7.15	8.24	7.46	7.95	-	7.90
Fecal coliform on arrival Mpn/100ml	3000	500	3000	160000	3000	11000	900	9000	17000	50000	5000	900
Fecal coliform +1 hour Mpn/100ml	-	-	-	-	-	-	-	-	-	-	-	-
Fecal coliform + 2 hours Mpn/100ml	-	-	-	-	-	-	-	-	-	-	-	-
Fecal coliform + 3 hours MPn/100ml	220	1300	2400	30000	1700	30000	1600	2400	1700	900	300	16000
Cu (µg/l)(total)	183	13.6	21.6	21.5	27.9	18.4	31.9	34.0	29.8	50.0	81.2	107
Pb (µg/l)(total)	210	ND	17.4	T	ND	ND	T	T	T	T	93.3	136
Zn (µ/l)(total)	476	36.2	48.9	78.6	161	129	183	46.5	165	155	214	305
Hardness (calculated) mg/l	876	46.1	57.5	41.1	32.2	27.7	54.3	88	36.0	58.0	285	272
TSS mg/l	5631	49	273	125	55	29	32	120	65	52	712	596
4,4-DDE (µg/l)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

s.u.-standard units, °C- degrees Celsius, Mpn/100mg/l- most probable number per 100mg/l, mg/l- milligrams per liter, µg/l-micrograms per liter, --- no measurement taken or no sample collected, ND- not detected at or above the laboratory detection limit. T-trace
Site 1-Residential, low density
Site 2A- Residential, medium density
Site 3- Residential, high density
Site 4- Commercial
Site 5- Industrial

CAP Water Quality

The CAP aqueduct delivers Colorado River Water from Lake Havasu to the Tucson area. The CAP water delivered to the Tucson area is a sodium-sulfate water type and with the exception of turbidity and total coliform bacteria, which is expected in surface water, meets all primary drinking water standards established by the USEPA and ADEQ (Tucson Water, 2000b).

Total dissolved solids (TDS) concentrations in Colorado River water between 1972 and 1999 ranged between a low of 535 and a high of 747 and averaged 644 mg/l. Review of the data indicates the TDS concentration in Colorado River water is generally lower during periods of abundant precipitation (Tucson Water, 2000b).

Analytical results for common constituents for all CAP water samples collected at the pump station at the CAP aqueduct (Tucson Water sample point 713) between October 1997 and April 2000 are summarized on Table11. The data were collected by Tucson Water, which conducts extensive monitoring of CAP water delivered to the Clearwater Renewable Resource Facility.

CAP source water quality was also monitored at the Pima Mine Road Recharge Project during the year 2000. Analytical results of the source water samples did not indicate the presence of any analyte at concentrations exceeding the Arizona Aquifer Water Quality Standards (AWQS). No pesticides or herbicides were detected above the laboratory reporting limits. Results of the general minerals, and physical parameters (except temperature) were remarkably consistent among the three sampling periods conducted in 2000 (CAWCD, 2001). Results of the source water samples for mineral and physical parameters are shown on Table12.

Table 11. Summary of Water Quality for Untreated CAP Water at the Clearwater Site, October 1997-April 2000 (Tucson Water, 2000b).

Constituent	Mean	Std. Dev.	Min.	Max.	MCL	No of samples
Cations (mg/l)						
Calcium	66	4.53	56	75	-	14
Magnesium	28	3.05	26	38	-	14
Potassium	5.0	0.76	4.5	7.5	-	14
Sodium	92	12.8	85	135	-	14
Anions (mg/l)						
Bicarbonate*	133	24.4	70	156	-	18
Bromide	@0.015	0.041	<0.1	0.14	-	13
Chloride	82	13.2	72	123	-	13
Sulfate	248	30.5	227	348	-	13
Nitrate (as Nitrogen)	@0.0077	0.0277	<0.025	0.1	10	13
Fluoride	0.313	0.051	0.24	0.44	4	13
Orthophosphate (as	<0.3	0	<0.3	<0.3	-	11
Bicarbonate alkalinity as mg/l	109	20	57	128	-	18
Total Alkalinity	129	16.6	84	148	-	11
TDS	603	48	566	712	-	14
Hardness calculated as	280	12.6	261	303	-	13
Field Parameters						
pH	8.34	0.43	7.70	9.37	-	16
Electrical Conductivity	949	58.6	880	1010	-	4
Electrical Conductivity at 25	792	261	9.1	940	-	12
Temperature (Celsius)	22.6	5.1	10.6	32.1	-	16
Dissolved Metals (mg/l)						
Aluminum	<0.1	0	<0.1	<0.1	-	5
Arsenic	@0.0023	0.0015	<0.002	0.0057	0.05	14
Barium	0.105	0.0102	0.095	0.13	2	14
Boron	0.131	0.0213	0.12	0.2	-	14
Iron	@0.072	0.120	<0.02	0.38	-	9
Lead	@0.0051	0.017	<0.002	0.064	0.015	14
Selenium	<0.005	0	<0.005	<0.005	0.05	12
Silicon	3.9	0.71	2.5	5.2	-	13
Zinc	@0.052	0.093	<0.02	0.31	-	10
Total Trihalomethane (µg/l)	<0.5	0	<0.5	<0.5	100	17
Haloacetic acids (µg/l)	<3	0	<3	<3	-	5
Total Coliform MPN-	@60	101	<2	300	-	8
TOC	3.3	0.32	2.7	3.81	-	18
Radon (pCi/l)	<22	-	<22	<22	-	1
Perchlorate	@0.0066	0.005	<0.004	0.014	-	6

Source: Sample point 713 (CAP Aqueduct M.P. 308.175)
Mg/l- milligram per liter
*Bicarbonate concentration- 1.22 times the results of bicarbonate alkalinity reported above.
µmho/cm- micromohos per centimeter
MPN/100 ml- most probable method; results given in colony forming units (CFU) per 100 milliliters
< less than; constituent not detected above the laboratory reporting limit
@- Constituent was not detected above the laboratory reporting limit in some or all of the samples included in calculation

Table 12. Water Quality Monitoring Results, Source Water, Pima Mine Recharge Project Mineral and Physical Parameters. Fourth Quarter/2000 Annual Report.

Constituent	Units	AWQS limit	Sample date 01/06/2000 Results	Sample Date 03/03/2000 Results	Sample Date 10/19/00 Results
Alkalinity, total	mg/l		109	110	104
Alkalinity, bicarbonate	mg/l		133	133	126
Alkalinity, Carbonate	mg/l		0.864	1.72	1.30
Chloride	mg/l		76.3	72.2	88.7
Fluoride	mg/l	4	0.32	0.31	0.36
Nitrate (as N)	mg/l	10	ND	ND	ND
pH	Std unit		8.0	8.3	8.2
Specific Conductance	Us/cm		915	855	905
Sulfate	mg/l		253	236	267
Total Dissolved Solids	mg/l		530	530	650
Temp (field)	°F		65.5	74.1	nm
Aluminum, dissolved	mg/l		ND	ND	ND
Antimony, dissolved	mg/l	0.006	ND	ND	ND
Arsenic, dissolved	mg/l	0.05	0.0045	0.0025	0.004
Barium, dissolved	mg/l	2	0.066	0.091	0.105
Beryllium, dissolved	mg/l	0.004	ND	ND	ND
Cadmium, dissolved	mg/l	0.005	ND	ND	ND
Calcium	mg/l		120*	68	62
Chromium, dissolved	mg/l	0.1	ND	0.0041	ND
Copper, dissolved	mg/l		ND	0.0037	0.021
Iron, dissolved	mg/l		ND	ND	ND
Lead, dissolved	mg/l	0.05	0.019	ND	0.66
Magnesium	mg/l		18.1*	29	31
Mercury, dissolved	mg/l	0.002	ND	ND	ND
Nickel, dissolved	mg/l	0.01	ND	0.005	ND
Potassium	mg/l		3.5*	4.1	5.5
Selenium, dissolved	mg/l	0.05	ND	ND	ND
Silver, dissolved	mg/l		ND	ND	ND
Sodium, dissolved	mg/l		51.5*	84	100
Thallium, dissolved	mg/l	0.002	ND	ND	ND
Zinc, dissolved	mg/l		0.14	0.015	0.088
TOC	mg/l		0.9	2.8	3
nm=not measured		Nd= Not detected above		Laboratory reporting limit	

* results are questionable for these analytes, laboratory results appear to have been switched with another sample but could not be confirmed by the laboratory.

Treated Wastewater Water Quality

Roger and Ina Road Effluent

The Roger Road Wastewater Treatment Facility (WWTF) and the Ina Road Water Pollution Control Facility (WPCF) are required to monitor for a number of constituents and parameters to comply with NPDES (1999) and Aquifer Protection Permits (2001). These monitoring requirements, provided by Pima County Wastewater Management Department, are shown on Tables 13 and 14.

Table 13. Roger Road WWTF Monitoring Requirements

Daily	Monthly	Bi-monthly	Quarterly
BOD	Enteric Virus	As, Cd, Cu, Cr	1,1,1-TCA
TSS	Acute Toxicity	Cyanide	
Fecal Coliform	Chronic Toxicity	Pb, Hg, Se, Ag, Zn	
Settleable Solids	Alkalinity	phenols	
Residual Chlorine		phthalates	
pH		methylene chloride	
		chloroform	
		PCE, PCA	

Table 14. Ina Road WPCF Monitoring Requirements

Daily	Monthly	Bi-monthly
BOD	Enteric Virus	As, Cd, Cu, Cr
TSS	Acute Toxicity	Cyanide
Fecal Coliform	Chronic Toxicity	Pb, Hg, Se, Ag, Zn
Settleable Solids	Alkalinity	phenols
Residual Chlorine		PCE
pH		Total Ammonia
		Temperature
		Dissolved Oxygen

The data collected from the County's monitoring have been summarized in several previous studies, including those by PAG (1994b, 1996) and Malcolm Pirnie (1994). In addition, more recent monitoring data were provided by Pima County Wastewater Management Department for this report; these data included information summarized from year 2000 discharge monitoring reports. The recent data indicate that the effluent water quality is well within the NPDES and APP permit limits.

Table 15. Roger Road Wastewater Treatment Facility Discharge Monitoring Report Summarized Information Year 2000.

Constituent (Units)*	Permit Limit	1st Quarter Averages Jan- Mar	2nd Quarter Averages Apr-June	3rd Quarter Averages July-Sept	4th Quarter Averages Oct-Dec
Flow (MGD)	Up to 41	26.3	23.2	28.0	29.2
Suspended Solids (Kg/day)	4,654	2,217	2,090	1,470	2,247
Suspended Solids (mg/l)	45	25	30	16	23.5
Fecal Coliform (#/100ml)	200	4	16	35	12
pH	6.5 - 9.0	7.6	7.6	7.6	7.6
Disinfectant Residual (mg/l)	0.5	0.22	0.07	0.15	0.09

*MGD- Million gallons per day, Kg/day- Kilograms per day, mg/l- Milligrams per liter
#/100 ml- counts per 100 milliliters.

Table 16. Ina Road Water Pollution Control Facility Discharge Monitoring Report Summarized Information Year 2000.

Constituents (Units)*	Permit Limits	1st Quarter Averages Jan - Mar	2nd Quarter Averages Apr - Jun	3rd Quarter Averages Jul - Sept	4th Quarter Averages Oct-Dec
Flow (MGD)	Up to 25	22.5	23.1	22.1	24.3
Suspended Solids (Kg/day)	2,839	1,516	1,398	1,151	2,103
Suspended Solids (mg/l)	45	19	18	16	31
Fecal Coliform (#/100ml)	200	5	14	31	28
pH	6.5 - 9.0	7.1	7.1	7.2	7.2
Disinfectant Residual (mg/l)	0.5	0.30	0.44	0.15	0.35

*MGD- Million gallons per day, Kg/day- Kilograms per day, mg/l- Milligrams per liter
#/100 ml- counts per 100 milliliters.

Additional sampling data are available in ADEQ's Year 2000 305(b) report and 1998 Water Quality Limited Waters 303(d) List, and the United States Geological Survey's 2000 report *Water Quality in the Central Arizona Basins, 1995 - 98*. These data are for the effluent dependent reach of the Santa Cruz River downstream from the treatment facilities. Stressors of concern noted in this literature included turbidity and dissolved oxygen, with the standard for dissolved oxygen being exceeded in 6 of 12 samples collected by the USGS and the standard for

turbidity being exceeded in only 1 of 12 samples. In its 1998 303(d) report, ADEQ de-listed this reach of the Santa Cruz, noting that only one sample had exceeded the turbidity standard.

Although the USGS (2000) suggested that the quality of effluent-dependent streams, including low dissolved oxygen, limits restoration of in stream communities and presents a challenge for fish survival, they also noted that these streams provide a variety of benefits, including riparian communities with a high level of terrestrial plants and animal diversity. This observation is supported by a variety of literature available from Pima County's Water Quality Research Project, which seeks to identify appropriate water quality standards for ephemeral and effluent-dependent streams in the arid western United States.

Reclaimed Water

Reclaimed water is ideally suited for turf irrigation and other commercial and industrial uses (Tucson Water, 2001, PAG, 1994b).Under a state wastewater reuse permit the reclaimed water is monitored for flow, turbidity, fecal coliform, pH, enteric virus, and *Ascaris lumbricoides* (Dotson, 2001). Water is sampled at a point that is representative of the quality of water received by the reclaimed water customers. The reclaimed water has a higher TDS concentration than secondary effluent. This is due in part to mixing with groundwater at the Sweetwater facility, where background TDS levels are higher than most Tucson Water wellfields (PAG, 1994b). Tables 17 and 18 present data provided by Tucson Water for this sample point. All of the data are within permitted limits.

Table 17. Average Values, Water Quality Data, Tucson Water Reclaim System, January –July 2001. Data from Tucson Water.

Constituent	Average	No. of Samples
Total Dissolved Solids	657 mg/l	6
Total Kjeldahl Nitrogen	10.09 mg/l	6
Total Organic Carbon	7.75 mg/l	6
Total Suspended Solids	1.6 mg/l*	7
Turbidity	3.28 NTU	6
Ammonia as N	6.29 mg/l	6
Nitrate as N	3.87 mg/l	7
Chloride	107.43 mg/l	7
pH	7.7 su	6
Conductivity	1012.66 umhos/cm	6
Fluoride	0.9	7
Potassium	8.2 mg/l	2
Phosphate as P	1.52 mg/l	6
Sulfate	120.8	7
Calcium	59.5	2
Total Alkalinity	247	3
Sodium	130 mg/l	2

*- This value calculated using a value of zero for one sample with a result of <1.

Samples collected on January 4, 2001, and April 12, 2001, were also analyzed for VOCs and metals. In general these constituents were only detected at levels less than the lowest standard or quantification limit of the method. Aluminum, Arsenic, Barium, Boron, Copper, Iron, Magnesium, Nickel and Zinc were all present at detectable levels, but below permit limits. The results of the two samples are listed on Table 18.

Table 18. Analytical Results for Reclaimed Water, Sample Dates January 4, 2001 and April 12, 2001. Data provided by Tucson Water.

Constituent (mg/l)	Sample Date 1/4/01	Sample Date 4/12/01
Aluminum, Total	<.1	.12
Arsenic, Total	0.0038	0.0055
Barium, Total	0.033	0.031
Boron, Total	0.3	0.29
Copper, Total	0.015	<0.01
Iron, Total	0.11	0.084
Magnesium, Total	10	9.9
Nickel, Total	0.013	<0.01
Zinc, Total	0.026	0.039

mg/l= milligrams per liter.

Summary and Conclusions

Summary

This report summarizes general findings about water sources and their quality in Pima County. Water sources in Pima County include groundwater, CAP water, treated wastewater, stormwater runoff, and perennial and intermittent surface waterbodies.

General water quality in Pima County is summarized on the following table. Mean values are presented for each constituent. Reclaimed water has the highest TDS of the water sources, with a mean value of 657 mg/l. Water from stormwater has the lowest TDS, with a mean value of 93 mg/l. Mean hardness values for the CAP water are higher than well water with CAP water at 280 mg/l as CaCO3 and well water having a mean value of 119 mg/l as CaCO3. (PAG, 1994).

Table 19. Average Water Quality Data (mg/l) for Tucson Area Water Sources

Constituent	Tucson Water Well*	Combined Effluent**	Reclaimed Water (avg.)***	CAP Water ‡ (avg.)	Stream Water (avg.)+	Stormwater (avg.)†
TDS	259	509	657	603	232	93
Hardness as CaCO3	119	139	-	280	56.2	-
Sodium	39.6	109	130	92	18.1	6.0
Chloride	17.4	83.2	107.4	82	7.6	4.0
Calcium	39.2	46.6	59.5	66	48.8	10.4
Magnesium	4.99	6.25	10	28	7.9	1.6
Sulfate	45.1	85	120.8	248	37.76	9.9
Alkalinity	126	224	247	129	-	-

* Average drinking water quality for Tucson Water production wells, 1991 data supplied by Tucson Water.
** Combined effluent is flow-weighted average secondary effluent quality for Ina and Roger Road Wastewater Treatment Plants.
***- Reclaimed Water, average values from January 2001- July 2001. Data supplied by Tucson Water.
‡ Data from CAP water at the Clearwater Site October 1997-April 2000. Tucson Water
+ Average stream water quality for 6 streams in Pima County, data from ADEQ
† Average Stormwater quality data from USGS measurements at Tanque Verde Creek at Sabino Canyon.

Conclusions

Groundwater

Groundwater is the most widely used water resource in Pima County. Water quality data for this source are abundant, due to its extensive use and regulatory monitoring requirements. It is generally of very good quality and suitable for its intended uses, which include drinking water, irrigation and industry. Groundwater contamination has occurred in several locations. Nitrates and VOCs are the predominant contaminants. Other contaminants, such as metals and pesticides, are insignificant compared to VOCs. Contaminated groundwater is generally not used for potable purposes, with the exception of locations where it is either treated or blended to meet drinking water standards. Contaminated groundwater in Pima County is intensively monitored, and in most cases is either under remediation or further investigation.

CAP Water

CAP water is being used in increasing quantities in Pima County. Current uses include artificial groundwater recharge and crop irrigation. The quality of this water is extensively monitored, and its quality is sufficient for its intended uses, which include drinking water, aquifer recharge, irrigation and industry.

Treated Wastewater

Treated wastewater is also being used in increasing quantities. It is extensively monitored, and its quality meets standards for its intended uses, which include reuse for turf irrigation, agriculture and discharge to an effluent dependent stream. The effluent discharges currently support valuable riparian habitat subject to major stormwater events.

Stormwater Runoff

This water is not widely used as a resource. However, it is extensively monitored under existing regulations. The water quality meets NPDES permit requirements.

Surface Waterbodies

Although it is relatively scarce, naturally occurring surface water in perennial and intermittent streams provides very important habitat in Pima County. Most of the streams that have been monitored are of a quality sufficient for their intended use or habitat. However, monitoring is very limited compared to the other water sources. The vast majority of perennial and intermittent streams in Pima County are not regularly monitored for water quality.

Appendix A: Santa Cruz-Rio Madalena-Rio Sonoyta Watershed Streams Assessments and Streams Monitoring Data (ADEQ).

SANTA CRUZ-RIO MAGDALENA-RIO SONOYTA WATERSHED -- STREAMS MONITORING DATA

STREAM NAME SEGMENT WATERBODY ID DESIGNATED USES	AGENCY PROGRAM SITE DESCRIPTION SITE ID	SAMPLES	PARAMETER UNITS	STANDARD	RANGE OF RESULTS (MEDIAN)	FREQUENCY EXCEEDED STANDARDS	USE SUPPORT*	COMMENTS
Agua Caliente headwaters-Coronado Forest AZ15050302-348A A&Ww, FC, FBC, AgL	ADEQ Biocriteria Program Above Coronado Natl Forest Boundary SCACW004.93	1995 - 1 water, bugs	Ok					Need more information to assess.
Alamo Wash headwaters-Rillito Creek AZ15050302-002 A&We, PBC	USGS #09485570 USGS report 95-4062 At Fort Lowell Road SCAAW001.27	1991-1994 - 9 water	Copper (dissolved)µg/l	varies (12)	<10-80	1 of 6	Partial A&We	Stormwater only.
Arivaca Creek headwaters-Puertocito/Alta AZ15050304-008 A&Ww, FC, FBC, AgL	ADEQ Fixed Station Network At Figueroa Spring SCARI008.19	1991 - 6 water 1992 - 6 water 1993 - 4 water	Dissolved oxygen mg/l	6.0 (90% saturation)	5.3-10.1 (68.5-128.6%)	1 of 10	Full	Naturally low dissolved oxygen during low flows.
	ADEQ Fixed Station Network At Ruby Road SCARI010.54	1991 - 8 water 1992 - 6 water 1993 - 4 water	Dissolved oxygen mg/l	6.0 (90% saturation)	1.1-12.0 (14.2-119%)	8 of 18	Full	Naturally low dissolved oxygen during low flow.
	ADEQ Fixed Station Network Near headwater spring SCARI010.86	1991 - 4 water 1992 - 1 water 1993 - 1 water	Dissolved oxygen mg/l	6.0 (90% saturation)	5.2-6.91 (60.6-77.1%)	3 of 6	Full	Naturally low Dissolved oxygen at springs.
Cave Creek headwaters-Cienega Creek AZ15050302-185 A&Ww, FC, FBC, AgL	ADEQ Biocriteria Program Near Mount Wrightson Wilderness SCCAV002.95	1992 - 1 water, bugs	Ok					Need more information to assess.

Appendix A	SANTA CRUZ-RIO MAGDALENA-RIO SONOYTA WATERSHED -- STREAMS MONITORING DATA (ADEQ)							
Canada del Oro headwaters-Big Wash AZ15050301-017 A&Ww, FC, FBC, DWS, AgI, AgL	ADEQ Biocriteria Program South of Pinal County Line SCCDO016.55	1992 - 1 water, bugs 1993 - 1 water, bugs 1994 - 1 water, bugs	Ok				Full	
Cienega Creek Interstate 10-Del Lago Dam AZ15050302-006B A&Ww, FBC, FC, AgL	ADEQ Stream Ecosystem Monitoring Above Diversion Dam SCCIE000.4	1998 - 1 water, bugs, physical	Dissolved oxygen mg/l	6.0 (90% saturation)	4.59	1 of 1	Full	Naturally low DO. Interrupted stream flow with spring source.
	ADEQ Stream Ecosystem Monitoring Below Davidson Canyon SCCIE001.1	1998 - 1 water, bugs, physical	Ok				Full	
	ADEQ Stream Ecosystem Monitoring Above Davidson Canyon SCCIE001.2	1998 - 1 water, bugs, physical	Dissolved oxygen mg/l	6.0 (90% saturation)	5.4	1 of 1	Full	Naturally low DO. Interrupted stream flow with spring source.
	ADEQ Fixed Station Network At Marsh Station Road SCCIE002.86	1991 - 6 water 1992 - 6 water 1993 - 4 water 1995 - 4 water	Dissolved oxygen mg/l	6.0 (90% saturation)	4.75-11.2 (60.6-110%)	1 of 25	Full	
	ADEQ Stream Ecosystem Monitoring Below tilted beds SCCIE003.5	1998 - 1 water, bugs, physical	Ok				Full	
	ADEQ Fixed Station Network At Tilted Bed site SCCIE005.36	1993 - 2 water	Ok				Full	

Appendix A	SANTA CRUZ-RIO MAGDALENA-RIO SONOYTA WATERSHED -- STREAMS MONITORING DATA (ADEQ)							
STREAM NAME SEGMENT WATERBODY ID DESIGNATED USES	AGENCY PROGRAM SITE DESCRIPTION SITE ID	SAMPLES	PARAMETER UNITS	STANDARD	RANGE OF RESULTS (MEDIAN)	FREQUENCY EXCEEDED STANDARDS	USE SUPPORT*	COMMENTS
Cienega Creek Headwaters-Interstate 10 AZ15050302-006A A&Ww, FC, FBC, AgL	BLM Routine Monitoring At Narrows SCCIE010.99	1993 - 1 water (2 sites)	Ok				Full	
	ADEQ Stream Ecosystem Monitoring Below Stevenson Canyon SCCIE011.8	1998 - 1 water, bugs, physical	Ok				Full	
	ADEQ Stream Ecosystem Monitoring Below narrows SCCIE012.4	1998 - 1 water, bugs, physical	Ok				Full	
	ADEQ Biocriteria Program Above the Narrows SCCIE012.55	1992 - 1 water, bugs 1993 - 1 water, bugs 1994 - 1 water, bugs 1996 - 1 water, bugs	Ok				Full	
	ADEQ Fixed Station Network Below E.C. Conserv. SCCIE013.61	1992 - 1 water 1993 - 1 water	Ok				Full	
Gardner Canyon Creek headwaters-Cienega Creek AZ15050302-195 A&Ww, FC, FBC	ADEQ Biocriteria Program Near Mount Wrightson Wilderness SCGDN010.49	1992 - 1 water, bugs	Ok					Need more information to assess.

Appendix A	SANTA CRUZ-RIO MAGDALENA-RIO SONOYTA WATERSHED -- STREAMS MONITORING DATA (ADEQ)							
Madera Canyon Creek headwaters-Santa Cruz AZ15050301-322 A&Ww, FC, FBC, AgL	ADEQ Fixed Station Network 2 sites (Whitehorse and Round-up) SCMAD006.20	1991 - 1 sample (2 sites)	Ok				Full	
	ADEQ Biocriteria Program 1 mile below Sprung Spring SCMAD007.63	1992 - 1 water, bugs 1993 - 1 water, bugs 1994 - 1 water, bugs	Ok				Full	
Sabino Canyon Creek Headwaters-Tanque Verde RAZ15050302-014 A&Wc, FC, FBC, DWS, AgI	ADEQ Fixed Station Network At USGS gage SCSAB003.66	1991 - 2 water	Ok				Full	
	ADEQ Biocriteria Program Above East Fork Sabino Canyon SCSAB007.56	1992 - 1 water, bugs 1993 - 1 water, bugs 1994 - 1 water, bugs 1996 - 1 water, bugs	Dissolved oxygen mg/l	7.0 (90% saturation)	3.99-9.5	1 of 4	Full	Only a few isolated slow moving pools - natural low DO.
	ADEQ Fixed Station Network Below Summerhaven on Mount Lemmon SCSAB012.35	1991 - 9 water 1992 - 1 water & 5 bacts 1993 - 3 bacts	Ok				Full	
STREAM NAME SEGMENT WATERBODY ID DESIGNATED USES	AGENCY PROGRAM SITE DESCRIPTION SITE ID	SAMPLES	PARAMETER UNITS	STANDARD	RANGE OF RESULTS (MEDIAN)	FREQUENCY EXCEEDED STANDARDS	USE SUPPORT*	COMMENTS
Santa Cruz Josephene-Tubac bridge AZ15050301-008A A&Wedw, PBC, AgL	ADEQ Fixed Station Network At Tubac bridge SCSCR077.08	1991 - 1 water 1992 - 2 water	Ok				Full	
			Turbidity NTU	50	6.25-72	1 of 3	Partial A&Wedw	
	ADEQ Fixed Station Network At Tumacacori SCSCR080.43	1993 - 5 water 1995 - 6 water (limited)	Copper (dissolved) µg/l	varies (35)	4-70	1 of 3	Partial A&Wedw	
			Cyanide (total) µg/l	41	7-1500	1 of 5	Partial A&Wedw	
			Turbidity NTU	50	6.5-114	1 of 16	Full	
Santa Cruz River Tubac bridge-Sopori Wash AZ15050301-008B A&We, PBC, AgL	ADEQ Fixed Station Network Chavez Siding Road SCSCR074.67	1992 - 1 water 1993 - 9 water 1995 - 6 water	Ok				Full	

Santa Cruz River Airport Wash-Rillito Creek AZ15050301-003 A&We, PBC, AgL	ADEQ Fixed Station Network At Congress Street SCSCR038.95	1991 - 1 water	Ok					Need more information to assess.
Santa Cruz River Canada del Oro-Guild Wash AZ15050301-001 A&Wedw, PBC	USGS NAWQA Site #09486500 At Cortaro, AZ SCSCR029.16	1996 - 8 water 1997 - 4 water	Dissolved oxygen mg/l	3.0 (3 hours after sunrise to sunset)	2.0-3.7	6 of 12	Non A&Wedw	
	ADEQ Fixed Station Network At Cortaro Road bridge SCSCR029.18	1991 - 8 water 1992 - 6 water 1993 - 6 water	Turbidity NTU	50	10.3-8970	1 of 12	Full	
Tanque Verde Creek Wentworth Road-Rillito Creek AZ15050302-009B A&We, PBC, AgL	USGS #09484500 USGS report 95-4062 At Sabino Canyon Road SCTAN001.29	1991-1994 - 9 water	Ok				Full	Stormwater only.

From: Arizona Department of Environmental Quality, *The Status of Water Quality in Arizona, Clean Water Act Section 305 (b) Report 2000.*

Appendix A: Santa Cruz-Rio Magdalena-Rio Sonoyta Watershed Streams Assessments and Streams Monitoring Data (ADEQ).

SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED STREAMS ASSESSMENTS

WATERBODY NAME SEGMENT WATERBODY SIZE WATERBODY ID	TYPE OF ASSESSMENT BIOASSESSMENT* YEAR ADDED TO 303(d) LIST	DESIGNATED USE SUPPORT	STRESSORS	POTENTIAL SOURCES	ASSESSMENT COMMENTS
Alamo Wash headwaters-Rillito Creek 9 miles AZ15050302-002	Monitored -- --	Partial	Copper	Urban runoff	USGS study of water and sediment from stormwater discharges in Alamo Wash in 1993, 5 samples: copper exceeded standard once (Tadayon, 1995).
Arivaca Creek headwaters- Puertocito/Altar Wash 15 miles AZ15050304-008	Evaluated -- --	Fully			ADEQ 3 stations 1991-93 with a total of 39 samples: full support. Low dissolved oxygen due to spring sources and low flows (all natural).
Canada del Oro headwaters-Big Wash 31miles AZ15050301-017	Evaluated -- --	Fully			ADEQ bioassessment site (phys/chem monitoring) 1992-94, 3 samples: full support. Biassessment not appropriate, because Index of Biological Integrity developed for perennial waters cannot be applied to intermittent waters.
Cienega Creek Interstate 10 to Del Lago Dam 11 miles AZ15050302-006B	Monitored Exceptional community --	Fully			ADEQ monitoring at 6 sites 1991-1998, 26 samples: full support.
Cienega Creek headwaters-Interstate 10 38 miles AZ15050302-006A	Evaluated -- --	Fully			ADEQ monitoring 1992-1998, 5 sites, 8 samples: full support.
Madera Canyon Creek headwaters-Santa Cruz 13 miles AZ15050301-322	Evaluated -- --	Fully			ADEQ 2 stations in 1991 (Roundup and Whitehorse) 2 samples: full support. ADEQ Biocriteria Development Reference Site (phys/chem monitoring) 1992-94, 3 samples: full support.

Sabino Canyon Creek headwaters-Tanque Verde River 20 miles AZ15050302-014	Evaluated Good community --	Fully			ADEQ monitoring (Summerhaven) 1990-93, 10 samples: full support. ADEQ Biocriteria Development Sit 1992-96, 4 samples: full support.
Santa Cruz River Canada del Oro-Guild Wash 9 miles AZ15050301-001	Monitored -- --	Not supporting	Low dissolved oxygen	Point source, sand and gravel operations, bridge repair, natural conditons	USGS NAWQA site 1996-1997, 12 samples: dissolved oxygen did not meet standards in half of the samples. Pima County Wastewater Management Department instream monitoring 1992-1994, 2 sites, total of 130 dissolved oxygen and ammonia samples: full support but median value for dissolved oxygen dropped every year. ADEQ fixed site 1991-1993, 20 samples: full support.
Santa Cruz River Josephine Canyon-Tubac Bridge 6 miles AZ15050301-008A	Monitored -- 1992	Not supporting	Turbidity, unknown toxic	Land development, grazing, natural, wastewater treatment plant	USGS NAWQA site 1996-97, 25 samples: full support (no turbidity samples). ADEQ monitoring 2 sites 1991-95, 13 samples: turbidity exceeds standards. USFWS report (King et al., 1999) indicates toxicity is occurring.
Santa Cruz River Tubac Bridge-Sopori Wash 9 miles AZ15050301-008B	Monitored -- --	Fully			ADEQ monitoring at Chavez Siding Road, 19 samples 1992-1995: full support.
Tanque Verde Creek Wentworth Road-Rillito Creek 10 miles AZ15050302-009B	Evaluated -- --	Fully			USGS monitoring 1990-94, 9 samples: full support.

Appendix A		SANTA CRUZ - RIO MAGDALENA - RIO SONOYTA WATERSHED STREAMS ASSESSMENTS			
WATERBODY NAME SEGMENT WATERBODY SIZE WATERBODY ID	TYPE OF ASSESSMENT BIOASSESSMENT* YEAR ADDED TO 303(d) LIST	DESIGNATED USE SUPPORT	STRESSORS	POTENTIAL SOURCES	ASSESSMENT COMMENTS
Arivaca Lake 119 acres AZL15050304-0080	Monitored Hypereutrophic 1996	Not supporting	Mercury, low dissolved oxygen, high pH	Resource extraction, lake design and maintenance, natural, unknown, atmospheric deposition	Fish advisory due to mercury in fish tissue 1995 (AGFD and ADEQ samples). ADEQ and EPA water samples collected in 1997-1998, total of 52 samples: high pH and low dissolved oxygen. TMDL completed in 1999 for mercury.
Kennedy Lake 10 acres AZL15050301-0720	Monitored Eutrophic --	Not supporting	High pH	Point source, lake design and maintenance, natural	AGFD routine monitoring 1994-1997, 3 sampling events: high pH. AGFD urban lakes project, 11 field measurements, 4 lab samples: high pH (some low dissolved oxygen).
Lakeside Lake 15 acres AZL15050302-0760	Monitored Hypereutrophic --	Partial	High pH, low dissolved oxygen	Point source, lake design and maintenance, natural	AGFD routine monitoring 1994-1997, 4 sampling events: low dissolved oxygen. AGFD urban lakes project monitoring 1998, 11 field measurements, 4 lab chemistries: partial support due to low DO and high pH.

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Water Quality
Regulatory Summary

Prepared for the Pima County Comprehensive Plan and Sonoran Desert Conservation Plan

Draft

August, 2001

Prepared by

Pima Association of Governments

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Background

Pima County is in the process of updating the Pima County Comprehensive Land Use Plan as required by the state's Growing Smarter Legislation. Pima County intends to integrate the updated Comprehensive Land Use Plan with the recently developed Sonoran Desert Conservation Plan. This combined plan will contain a water quality element to meet the legislated requirement and to ensure the preservation of species that depend on surface water and groundwater. Pima Association of Governments (PAG) is the state designated Water Quality Planning Agency for Pima County under section 208 of the Clean Water Act and at the County's request will assist in the preparation of the water quality portion of the Plan. As part of the Plan, PAG recently prepared the *Water Quality in Pima County* report that addressed different water sources and their water quality. As a companion report, this document summarizes a review of existing state and federal regulations that pertain to water quality and its protection and seeks to identify the regulations that affect each of the different water sources.

Purpose

The purpose of this report is to review and summarize existing state and federal laws, regulations, and programs protecting groundwater and surface water quality. This will include a review of PAG's 208 plan and amendments. This report along with the PAG report: *Quality of Water Sources in Pima County* will provide a foundation upon which the water quality element of the County Comprehensive Plan can be developed.

Information Sources

Information sources used in the preparation of this report include the Arizona Department of Water Resources, *Third Management Plan 2000-2010*, PAG's *Integrated Land Use Planning and Water Quality Planning Report*, April 1994, Arizona Department of Environmental Quality's *Arizona Laws Relating to Environmental Quality, 2000-2001 Edition*, and the United States Environmental Protection Agency web site.

Scope and Limitations

This report is the second deliverable under PAG's contract with the County to provide assistance with the water quality element of the *Sonoran Desert Conservation Plan and Comprehensive Land Use Plan*. This report relied heavily upon information readily

available and, in keeping with the time and budget limits, did not delve into all areas of existing regulations as extensively as might be possible, but focused on those regulations and programs that have a local impact on water and water quality.

This document is intended as a general overview for informational purposes only. Efforts have been made to use current information. However, laws, rules and regulations are routinely subject to change and those who need specific regulatory guidance should obtain the most current regulatory information from the appropriate authority. This report was not intended to cover all regulations that may impact individual situations. A complete review and comprehensive summary of the legal basis and institutional structure of government mechanisms that affect water quality is beyond the scope of this project.

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Laws Addressing Water Quality

Background

In the late 1960's and early 1970's there was new emphasis and great public interest in protecting and remediating the waters of the United States. Nationwide there were examples of waterbodies that had been degraded to the point that aquatic life or public health was likely threatened. The public outcry against polluting the environment resulted in a number of new laws. The most comprehensive law that affected water was the Clean Water Act. This was followed by the Safe Drinking Water Act and a number of state and local laws and regulations that were designed to protect and mitigate future environmental damage. Other major federal laws that had a direct or indirect effect on surface and groundwater quality were also enacted. The result is that we now have a complex web of laws and regulations, administered by different agencies, which deal with water, its use and the protection of its quality.

Federal Laws

Clean Water Act

The Clean Water Act (CWA) began as the Federal Water Pollution Control Act of 1948, was completely revised by amendments in 1972, and was renamed the Clean Water Act in 1977. The objective of this law was "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The Act, along with the 1987 Amendments, provided funding for the construction of publicly owned treatment works and also created a nonpoint source pollution program.

Federal and state governments both play a role in the implementation of the Act. Federal jurisdiction under the Act is broad with regard to establishing national standards and effluent limitations. States are responsible for the day-to-day implementation and enforcement of the standards set by the federal government, and are required to establish water quality standards for designated uses of navigable waterways.

The states and EPA share enforcement of the CWA. The states have the primary enforcement responsibility but EPA has oversight of state enforcement and can take direct action where it believes the state has failed to take action or when the state requests EPA involvement (USGS, 2001; Copeland, 2001).

In addition to the EPA, the U.S. Army Corps of Engineers is also involved in the administration of the CWA. The Corps is responsible for issuing permits for dredge and fill material under section 404. This is considered to be the wetlands provision of the Act and requires a permit for any disposal of dredged or filled material into navigable waters. Major provisions of the Act, related to water quality, are shown by section on Table1.

Table 1. Clean Water Act, Major Provisions by Section. From the United States Geological Survey Guide to Federal Environmental Laws and Regulations.

SECTION	TITLE	GENERAL DESCRIPTION
201-209 (33 U.S.C. 1281-1299)	Grants for Construction of Treatment Works	Originally provided federal grants for construction of wastewater treatment plants. This program was phased out by the 1987 amendments and replaced with a revolving loan fund
208 (33 U.S.C. 1288)	Areawide Waste Treatment Management	Requires states to designate planning agencies and develop areawide plans to ensure a regional approach is used in water quality planning.
301 (33 U.S.C. 1311)	Effluent Limitations	The discharge of any pollutant into the nation's waters except in compliance with the CWA is prohibited. Limitations that vary based on type of pollutant and the location of outfall are placed on existing sources.
302 (33 U.S.C. 1312)	Water Quality Related Effluent Limitations	Point sources that may degrade desired water quality are subject to more stringent effluent limitations.
303 (33 U.S.C.1313)	Water Quality Standards and Implementation Plans	States are required to protect designated uses of waterbodies by establishing water quality based regulatory controls known as Water Quality Standards (WQS).
304 (33 U.S.C. 1314)	Information and Guidelines	Requires EPA to develop water quality criteria for effluent limitations, pretreatment programs and administration of the NPDES program.
305 (33 U.S.C.1315)	State Reports on Water Quality	Each state must prepare and submit a description of water quality of all navigable waters, which includes a description of nonpoint source pollution and recommendations for the elimination of pollutants.
306 (33 U.S.C. 1316)	National Standards of Performance	Effluent sources must conform to technology based new source performance standards.
319 (33 U.S.C. 1329)	Nonpoint Source Management Programs	Requires states to identify waters that are not able to meet WQS because of nonpoint sources. Activities responsible for the pollution need to be identified and a management plan created to address the problem.
402 (33 U.S.C. 1342)	National Pollutant Discharge Elimination System	Establishment of the National Pollutant Elimination System, which translates standards into enforceable limitations. NPDES Permits are issued for point source discharges.
404 (33 U.S.C.1344)	Permits for Dredged or Filled Material	A wetlands provision of the CWA requires permits issued by the U.S. army Corp of Engineers for disposal of dredged or filled material into navigable waters, notably wetlands.
405 (33 U.S.C. 1345)	Disposal/Use of Sewage Sludge	Sewage Sludge Disposal from Treatment Works must be in accordance with permit requirements

U.S.C.- United States Code

The EPA and the Army Corps of Engineers are authorized to establish the regulations necessary for implementation of the Act. Some of the pertinent regulations that have been codified are included on Table 2.

Table 2. Pertinent Regulations Implementing the Clean Water Act. From the United States Geological Survey Guide to Environmental Laws and Regulations.

TITLE	DESCRIPTION	REGULATION
33 CFR Part 323	Permits for Dischargers of Dredged or Fill Material into Waters of the United States, Army Corps of Engineers	Contains policies, practice and procedures followed by the Corps for review of permit applications under section 404 of the CWA
40 CFR Part 122	EPA Administered Permit Programs: The National Pollutant Discharge Elimination System (NPDES).	Contains definitions and basic permit requirements for EPA-administered NPDES programs under sections 402,and 405 of CWA.
40 CFR Part 125	Criteria and Standards for NPDES, EPA	Prescribes criteria and standards for various requirements imposed as conditions for NPDES approval.
40 CFR Part 130	Water Quality Planning and Management, EPA	Establishes policies for water quality planning, management, and implementation of section 303 of the CWA by states. This rule includes the Total Maximum Daily Load Program (TMDL).
40 CFR Part 131	Water Quality Standards, EPA	Presents procedures for developing, reviewing, revising and approving the WQS by the states and EPA.

CFR- Code of Federal Regulations

The 1987 Amendments to the CWA added requirements for nonpoint source pollution and regulation of known toxins. They also expanded the NPDES program to include municipal and industrial stormwater runoff. EPA now requires NPDES permits for municipal storm drainage systems serving cities with populations of more than 100,000 and for certain types of industrial facilities. The Phase I rule for the stormwater permits was issued in 1990, and the final Phase II rule was published in December of 1999 (Woelker).

Under Section 208 of the Clean Water Act, PAG has been designated by the Governor of Arizona and the EPA as the lead agency for water quality planning in Pima County. PAG maintains, administers and updates the Section 208 *Areawide Water Quality*

Management Plan, which contains information on wastewater treatment facilities and potentially polluting activities in Pima County.

Section 208 of the Clean Water Act prohibits the issuance of a NPDES permit that is inconsistent with the State's Areawide Water Quality Management (WQM) Plan. The 208 Planning Process stresses regionalization of wastewater treatment and identifies strategies for dealing with water quality impairments within their area. All plans or plan amendments must be certified by the Governor prior to sending the document to EPA for approval (ADEQ, 2001d).

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was enacted in 1974 to protect the quality of drinking water the public receives through public water systems. This is done in two ways: by focusing on prevention of contamination of groundwater that is a source for drinking water, and by assuring quality water at the tap. The Act mandates the EPA to set drinking water standards for the protection of public health. The 1986 amendments strengthened the standard setting procedure and groundwater protection provisions of the Act. Additional amendments in 1996 require the EPA to perform cost-benefit analyses and consider risk assessments when setting new standards, and further address source water protection. Major provisions of the Act are listed on the following table (USGS, 2001).

Table 3. Safe Drinking Water Act, Major Provisions by Section. From the United States Geological Survey Guide to Environmental Laws and Regulations.

SECTION	TOPIC	GENERAL DESCRIPTION
1412 (42 U.S.C. 300g-1)	National Drinking Water Regulations	Requires EPA to establish Maximum Contaminant Level Goals (MCLGs) and Maximum Contaminant Levels (MCLs) for public water systems
1413 (42 U.S.C. 300g-2)	State Primary Enforcement Responsibility	Authorizes the states to assume primary enforcement of the Act
1417 (42 U.S.C. 300g-6	Prohibition of use of Lead pipes, solder, or flux.	Prohibits any use of lead in pipes, solder or flux in public water systems.
1427 (42 U.S.C. 300h-6)	Sole Source Aquifer Demonstration Program	Establishes procedures to develop programs to protect critical aquifers
1428 (42 U.S.C. 300h-7)	State Program to establish wellhead protection areas	Authorizes States to establish wellhead protection programs that address the kinds of activities that might be conducted in proximity of wells.

U.S.C.- United States Code

Regulations adopted pursuant to the SDWA established goals and standards for water provided to the public. Pertinent regulations implementing the SDWA are shown on Table 4.

Table 4. Pertinent Regulations Implementing the Safe Drinking Water Act. From the United States Geological Survey Guide to Environmental Laws and Regulations.

TITLE	REGULATION	DESCRIPTIONS
40 CFR Part 141	National Primary Drinking Water Regulations, EPA	Establishes the MCLs for inorganic and organic constituents, MCLGs, and details monitoring and analytical requirements for the regulated constituents
40 CFR Part 142	National Primary Drinking Water Regulations Implementation, EPA	Applies to public water systems in each state. Gives States primary enforcement responsibility
40 CFR Part 143	National Secondary Drinking Water Regulations, EPA	Controls constituents that primarily affect the aesthetic qualities of drinking water and provides monitoring requirements.
40 CFR Part 149	Sole Source Aquifers, EPA	Provides criteria for identifying critical aquifer protection areas.

CFR-Code of Federal Regulations

Other Federal Laws

Other federal laws that have an impact on water quality include:

- Resource Conservation and Recovery Act (RCRA) (42 USC §6901 et seq.), along with the Hazardous and Solid Waste Amendments of 1984, which regulate solid and hazardous waste;

- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 USC §9601 et seq.) which provides for response to releases of hazardous substances, and established the Federal Superfund; and the Superfund Amendment and Reauthorization Act (SARA) of 1986 which strengthened the Superfund provisions and established a response mechanism for release of regulated substances from underground storage tanks (USTs);

- Pollution Prevention Act of 1990 (42 USC §13101 et seq.) which makes contaminant reductions at the source a national policy;

- Endangered Species Act of 1973 (16 USC §1531 et seq.) provides a means of protection to all endangered species and protection for critical habitat. Regulations in 50 CFR Part 17 address critical habitat and its protection.

- Colorado River Basin Act of 1968 (43 USC §1501-1556) which provides for the Central Arizona Project and provides for restrictions and contracts.

RCRA's role in regulating hazardous waste treatment, storage and disposal helps protect water quality by addressing underground storage tanks, landfill design and operation, and groundwater monitoring. It also plays a major role in helping states develop solid waste

management plans. CERCLA addresses water quality through the regulation and clean up of contaminated sites. With the Superfund (CERCLA) program funding is made available to remediate groundwater contamination and to respond to releases of hazardous substances into surface water. The Pollution Prevention Act was designed to encourage reduction of all pollutants at the source and eliminate waste generation, thus reducing the likelihood of water quality degradation due to fewer potential pollutants entering the environment (PAG, 1994). The Endangered Species Act includes provisions protecting against the destruction of the habitat of certain species, which includes waterbodies.

Other Federal Agencies

The EPA is one of several federal agencies that play a role in protecting the nation's water resources. Many other federal agencies carry out programs that are designed to minimize environmental degradation.

The U.S.Department of Agriculture (USDA) has a major role in stewardship of the land and resources. The USDA is responsible for the management of National Forest land. The Forest Service manages 191 million acres of public land and utilizes several programs to ensure water quality. The Forest Service Water Quality Program includes the Nonpoint Source Pollution Management Plan, and the Watershed Restoration Program. Under the USDA, the Natural Resources Conservation Service (NRCS) in conjunction with local conservation districts carries out programs that protect water resources. They have also developed a county-based soil survey that ranks soils for groundwater contamination vulnerability assessments using leaching rates.

The Department of Defense (DoD) established the Defense Environmental Restoration Program (DERP) in 1984 to promote and coordinate efforts for the assessment and cleanup of contamination at Department installations.

The USGS provides geologic, topographic and hydrologic scientific information that can be used in developing resource management plans. They also are involved in groundwater research in the areas of quantity and quality, they investigate contamination problems (EPA, 1993).

The EPA's *Guide to Federal Water Quality Programs and Information* lists the following programs that the U.S. Department of the Interior is involved in to help assess and protect surface water quality on the national level.

- National Contaminant Biomonitoring Program
- Colorado River Salinity Program
- National Stream Quality Accounting Network Program
- National Water Quality assessment Program
- Watershed Protection Program: Park Based Water Quality Data Management System
- Water Resources Assessment Program
- Biomonitoring of Environmental Status and Trends
- National Wetlands Inventory
- National Irrigation Water Quality Program

- National Wild and Scenic River System
- US Fish and Wildlife Service water quality and habitat studies
- Bureau of Land Management Initiatives

Arizona State Laws

In Arizona the Department of Environmental Quality (ADEQ) has the responsibility for regulating water quality. Arizona state laws regulating water quality center around two major Acts: the Environmental Quality Act (EQA) and the Groundwater Management Act (GMA). In addition to concerns specific to Arizona, components of these Acts address provisions of the major federal water laws reviewed above. Laws affecting water quality are codified in the Arizona Revised Statues, mainly under Title 49, The Environment.

Arizona Revised Statutes

The Arizona Revised Statutes (A.R.S.) contain the Arizona laws relating to environmental quality. The following Chapters in Title 45, Waters, deal with specific water issues:

Table 5. A.R.S. Title 45 Selected Chapters

CHAPTER	DESCRIPTION
Chapter 1, Article 1	Establishes the Arizona Department of Water Resources (ADWR)
Chapter 2	§ 45-411Active Management Areas
Chapter 3	Underground Water Storage
Chapter 3.1	Underground Water Storage Savings and Replenishment
Chapter 11	County Water Augmentation Authority
Chapter 13	County Water Authority
Chapter 14	Water Banking Authority.

Title 49, Environment, Chapter 1 (§ 49-101) establishes ADEQ and Chapter 2 addresses water quality. The primary responsibility for water quality rests with ADEQ while Arizona Department of Water Resources (ADWR) is primarily responsible for water quantity and supply (PAG, 1994). The articles and sections of A.R.S. Title 49, Chapter 2 are listed below on Table 6.

Table 6. A.R.S. Title 49 Chapter 2 – Water Quality Control

ARTICLE
Article 1 General Provisions § 49-201 through § 49-218
Article 2 Water Quality Standards § 49-221 through § 49-225
Article 2.1 Total Maximum Daily Loads § 49-231 through § 49-238
Article 3 Aquifer Protection Permits § 49-241 through § 49-252
Article 4. Enforcement
Article 5. Remedial Actions
Article 6. Pesticide Contamination Prevention
Article 7. Water Quality Appeals
Article 8. Dry Wells
Article 9. Potable Water Systems
Article 10. Wastewater Collection and Treatment Sewage Treatment Plants
Article 11. Repealed
Article 12. Local Water Pretreatment

Other Chapters under Title 49 that impact water in Arizona include: Chapter 4- Solid Waste Management, Chapter 5- Hazardous Waste Disposal, Chapter 6- Underground Storage Tank Regulation, and Chapter 8-Water Infrastructure Financing Program.

Arizona Administrative Code

The Arizona Administrative Code (A.A.C.) contains the regulations associated with the statutes discussed above. Title 18, Environmental Quality, contains the bulk of the regulations that directly pertain to water, and these are shown on Table 7.

Table 7. Arizona Administrative Code, Title 18, Environmental Quality

CHAPTER	SUBJECT
Chapter 1	Administration
Chapter 2	Air Pollution Control
Chapter 3	Repealed
Chapter 4	Safe Drinking Water
Chapter 5	Environmental Reviews and Certifications
Chapter 6	Pesticides and Water Pollution Control
Chapter 7	Remedial Action
Chapter 8	Waste Management
Chapter 9	Water Pollution Control
Chapter 10	Repealed
Chapter 11	Water Quality Standards
Chapter 12	Underground Storage Tanks
Chapter 13	Solid Waste Management
Chapter 14	Permits and Compliance Fees
Chapter 15	Water Infrastructure Finance Authority of Arizona
Chapter 17	Pollution Prevention

Environmental Quality Act

The Arizona Environmental Quality Act (EQA) established ADEQ and created a comprehensive water quality management structure. ADEQ is the responsible agency for all purposes of the major federal water quality legislation, including the CWA, SDWA, and RCRA. The Act covers point and non-point source pollution as well as setting standards for aquifers and surface waters. The EQA is part of Arizona Revised Statutes Title 49. Under this statute the Arizona Water Quality Standards and the Aquifer Protection Programs were established (ADWR, 1999).

Groundwater Management Act

The Arizona Groundwater Management Act (GMA) was passed in 1980 to address the issue of groundwater overdrafting in several critical areas of the state. The GMA requires Arizona Department of Water Resources (ADWR) to administer safe-yield and 100-year assured water supply requirements in Arizona (PAG, 1994). The GMA also established the active management areas (AMA). These were areas in the State that had severe groundwater overdraft problems. The GMA is incorporated in Arizona Revised Statute Title 45.

Local Ordinances

Pima County Code

Pima County has its own municipal regulations that are listed in the Pima County Code. The Code is organized into Titles, which contain Chapters addressing specific issues. Pima County Code Title 7, Environment Quality, contains the bulk of the ordinances addressing water quality concerns. The Titles containing water quality provisions are shown on Table 8.

Water Consumer Protection Act

Tucson Water began the direct delivery of Central Arizona Project water to 60% of its customers in 1992. Direct delivery was eventually scaled back and ultimately ceased in 1994 due to customer complaints and concerns over water quality. In 1995, in response to the water quality problems experienced by area residents, the Citizens Water Protection Initiative was passed. This required the City to develop a new plan for delivering water to its customers and had significant impacts on the management of water supplies in Tucson and the area. The Act amended the City code for five years and portions of the Act were to remain in effect until citizens voted to repeal or amend it.

The Act required the City to treat CAP water to concentrations equal to or below the levels found in Avra Valley groundwater for salinity, hardness, and dissolved organics if it was going to used as a potable water source. The Act also required the City of Tucson to use only groundwater from "unpolluted sources" as its potable water supply. Pollution was defined as the "...presence of an amount of any substance in groundwater which exceeds any standards prescribed by the laws of the State of Arizona or the United States" (ADWR, 1999). In November 2000 the voters of the City of Tucson defeated a subsequent initiative that would have further restricted the use of CAP water.

Table 8. Pima County Code. Provisions Relating to Water Quality

TITLE NUMBER AND CHAPTER	SUBJECT	DESCRIPTION
Title 7, Chapter 7.03	Environmental Quality	Plan approval and operating permits for public and privately owned water systems
Title 7, Chapter 7.09	Hazardous Waste Generators	Hazardous waste generators must register with PDEQ and submit a Hazardous Waste Management Plan.
Title 7, Chapter 7.21	Liquid Waste	Regulates septic system design, haulers and permitting
Title 7, Chapter 7.25	Waste Collection	Waste collection and licensing of collectors and recycling
Title 7, Chapter 7.29	Solid Waste	Users and producers must dispose of waste in an approved method
Title 7, Chapter 7.37	Water Potablity	Requires public water suppliers to comply with the secondary MCLs and water quality aesthetics
Title 13	Public Services	Sewer layout, industrial discharges to publicly owned treatment works and sanitary landfills.
Title 15	Buildings and Construction	Building codes including plumbing codes and pools/spas.
Title 16	Floodplain and Erosion Hazard Management	Specifies floodplain management, floodplain acquisition, and overall watershed management
Title 16, Chapter 16.52	Sediment and Erosion Control	Grading of any watercourse must be controlled to minimize loss of soil through erosion from rainfall or stormwater runoff
Title 16, Chapter 16.54	Watercourse and Riparian Habitat Protection and Mitigation	Enhance wildlife and recreation values by preserving riparian vegetation along watercourses and floodplains
Title 18	Zoning	The county zoning code. One purpose of the zoning code is to develop a land use plan.
Title 18, Chapter 18.59	Golf Course Zone	Allow golf courses while preserving water resources and specifying effluent use.

Local Applicability of Laws and Regulations

Implementation and compliance with the myriad of federal, state and local laws and regulations can be quite complex. There are five, essentially interconnected principal sources of water in Pima County. Just as these water sources are interconnected, potentially impacting one another, so is the regulatory framework that governs their use and protection. Federal and state laws cover these different sources through different statutes and regulations. This section looks at each of these water sources in the context of the regulations and rules that protect water quality:

- Groundwater from wells
- Surface waterbodies such as streams and lakes
- Stormwater runoff
- Imported Central Arizona Project (CAP) water that is primarily Colorado River water.
- Treated wastewater.

Groundwater

Safe Drinking Water Act

Groundwater used as a source of drinking water is covered under the SDWA. The Act sets two types of standards: national primary drinking water standards and secondary drinking water standards. The primary drinking water standard may be either primary Maximum Contaminant Levels (MCLs) or treatment technique requirements (TT). MCLs are the enforceable standard for safe drinking water and represent the maximum permissible concentration of a constituent in water provided to the public. TT requirements set action levels for constituents that cannot be directly removed by water systems like lead and copper. The secondary drinking water standards are guidelines based on aesthetics including taste, odor and color components of water. Some localities, including Pima County, have adopted ordinances requiring compliance with some secondary MCLs. ADEQ has adopted the Safe Drinking Water Act MCLs as the state Drinking Water Standards and has the authority to adopt more stringent standards (ADWR, 1999).

In Pima County, the County has been designated the authority to enforce drinking water standards for privately-owned drinking water systems, while ADEQ is responsible for publicly owned systems, such as Tucson Water.

Aquifer Water Quality Standards

Arizona's Aquifer Water Quality Standards (AWQS), A.A.C. Title 18, Chapter 11, sets the primary drinking water MCLs as the standard for water quality in the state's aquifers that are classified and protected for drinking water use. Since all aquifers in Arizona are classified and protected for drinking water use, Arizona's AWQS are enforceable standards for all state aquifers. Arizona has also adopted narrative AWQS to regulate pollutant discharges for which no numeric standard has been established (ADWR, 1999).

Aquifer Protection Program

The Aquifer Protection Program (APP), A.A.C. Title 18, Chapter 9, of the Arizona Administrative Code, requires an individual or general permit for any person or facility that discharges a pollutant directly to an aquifer, the land surface, or the vadose zone with the likelihood that the pollutant will reach the aquifer. The purpose of this rule is to protect groundwater quality for drinking water purposes. Discharging facilities that require either an individual or general permit include wastewater treatment facilities and underground water storage facilities if wastewater effluent is used; surface impoundments, pits, ponds, and lagoons; solid waste disposal facilities; injection wells; land treatment facilities; mine tailings; mine leaching operations; septic tank systems with a capacity of greater than 2000 gallons per day; point source discharges to navigable waters; sewage or sludge ponds. The recently revised rule became effective January 1, 2001. The new rule requires more detailed information from the permit applicant as well as information on sources of flow and characteristics of the sewage discharges (A.A.C. 18-9).

Underground Storage Tanks

Underground storage tanks and their operation are covered under ADEQ's Underground Storage Tank (UST) Program, Title 18, Chapter 12. A part of RCRA, the UST program consists of technical standards for new and existing tanks, leak detection and closure procedures, corrective actions for remediation, and a notification requirement (PAG, 1994).

Source Water Assessment Program

The Arizona Department of Environmental Quality has implemented a Source Water Assessment Program with the goal of evaluating each source water that provides drinking water to public water systems. The assessment will determine the level of risk of contamination, based on land use practices, and the risk they might present to water sources for individual public water systems. This information can then be used to determine source protection measures such as wellhead protection. In addition, specific monitoring programs may be developed based on the likelihood of a particular contaminant (ADEQ, 2001a).

Wellhead Protection

The SDWA contains the Wellhead Protection element. Each state is required to develop a Wellhead Protection Plan that defines and enforces an area of protection around public groundwater supply wells. ADEQ's Wellhead Protection Program supplements the state's well construction standards and well drillers licensing program to increase groundwater quality protection. These standards help to minimize the possibilities of contaminant flow from the surface to groundwater or between aquifers. The Wellhead Protection (WHP) Program encourages the protection of all wells. ADEQ administers the program with funding provided by the EPA and provides assistance to the public water systems during development and implementation of a WHP program. Wellhead protection is a voluntary program that is developed by local communities (PAG, 1994; ADWR, 1999).

Arizona Department of Water Resources

The Arizona Department of Water Resources (ADWR) protects groundwater through its permitting process, water quantity management programs, and the role it plays in the WQARF program. It is also responsible for administering the GMA through the development and implementation of five management plans for each Active Management Area (AMA) covering 1980 through 2025 (Malcolm Pirnie, 1995).

One of the things the ADWR does to conserve water supplies is appropriate the uses of poor quality groundwater. Permits are issued by the Department for the withdrawal of groundwater, that because of its quality, has no beneficial use. These permits are usually issued in conjunction with a CERCLA or WQARF project and the objective is to match poor quality groundwater with a beneficial use within the AMA.

CERCLA and WQARF Programs

The WQARF Program further protects state groundwater. The Water Quality Assurance Revolving Fund monies are used to support hazardous substance cleanup efforts and may be used in conjunction with federal funds. Funds from this program can also be used for statewide water quality monitoring, health and risk assessment studies and remediating hazardous substances that may impact state waters. There are several groundwater contamination sites in Pima County that are currently monitored or remediated under the State WQARF program and Federal CERCLA program.

The state lists the following WQARF sites in Pima County: 7th St. and Arizona Ave., Broadway-Pantano Site, Los Reales Site, El Camino del Cerro, Miracle Mile, Park-Euclid, Shannon Road-Rillito Creek, and the Silverbell Jail Annex. The Tucson Airport Area Remediation Project is part of a Federal Superfund site (ADWR, 1999; ADEQ, 2001c).

RCRA

Facilities that treat, store or dispose of hazardous waste are permitted under RCRA. The individual permits specify design, performance and operational standards that include required groundwater monitoring. There are also specific closure requirements that require long-term groundwater monitoring (ADWR, 1999).

Surface Water

Section 404 Permits

Section 404 of the CWA is the primary statute regulating the discharge of dredged or fill material into waters of the United States. This provision requires dischargers to obtain a Section 404 permit from the U.S. Army Corps of Engineers. The Corps manages the permit program in cooperation with the EPA and has the specific responsibilities of day to day administration, policy development and enforcement. The EPA's responsibilities include identifying exempt activities and developing environmental criteria in evaluating permit applications. The EPA also has the authority to veto the Corps' permit decisions.

The Corps has developed *general permits* for discharges that have only minimally adverse effects. These general permits can be issued on a national, regional or state basis. They are typically issued for particular types of activities such as utility line backfill and minor road crossings. There are currently 40 nationwide general permits in effect, and CWA 401 certified by ADEQ. The Arizona Department of Environmental Quality has the authority under Section 401 of the CWA to grant, deny, or waive water quality certification for both individual and nationwide permits. The Corps cannot issue a permit where ADEQ hasn't approved or waived certification or where ADEQ has denied certification (ADEQ, 2001b).

Section 208 Plan

Section 208 of the CWA requires regional planning in developing comprehensive water quality management plans. These plans must identify current and proposed wastewater treatment facilities to meet regional municipal and industrial waste treatment needs for 20 years. The plans provide guidance on the issues of non-point source pollution, stormwater and discharge. The Plan ensures that effluent discharge permits are consistent with local plans and that wastewater construction projects are consistent with the areawide plan (PAG, 1990).

National Pollutant Discharge Elimination System

The National Pollutant Discharge Elimination System Permit Program, section 402 of the CWA, regulates the discharge of pollutants from point sources to waters of the United States. Point sources include industrial facilities, feedlots and municipal facilities that discharge directly into surface water. These dischargers are required to obtain permits and meet industry specific requirements with regard to quantity and quality of discharge. Since its creation in 1972, this permit program is credited for the significant improvement in the nation's water quality (EPA, 2001).

The State of Arizona is currently seeking primacy over the National Pollutant Discharge Elimination System (NPDES) Permit Program. Arizona is one of only six states that does not have this type of authorization from the U.S. Environmental Protection Agency (EPA). To gain primacy over the program, Arizona must demonstrate that it has appropriate statutory authority to administer the program, must develop a Memorandum of Agreement with EPA, and must develop rules to implement the program. During the 2001 legislative session, the Arizona Department of Environmental Quality (ADEQ) was given authority to administer the Arizona Pollutant Discharge Elimination System (AZPDES) program. A Memorandum of Agreement between Region 9, EPA and ADEQ, which delineates the responsibilities of the two agencies during the transition, has been drafted and is in the final review process. ADEQ convened a NPDES Rules Subcommittee that reviewed the federal NPDES rules to determine which rules should be incorporated by reference by the State. AZPDES program rules were released for review in the summer of 2001. The State plans to complete the primacy process by 2002.

In July 2001 the EPA issued a general water pollution discharge permit to large Arizona feeding operations. The intent of this permit is to prevent the discharge of manure and other pollutants into Arizona rivers and lakes (EPA Region 9, 2001).

Clean Water Act Section 305(b)

Arizona Department of Environmental Quality is required under the CWA section 305(b) to report information on statewide water quality to the Environmental Protection Agency. ADEQ addresses this requirement in A.A.C. Title 18, Chapter 11. This report must identify surface waterbodies that are not supporting their designated uses and identify stressors, and their possible sources, that are causing water pollution. Under this section ADEQ is also required to identify waterbodies where existing data are insufficient to determine whether the designated uses are supported. The report must also describe regulatory programs that are aimed at protecting and improving water quality.

Under this section the specifications and criteria for "unique waters" are addressed. ADEQ may classify surface water as a "unique water" upon finding that the surface water is an outstanding state resource based on specific criteria. The criteria include that the surface water be perennial, must be in a free flowing condition, have good water quality and be of exceptional recreational or ecological significance or have endangered species known to be associated with and dependent on the water quality. In Pima County portions of Cienega Creek and Buehman Canyon Creek meet these criteria and have been designated as "unique waters" (ADEQ, 2000; AZ. Admin.Code, 2001).

Clean Water Act TMDL Program, Section 303(d)

Separate but related to the 305 (b) requirement is the CWA section 303 (d) TMDL Program. States are required to identify and list waterbodies that are not meeting water quality based standards. Known as the "303(d) list", these water quality limited segments must be prioritized by the State based on the level of pollution and the designated uses of the water. For each identified pollutant, the State must determine a total maximum daily load (TMDL) which is the amount of that pollutant a waterbody can tolerate without exceeding the water quality standard. TMDLs should take into account all sources of a pollutant - point and nonpoint sources - seasonal variations and a margin of safety.

Arizona currently has 102 waterbodies on the 303(d) list. EPA policy requires States to complete TMDLs within a reasonable period of time or approximately 8 to 13 years from first listing. ADEQ currently has a schedule for completing all TMDLs for the current listing by 2010. As stated in the PAG report: *Water Quality in Pima County* only one surface waterbody in Pima County, Arivaca Lake, is currently on the state's 303 (d) list.

TMDLs and impaired waters must be considered in the National Pollution Discharge Elimination System (NPDES) permitting process. Where there is a discharge proposed to an impaired waterbody, if pollutants in the discharge exceed the tolerable loading, discharges would have to be reduced or denied (ADEQ, 2001e).

EPA and ADEQ have begun focusing on implementing the water quality programs on a watershed basis. The goal is to integrate ADEQ's regulatory, monitoring, permitting and planning efforts internally and externally with other government agencies and the needs of communities within the watershed. To accomplish this, ADEQ divided the State along the natural watershed boundaries and focussed resources, rotating through the various

watersheds. Working with the local communities, ADEQ will conduct a detailed assessment of the water quality in the watershed. Over the course of a watershed cycle, problems and concerns will be identified and prioritize in order to develop a plan to address them. At the end of the cycle, a detailed assessment will determine the success of the effort, identify new issues and begin again.

An important aspect of the watershed management process is scheduling permitting activities at the appropriate time in the cycle. EPA and ADEQ are evaluating the best ways to refine the NPDES framework to make decisions based on a watershed analysis and to involve local leadership in planning and in pollution control. In 1996, EPA and ADEQ began coordinating the renewal of the NPDES permits to coincide with the watershed schedule to begin the process. Adherence to the schedule will depend on a number of programmatic factors including TMDLs, local issues, and EPA inputs (ADEQ, 2001e).

National Nonpoint Source Program

The National Nonpoint Source Program was established to control nonpoint sources of water pollution. Section 319 of the CWA required all states to develop source assessment reports and to adopt management programs to control pollution. All states have approved management programs. State law requires that a program to control non-point source discharges of any pollutant or combination of pollutants into navigable waterways be formed. Under this provision the state implemented a surface water quality general grazing permit consisting of voluntary best management practices (EPA, 1993).

RCRA

This law regulates hazardous and solid waste management and sets standards for the operation of landfills. The rules that specify the criteria for municipal solid waste landfills are found in 40 CFR, Chapter 1 Part 258. The criteria include location restrictions that ensure landfills are built in suitable geological areas and away from faults, floodplains, wetlands and other restricted areas. In addition, to further protect surface water a landfill must have a system to control runoff from storms and prevent discharges that may violate the CWA (EPA, 2001a; PAG 1994).

Endangered Species Act

The Endangered Species Act (ESA) of 1973 was written to provide a means for the protection of all endangered and threatened species of life. It is comprehensive in that it also provides for the protection of the critical habitats on which these species depend for survival. The U.S. Fish and Wildlife Service (FWS), and the National Marine Fisheries Service (NMFS) are responsible for administering the Act, with FWS covering all non-marine species and NMFS covering all marine species.

In 1982 the ESA was amended to allow "taking" of listed species incidental to otherwise lawful activities. The Habitat Conservation Planning (HCP) process was developed to resolve issues between economic development on private lands and species conservation. Under section 10(a)(1)(B) of the ESA, the conservation plan must ensure that the permittee will minimize and mitigate the effects of the authorized incidental take to the maximum extent possible. One of the objectives the county has for integrating the

Comprehensive Land Use Plan and the Sonoran Desert Conservation Plan is to work toward acquiring a Section 10 Permit (Pima County, 2000; US Fish and Wildlife, 2001).

Stormwater Runoff

National Pollutant Discharge Elimination System

In 1987, Congress directed EPA to develop a regulatory program to address stormwater quality issues. In 1990, EPA included a permitting process for stormwater discharges under the National Pollutant Discharge Elimination System (NPDES). An NPDES permit is required for any point source discharge of pollutants to a Water of the United State. The NPDES Stormwater Permit Program, Phase I, regulates medium and large municipalities (populations greater than 100,000) and certain types of industries. In Pima County, both the City of Tucson and Pima County are regulated under Phase I rules. (ADEQ, 2001f).

On December 8, 1999, EPA published rules for Phase II of the stormwater program. This phase brings in two previously unregulated entities: certain small municipalities, and those construction sites that disturb one acre but less than five acres.

Several dischargers to municipal separate storm sewers are regulated under Phase II. These include those that were not already covered by Phase I of the NPDES stormwater program, are located in urbanized areas, as defined by the Bureau of the Census, and some municipal separate storm sewer systems located outside urban areas that the NPDES permitting authority designates on a case-by-case basis. In Pima County this will include the City of South Tucson, Town of Oro Valley and the Town of Marana (ADEQ, 2001f).

In addition, the term "small municipal separate storm sewer system" also includes systems similar to small municipal storm sewer systems such as systems at military bases, large hospitals or prison complexes. The definition of a "separate storm sewer system" includes any method of conveying surface water, including streets, gutters, ditches, swales or other drainages not considered to be waters of the United States.

Phase II stormwater regulations require construction sites disturbing land equal to one acre and less than five acres acquire permit coverage. Also, those construction activities that disturb less than one acre that are part of a greater common plan of development or sale are required to obtain permit coverage, where the greater common plan of development or sale is one acre or more. This will impact development in the City of Tucson and unincorporated Pima County.

Pima County and the City of Tucson are in the process of writing their NPDES stormwater permit applications for their second 5-year permit term. If the State gets NPDES primacy, then ADEQ will likely issue the permits for the County and the City.

Floodplain and Erosion Hazard Management Ordinance

The Pima County "Floodplain and Erosion Hazard Management Ordinance" requires that floodplain management be included as part of an integrated program of natural resource management and flood and erosion hazard reduction. It also stresses that the County acquires lands within the regulatory floodplain and erosion hazard areas and that these lands are then managed by the Pima County Flood Control District to preserve or enhance natural values and expressed resource management goals. Regulatory land use control for floodplain management emphasizes overall watershed management and that management polices should be used to prevent unwise human occupation and encroachment into regulatory floodplain areas (Pima County, 2001).

Watercourse and Riparian Habitat Protection and Mitigation Requirements

The purpose of the Pima County "Watercourse and Riparian Habitat Protection and Mitigation Requirements" ordinance (Chapter 16.54) is to enhance wildlife and recreation values where appropriate by preserving riparian vegetation along watercourses and floodways. This helps to protect the limited and endangered natural riparian habitat resources in Pima County while providing recreation and wildlife riparian habitat for the enjoyment of the community (Pima County, 2001).

CAP Water

Clean Water Act

The primary source of CAP water, the Colorado River, and the surface waters that contribute to it, are protected under the various provisions of the CWA that are addressed in the surface water section.

Safe Drinking Water Act

All CAP water that is used for public drinking water must comply with the Safe Drinking Water Act and conform to the rules specified in A.A.C. Title 18 Chapter 4.

Arizona Department of Water Resources

ADWR is responsible for many water quantity management programs directly involved with the utilization of CAP water. The Colorado River Basin Act of 1968 provided for the creation of the Central Arizona Project. As a condition for federal funding of the CAP canal and to address a long-term groundwater overdraft problem, the Groundwater Management Act was passed in 1980. The Act established the active management areas (AMAs) having the most severe groundwater overdraft problems. The goal of the management plans is to achieve safe yield – a condition where long-term groundwater withdrawals don't exceed groundwater recharge. Using CAP water in the Tucson AMA would greatly reduce the demand for groundwater, thus meeting the safe-yield requirement (Malcolm Pirnie, 1995).

The Arizona Water Protection Fund was established in 1994 to issue grants to water users for implementing projects to protect the state's rivers and streams including the use of excess CAP water for riparian enhancement (ADWR, 1999).

The 1995 Assured Water Supply Rules specify that new residential development within the AMA must demonstrate that sufficient water supplies are available to meet proposed uses for 100 years, consistent with achieving the safe-yield goals. In 1996 legislation established the Arizona Water Banking Authority (AWBA) for the purpose of increasing the use of excess CAP water, primarily through recharge in Phoenix, Pinal and Tucson AMAs. In 1994 passage of the Underground Water Storage Savings, and Replenishment Act integrated the various underground water storage programs adopted since 1986 into a single unified program (ADWR, 1999).

Water Consumer Protection Act

It was planned that CAP water would be used for direct delivery by Tucson Water to its customers, therefore replacing groundwater use. The water was treated to SDWA standards at the Hayden-Udall Water Treatment Plant prior to delivery. However, water quality problems resulted in the discontinuation of direct delivery and in the passage of the Water Consumer Protection Act by City of Tucson voters in 1995 which limited direct delivery of the water. Since that time other ways of using the CAP water for a potable supply have been researched, as well as recharge and use by non-municipal entities (ADWR, 1999; Tucson Water, 2000). In November 2000 the voters of the City of Tucson defeated a subsequent initiative that would have further restricted the use of CAP water.

Recharge Regulations

The Clearwater Renewable Resource Facility is a water supply project designed to recharge Colorado River water in Avra Valley where it blends with native groundwater in the aquifer. The Clearwater facility operates with both an Underground Storage Permit and Water Storage Permit. These permits will allow Tucson Water to store up to 60,000 acre-feet per year. The full scale project will be monitored in accordance with the Underground Storage Permit and will require monitoring of the water levels, volume, infiltration rates, and water quality including monitor wells and raw CAP water. A Water Storage Permit issued to the Arizona Water Banking Authority by ADWR allows Tucson Water to store excess CAP water at the recharge project. In May of 2001, Tucson Water customers began receiving the recharged CAP water/groundwater blend. As stated above this blended water must meet all drinking water standards set forth by the SDWA.

Other CAP recharge facilities include the Pima Mine Road Recharge Project (PMRRP) and the Avra Valley Airport Project. The PMRRP operates under a full-scale Underground Storage Facility Permit and water recharged during the year was stored on behalf of the Arizona Water Banking Authority and the Central Arizona Groundwater Replenishment District. The Avra Valley project is run by the Central Arizona Project using CAP water purchased by Metropolitan Water District and the Arizona Water Bank.

The regulatory setting for recharge is complex. Federal, state, and local regulations and policies and the actions of other institutions and agencies have significant impacts on recharge and supply augmentation efforts. Key factors include (ADWR, 1999):

- Indian water rights settlements;
- ADEQ regulations including aquifer protection permits (APP), water disinfection rules for groundwater under the influence of surface water, aquifer water quality standards (AWQS) and wastewater reuse permits;
- Federal Clean Water Act requirements including National Pollutant Discharge Elimination System (NPDES) permits and section 404 permits (administrated by the United States Army Corp of Engineers);
- United States Fish and Wildlife activities and Endangered Species Act (ESA) requirements;
- The State Historic Preservation Act and local requirements for archaeological surveys;
- U.S. Bureau of Reclamation activities and requirements of the Reclamation Reform Act (RRA);
- Local zoning and flood control regulations; and
- City of Tucson 1995 Water Consumer Protection Act

Wastewater

Clean Water Act

Federal and state regulatory requirements apply to effluent discharge uses, such as river discharge, aquifer recharge, underground storage and recovery, and irrigation. The Clean Water Act established the guidelines for the issuance of NPDES Permits. The Federal NPDES permit program establishes discharge quality requirements that are enforced through monitoring and reporting. Plant specific discharge standards are established under the CWA and the state's Surface Water Quality Standards. In Arizona effluent is defined by A.R.S. §45-101(4) as "water that has been collected in a sanitary sewer for subsequent treatment in a facility that is regulated pursuant to A.R.S. §49-361 and 49-362".

Aquifer Protection Permit Program

Under the state Aquifer Protection Permit program ADEQ requires all dischargers to obtain APP permits and to achieve the Aquifer Water Quality Standards (Malcolm Pirnie, 1995).

Section 208 Plan

Under section 208 of the Clean Water Act an Areawide Water Quality Management Plan must be developed to guide regional water quality issues. The law prohibits the issuance of any NPDES discharge permit that is inconsistent with the 208 Plan. This requires all wastewater treatment plant permitted discharges to be consistent with the 208 Plan. New

APP rules preclude issuance of an APP to a wastewater treatment facility that is not consistent with the 208 Plan.

Reuse Rules

Regulations apply to wastewater treatment facilities supplying reclaimed water and to the sites where water is applied or used. In 1994 legislation was passed to consolidate the state's programs to encourage the use of renewable water sources (Malcolm Pirnie, 1995). Reuse permits are issued to facilities that provide wastewater for reuse. ADEQ wastewater reuse rules (A.A.C. R18-9-701) set the criteria for the use of treated effluent or reclaimed water. The permits specify the amount of effluent to be reused and its quality (ADWR, 1999).

Recent revisions to the state's APP and reuse permit program rules, A.A.C. R18-9, enabled ADEQ to modify the rules with regard to the use of graywater by state residents. It is now possible for homeowners to utilize graywater generated at their home for landscape use under a general permit. The new rules went into affect in January of 2001(Water Conservation Alliance of Southern Arizona, 2001).

Reclaimed Water Standards

The Reclaimed Water Standards, A.A.C. R18-11-301 through R18-11-309, establish the five classes of reclaimed water expressed as a combination of minimum treatment requirements and a limited set of numeric reclaimed water quality criteria (ADEQ, 2001d).

Reclaimed water dispensed to a direct reuse site from a sewage treatment facility is regulated under the Reclaimed Water Quality Standards, ARS 49-221(E) and reclaimed water permit requirements ARS 49-203 (A) (6). ADEQ requires that a "Reclaimed Water Individual Permit or Reclaimed Water General Permit is necessary for the application of reclaimed water. The generator of the wastewater must treat it to one of five reclaimed water quality classes to qualify for reuse and is required to obtain an individual Aquifer Protection Permit (APP). The APP requires monitoring and reporting of reclaimed water quality to ensure that effluent limitations for reuse water quality classes are met. Persons who receive reclaimed water from a wastewater treatment plant, with the intent of using it for beneficial purposes, are required to obtain a Reclaimed Water Permit. There are nine general permits: one Type 1, five Type 2 and three Type 3. Two general permits are issued for graywater, one for a Reclaimed Water Agent, one for a Reclaimed Water Blending Facility and five for end-users based on the Reclaimed Water Class. In most cases, if these general permits meet certain Water Quality class requirements, they can be permitted in less time and with lower review fees than the Reclaimed individual permit."

Summary and Conclusions

Federal and state laws enacted over the last 25 years have accomplished much in water quality protection. Due to a variety of water quality problems that have been identified at the national, state and local levels, a wide-ranging, complex network of regulations has been enacted. The regulations are in a constant state of review and revision, and new regulations are adopted as additional environmental problems are discovered. Existing regulations are revised as the need for improvements or increased efficiency are identified. In some cases, graywater for example, regulations have been eased to encourage efficient use and conservation of water resources.

All of the major categories of water sources in Pima County are amply regulated with regard to water quality by multiple programs at the state, federal and local levels. Surface waterbodies, stormwater runoff, CAP water and treated wastewater are protected to varying degrees by the Clean Water Act, Resource Conservation and Recovery Act and other regulations at the federal level, and by the Environmental Quality Act at the state level. Permits issued under the federal NPDES program and the state Aquifer Protection Permit program are key mechanisms by which water pollution is prevented. Arizona's Unique Waters program is a means by which surface waterbodies can receive additional protection. Groundwater quality in Arizona is protected primarily through the state's Aquifer Protection Permit program. Additional protection and remediation occurs through the federal CERCLA and RCRA programs and the state's Water Quality Assurance Revolving Fund. Opportunities for further protection are available through the state's voluntary Wellhead Protection program.

Given the extensive set of state and federal regulations, additional laws aimed directly at regulating water quality and pollutant discharges are probably not warranted. However, the effectiveness of the existing regulatory programs depends on the financial resources available to implement them and the degree to which regulatory agencies are able to enforce them. Also, even though existing regulations contain numerous provisions relating to pollution prevention, they cannot eliminate the possibility that spills or other accidental discharges of pollutants will occur.

Future unforeseen discharges of pollutants will presumably be of a short-term nature, due to the regulations that are already in place, provided that state and federal water quality regulatory programs are adequately funded. Such discharges are therefore unlikely to have significant, long-term adverse impacts on most of the water resources in Pima County, such as CAP water, groundwater, and stormwater runoff. However, the impact of an unforeseen discharge on some surface waterbodies would probably be more severe. For example, a chemical spill into a small, perennial waterbody supporting an endangered aquatic species population could have serious consequences. Therefore, additional protection of surface waterbodies, through land use planning to limit the potential for unforeseen discharges, and emergency response plans for existing transportation corridors, might be warranted.

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Appendix A. Selected Arizona Water Quality Protection Programs

From ADEQ: *The Status of Water Quality in Arizona, Clean Water Act Section 305(b) Report 2000*

PROGRAM	AGENCY*	PROGRAM DESCRIPTION
Ambient Monitoring and Assessments	ADEQ ADWR USGS AGFD	ADEQ monitors surface and ground water, sediment, animal tissue, habitat, and biological communities to assess water quality as required under the federal Clean Water Act and state statutes. Surface water quality standards are reviewed and revised in a 3-year cycle.
Border Issues (U.S/ Mexico Trans-boundary Water Quality Projects	ADEQ EPA IBWC	This program conducts water quality studies, follows up trans-boundary water quality issues, provides hydrological support to the ADEQ border infrastructure projects, and provides general ADEQ Water Border Program coordination in the Arizona-Sonora border area.
Aquifer Protection Permit (APP)	ADEQ	The APP Program is Arizona's cornerstone program for protecting ground water quality. Any facility that discharges directly into an aquifer or onto the land surface in a manner that could pollute an aquifer must operate in accordance with an Aquifer Protection Permit. General permits cover many categories of less significant and often numerous discharging activities (e.g., most septic tank and leach field systems).However, large discharging facilities, such as mines, industrial facilities, and most wastewater treatment plants require an individual APP
Capacity Development Program	ADEQ	This new program (rules approved in 1999) requires that newly proposed water systems demonstrate their ability to operate in compliance with the Safe Drinking Water Act before receiving approval to commence operation. The purpose of the rules is to help ensure that a viable water system will be formed. (See also Safe Drinking Water)
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	EPA ADEQ ADWR	CERCLA is commonly referred to as the federal Superfund Program. Administered by EPA, 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.)

Appendix A. Selected Arizona Water Quality Protection Programs

From ADEQ: *The Status of Water Quality in Arizona, Clean Water Act Section 305(b) Report 2000*

PROGRAM	AGENCY*	PROGRAM DESCRIPTION
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.
401 Certification and 404 Permits	ADEQ US Army Corps of Engineers	Under the federal Clean Water Act sections 401 and 404, a federal "dredge and fill" permit is required for modification of a stream channel or lake. ADEQ certifies that the modification activities will maintain surface water quality standards.
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. Each facility must meet standards set to prevent releases to the environment and minimize health risks. ADEQ is working with industry and government to find new ways of reducing waste streams and minimizing the volume and toxicity of hazardous waste
National Pollutant Discharge Elimination System (NPDES)	EPA ADEQ	This program's goal is to ensure Arizona's surface water quality is not compromised by discharges from various sources, especially industrial and municipal wastewater treatment discharges and stormwater runoff. Permits control the amounts of pollutants entering surface waters. The program is coordinated with EPA, which issues all permits. Typically, ADEQ drafts the permit and certifies that the permit meets all state environmental requirements prior to sending it to EPA for issuance.

Appendix A. Selected Arizona Water Quality Protection Programs

From ADEQ: *The Status of Water Quality in Arizona, Clean Water Act Section 305(b) Report 2000*

PROGRAM	AGENCY*	PROGRAM DESCRIPTION
Nonpoint Source Program	ADEQ	Nonpoint source activities are guided by the state's nonpoint source management plan. 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. Aquifer Protection Permits are required for many nonpoint source activities.
Pesticide Prevention Program	ADEQ AZ Dept. of Agriculture	Arizona's Pesticide Contamination Prevention Program works to prevent or eliminate water contamination from routine agricultural pesticide use. All agricultural pesticides must be registered and approved for use in Arizona. Information from the registration process is used to generate the Ground Water Protection List. This list has been used to direct soil, surface and ground water monitoring.
Pollution Prevention Program (Pretreatment)	ADEQ	The program helps Arizona's large hazardous waste generators and toxic substance users reduce waste production, toxic substance use, and environmental releases.
Poor Quality Groundwater Withdrawal Permit	ADWR	Permits may be issued for non-irrigation use if the ground water 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.
Reuse Permits	ADEQ	This program regulates facilities that provide wastewater for reuse. The permits specify the amounts of effluent to be reused and its chemical quality
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. (See Source Water Assessment and Capacity Development Program)
Septic System Permits	County Health Depart. ADEQ	Under state statutes and county regulation, the construction and repair of all septic tanks and leaching systems must be approved.

Appendix A. Selected Arizona Water Quality Protection Programs

From ADEQ: *The Status of Water Quality in Arizona, Clean Water Act Section 305(b) Report 2000*

PROGRAM	AGENCY*	PROGRAM DESCRIPTION
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). (See Aquifer Protection Permits)
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. (See Aquifer Protection Permits)
Source Water Assessment	ADEQ	The Source Water Assessment Program, established under the federal Safe Drinking Water Act, provides an inventory of major land use activities adjacent to Public Water Systems. This information will be useful at the local level for making planning and zoning policy decisions to protect water quality for these water supplies. (See Safe Drinking Water)
Total Maximum Daily Loads (TMDLs)	ADEQ	This program addresses polluted waterbodies through the identification and listing of all impaired waters, the identification source contributions, the establishment of a total maximum daily load for each stressor so that standards are met, and the implementation of a TMDL reduction program.
Underground Injection Control and Stormwater Drywell Registration	ADEQ EPA	A permit is required for any "well" which would inject wastewater or stormwater into the ground, including drywells and septic tanks. (See Aquifer Protection Permits)

Appendix A. Selected Arizona Water Quality Protection Programs

From ADEQ: *The Status of Water Quality in Arizona, Clean Water Act Section 305(b) Report 2000*

PROGRAM	AGENCY*	PROGRAM DESCRIPTION
Underground Storage and Recovery Projects	ADWR ADEQ	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.
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.
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 threat to "waters of the State". Mitigation of non-hazardous substances is also allowed under state statutes.
Water Quality Management Planning/ Watersheds	ADEQ	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.
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.
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.

Source: ADEQ, *The Status of Water Quality in Arizona, Clean Water Act Section 305(b) Report 2000*, Table 23.

*EPA- Environmental Protection Agency
ADEQ-Arizona Department of Environmental Quality
ADWR-Arizona Department of Water Resources
USGS-United States Geological Survey
AGFD- Arizona Fish and Game Department
IBWC- International Boundary and Water Commission

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