Groundwater Protection In Arizona: An Assessment of Groundwater Quality and the Effectiveness of Groundwater Programs A.R.S. §49-249

As required by A.R.S. §49-249, this document reports on levels of pollutants in Arizona's aquifers and the effectiveness of groundwater protection programs established in Title 49, Chapter 2 of the Arizona Revised Statutes. This is the third such report prepared pursuant to the statutory requirement (the previous reports are dated 1993 and 1997 and are available in the ADEQ Library, which is located at 1110 W. Washington St., Phoenix, Ariz., 85007).

Because groundwater is a source for public water supply in Arizona, groundwater quality is a major concern. Groundwater quality data that ADEQ and other agencies collect show that groundwater throughout the state generally meets drinking water standards. Despite the effectiveness of state groundwater protection programs in preventing groundwater contamination, many groundwater quality problems have been identified due to human-caused contamination and pollutants present at naturally elevated levels.

Major pollutant sources in Arizona include agricultural activities, wastes from industries, leaking underground storage tanks, septic tanks, landfills, mining and wastewater treatment plants. Many of the groundwater quality problems are located in the Phoenix and Tucson metropolitan areas, but groundwater quality problems are found in all of Arizona's 10 watersheds (the list of maps with links begins on Page 38).

Pollutants detected in groundwater include volatile organic compounds (typically industrial solvents), nitrate, sulfate, dissolved solids, metals, pesticides, petroleum hydrocarbons (usually gasoline or diesel), radiochemicals and bacteria. Although groundwater contamination is a serious problem, it is stressed that the quality of water delivered in public supplies is strictly regulated and monitored to meet federal and state standards set to protect public health.

Title 49 established broad authorities for managing and protecting groundwater quality and remediating point and nonpoint sources of pollution. The explicit goal of the statute is to preserve and protect groundwater quality for all present and reasonably foreseeable future uses. This report describes the major milestones from 1998 to 2002 achieved by programs established under Title 49, Chapter 2.

The Aquifer Protection Permit (APP) Program, with its reliance on best available demonstrated control technology (BADCT, pronounced *bad cat*) and best management practices, and the Water Quality Assurance Revolving Fund (WQARF, pronounced *wharf*), are the key groundwater protection and groundwater cleanup programs, respectively, established in Chapter 2. Other Chapter 2 programs include aquifer boundaries and water quality standards, dry wells, pesticides, nonpoint source, compliance, and ambient monitoring and database management. In total, these programs have demonstrably prevented new discharges to groundwater while accomplishing cleanup of existing contamination sites. Most existing contamination sites are due to discharges that occurred prior to the establishment of the Title 49 programs.

Effectiveness of the programs can be measured by noting the accomplishments over the past five years. These include:

- Recovering $4.5 million from responsible parties for restitution of ADEQ's emergency and remedial costs
- Conducting remedial investigations or remediations at 33 WQARF sites
- Performing approximately 2,844 inspections of regulated facilities and responding to 705 public complaints
- Issuing 32 notices of correction, 522 notices of violation and 32 administrative orders to identify and correct noncompliance at facilities discharging domestic and industrial wastewaters
- Taking 43 civil penalty actions and assessing nearly $2.5 million dollars in penalties
- Collecting 211 groundwater samples from 117 wells for pesticides
- Conducting regional ambient groundwater quality studies in all 10 watersheds
- Adding over 1,000,000 records of water quality data to the groundwater database
- Issuing 570 APP actions including 103 clean closure approvals
- Improving and updating databases
- Rewriting water quality permitting rules to consolidate most water quality permits into a single unified water quality permit program

Arizona's groundwater protection programs are highly regarded by many states and agencies, including the U.S. Environmental Protection Agency (EPA), as comprising one of the most comprehensive approaches in the nation. ADEQ continues to work in partnership with the public, the regulated community, EPA and other agencies to improve groundwater protection efforts.

Introduction

This report is submitted in accordance with A.R.S. §49-249, which requires ADEQ to report every five years to the governor, the president of the senate, and the speaker of the house of representatives, on levels of pollutants in Arizona's aquifers and the effectiveness of groundwater protection programs described in Title 49, Chapter 2 of the Arizona Revised Statues. Previous reports were prepared pursuant to the statute in 1993 and 1997. As required by statute, this report assesses levels of pollutants in aquifers and describes the effectiveness of groundwater protection programs at controlling or reducing pollution in aquifers.

In Arizona, both water quantity and quality are critical to the viability of our state. Groundwater quality is a major concern because groundwater is a source of public water supplies in Arizona, and is an important component of our river and wetland environments (Wilson, 1991). Groundwater accounts for approximately 40 percent of the total supply of approximately 6.8 million acre-feet of water annually used in Arizona (ADWR, 2002). The availability of suitable quality and quantity of water has influenced the development of cities and croplands in Arizona. Rapid population growth has increasingly resulted as cropland is retired and agricultural water supplies are converted to urban drinking water uses.

Arizona's groundwater has long been subject to pressures of overdraft and waste disposal. In 1980, the enactment of the Groundwater Management Act, which established the Arizona Department of Water Resources, set in motion a comprehensive long-term effort to eliminate overdraft, and to manage groundwater as a public resource, including consideration of water quality in planning for sustained yield of groundwater.

At the inception of the Groundwater Management Act, state legislation mandating groundwater quality protection was limited. However, the Arizona Department of Health Services initiated development of a state program to protect groundwater quality in 1981. The Arizona Department of Health Services adopted narrative groundwater quality standards in 1983 and the Groundwater Quality Protection Permit program in 1984. Enactment of environmental legislation followed, culminating in the Environmental Quality Act of 1986, which established ADEQ. The Environmental Quality Act put into place a strong and comprehensive groundwater quality management program in Arizona. As in the 1980s, protection of groundwater remains a major issue entering this new millennium.

Summary of Groundwater Quality and Levels of Pollutants in Aquifers

ADEQ has adopted the groundwater basin boundaries delineated by the Arizona Department of Water Resources (see Figure 1). These basins were designated on the basis of physiography, surface drainage patterns, subsurface geology and aquifer characteristics. As specified in the Groundwater Management Act, four of the basins were designated active management areas (AMAs): Phoenix AMA, Tucson AMA, Prescott AMA, and Pinal AMA. Subsequently, the Santa Cruz AMA was designated on July 1, 1994. These basins contain the largest population centers, the greatest amount of irrigated acreage and the highest density of industry. Due to concern about groundwater overdraft, the AMAs are highly regulated with regard to groundwater pumping, water use, irrigation efficiency and conservation requirements. For the purpose of this report, ADEQ has grouped the Arizona Department of Water Resources groundwater basins into 10 watersheds (see Figure 1 on Page 6).

Principal Aquifers and Groundwater Quality

Principal aquifers in Arizona are composed of unconsolidated sediments (alluvial aquifers), consolidated sedimentary strata (sandstone and limestone aquifers), and crystalline rocks of igneous and metamorphic origin (fractured and decomposed bedrock aquifers). These aquifers are located within the three physiographic provinces of Arizona: the Plateau Uplands Province, the Central Highlands Province, and the Basin and Range Province (see Figure 1 on Page 6). The potential sources of pollution and the susceptibility of these aquifers to pollution vary depending on aquifer type and physiographic province.

The Plateau Uplands Province in the northeastern 40 percent of the state is underlain by extensive consolidated sedimentary rock formations. Most of the groundwater is withdrawn from these strata, although localized alluvial aquifers also provide supplies. While groundwater may be found near land surface, it generally occurs at a depth of more than 1,000 feet in the consolidated sedimentary rocks.

The Central Highlands Province, covering 15 percent of the state, provides a geologic and physiographic transition from the Plateau Uplands to the Basin and Range Lowlands. The Mogollon Rim marks the northern boundary of this province. Aquifers in this province are varied, including alluvial aquifers occupying relatively small basins, aquifers in consolidated sedimentary rocks, and fractured and decomposed bedrock aquifers. Much of the surface water flow within Arizona originates in the Central Highlands Province. The streams and rivers within this province are often fed by groundwater along parts of their length.

The desert Basin and Range Lowlands Province constitutes 45 percent of the state’s land surface area. This province is characterized by broad alluvial basins bounded by long mountain ranges rising sharply from the desert floor. The basins are filled by great thicknesses of fine-grained and coarse-grained sediments eroded from the mountains. The sediments deposited in the basins show much variation laterally and vertically in groundwater storage and transmission properties. Groundwater occurs in confined, unconfined and perched conditions. This basin-fill alluvium forms the most productive aquifers in Arizona, from which about 97 percent of all groundwater is pumped (Wilson, 1991). Depth to groundwater ranges from just below land surface to more than 1,000 feet.

Groundwater quality data collected from 1997 to 2002, primarily by ADEQ, the Arizona Department of Water Resources, U.S. Geological Survey and other agencies and organizations, show that groundwater throughout the state generally meets drinking water standards. Despite this finding, many groundwater quality problems have been identified, due to both human-caused contamination and pollutants present at naturally elevated levels. Although groundwater contamination is a serious problem, it is stressed that the quality of water delivered in public supplies, including those supplied by groundwater sources, is strictly regulated and monitored to meet federal and state standards set to protect public health.

Groundwater quality problems in Arizona are diverse, reflecting the multiplicity of land uses and the differing hydrogeologic characteristics of Arizona's groundwater basins. Pollutants detected in groundwater include volatile organic compounds (usually solvents such as trichloroethylene, tetrachloroethylene and 1,1,1-trichloroethane), nitrate, sulfate, dissolved solids, metals (chromium, arsenic and others), pesticides, petroleum hydrocarbons (usually gasoline or diesel), radionuclides (radon and other radiochemicals) and bacteria. Table 1 lists the major groups of pollutants found in Arizona groundwater.

The five AMAs contain the greatest number of known and potential contamination sources, as they contain nearly 80 percent of Arizona's population and much of the agricultural land. Urban (including industrial) and agricultural activities represent the two land uses most associated with contaminated groundwater in Arizona.

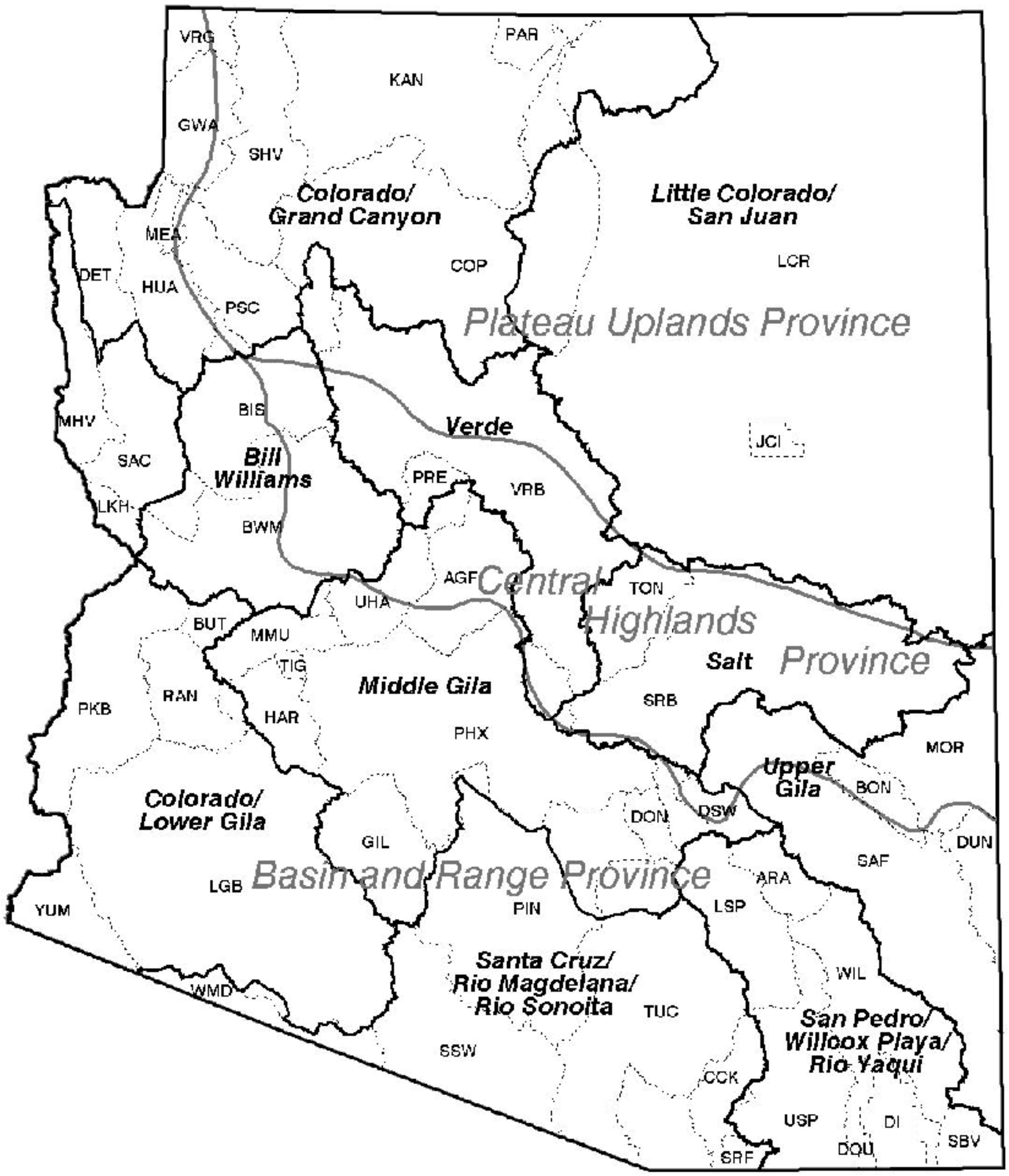


Figure 1. Arizona Watersheds and Groundwater Basins

Legend for Figure 1. Arizona Watersheds and Groundwater Basins

Watersheds

Bill Williams
Colorado/Grand Canyon
Colorado/Lower Gila
Little Colorado/San Juan
Middle Gila
Salt
San Pedro/Wilcox Playa/Rio Yaqui
Santa Cruz/Rio Magdelena/Rio Sonoita
Verde
Upper Gila

Groundwater Basin Designations

Map Code	Basin Name
AGF	Agua Fria
ARA	Aravaipa Canyon
BIS	Big Sandy
BON	Bonita Creek
BUT	Butler Valley
BWN	Bill Williams
CCK	Cienega Creek
COP	Coconino Plateau
DET	Detrital Valley
DI	Douglas INA
DON	Donnelly Wash
DOU	Douglas
DSW	Dripping Springs Wash
DUN	Duncan Valley
GIL	Gila Bend
GWA	Grand Wash
HAR	Harquahala
HUA	Hualapai Valley
JCI	Joseph City INA
KAN	Kanab Plateau
LCR	Little Colorado River
LGB	Lower Gila
LKH	Lake Havasu
LSP	Lower San Pedro
MEA	Meadview
MHV	Lake Mohave
YUM	Yuma

Map Code	Basin Name
MMU	McMullen Valley
MOR	Morenci
PAR	Paria
PHX	Phoenix AMA
PIN	Pinal AMA
PKB	Parker
PRE	Prescott AMA
PSC	Peach Springs
RAN	Ranegras Plain
SAC	Sacramento Valley
SAF	Safford
SCA	Santa Cruz AMA
SBV	San Bernadino Valley
SHV	Shivwits Plateau
SRB	Salt River
SRF	San Rafael
SSW	San Simon Wash
TIG	Tiger Wash
TON	Tonto Creek
TUC	Tucson AMA
USP	Upper San Pedro
UHA	Upper Hassayampa
VRB	Verde River
VRG	Virgin River
WIL	Willcox
WMD	West Mexican Drainage

Groundwater Pollutants

Groundwater pollution is closely related to land use, although some contamination cases are due to naturally occurring constituents in groundwater. Contamination may occur as relatively well-defined plumes emanating from point sources (for example, landfills, waste lagoons and industrial dump sites) or it may exist as a general deterioration of water quality over a wider area due to nonpoint sources (for example, agricultural fertilizer and pesticide applications, septic system discharges, leaking sewage collection systems and mining activities). Because groundwater quality degradation from nonpoint sources often affects large areas, it may be difficult to definitively pinpoint specific sources. Detailed studies are often needed to better relate these dispersed human activities to regional groundwater quality.

The most widely documented sources of contamination in Arizona include agricultural activities, wastes from industries, leaking underground storage tanks (LUSTs), septic tanks, landfills, mining activities and wastewater treatment plant effluent (ADEQ, 2000). A synopsis of the major pollutants found in Arizona groundwater follows.

Volatile Organic Compounds

Aside from gasoline leaks reaching groundwater, disposal of solvents has resulted in most of the state's documented cases of volatile organic compound-contaminated groundwater. High-technology manufacturing facilities (often electronics and aerospace), which use these solvents for degreasing, are generally located in urbanized areas where most of the volatile organic compound problems have been found. Disposal of solvents has been documented from the early 1950s and probably began earlier. Specific industrial waste disposal practices leading to groundwater contamination by volatile organic compounds include injection into dry wells and disposal into surface impoundments, leach fields, dry washes and unregulated landfills (Graf, 1986). Many of the recently discovered volatile organic compound problems can be traced to disposal or leaks at dry cleaning facilities. Surface spills are less common causes of volatile organic compounds in groundwater. In the past, public drinking water wells in the Phoenix and Tucson metropolitan areas and in Payson have been closed because of volatile organic compound contamination.

Nitrate

Nitrate is one of the most common pollutants in the state's groundwater and is associated with both human activities and, infrequently, natural nitrogen sources. Nitrate levels in groundwater have decreased in some areas where agricultural activities have been replaced with urbanization, but have increased in other areas. Percolation of nitrate-laden water from irrigation, septic tanks, wastewater treatment plants, concentrated animal feedlots and natural nitrate occurrences are likely causes of elevated nitrate levels. Nitrate is not significantly attenuated by the soil and therefore travels with the groundwater largely unchanged.

Large portions of aquifers within the Salt River Valley, including areas in Glendale, Mesa, Chandler and Phoenix, contain groundwater with nitrate concentrations high enough to render the water unfit for potable use. In addition, high nitrate levels occur in Marana, St. David, Quartzsite, Bullhead City, Lake Havasu City and other areas. Septic tank discharges are common nitrate sources in rural areas of Arizona and have contaminated drinking water wells. Quartzsite, Bullhead City and Lake Havasu City are just a few locations with documented nitrate problems from septic tanks.

Major Cations and Anions (Dissolved Mineral Content)

Ambient groundwater quality can vary widely between basins. Dissolved mineral content is one measure of ambient water quality and is expressed as the total dissolved solids (TDS) content. In Arizona, the TDS content, which can be used to gage potability, generally falls within the range of suitability for human consumption, although higher concentrations are relatively common. Some areas in the state, particularly in some alluvial basins and along the Gila River, exhibit much higher TDS concentrations, rendering the groundwater unsuitable for drinking and other uses.

Table 1: Major Types of Pollutants Contaminating Groundwater in Arizona

Pollutant Group	Pollutant
Major Cations/Anions	Fluoride Total Dissolved Solids (TDS) Sulfate
Metals	Arsenic Lead Chromium (Cr^{+3}, Cr^{+6}) Iron Manganese Barium
Microorganisms	Total Coliform Bacteria Fecal Coliform Bacteria
Nutrients	Nitrate
Petroleum Hydrocarbons	Gasoline Diesel Jet Fuel
Pesticides	Ethylene dibromide (EDB) Dibromochloropropane (DBCP)

Table 1: Major Types of Pollutants Contaminating Groundwater in Arizona	
Pollutant Group	Pollutant
Radiological	Uranium Radium-226 and 228 Radon
Physical	pH
Volatile Organic Compounds	Trichlorethylene (TCE) Tetrachloroethylene (PCE) Chloroform 1,1,1-trichloroethane (TCA) Methylene chloride Freon-11®, Freon-12®, Freon-113® 1,1-dichloroethylene (1,1-DCE) 1,2-dichloroethylene (1,2-DCE) 1,1-dichloroethane (DCA) Vinyl chloride Benzene Toluene Ethylbenzene Xylene

Mining activities have been responsible for high levels of dissolved cations and anions (the individual constituents composing the dissolved mineral content) in groundwater in certain areas. Sulfate, TDS and hardness are commonly elevated downgradient from historic mining operations and tailings ponds. Excessive amounts of sulfate and TDS in groundwater may also result from discharge of treated wastewater effluent and deep percolation of salts leached by irrigated agriculture.

Fluoride, which occurs naturally in groundwater, is found in moderate to high levels in some alluvial basins of the Basin and Range Province.

Metals

Heavy metals occur naturally in groundwater, and elevated levels are often associated with mineralized areas. For example, hexavalent chromium is found in groundwater at elevated levels in Paradise Valley and Kingman (Robertson, 1975; Robertson, 1986).

Arsenic also occurs naturally in some areas at elevated levels. Currently, the federal and state maximum contaminant level for arsenic in drinking water is 0.05 milligrams per liter. Arsenic occurs in groundwater above this level at several localities in Arizona, which prevents its use in public drinking water systems unless treated. In

2006, EPA will lower the arsenic maximum contaminant level to 0.01 milligrams per liter. Much groundwater in Arizona contains naturally-occurring arsenic above this level. As a result, many public water systems in Arizona will have to implement treatment, blending or alternative supply measures to meet the new standard.

Metals may also reach groundwater from anthropogenic sources. Chromium has been found in groundwater in several locations in the Phoenix and Tucson metropolitan areas due to industrial discharges from electronics, aviation and plating firms.

Metals such as manganese, copper, iron, chromium and others have been found in groundwater downgradient from mining operations and tailings ponds, particularly where acid drainage has developed. Groundwater downgradient from landfills commonly contains elevated concentrations of iron, manganese and barium.

Pesticides

Prior to 1980, only two pesticides had been detected repeatedly in groundwater – dibromochloropropane (DBCP) and ethylene dibromide (EDB). These pesticides were found in groundwater in the Yuma area and in the Salt River Valley. DBCP and EDB were applied from the 1950s through the 1970s to soils in citrus and cotton fields as fumigants for the control of nematodes (Daniel, et al., 1988). These pesticides were banned more than a decade ago because of their potential carcinogenicity.

More recently, the agricultural pesticides atrazine, methomyl, metribuzin and prometryn have been detected in Maricopa and Yuma counties. The detections are localized and transitory, and do not represent a regional contamination problem. All detections are below health-based guidance levels.

Petroleum Hydrocarbons

Leaking underground storage tanks (LUSTs), primarily those containing petroleum fuels, are a significant source of groundwater contamination in Arizona. LUSTs are located throughout the state, but are concentrated in urban areas. There were 27,641 underground storage tanks that contain regulated substances reported to ADEQ by June 30, 2002. The total number of leaks or releases from USTs reported to ADEQ is 7,945. Of these, 5,523 have been remediated or properly closed. Approximately 19 percent of the reported tank leaks have affected or potentially could affect groundwater quality.

Many reported LUST sites are associated with service stations. Other locations included utility, transportation and shipping companies; municipal facilities; pipelines; and mining, food, lodging, high technology and paint companies. Benzene, toluene, ethylbenzene and xylene (BTEX), which are aromatic hydrocarbon components of petroleum fuels, are the most commonly detected LUST-related chemicals in groundwater. At some LUST sites, total petroleum hydrocarbons (TPH), methyl tertiary-butyl ether (MTBE) and 1,2-dichloroethylene (1,2-DCE) have been detected.

Radionuclides

Radioactive elements such as uranium, radon and radium occur naturally in the soil and water at locations throughout Arizona, sometimes in concentrations elevated enough to be of concern. Studies by ADEQ, the Arizona Geological Survey and Arizona State University found that radon concentrations greater than 300 picocuries per liter are normal for groundwater in several areas across the state. Anthropogenic contamination of groundwater has also resulted from uranium mining activities (waste dumps and mine tailings) and mine dewatering. These uranium mining activities mainly occurred in the Plateau Uplands Province.

Bacteria

Septic tank effluent often has been linked to groundwater contamination by bacteria. The 2000 census estimated that approximately 377,000 septic tank systems are operating in Arizona, serving about 17.4 percent of the population. Contamination of groundwater by microorganisms may result when the tanks are installed in areas with inadequate soils or shallow depth to groundwater. Bad well construction and well seals also can lead to the entry of microorganisms into a well so as to contaminate the drinking water. Generally, however, most microorganisms will be removed from the septic tank effluent after passing through a few feet of soil.

Effectiveness of Groundwater Protection Programs Established by Title 49, Chapter 2

Title 49, Chapter 2 of the Environmental Quality Act established broad authorities for management, control, remediation and regulation of point and nonpoint sources of pollution. The explicit goal of the statute is to preserve and protect groundwater quality for all present and reasonably foreseeable future uses. Both preventive and remedial strategies are employed to achieve this objective.

This section assesses the effectiveness of programs in Title 49, Chapter 2 for preserving and protecting groundwater quality. A brief description of each groundwater program is presented, followed by a discussion of the effectiveness of the program.

The effectiveness of groundwater programs can be measured both by analyzing groundwater quality trends or by reviewing major implementation milestones of the programs. The groundwater protection programs established in Title 49, Chapter 2 have demonstrably prevented new discharges to groundwater while effecting cleanup of existing contamination sites. It is emphasized that most existing contamination sites are due to discharges that had occurred prior to the establishment of the Title 49 programs.

Aquifer Boundaries and Aquifer Water Quality Standards

Under Title 49, ADEQ has the responsibility to define the boundaries of all aquifers in the state (A.R.S. § 49-224.A). To this end, the agency has adopted the groundwater basin boundaries promulgated by the Arizona Department of Water Resources as the limiting boundaries of the various aquifers of the state. Within these boundaries, any geologic unit capable of yielding five gallons or more of water per day is regarded as an aquifer and protected by statute.

Title 49 initially classified all aquifers of the state as drinking water aquifers. Thus, all groundwater resources in the state are protected for drinking water use. While there is a statutory provision for reclassifying aquifers designating other uses, ADEQ has not received any petitions for reclassification.

Title 49 also adopted primary drinking water maximum contaminant levels as aquifer water quality standards for aquifers protected for drinking water use. The statute requires ADEQ to adopt within one year as aquifer quality standards any newly promulgated drinking water maximum contaminant levels. If aquifers are designated for other uses, ADEQ must adopt aquifer water quality standards appropriate for those uses.

Program Effectiveness

- Aquifers statewide were delineated and classified by rule for drinking water use.
- Numeric aquifer water quality standards are established in rule; numeric standards are equivalent to federal primary drinking water maximum contaminant levels.
- Narrative aquifer water quality standards are established in rule. These standards ensure that contaminants without established numeric standards do not endanger human health if the groundwater is used for drinking water and do not impair existing uses of the groundwater.
- No petitions for aquifer reclassification have been received, therefore all aquifers in the state continue to be protected for drinking water use.
- The adoption by ADEQ of aquifer boundaries and aquifer water quality standards, which protect entire aquifers to drinking water standards, lay the foundation for effective implementation of all state groundwater protection programs.

Programs Administered by the Water Permits Section

Program Goal

The goal of the Water Permits Section is to ensure that public health and the quality of Arizona’s groundwater are protected by controlling discharges from wastewater treatment facilities, industrial sources and mining operations. The program accomplishes this through the issuance of the following state permits and approvals:

- Aquifer protection permit
- Clean closure approval
- Direct reuse of reclaimed water permit
- Stormwater dry well registration
- Certification of recharge permit (issued by the Arizona Department of Water Resources)

A discussion of each of these programs follows, including how effective these regulations are in improving groundwater quality.

State Permits and Approvals Affecting Groundwater Quality

1. Aquifer Protection Program

The Aquifer Protection Program is Arizona's cornerstone program for protecting groundwater 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 (APP). If the owners or operators of a facility are not eligible to operate under a general APP, they must apply for and obtain an individual APP prior to discharging.

General permits cover many categories of less significant and often numerous discharging activities (for example, septic tank and leach field systems and agriculture activities). However large discharging facilities, such as mines, industrial facilities and most wastewater treatment plants, require an individual APP. ADEQ can issue the individual APP only if the applicant makes two demonstrations: 1) that pollution control measures (BADCT) designed to minimize the discharge are employed, and 2) that aquifer water quality standards will not be violated at a point of compliance within the aquifer. The individual APP contains provisions for discharge monitoring, groundwater monitoring, and other requirements to ensure that groundwater quality will be protected.

In the summer of 1997, the department formed the Unified Water Quality Permit Rewrite Steering Committee comprised of representatives of private businesses, large and small municipalities, county governments, and other agencies. The department tasked the committee to review existing water permitting processes and develop recommendations for process improvements.

In the three-year process that followed, the existing Water Permits Section permitting procedures were evaluated and revisions were recommended. As a result of this effort, the rules for the Aquifer Protection Program were revised, the sewerage system construction rules were repealed, and new rules for the direct reuse of reclaimed water were adopted. The "unified rules," as they are known, became effective in January 2001.

The unified rules are designed to improve the permitting process by streamlining some permitting requirements, eliminating others that are redundant and relying on general permits to a much greater extent than previous rules allowed while still protecting groundwater quality. These process improvements affected mining operations, sewage treatment facilities, solid waste disposal facilities, septic tank systems and certain industrial facilities. The rules establish technical standards to achieve prompt project approval, resulting in a more efficient and effective regulatory process.

The unified rules produced four major program improvements:

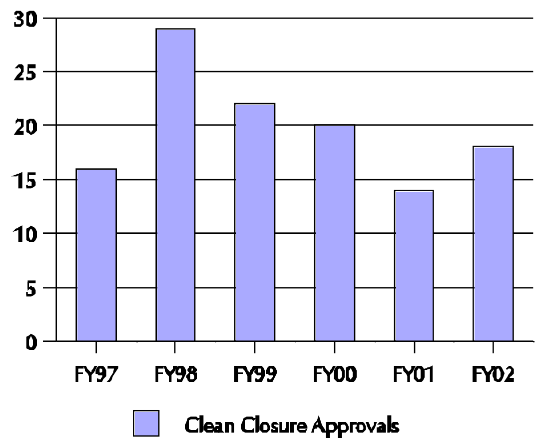
A. Eliminated duplicative processes by consolidating engineering design reviews for sewage treatment facilities into the permitting process of the individual APP as a component of BADCT. Permits are issued more quickly so that applicants can implement best management practices and BADCT sooner to control or reduce discharges of pollutants to aquifers.

B. Raised the standard of treatment for new sewage treatment facilities and major expansions of old facilities. Improved effluent quality will reduce the risk of groundwater contamination, encourage the use of reclaimed water, contribute to water conservation efforts and minimize wastewater disposal.

C. Expanded the number of general permits. Thirty-three new general permits were established. These general permits replace individual permits for major industry groups, such as mining and other industrial operations, and rely on clear technical standards to ensure that a discharging facility does not violate aquifer water quality standards. The facility must still employ BADCT in its design, construction and operation and maintenance.

D. Included technical standards for location, design, installation and maintenance of on-site wastewater treatment systems that usually serve individual residences. The most common systems use a septic tank and a soil absorption trench. Previously, these standards were contained in guidance documents. Clear criteria are provided to assess site conditions to determine whether a conventional system is appropriate or whether an alternative system is necessary. Because alternative systems tend to be more expensive to install and maintain, this provides assurance to the public that the system they install is the best one suited to their needs and to protection of groundwater quality.

2. Clean Closure Approval



Under A.R.S. §49-252, ADEQ can issue a clean closure approval in lieu of an APP for dry wells and facilities operating under either a notice of disposal or groundwater quality protection permit. To qualify for this approval, these facilities must close in such a clean condition that no post-closure monitoring is needed. The ability to clean close this way encourages facilities to investigate the impact of past discharges and conduct soil remediation if needed. The clean closure process is attractive for qualifying facilities because it is an expedited process that eliminates the need for an APP. In the five year period from FY 1998 to FY 2002, ADEQ issued 103 clean closure approvals.

3. Direct Reuse of Reclaimed Water

The Water Permits Section issues reclaimed water permits to regulate the reuse of treated effluent for beneficial uses, such as irrigation of landscaping and crops, thus conserving our high quality surface water and groundwater resources for drinking water purposes. The reclaimed water permit ensures that public health and water quality is protected.

Under the unified rulemaking effort, the department significantly revised the program for the direct reuse of reclaimed water and created new reclaimed water quality standards with five classes of reclaimed water. The program now relies heavily on nine general permits. All wastewater treatment facilities providing reclaimed water for reuse must have an individual APP, or amend their existing APP to contain certification for a particular Class (A+, A, B+, B or C) of reclaimed water. All reclaimed water quality monitoring and reporting is performed under the APP.

A reclaimed water individual permit is required for reclaimed water uses which do not otherwise fall into one of the general permit categories. An individual permit is also required for the application of industrial wastewater if it is used in the processing of any human or animal food crop or substance, or if reclaimed water is blended with industrial wastewater. End users of reclaimed water who cannot qualify under a general permit are required to obtain an individual permit.

4. Stormwater Dry Well Registration

The dry well program was established by the Environmental Quality Act in 1986 and requires the registration of stormwater dry wells. It is estimated that up to

40,000 dry wells have been constructed in Arizona, most of them in the Salt River Valley, to dispose of stormwater runoff. Regulation of dry wells is important because dry wells can provide a relatively direct conduit for pollutants to enter groundwater by way of leaks, spills, and other contaminant discharges. To date, ADEQ has registered 24,872 dry wells and receives an average of 90 registrations per month.

Dry wells that drain areas where hazardous substances, including motor fuels, could enter the dry well are required to obtain either an individual or general APP. Alternatively, people are encouraged to evaluate the use of engineering controls to prevent spills from reaching the dry well so as to eliminate the need for an APP.

During the unified rulemaking, a new APP general permit for dry wells that drain areas where hazardous substances are used, stored, loaded or treated was established to help expedite the permitting of dry wells that previously needed an individual APP. The department is currently promulgating another APP general permit for dry wells exclusively for motor fuel dispensing facilities. The intent of both general permits is to ensure that the dry well is protected and does not receive any discharges other than stormwater. ADEQ hired Brown & Caldwell to evaluate flow control and pre-treatment technologies to assist applicants in qualifying for the dry well general permits. The list of technologies for evaluation was developed in conjunction with stakeholders during meetings convened in October and November 2001 and January 2002. The department is developing guidance on flow control and pretreatment technologies for use with dry wells based on the report prepared by Brown & Caldwell.

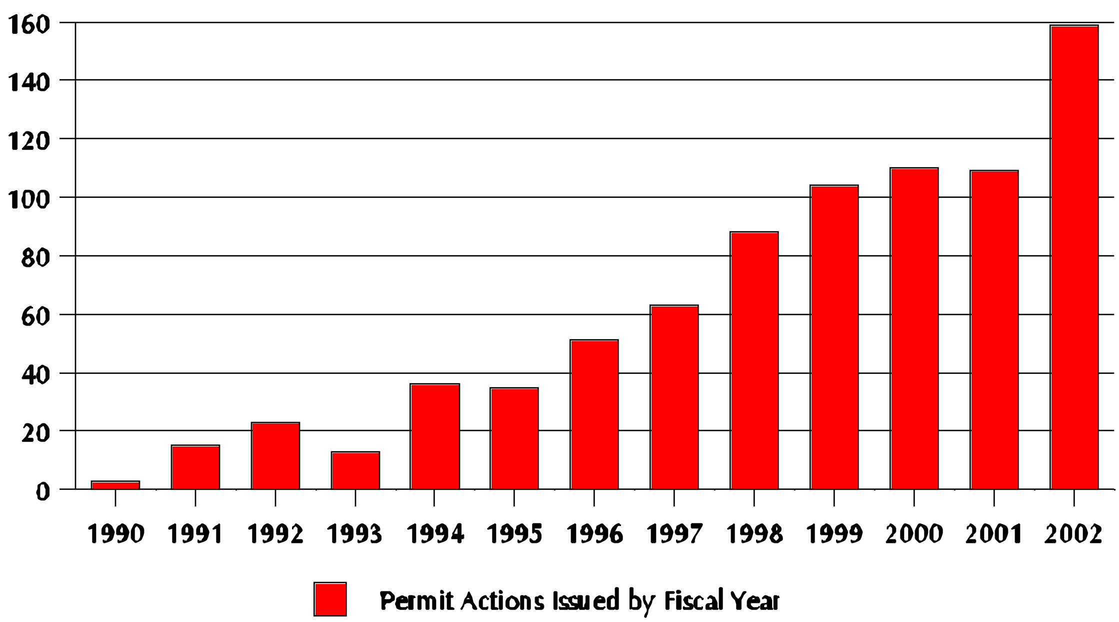
5. Certification of Recharge Permit issued by the Arizona Department of Water Resources

ADEQ writes APPs for the recharge of treated wastewater to ensure that underlying groundwater quality is protected. However, most of the water recharged in Arizona to augment our groundwater supply is not wastewater, but is derived from surface water sources and is transferred to the recharge site through canals such as the Salt River Project canal system or the Central Arizona Project Canal. For this source of recharge, ADEQ does not issue an APP. Instead, by law, ADEQ certifies a Recharge Permit that the Arizona Department of Water Resources issues. ADEQ's certification is contingent on a finding that the project will not cause contaminants to be leached from the vadose zone or cause a contaminant plume to migrate. ADEQ also reviews and approves the water quality monitoring plan for the recharge project. This cooperative approval process ensures that both existing groundwater and the recharged water is protected for future withdrawal and use.

Program Effectiveness

The legislature established the Aquifer Protection Permit Program to regulate discharging facilities to prevent groundwater contamination. APPs, along with the other supporting state water quality permits and approvals described above, have been highly successful in achieving this goal through requirements for treatment technology, discharge reduction and monitoring. Similarly, ADEQ plays a significant role by certifying federal permits designed to protect surface water quality, which can also indirectly affect groundwater quality. Because of these programs, drinking water sources are being protected on a routine basis. It can be stated with confidence that these programs have eliminated water contamination problems of the magnitude of those caused by pre-permit disposal practices.

Program effectiveness can also be measured by the scope of improvements made, especially during the current reporting period, to increase permitting productivity, shorten turnaround times and focus on only the most significant water pollution threats. The following graph showing the rapid rise in permit issuance clearly indicates that these measures are working.



Despite improved productivity in issuing permits, an inventory of existing facilities requiring permit actions still exists. This is primarily the result of an instant inventory of 1,072 facilities that was created when the APP rules were promulgated in 1989. In the past five years, program personnel have focused on reducing the inventory by eliminating those that did not actually need an individual APP (the facility might qualify for an exemption or a general permit, for example). By law, ADEQ must issue permits to all the existing non-mining facilities by Jan. 1, 2004 and existing mining facilities by Jan. 1, 2006. When all existing permits are issued, only applications for new facilities, closures or amendments to an existing permit will flow into the program.

In January 2002, the Water Permits Section began work on a new initiative, Operation Permit Arizona (OPERA), with the goal of permitting all existing non-mining facilities by Dec. 31, 2002. This date is one year before the statutory deadline of Jan. 1, 2004. Dedicated resources and focus on this goal has resulted in a reduction of the existing non-mining facility inventory from 120 in January to 80 in June 2002. OPERA is on its way to success even though the program has received record numbers of new permit applications.

WQARF (State Superfund) Program

Description

The Water Quality Assurance Revolving Fund Program was created as part of the Environmental Quality Act of 1986 for purposes of addressing historic hazardous substance contamination at sites within the state. The statutes governing the WQARF program were substantially reformed during the 1997 legislative session, with the new laws becoming effective on April 29, 1997.

The original WQARF law had a liability system similar to that of the federal Comprehensive Environmental Response Compensation and Liability Act (CERCLA, or federal Superfund) program, including strict, joint, several and retroactive liability. The 1997 WQARF reforms replaced joint liability with a proportionate, or “fair share,” liability system.

In FY 1998, a Registry was created, as required by A.R.S § 49-287.01, to replace the former WQARF Priority List. Sites are added to the WQARF Registry through the Registry listing process which includes site scoring, notifying owners and operators within the site, and providing a 30-day public comment period. The current WQARF program also provides for enhanced community participation during the site investigation and clean up process. At this time, there are 33 WQARF Registry sites in Arizona.

Authorized uses of WQARF include:

- State matching funds for federal Superfund sites
- Costs of undertaking remedial actions including remedial investigations, health effects studies and risk assessments, feasibility studies, conducting responsible parties searches and allocation proceedings, funding “orphan” shares, and supporting community involvement activities and community advisory boards
- Costs of administering the fund
- Costs associated with statewide surface and groundwater quality monitoring
- Costs of compliance monitoring

- Costs associated with program support of other agencies, including the Office of the Attorney General, the Arizona Department of Health Services and the Arizona Department of Water Resources

Under the current liability system, WQARF funding is used to pay for remediation of hazardous substance contamination associated with “orphan shares” at WQARF sites, where the responsible parties are unable or unwilling to perform the work. WQARF funding is also available for responding to hazardous substance emergencies and for reimbursement of emergency response efforts taken by local governments.

WQARF funding is used to help support the ADEQ Voluntary Remediation Program which currently oversees facility-lead cleanups at more than 60 sites. An additional authorized use of the fund is to make matching-funds loans to state agencies and political subdivisions within the state to assist them in responding to hazardous substance sites in their communities. WQARF also funds a large portion of the efforts to collect the water quality data that is summarized in this report.

Once a site enters the WQARF program, ADEQ may either conduct the remedial action itself or work with outside parties who may be responsible, in which case ADEQ would oversee their efforts. The early phases of an investigation include records searches and preliminary field investigations. This work helps to assess additional data collection needs and identify potential responsible parties. Depending on the specifics of the site and contaminants present, an early response action may be conducted to minimize any risk to the public health and the environment and/or to reduce the source of the contamination to make the final cleanup action more cost effective or efficient.

At the appropriate time, a full characterization, or remedial investigation, of the site is conducted. Prior to beginning a remedial investigation, ADEQ is required to establish a community advisory board for the site. As of the end of FY 2002, there were 15 community advisory boards representing 21 of the 33 WQARF Registry sites. Community advisory boards meet at least four times per year to receive updates and provide input on the progress at WQARF Registry sites.

After the remedial investigation is completed, a feasibility study is conducted to determine the most reasonable, cost-effective and technically feasible approach for addressing the contamination. The most appropriate alternative identified by the feasibility study is introduced to the community in the form of a proposed remedial action plan, and the community is provided an opportunity to comment on the proposed remedial action plan.

Table 2: Status of Designated WQARF Sites		
WQARF Site Name	Location	Status
1. 7th Street and Arizona Avenue	Tucson	ERA in process
2. 16th Street and Camelback Road	Phoenix	ERA in process
3. 20th Street and Factor Avenue	Yuma	ERA complete
4. Broadway-Pantano	Tucson	RI/ERA in process
5. Central and Camelback	Phoenix	ERA in process
6. East Central Phoenix – 24th Street and Grand Canal	Phoenix	ERA evaluation complete
7. East Central Phoenix – 32nd Street and Indian School Road	Phoenix	ERA in process
8. East Central Phoenix – 38th Street and Indian School Road	Phoenix	ERA evaluation complete
9. East Central Phoenix – 40th Street and Indian School Road	Phoenix	ERA evaluation complete
10. East Central Phoenix – 40th Street and Osborn	Phoenix	ERA in process
11. East Central Phoenix – 48th Street and Indian School Road	Phoenix	IRA in process
12. East Washington Fluff Site	Phoenix	ERA complete/RI in process
13. El Camino del Cerro	Tucson	ERA complete/RI in process
14. Estes Landfill	Phoenix	PRAP in process
15. Klondyke Tailings	Klondyke, Graham County	RI in process
16. Los Reales Landfill	Tucson	RA in process
17. Miracle Mile	Tucson	RI in process
18. Park-Euclid	Tucson	RI/ERA in process
19. Payson PCE	Payson	PRAP/ERAs in process
20. Pinal Creek	Miami/Globe	RA/ERAs in process

Table 2: Status of Designated WQARF Sites		
WQARF Site Name	Location	Status
21. Shannon Road – Rillito Creek	Tucson	RI/IRA in process
22. Silverbell Jail Annex Landfill	Tucson	RA in process
23. South Mesa	Mesa	RI in process
24. Tonto Drive and Cherry Street	Payson	RI in process
25. Tyson Wash	Quartzsite	RI/ERA in process
26. Vulture Mill	Wickenburg	RA in process
27. West Central Phoenix – East Grand Avenue	Phoenix	RI/ERA in process
28. West Central Phoenix – North Canal Plume	Phoenix	RI in process
29. West Central Phoenix – North Plume	Phoenix	RI/ERA in process
30. West Central Phoenix – West Grand Avenue	Phoenix	RI in process
31. West Central Phoenix – West Osborn Complex	Phoenix	RI/ERA in process
32. West Van Buren	Phoenix	RI/ERAs in process
33. Western Avenue Plume	Avondale/ Goodyear	RI/ERA in process

Status Codes:

RI	=	*Remedial investigation*
FS	=	*Feasibility study*
PRAP	=	*Preliminary remedial action plan*
RA	=	*Remedial action*
RC	=	*Remediation complete*
ERA	=	*Early response action*
IRA	=	*Interim remedial action*

Prior to the 1997 reforms, WQARF remedial actions were only authorized where there were actual or threatened impacts to waters. Now, responses at sites that do not threaten waters of the state are authorized as well, allowing cleanup at sites that may pose significant risk, but where only soils have been affected by the contamination. Also under the current program, the ADEQ has the authority to approve remedies that do not attain regulatory standards, but are based on remedial objectives. Remedial objectives are determined based on the current and future planned uses of the property. Although the applied remedial technologies remain similar between the former and the current programs, 1997 WQARF reforms allow greater flexibility in remedy selection.

Program Effectiveness

- ADEQ has successfully negotiated with EPA to clean up sites under the WQARF program rather than EPA adding the sites to the National Priority List, and 33 sites are currently listed on the WQARF Registry. From fiscal years 1998 through 2002, the WQARF program has been responsible for the cleanup of 10.48 billion gallons of water, 109,737 pounds of volatile organic compounds and 20,066,517 pounds of metals, as well as the removal and proper disposal of 11,430 tons of contaminated soil.
  - WQARF-funded groundwater monitoring wells are used to collect data on the extent of contamination, source areas, groundwater depth, flow direction and other information. This information is critical to select the remedies for the site. Since 1997, more than 400 monitoring wells have been installed by the WQARF Program.
  - Soil and soil-gas investigations funded by WQARF are used to determine the extent of contamination at a particular facility and identify source areas and potentially responsible parties. Soil and soil-gas studies have been or will be conducted at WQARF sites to provide valuable information to aid the remedy selection process.
  - The WQARF program has been able to use WQARF-funded investigations to prompt facilities to conduct remedial activities themselves.
  - Since FY 1998, ADEQ has received $4.57 million in settlements under the WQARF program.

Solid Waste Landfill Permitting

Description

Municipal solid waste landfills are regulated under federal requirements (40 CFR Part 258). Landfill design and operation requirements under the federal program are aimed at protecting public health and the environment. These requirements include groundwater monitoring to ensure protection of aquifers.

For other types of solid waste facilities, such as non-municipal solid waste landfills, state APP Program requirements apply if there is a potential for discharge. The APP Program also includes design, operation and monitoring requirements. Over the last five years, the ADEQ Solid Waste Section completed the following APP actions pertaining to solid waste facilities not regulated under the federal program:

Table 3: APP Actions Pertaining to Solid Waste Facilities, July 1, 1997 through June 30, 2002			
Facility	APP Permit Action	Date	Watershed
Butterfield Station Landfill leachate impoundment	Permit modification	11/97	Middle Gila
Lone Cactus Construction and Demolition Debris (C&D) Landfill	Permit modification	6/98	Middle Gila
Copper Mountain Landfill leachate impoundment	Permit modification	7/98	Lower Gila
Navajo County Lone Pine Landfill septage impoundment	Permit for closure	7/98	Little Colorado
Gray Wolf Landfill leachate impoundment	Permit modification	8/98	Middle Gila
Mohave Valley Landfill septage impoundment	Permit for closure	8/98	Colorado
Ina Road C&D Landfill	Permit issued	8/98	Santa Cruz
CalMat C&D Landfill	Permit modification	10/98	Middle Gila
Lone Cactus C&D Landfill	Permit modification	12/98	Middle Gila
Central Avenue Union Rock C&D Landfill	Permit for closure	4/00	Middle Gila
Russel Gulch Landfill leachate ponds	Permit issued	4/00	Salt
Abitibi Monofill	Permit modification	5/00	Little Colorado
BHP Superior Mine Landfill	Permit for closure	7/00	Middle Gila
CalMat C&D Landfill	Permit modification	10/00	Middle Gila
Graham County Safford Landfill septage pond	Permit for closure	4/01	Upper Gila
Stone Forest Ash Pit	Permit for closure	5/01	Little Colorado

Table 3: APP Actions Pertaining to Solid Waste Facilities, July 1, 1997 through June 30, 2002			
Facility	APP Permit Action	Date	Watershed
Bradley C&D Landfill	Permit for closure	6/01	Middle Gila
Yavapai County Prescott Valley Landfill	Permit for closure	10/01	Middle Gila
South Yuma County Landfill septage impoundment	Permit issued	1/02	Lower Gila
Iron King Waste Reduction Facility C&D Landfill	Permit issued	1/02	Middle Gila
City of Tucson Vincent Mullins Landfill	Permit for closure	1/02	Santa Cruz
CalMat C&D Landfill	Permit modification	2/02	Middle Gila
Phelps Dodge Bagdad Mine Landfill	Permit issued	5/02	Bill Williams

Program Effectiveness

The APP Program has been effective in controlling pollution from solid waste facilities not regulated under the federal program. Groundwater monitoring conducted at facilities issued an APP or closed under an APP during the last five years, as well as facilities operating under an APP issued prior to July 1, 1997, indicate that no groundwater contamination has occurred due to facility operation.

Pesticide Program

Description

ADEQ's pesticide program is designed to prevent contamination of groundwater, soils and the vadose zone from pesticides. A major component of the program is to identify those pesticides which, based on physico-chemical characteristics (mobility factor) and their environmental fate (persistence factor) have the potential to leach to groundwater. Prior to registration of agricultural pesticides by the Arizona Department of Agriculture, registrants must submit information to ADEQ for review and approval on both mobility and persistence for each active ingredient of a pesticide.

ADEQ rule (A.A.C. R18-6-103) establishes allowable threshold values (termed specific numeric values) for both mobility and persistence factors. Any pesticide active ingredient exceeding one of the specific numeric values is considered a threat to pollute groundwater and is added to the groundwater protection list (GWPL). A person who applies a pesticide for agricultural production with an active ingredient listed on the GWPL, either directly or amended to the soil, is required to provide ADEQ with information regarding the application and use on a revised Form 1080. Pesticide dealers or sellers also must submit quarterly reports to ADEQ on all agricultural pesticides containing one or more listed active ingredient.

Within one year of listing of a pesticide active ingredient on the GWPL, ADEQ must monitor soil and groundwater to determine whether it has migrated to groundwater. If sampling determines that the active ingredient is present in the groundwater and its presence is due to agricultural use, ADEQ is required to initiate appropriate compliance and enforcement actions. If the active ingredient is a known carcinogen, mutagen, teratogen or is toxic to humans and detected at a harmful level, ADEQ is required to notify the Arizona Department of Agriculture to cancel the registration of all agricultural pesticides containing the active ingredient.

If the pesticide active ingredient is not a known carcinogen, mutagen, teratogen and is not toxic to humans at the detected level, ADEQ is required to notify the pesticide registrant to modify the label directions to prevent further contamination of the groundwater by the active ingredient.

Starting in August 2001, ADEQ implemented a program prescribed in 2000 in A.R.S. §49-310 for conditional registration of agricultural pesticides. This program allows for conditional registration of an agricultural pesticide product for which all data on the mobility and persistence factors has not been submitted to ADEQ for review and approval. The conditional registration is valid for one year with an option to renew annually for a period not to exceed three years. ADEQ implemented the program in two phases. Phase I allows conditional registration of a pesticide containing an active ingredient identified as “reduced risk” by EPA. Phase II allows conditional registration of an active ingredient that is considered “important to Arizona agriculture,” meaning that the active ingredient meets criteria in law for being “important to Arizona agriculture.”

Program Effectiveness

The pesticide program has been highly effective in protecting groundwater quality. Although a number of mobile or persistent pesticides on the GWPL have been detected in groundwater sporadically, the preventative and corrective provisions of the pesticide program have eliminated any further incidences of the of large-scale groundwater contamination problems that typified some agricultural areas prior to 1980 (specifically, extensive plumes of DBCP- and EDB-contaminated groundwater that forced closure of many drinking water wells).

Specific accomplishments of the pesticide program from 1997 through 2002 include:

- Completed the review and approval of the physico-chemical (mobility) and environmental fate (persistence) information of 57 pesticide active ingredients. ADEQ has completed the review and approval of a total of 312 pesticide active ingredients since 1987.
- Maintained the GWPL, which currently names 158 pesticide active ingredients.
- Completed the pesticide database. This database contains information on mobility, persistence, degradation products, metabolites, sales/use, registration, and monitoring results for all registered agricultural pesticide active ingredients.
- Cancelled registrations for more than 55 pesticide active ingredients due to failure by the potential registrant to supply required environmental fate data on mobility and persistence. This alone has significantly protected Arizona groundwater quality, as many of the active ingredients clearly would not have met the mobility and persistence criteria and would have posed great threat to groundwater quality if sold in Arizona.
- Collected a total of 211 groundwater samples from 117 wells for analysis for pesticide active ingredients on the GWPL.
- Used FIFRA funding from the Department of Agriculture to drill and develop 44 monitoring wells in Maricopa and Yuma Counties to monitor groundwater for agricultural pesticide active ingredients on the GWPL.
- Received monitoring results indicating that atrazine, methomyl, metribuzin, and prometryn were detected in groundwater in both Maricopa and Yuma counties. However, detected levels were below the Health Based Guidance Levels for all of these chemicals and the detections were localized and transitory.
- Published a report entitled, "Monitoring Report of the Pesticide Contamination Prevention Program of Arizona (1987-1997)."
- Implemented the program for conditional registration of agricultural pesticides prescribed in A.R.S. §49-310.

Nonpoint Source Program

Description

Until 1999, Arizona managed its nonpoint source program activities separate from the rest of its Clean Water Act (CWA) programs. In 1999, as part of ongoing program improvements, ADEQ integrated the nonpoint source program with other CWA programs to provide a comprehensive pollution control approach consistent with CWA goals and focus on public involvement at the watershed or community level.

Early implementation of CWA programs concentrated on point sources of pollution and achieved great improvements in water quality by limiting the load of pollutants present in wastewater discharges. However, Arizona's water resources continue to be affected by nonpoint sources of pollution, now considered the single largest cause of water pollution throughout the nation.

Arizona's nonpoint source program focuses on surface water and groundwater affected by:

- Onsite/septic waste treatment systems
- Sand and gravel operations
- Irrigated agriculture
- Recreation, including unpaved roads
- Silviculture
- Abandoned or inactive mines
- Old landfills
- Grazing

ADEQ's nonpoint source plan integrates the state's CWA and Safe Drinking Water Act programs with voluntary incentives. The program works closely with stakeholders to develop community-led, watershed-based planning efforts. These local planning efforts assist ADEQ in developing programs and outreach activities appropriate to the specific area and the water quality issues. Since Arizona has a large amount of publicly owned lands, partnerships with federal, state, and tribal land and resource management agencies are a key element in the program's success.

The nonpoint source program uses a combination of tools to effect water quality improvement, including TMDL plans for specific impaired waters, general permits controlling stormwater discharges (A.R.S. 49-245.01) and guiding agricultural (49-247) and grazing (49-202.01) operations, and best management practices (49-246) to protect the state's water resources from nonpoint sources of pollution.

Nonpoint source program activities from 1999 to 2002 were built upon the foundation of the earlier work. The accomplishments of the program, both past and current, are highlighted below.

Program Effectiveness

- Initiated a watershed focus, which fostered local community efforts in targeted watersheds to control nonpoint sources of pollution.
- Implemented nonpoint source CWA 319(h) demonstration projects to address polluted runoff from nonpoint sources.
- Initiated a direct grant award process to replace the request for proposal process for awarding CWA 319(h) dollars. The Water Quality Improvement Grant Program provides informational grant planning workshops throughout the state, easy to understand application materials, and an annual awards cycle. Since moving to a direct grant program in 2000, the Water Quality Improvement Grant Program has awarded more than $3 million dollars for nonpoint source control projects throughout the state.
- Formalized agreements with the U.S. Forest Service, the U.S. Bureau of

Land Management, the U.S. Natural Resource Conservation Service, the Arizona Department of Transportation, the Arizona Game and Fish Department, and the San Carlos Apache Tribe.

- Participated as an active member of the Coordinated Resource Management Executive Group, an association of state, federal and tribal agencies with resource management responsibilities to work together, share information and develop complementary policies, procedures and methodologies whenever possible. ADEQ also is an active member of the Arizona Rural Watershed Initiative and the Arizona Rural Watershed Partnership, both of whose functions mirror the Coordinated Resource Management Executive Group but involve a different mix of agencies and entities.
- Developed and distributed school curricula for kindergarten through grade 12. These materials explain the causes and effects of water pollution, including nonpoint sources, and are successfully being used in many educational programs throughout the state.
- Co-sponsor the annual Arizona Envirothon, a science-based competition among Arizona high school students aimed at exposing young people to the principles and practices of natural resource management, ecology and environmental quality by challenging them to develop solutions to reality-based environmental problems.
- Developed a national short-term staff exchange program to share innovative approaches to nonpoint source issues.
- Developed draft best management practices for several nonpoint source activities including stormwater discharges, livestock grazing, and sand and gravel operations.
- Developed best management practice guidance documents to assist Arizona agriculture with minimizing nitrogen discharges from animal feeding operations and irrigated cropland activities. These best management practices form the basis for the agricultural general permits in rule to govern these activities.

Compliance Program

Description

Under water quality program authority, facility non-compliance may be addressed through a suite of tools. Pursuant to the ADEQ Compliance and Enforcement Handbook, these tools may include informal and formal enforcement actions. Warning letters, notices of correction and notices of violation are examples of informal enforcement actions. Administrative orders and consent orders are formal enforcement actions that may be taken. Enforcement case referrals by ADEQ to the Arizona Attorney General’s Office can yield injunctive relief and civil and criminal penalties.

Program Effectiveness

- ADEQ continues to consolidate all its Water Quality Division compliance activities into a single Water Quality Compliance Section. This coordination of compliance data management, inspections and enforcement has resulted in a consistent and efficient approach to ensuring water quality and regulatory compliance.
- ADEQ maintains a database tracking the compliance status of more than 2,200 point source facilities discharging pollutants that potentially may affect groundwater quality.
- ADEQ maintains both a routine inspection program and a complaint investigation program. Since 1998, ADEQ performed 2,844 inspections and responded to 705 public complaints. Together these activities result in more than 700 site visits per year.
- Since 1998, ADEQ issued 32 notices of correction, 522 notices of violation and 32 administrative orders to identify and correct noncompliance at facilities discharging domestic and industrial waste water.
- Over the last five years, ADEQ has taken 43 civil penalty actions and assessed $2,418,622 in penalties. This total includes both civil penalties and monies allotted for supplemental environmental projects.
- Over the last five years, ADEQ evaluated the compliance status of more than 661 facilities, closed 551 enforcement actions (242 within the last fiscal year) and returned these facilities to compliance.

Ambient Monitoring Program

Description

Ambient monitoring provides information on the quality of groundwater and movement of groundwater contaminants on a regional scale and is based on the legislative mandate contained in A.R.S. §49-225, which requires the ADEQ, in collaboration with the departments of agriculture and water resources, to "conduct ongoing monitoring of the waters of the state, including...aquifers to detect the presence of new and existing pollutants, determine compliance with applicable water quality standards, determine the effectiveness of best management practices, evaluate the effects of pollutants on public health or the environment, and determine water quality trends."

Ambient groundwater sampling is conducted on a basin-wide basis employing a statistical approach to allow determination of regional groundwater quality within constraints of budget and time. In known or suspected areas of groundwater contamination, more closely spaced sampling may be conducted to better characterize groundwater quality. Samples for inorganic chemicals regulated under the federal Safe Drinking Water Act are collected at each groundwater sampling site. Samples for VOCs, GWPL pesticides, banned pesticides, radionuclides, bacteria and other analyses are collected in areas where information indicates these constituents may be present. Based on the sampling results, index wells within each basin are selected for future resampling to provide a record of groundwater quality changes over time. The ambient groundwater monitoring program provides vital background information for conducting site-specific studies to delineate and remediate contaminated areas.

Additionally, the ambient groundwater monitoring program plays an important role by providing groundwater quality information that allows: 1) determination of anticipated groundwater quality provide well owners and all others involved with water quality issues, 2) identification of potential groundwater quality problems that may be addressed by other state and federal programs, and 3) delineation of groundwater quality trends over time.

The following tables summarize pollutants exceeding drinking water standards (primary and secondary maximum contaminant levels) present in groundwater samples collected by the ambient monitoring program from 1998 through 2002.

Table 4: Exceedances of the Primary MCL From Groundwater Samples Collected by the Ambient Monitoring Program, 1998 to 2002

Pollutant	Groundwater Basin (No. of samples exceeding MCL/ No. of samples collected in basin)
Antimony	Douglas (2/48) Willcox (1/58) Lower San Pedro (2/63)
Arsenic	Douglas (1/51) Prescott AMA (4/58) Lower San Pedro (1/63) Upper Santa Cruz (1/58) Willcox (3/58)
Barium	Prescott AMA (1/58)
Beryllium	Douglas (1/51)
Fluoride	Douglas (8/51) Prescott AMA (3/58) Sacramento Valley (4/48) Lower San Pedro (8/63) Sierra Vista (1/39) Upper Santa Cruz (1/58) Willcox (8/58)

Table 4: Exceedances of the Primary MCL From Groundwater Samples Collected by the Ambient Monitoring Program, 1998 to 2002	
Pollutant	Groundwater Basin (No. of samples exceeding MCL/ No. of samples collected in basin)
Gross Alpha Activity	Prescott AMA (1/58) Sacramento Valley (18/48) Lower San Pedro (2/63) Virgin River (1/38) Willcox (8/58)
Nitrate	Douglas (1/51) Prescott AMA (1/58) Sacramento Valley (6/48) Lower San Pedro (2/63) Upper Santa Cruz (5/58) Willcox (5/58) Yuma (5/55)
Radium (226 + 228)	Sacramento Valley (4/48) Willcox (1/58)

Table 5: Exceedances of the Secondary MCL From Groundwater Samples Collected by the Ambient Monitoring Program, 1998 to 2002	
Pollutant	Groundwater Basin (No. of samples exceeding MCL/ No. of samples collected in basin)
Chloride	Douglas (1/51) Sacramento Valley (7/48) Lower San Pedro (2/63) Virgin River (7/38) Willcox (2/58) Yuma (32/55)

Table 5: Exceedances of the Secondary MCL From Groundwater Samples Collected by the Ambient Monitoring Program, 1998 to 2002	
Pollutant	Groundwater Basin (No. of samples exceeding MCL/ No. of samples collected in basin)
Iron	Douglas (1/51) Prescott AMA (2/58) Sacramento Valley (2/48) Lower San Pedro (4/63) Sierra Vista (1/39) Virgin River (7/38) Willcox (1/58) Upper Santa Cruz (1/58) Yuma (7/55)
Manganese	Douglas (1/51) Prescott AMA (2/58) Sacramento Valley (3/48) Lower San Pedro (9/63) Sierra Vista (1/39) Virgin River (5/38) Willcox (1/58) Upper Santa Cruz (1/58) Yuma (38/55)
pH	Douglas (2/51) Lower San Pedro (4/63) Virgin River (1/38) Sierra Vista (2/39) Upper Santa Cruz (2/58) Willcox (4/58)
Sulfate	Douglas (2/51) Prescott AMA (2/58) Sacramento Valley (7/48) Lower San Pedro (11/63) Sierra Vista (2/39) Virgin River (17/38) Willcox (4/58) Upper Santa Cruz (2/58) Yuma (49/55)

Table 5: *Exceedances of the Secondary MCL From Groundwater Samples Collected by the Ambient Monitoring Program, 1998 to 2002*	
Pollutant	Groundwater Basin (No. of samples exceeding MCL/ No. of samples collected in basin)
Total Dissolved Solids	Douglas (8/51) Prescott AMA (6/58) Sacramento Valley (24/48) Lower San Pedro (24/63) Sierra Vista (2/39) Virgin River (25/38) Willcox (11/58) Upper Santa Cruz (14/58) Yuma (55/55)

The ambient groundwater monitoring program also conducted special studies to better delineate groundwater quality problems or improve groundwater sampling methodologies. These include an assessment of the extent of methyl tertiary-butyl ether (MTBE) contamination throughout Maricopa County (Boettcher and Yu, 2002), a study on the effectiveness of field versus laboratory filtration methods on certain pollutants (Freark et al, in review), and the development of an immunoassay analysis program for testing nitrate and other chemicals in groundwater (Yu et al., 2001).

Program Effectiveness

- Conducted ambient groundwater sampling in the following basins: Avra Valley, Cienega Creek, Duncan, Hualapai Valley, Salt River, San Rafael and Tonto. Reports on these sampling efforts are being prepared.
- Published regional ambient groundwater quality studies for the following basins or areas:
  –Douglas (Towne, 1999b)
  –Lower San Pedro (Towne, 2002)
  –Prescott AMA (Towne and Freark, 2000)
  –Sacramento Valley (Towne and Freark, 2001a)
  –Sierra Vista (Coes et al, 1999)
  –Upper Santa Cruz (Coes et al, 2000)
  –Willcox (Towne and Freark, 2001b)
  –Virgin River (Towne, 1999a)
  –Yuma (Towne and Yu, 1998)
  In these studies, groundwater quality parameter levels are statistically analyzed to determine significant differences between sub-basins, physiographic areas and aquifers.

- Provided groundwater sampling support for other internal and external monitoring programs, including ADEQ's border, pesticide, aquifer protection and the total maximum daily load programs. Provided support to the Arizona Departments of Agriculture and Health Services and collaborated with the U.S. Geological Survey on its National Water Quality Assessment Program.
- Established groundwater quality index wells in basins in which regional studies were conducted for resampling in the future to determine groundwater quality changes over time. Statistical analyses are conducted on data collected from index wells to determine if any significant changes in water quality have occurred over time.
- Incorporated all ambient groundwater quality sampling results into the ADEQ Groundwater Quality Database.
- Provided groundwater quality information for the annual report to the Legislature and the biannual Water Quality Assessment Report (known as the 305(b) report)
- Refocused the ambient groundwater sampling program to correspond with ADEQ's five year watershed program cycle.
- Presented the results of ambient groundwater studies to professional organizations such as the Arizona Hydrologic Society and the Arizona-Nevada Academy of Science.
- Responded to citizen requests for groundwater quality testing when potential threats to an aquifer were present.

Groundwater Quality Database

Description

In 1999, the Water Quality Division formed the Data Management and Analysis Group to better support the division's data management and analysis responsibilities. A key goal of the group is to improve database applications to meet expanding needs of the water quality monitoring, permitting, compliance and drinking water programs. This includes development of electronic reporting capabilities for the regulated community and provision of Internet access to water quality data.

The group maintains the Groundwater Quality Database, which is the most comprehensive database system on groundwater quality in Arizona and is a primary component of the division's suite of Oracle database applications. The Groundwater Quality Database application was developed in 1988, as mandated by A.R.S. § 49-225, to store and maintain information on groundwater quality monitoring by ADEQ (e.g., ambient and targeted groundwater monitoring projects, WQARF projects, underground storage tank investigations) and cooperators with water monitoring responsibilities. The database now holds millions of records containing information on well locations, well use, well construction details, water quality and other data collected in the field, and laboratory water quality sampling results. Key cooperators that contribute water data to the system include the Arizona Department of Water Resources, U.S. Geological Survey and other entities.

The group also supports the use of geographic information systems (GIS) for analysis of water quality and environmental data. GIS is used in conjunction with the Groundwater Quality Database to provide technical and management products for ADEQ's water quality protection, cleanup and assessment programs. For example, GIS facilitates groundwater flow modeling, determination of contaminant plume configuration, and analysis of causal relationships between water quality and other spatially distributed data such as land use or pollution sources.

Beginning in 2001, the Water Quality Division, the WQARF Program and the department's Information Technology Section collaborated on an initiative to better organize and expedite the entry of WQARF data into the Groundwater Quality Database. Most significantly, as part of this initiative, a desktop GIS environmental mapping and analysis tool, E-Map, is being developed to facilitate data analysis and decision-making capability. E-Map is a user-friendly GIS tool that allows rapid retrieval, analysis and mapping of contaminant, well and other hydrologic data. In the future, the Water Quality Division intends to expand E-Map for agencywide application because of its ease of use and power.

Program Effectiveness

- Completed improvements to the Groundwater Quality Database, including customized reports to summarize water monitoring results, and established an automated electronic loading process for WQARF water quality data.
- Transferred a large amount of groundwater quality data for Arizona to EPA's modernized STORET database system. Data transfers will be performed annually and the data can be accessed at www.epa.gov/storet/.
- Upgraded global positioning system equipment and technical support to facilitate accurate locations of wells, sampling sites and pollution sources for Groundwater Quality Database, GIS and other database uses.
- Implemented an Oracle database query tool, *Discoverer*, to allow department staff ad hoc, easy queries of the Groundwater Quality Database system.
- Responded to hundreds of data requests from customers for information from the Groundwater Quality Database.
- Established a direct database link with the Arizona Department of Water Resources allowing both agencies to cross-access each others Oracle-based data, resulting in significant savings of resources and staff time.

References

ADEQ, 2000. The Status of Water Quality in Arizona, Clean Water Act Section 305(b) Report 2000. ADEQ Environmental Quality Report EQR-00-03.

ADWR, 2002. ADWR Website: Arizona's Water Supplies and Water Demands. http://www.adwr.state.az.us/AZWaterInfo/statewide/supplyde.html

Boettcher, Elizabeth and Wang Yu, 2002. An Assessment of Methyl Tertiary-Butyl Ether (MTBE) Occurrence in Maricopa County Groundwater Resources, ADEQ Open File Report 02-03.

Coes, Alissa L., D. J. Gellenbeck, and Douglas C. Towne, 1999. Ground-Water Quality in the Sierra Vista Subbasin, Arizona, 1996-97. U.S. Geological Survey Water-Resources Investigations Report 99-4056.

Coes, Alissa L., D. J. Gellenbeck, Douglas C. Towne, and Maureen C. Freark, 2000. Ground-Water Quality in the Upper Santa Cruz Basin, Arizona, 2000. U.S. Geological Survey Water-Resources Investigations Report 00-4117.

Daniel, Debra L., Brian E. Munson, and Charles G. Graf, 1988. Groundwater Contamination by Pesticides in Arizona: An Overview. Proceedings of the Arizona Hydrological Society 1st Annual Symposium. Phoenix.

Graf, Charles G., 1986. VOCs in Arizona's Groundwater: A Status Report. Proceedings of the Focus Conference on Southwestern Groundwater Issues, National Water Well Association, Oct. 20-21, 1986.

Robertson, F.M., 1975. Hexavalent Chromium in the Groundwater in Paradise Valley, Arizona. Groundwater, Vol. 13, No. 6, pp 516-527.

Robertson, F.M., 1986. Occurrence and Solubility Controls of Trace Elements in Groundwater in Alluvial Basins in Arizona. American Water Resources Association Monograph Series No. 7, pp. 69-80

Towne, Douglas C., 1999a. Ambient Groundwater Quality of the Virgin River Basin: A 1997 Baseline Study. ADEQ Open File Report 99-4.

Towne, Douglas C., 1999b. Ambient Groundwater Quality of the Douglas Basin: A 1995-1996 Baseline Study. ADEQ Open File Report 99-11.

Towne, Douglas C., 2002. Ambient Groundwater Quality of the Lower San Pedro Basin: A 1999-2000 Baseline Study. ADEQ Open File Report 02-01.

Towne, Douglas C. and Maureen C. Freark, 2000. Ambient Groundwater Quality of the Prescott Active Management Area: A 1997-1998 Baseline Study. ADEQ Open File Report 00-01.

Towne, Douglas C. and Maureen C. Freark, 2001a . Ambient Groundwater Quality of the Sacramento Valley Basin: A 1999 Baseline Study. ADEQ Open File Report 01-04.

Towne, Douglas C. and Maureen C. Freark, 2001b. Ambient Groundwater Quality of the Willcox Basin: A 1999 Baseline Study. ADEQ Open File Report 01-09.

Towne, Douglas C. and Wang Yu, 1998. Ambient Groundwater Quality of the Yuma Basin: A 1995 Baseline Study. ADEQ Open File Report 98-7.

Wilson, Richard P., 1991. Summary of Groundwater Conditions in Arizona. USGS Water-Resources Investigations Report 90-4179. Tucson.

Yu, Wang, et al., 2001a. Monitoring Report of the Pesticide Contamination Program of Arizona (1987-1997). ADEQ Open File Report 01-01.

Yu, Wang, et al., 2001b. Enzyme Linked Immunosorbent Assay (ELISA): A New Testing Method to Characterize/Quantify Chemical Parameters in Groundwater. ADEQ Open File Report 01-05.

Maps

Groundwater Monitoring in the Bill Williams Watershed, 1995-2000 (185 KB)

Groundwater Monitoring Results for Nitrate, Bill Williams Watershed (176 KB)

Groundwater Monitoring Results for TDS, Bill Williams Watershed (178 KB)

Groundwater Monitoring in the Colorado-Grand Canyon Watershed, 1995-2000 (287 KB)

Groundwater Monitoring Results for Nitrate, Colorado-Grand Canyon Watershed (278 KB)

Groundwater Monitoring Results for TDS, Colorado-Grand Canyon Watershed (283 KB)

Groundwater Monitoring in the Colorado-Lower Gila Watershed, 1995-2000 (305 KB)

Groundwater Monitoring Results for Nitrate, Colorado-Lower Gila Watershed (189 KB)

Groundwater Monitoring Results for TDS, Colorado-Lower Gila Watershed (184 KB)

Groundwater Monitoring in the Little Colorado-San Juan Watershed, 1995-2000 (402 KB)

Groundwater Monitoring Results for Nitrate, Little Colorado-San Juan Watershed (187 KB)

Groundwater Monitoring Results for TDS, Little Colorado-San Juan Watershed (184 KB)

Groundwater Monitoring in the Middle Gila Watershed, 1995-2000 (371 KB)

Groundwater Monitoring Results for Nitrate, Middle Gila Watershed (255 KB)

Groundwater Monitoring Results for TDS, Middle Gila Watershed (255 KB)

Contamination of Groundwater by Volatile Organic Compounds, Middle Gila Watershed (342 KB)

Groundwater Monitoring in the Salt Watershed, 1995-2000 (264 KB)

Groundwater Monitoring Results for Nitrate, Salt Watershed (269 KB)

Groundwater Monitoring Results for TDS, Salt Watershed (265 KB)

Groundwater Monitoring in the San Pedro-Willcox Playa-Rio Yaqui Watershed, 1995-2000 (233 KB)

Groundwater Monitoring Results for Nitrate, San Pedro-Willcox Playa-Rio Yaqui Watershed (205 KB)

Groundwater Monitoring Results for TDS, San Pedro-Willcox Playa-Rio Yaqui Wateshed (195 KB)

Groundwater Monitoring in the Santa Cruz-Rio Magdalena-Rio Sonoyta Watershed, 1995-2000 (254 KB)

Groundwater Monitoring Results for Nitrate, Santa Cruz-Rio Magdalena-Rio Sonoyta Watershed (233 KB)

Groundwater Monitoring Results for TDS, Santa Cruz-Rio Magdalena-Rio Sonoyta Watershed (230 KB)

Groundwater Monitoring in the Upper Gila (Safford-San Carlos-Duncan) Watershed, 1995-2000 (234 KB)

Groundwater Monitoring Results for Nitrate, Upper Gila Watershed (218 KB)

Groundwater Monitoring Results for TDS, Upper Gila Watershed (214 KB)

Groundwater Monitoring in the Verde Watershed, 1995-2000 (338 KB)

Groundwater Monitoring Results for Nitrate, Verde Watershed (220 KB)

Groundwater Monitoring Results for TDS, Verde Watershed (222 KB)