Arizona

Nonpoint Source Assessment Report

Prepared By
Arizona Department of Environmental Quality
Rose Moffard, Governor

1988
NONPOINT SOURCE ASSESSMENT REPORT

State of Arizona
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Executive Summary

The Arizona Department of Environmental Quality (ADEQ) has prepared this report on the status of surface and groundwater quality related to nonpoint source pollution. The report is required by Section 319 of the Federal Clean Water Act and is designed to guide the development of nonpoint source water pollution management programs in Arizona.

Across the nine major surface water basins of Arizona, nonpoint source pollution is a leading cause of water quality degradation. The 22 year "window" (1965-1987) of data and information examined indicates that over 90 percent of the streams assessed were not fully supporting designated protected uses in the State Water Quality Standards. This historic record of protected use attainment does not necessarily reflect current water quality conditions.

In Figure 1, the 5,921 miles of stream assessed are shown. Of these, 323 miles fully supported their designated uses, 3,389 were partially supporting, 2,105 were non-supporting and 104 were threatened but still supported their designated protected uses. The surface water assessment indicates the principal non point pollution sources were, in descending order: unknown, rangeland, hydrologic/habitat modification, resource extraction, recreation, and other (natural). Water quality parameters which had elevated levels or exceeded water quality standards were, in decreasing order of magnitude: sediment/turbidity, metals, nutrients (NO_3, PO_4), salinity/total dissolved solids, and bacteria.

In the 50 groundwater basins in the State, impacts to groundwater were primarily from industrial and agricultural activities resulting in organic chemical, nitrate and other toxic chemical contamination of aquifers. The groundwater assessment indicates that over 40 percent of the wells sampled between 1979 to 1987 were exceeding recommended limits for contaminants. Recommended limits include federal primary or secondary Maximum Contaminant Levels (MCLs) or health based guidelines.

The nonpoint source assessment, presented by surface and groundwater basin, has utilized the Hydrologic Unit Code (HUC) system created by the U. S. Geological Survey and the U. S. Environmental Protection Agency Reach File to organize information derived from reports and ambient water quality sampling records extending back 22 years.

Basin summaries presented in Chapter III consist of three components:

1) **A tabulation** of water quality records for the Water Years 1983 to 1987 and a review of older data and literature which provides an assessment of the effects of nonpoint source pollution on Arizona's water bodies;

2) **Basin maps** illustrating features such as the location of potential nonpoint sources, stream locations, and standards attainment, by EPA reach segments; and

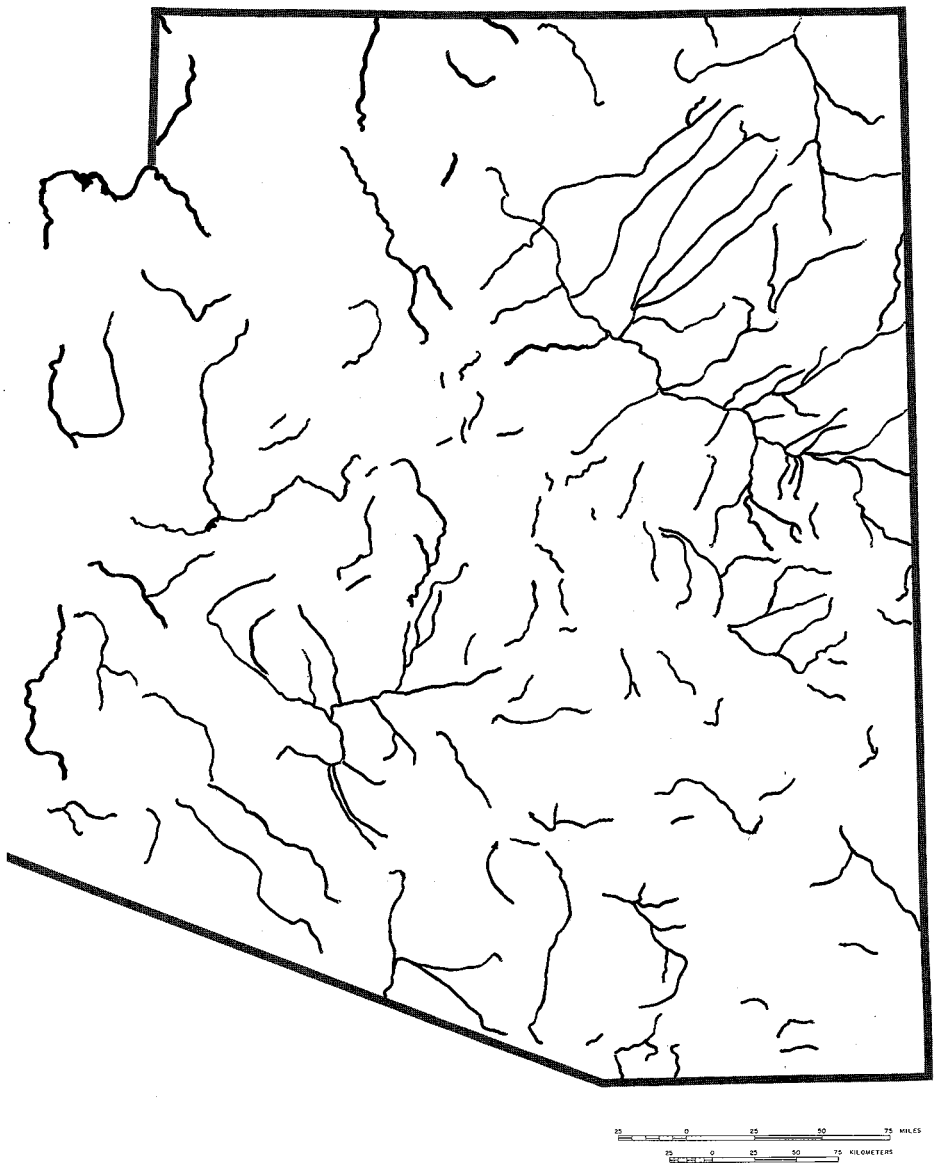
3) **A brief description** of the basin including land use, surface and groundwater quality, and the categories of nonpoint sources which contribute significant pollution to surface and groundwater within the basin.

The nonpoint source management program described in Chapter IV is proposed to respond to the 1986 State of Arizona Environmental Quality Act (EQA) and the Federal Clean Water Act Amendments of 1987, Section 319. The EQA identifies the ADEQ as the State agency responsible for nonpoint source water pollution control and abatement. In this role, ADEQ is responsible for the planning, management, implementation, and compliance for the Arizona Nonpoint Source Management Program.

Other public agencies, including resource management agencies, councils of government, and local governments, have also been identified to participate as designated planning or management agencies for control of specific categories of nonpoint source pollution.

Proposed measures for program implementation and best management practices development will be addressed in further detail in the Arizona Nonpoint Source Management Program document.

ARIZONA 1988
ASSESSMENT OF WATER QUALITY



Designated Use Support By
Attainment of Water Quality Standards

- FULL SUPPORT
- PARTIAL SUPPORT
- NON-SUPPORT
- THREATENED
- UNASSESSED WATERS

N

Figure 1. Map of protected use attainment of waters related to nonpoint source pollution in Arizona , 1988.

CHAPTER I
Arizona Water

A. Introduction

The Nonpoint Source Assessment Report prepared by the Arizona Department of Environmental Quality (ADEQ) describes the nature and extent of nonpoint source pollution in surface water and groundwater, the causes of such pollution, and the preliminary plans, programs, and methods for controlling this pollution. This assessment of navigable waters is based on monitoring data from October of 1982 through September 1987 presented by stream segment, watershed, and groundwater basin. Reports and additional information from earlier monitoring data were also used to evaluate these waters. The open assessment process has been aided by the Nonpoint Source Technical Work Group comprised of interested parties from federal, state, and local agencies as well as private citizens.

This Nonpoint Source Assessment Report has been prepared to meet the requirements of Section 319 of the Federal Clean Water Act (Appendix A). Section 319 requires that each state prepare and submit a report to the Environmental Protection Agency (EPA) which includes:

1. Definition of waterbodies with nonpoint source pollution problems;

2. Identification of the causes of nonpoint source pollution;

3. Existing programs at the state and local level which control nonpoint source pollution; and the

4. Process for developing the overall nonpoint source pollution control program, including institutional and technical factors.

B. Surface Water

The historical development of Arizona has been subject to both the relative availability and abundance of water resources to inhabitants of the land. During the period of 300-800 AD the Hohokam Indians developed a complex system of canals to distribute water for both domestic and agricultural purposes in Central Arizona. The ancient distribution network was later utilized by Hispanic and Anglo settlers. In the early 1900's this network was developed into the irrigation system currently known as the Salt River Project.

The early tradition of impounding and diverting major surface flows has resulted in a state characterized by dry rivers and stream fed impoundments. Although Arizona receives an estimated 80 million acre-feet of precipitation per year, more than 95 percent is lost to evaporation and transpiration. Arizona has the smallest average annual runoff in the Nation (0.4 inch).

Although surface water in Arizona has been regarded as a minor source of potable water, the continuing urbanization of previously rural agricultural areas has resulted in a trend toward increased reliance upon surface waters in the Phoenix area. The Central Arizona Project delivery system will, when operational, provide additional surface water allocations for the increasing demand of central Arizona's growing municipalities. It has been projected that demands by municipalities in Arizona for diverted Colorado River water will increase the 1982 level of approximately 21,000 acre-ft. to about 1,619,000 acre-ft. by the year 2000 (3). Figure I-1 displays water use by source in the State.

	Surface Water 3,000 MGD (a)	Groundwater 4,000 MGD (b)
Public Supply	9%	7%
Rural Supply	0.1%	1%
Industrial	2.3%	4%
Irrigation	90%	88%
Total	101.4 % (c)	100 %

Figure I-1. Water use by source in Arizona.
(a) USGS. 1985 National Water Summary. Water Supply Paper 2300.
(b) USGS. 1984 National Water Summary. Water Supply Paper 2275.
(c) More than 100 percent due to the independent rounding.

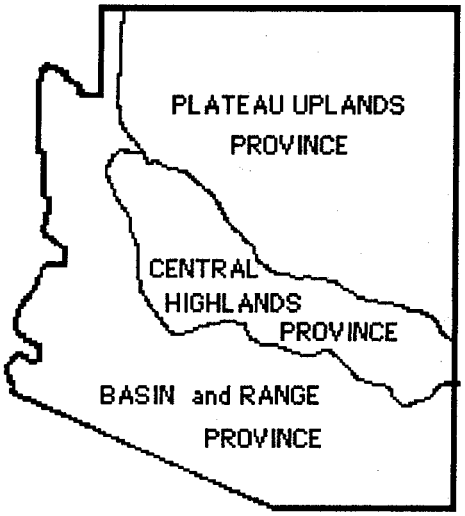


Figure I-2. Map of the physiographic provinces of Arizona.
[Adapted from USGS 1985]

For the purposes of this assessment, Arizona is divided into three physiographic provinces (Figure I-2) and nine surface water basins (Figure I-3). The Basin and Range province in the south, southwestern, and northwestern part of the State includes the Santa Cruz, San Pedro, Upper Gila, Middle Gila, and Colorado Main Stem basins. These broad alluvial-floored basins, bounded by high mountain ranges, are where the largest cities and agricultural lands are located. The valley environments are extremely dry, desert lowlands with annual precipitation ranging from 4 to 12 inches. The valleys are filled with unconsolidated deposits which form the major aquifers of the State (**4**). Portions of the Colorado Main Stem Basin, the San Pedro Basin and Santa Cruz Basin drain from Arizona into Mexico and from Mexico to Arizona. Therefore, use and quality of water in these areas are international issues.

The Central Highlands province is composed of the Verde, Salt and Upper Gila basins and forms a high topographic feature diagonally across the central part of Arizona. This province supplies the greatest amount of surface water because it receives the highest precipitation, about 15 to over 25 inches, and most perennial streams in the State originate here (**4**).

The northern 40 percent of Arizona comprises the Plateau Uplands province, where annual precipitation ranges from 10 to 25 inches. It includes the upper portion of the Colorado Main Stem, the Little Colorado, and the San Juan basins which have only a few perennial streams. Northwest of the Grand Canyon are wooded plateaus and mountain peaks which rise to more than 8,000 feet in altitude. Immediately south and east of the Colorado River, the terrain is similar to that north of the river. The northern and northeastern part of the province is a barren plateau. Broad alluvial valleys, common in other provinces, are uncommon here. Isolated alluvial deposits occur only as narrow strips along larger drainages (**4**).

Chapter III of this report contains a discussion which describes, in map, table, and narrative form, the nine surface water basins of the State, their water quality, and the possible sources of nonpoint source pollution in each. Groundwater basins associated with specific surface water basins are also assessed. Two levels of assessments of waters incorporated into this report (Table I-1) are as follows: (1) Monitored, and (2) Evaluated.

Monitored assessment of waters relied on ambient water quality data from Water Years 83-87 to establish use attainment. A discussion of the methodology used for monitored and evaluated categories is presented in Appendix B.

Evaluated information includes:

1. assessment as published in referenced reports;
2. qualitative assessment based on knowledge of land use patterns, locations, and categories of sources;
3. assessment results of predictive modeling; and
4. data from samples of water and biota more than five years old.

The most extensive source of monitoring data reviewed in this assessment was from the EPA STORET database which includes data from water quality studies, the fixed station network, and regularly sampled stream stations.

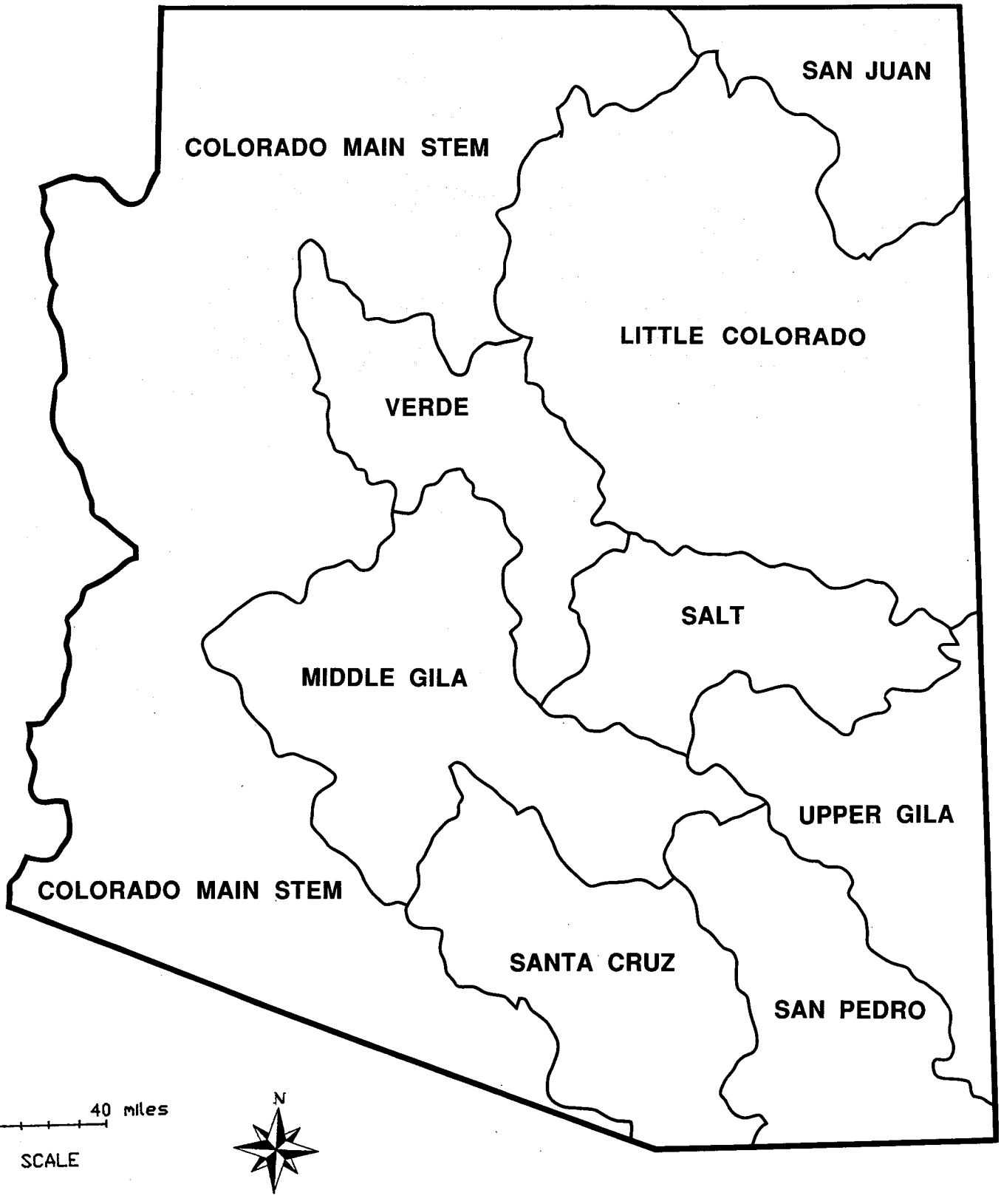


Figure I-3. Map of surface water basins of Arizona.

Table I-1. Use attainment criteria for monitored and evaluated assessment. Based on EPA "Guidelines for the Preparation of the 1988 State Water Quality Assessment (305(b) Report."

MONITORED SEGMENTS	EVALUATED SEGMENTS
STANDARDS ATTAINED : Pollutants not found at levels of concern in chemical analyses. In biological analyses, the community composition is no different from control or ecoregion standards.	**STANDARDS ATTAINED :** No sources are present that could interfere with the designated uses.
ATTAINED BUT THREATENED: Pollutants not found at levels of concern, but adverse trends might cause trouble later.	**ATTAINED BUT THREATENED :** No sources are presently interfering with uses but they might in future if adverse trends continue.
PARTIALLY ATTAINED : Some uncertainty about use support; some modifications of biological community noted; criteria exceeded 11 % to 25 %.	**PARTIALLY ATTAINED :** Sources are present but may not affect use. However, complaints are on record.
NOT ATTAINED : Definite modifications of biological community; pollutants found at levels of concern.	**NOT ATTAINED :** Magnitude of sources indicate use is likely to be impaired.

The monitoring data on the surface waters of the State, which document the attainment of standards, are limited to less than 10 percent of the total river-miles. The principal reason for this limited coverage is that over 84 percent of the river-miles in the State are ephemeral, and the remoteness of many areas precludes sampling efforts during precipitation events. A cooperative effort between state, federal and local authorities has been implemented in an effort to increase sampling and evaluation of surface water quality in the State.

Although standards are established for an extended stream or segments of a stream, mileage in this report is based on the Reach File system. Waters were assessed in EPA reaches based on the assumption that site specific sampling from one or more sites in that reach are representative of the entire reach. For more information on the assessment methodology, see Appendices B and C.

The ambient water quality for stream waters in Arizona was evaluated to determine compliance with State water quality standards for specified protected uses, and the degree to which these waters met standards. Arizona water quality standards are applied to a stream according to its potential uses. Waters which are tributary to a designated water quality segment must also meet water quality standards of the most immediate downstream segment, provided that this segment is not effluent dominated. The protected uses of waters are aquatic and wildlife (A and C), full body contact (F), incidental human contact (H), agricultural irrigation (I), agricultural livestock watering (L), and domestic water source (D). Numeric standards for water quality are reported in Appendix D. None of the protected uses are most restrictive or limiting for all parameters. It should be noted that standards for domestic water use are for waters prior to treatment and are not to be equated with post treatment drinking water standards.

Judgments relative to use attainment and NPS sources in the respective surface water basins were based on a variety of information gathered from the following sources: (1) 208 reports prepared for the EPA under the Clean Water Act, (2) the Association of State and Interstate Water

Pollution Control Administrators' report, America's Clean Water - The State's Nonpoint Source Assessment (1985), (3) file records, and (4) other literature and publications. The procedures or bases for making evaluated judgments are discussed in Appendix B on methodology.

Nonpoint source data have also been incorporated into a computerized geographic information system (GIS). Information on hydrography, land use, and point and nonpoint pollution source categories provides for a generalized description and correlation of these pollution sources with specific quality problems. Although these data were largely unincorporated in the GIS during the initial phases of the NPS assessment report preparation, checks of nonpoint sources associated with water quality problems were made as this information became available. This process will continue on a more frequent basis in the future.

Geographic Information System theme layers can also permit analyses of the land managers, owners, or agencies who have responsibilities for NPS control or abatement in the watersheds. The GIS based system is expected to become an invaluable tool in statewide analyses, planning, and NPS program priority development. For example, the analyses can provide the basis for identifying future sampling and evaluation sites to verify pollution problems. For further information on the GIS see Appendix E.

Together, the monitored, evaluated, and GIS information represent one hierarchical step (STEP 1) in the evaluation of NPS pollution on a broad geographic scale. A second step (STEP 2) of analyses will entail a more detailed evaluation and investigation on small watersheds, and will be utilized only when a watershed has been identified as having a NPS problem.

STEP 2 evaluations of NPS pollution potential will require additional information defining pollution sources from land use maps, aerial photographs, and recent indepth investigations. In the future, the ADEQ will determine which waters in the State were not assessed, prioritize the watersheds where more detailed information is needed, and develop monitoring and modeling studies to refine knowledge about NPS pollution impacts and the effectiveness of Best Management Practices.

The specific source information will be compared with data on soil characteristics, topography, slope, and precipitation in the GIS. Nonpoint source pollution potential will be determined using modeling based on the Universal Soil Loss Equation. This equation estimates annual average soil loss in tons per acre.

The STEP 2 methodology utilizes sediment discharge from watersheds as an indicator of NPS pollution. This is because sediment acts as a transport mechanism for nitrogen, phosphorus, organic matter, and pesticides from irrigated lands, and metals and low pH waters from mined lands.

Because nonpoint source pollution is often directly related to stormwater events, methods to determine the amount of flow and the constituents entrained in the flow are the most applicable. Prediction of the erosion potential of a specific area has always been a need of public and private land managers. Equations which assess erosion have proved to be very powerful management tools.

The Universal Soil Loss Equation (USLE) is the best known and the most widely used of these equations. Several programs based on the USLE are available which can be used with the attributes stored in a GIS. Models being considered include AGNPS, SPUR, CREAMS, VirGIS, and WEPPs. The AGNPS model predicts erosion using grid cell information; SPUR is better for rangeland impacts; and the State of Virginia has an integrated program called VirGIS. The USDA Agricultural Research Service (ARS) developed the Water Erosion Prediction Project (WEPP) model to replace the USLE for the use of the Soil Conservation Service, U.S. Bureau of Land Management and U.S. Forest Service. The model considers the effects of the major factors of climate, soil, topography, and land use on erosion. The WEPP model will apply to a broad range of land management practices. Evaluation of grazing effects, a variety of mechanical practices, disturbed forested areas, construction sites, urban and recreational areas will be possible. The model is intended to compute sheet and rill erosion where

overland flow occurs. It will also compute erosion by concentrated flow in "ephemeral" gullies. Three versions are under development: the hillslope, the watershed and the grid versions. The grid version will calculate erosion at all points and along all flow paths (at the grid resolution) within the area. Pollution potential will be calculated based on the use of available models.

C. Groundwater

The ADEQ is the lead agency authorized to administer protection programs for groundwater quality in Arizona. Selected components of Arizona's groundwater protection programs and activities are summarized by the following:

- Controls on sources of potential contamination through groundwater and surface water permit programs, including application of pollution control technologies;
- Programs for statewide surface water and groundwater monitoring, data collection, data management systems, and data analysis (e.g., modeling, statistical, Geographic Information Systems (GIS));
- Development of aquifer water quality standards, classifications, and comprehensive mapping of aquifer systems;
- Development of surface water standards and classifications which compliment aquifer water quality standards;
- Development of State waste management facilities, consisting of incineration, fixation, and landfill operations, will provide safe regional waste management and disposal services;
- Effective compliance and enforcement provisions, including monitoring and inspection activities;
- Surface-use restictions to protect groundwater quality and quantity, including wastewater reuse, surface water discharges, and agricultural best management practices (e.g., conservation, fertilizer and pesticide use);
- Programs to control groundwater withdrawals to protect groundwater resources, including strict water conservation requirements for water consumers (ADWR);
- Active coordination of groundwater programs with other relevant natural resource protection programs;
- Programs to effectively address recharge, artifical lakes, dry wells, well construction requirements, Underground Storage Tanks (UST), nonpoint pollution sources, and solid and hazardous waste management;
- Extensive administration and planning activities, including the research and development of groundwater information and planning documents, rule-making activities, and coordination of advisory groups and public participation activities;
- Promote programs to ensure that public water systems deliver safe water, including review and approval of facility design and construction of water treatment and supply facilities, certification of several thousand water treatment plant operators each year; and monitoring of data submitted by public water systems to ensure compliance with State standards;
- Efficient clean-up efforts of contaminated soils and water, including investigations, remedial action plans, enforcement/compliance actions, through use of the State Water Quality Assurance Revolving Fund (WQARF) or through access to the federal EPA Superfund or other remedial programs;
- An effective statewide program to address environmental impacts of pesticides currently being applied; and
- Efforts to promote State primacy of EPA delegated programs including Hazardous Waste Authority, Underground Storage Tanks (UST), Underground Injection Control (UIC), and National Pollutant Discharge Elimination System (NPDES)(1)

Like surface water, groundwater occurrence and quality are naturally controlled by the different geologic conditions of the three respective physiographic provinces in Arizona (Figure I-2). The Basin and Range Lowlands province is characterized by broad, flat alluvial basins from which isolated mountain ranges rise sharply. The mountains consist of resistant igneous and metamorphic rocks of Precambrian through Early Tertiary age. Generally, the coarse-grained, unconsolidated to weakly consolidated basin-fill sediments are found near the basin margins adjacent to the surrounding mountains from which they were derived. These poorly consolidated deposits are capable of storing large

amounts of ground water. Typically, wells within these basins have yields from a few hundred to several thousand gallons per minute. Aquifers within this province are generally unconfined, although artesian conditions occasionally do exist.

The Plateau Uplands province slopes gently to the north and generally exhibits only mild topographic relief. This province comprises 40 percent of the area within the State and is underlain with extensive, consolidated sedimentary rock formations that correlate with the Dakota Sandstone (Cretaceous), Navajo Sandstone (Jurassic), and Coconino Sandstone (Permian). Water-bearing sandstone constitutes the principal storage reservoir for groundwater, but well yields are generally small because the sediments are comparatively fine grained and consolidated. Groundwater occurs in the eastern two thirds of the uplands in consolidated sedimentary rocks, sometimes under confined conditions. Consequently, there are a few artesian wells in this province, but where the aquifer is unconfined, depths to water range from relatively shallow to greater than 100 feet. Well yields range from about 10 to several hundred gallons per minute.

The mountainous Central Highlands province covers 15 percent of the State's area and represents a geologic and physiographic transition between the Basin and Range Lowlands and the Plateau Uplands. The province consists of rugged, sharply pinnacled mountains that are comprised of Tertiary Age volcanic and Precambrian Age intrusive and metamorphic rocks. In the Central Highlands, the igneous and metamorphic rocks and the well-consolidated sedimentary rocks exhibit poor transmissivities and groundwater storage is generally associated with faults and fractures where permeabilities are greater. Groundwater occurs in consolidated rocks beneath flood plains of major streams. However, limestone units contain limited amounts of groundwater in solution channels and this water may be discharged as springs under certain circumstances. Water levels range from the land surface to more than 500 feet below the surface. Well yields range from about 10 to 1,000 gallons per minute.

Geologically, the principal aquifers in Arizona consist of: (1) unconsolidated alluvium, (2) consolidated sedimentary rocks, or (3) crystalline igneous and/or metamorphic rock. The permeability of these rock units control the amount of water attainable when a well is developed in an aquifer. Completed wells in unconsolidated alluvial sediments and in a few highly permeable basalt aquifers have reported discharge rates of 1500 - 5000 gallons per minute (gpm). In contrast, productive wells drawing groundwater from consolidated sedimentary aquifers have characteristic discharge capacities in the 300 - 1000 gpm range and igneous and/or metamorphic rock aquifers generally produce meager discharges measured in single or double digit figures.

Evaluation of groundwater quality presents difficulties different from those encountered in surface water systems. Groundwater flow occurs in a heterogeneous three-dimensional framework of geologic materials with generally complex patterns of flow. Whereas, surface water is confined to a relatively small area, groundwater occurs beneath much of the land surface.

The chemical quality of water at any point in an aquifer is a function of inadequately defined reactions that occur along the flow path, particularly between the moving fluids and geologic framework. The spatial variability of groundwater quality tends to be large, both in area and with depth below the land surface. Extreme changes in quality over short distances may occur due to the structure and mineralogy of the formation comprising the aquifer, to low groundwater flow velocities, subsurface chemical reactions, and limited opportunity for mixing. A simplifying characteristic of aquifer systems is that flow velocities are low, when compared to surface water systems, and that the water quality conditions tend to change much more slowly over time. Contaminants within the aquifer tend to move with the direction of groundwater flow, and tend to attenuate as a function of time and distance traveled due to dilution, absorption and die-off (in the case of pathogenic organisms).

Groundwater quality is a major concern because it is the principal source of public water supplies. Slightly more than half of the total amount of water used in the State is groundwater and many areas depend heavily on groundwater. In 1985,

about 79 percent of groundwater pumped was used for agricultural irrigation with the remainder used for public water supply, commercial, industrial and domestic uses (2). In 1987, more than 73,000 water wells, excluding an estimated 2,000 monitoring wells, were known to be withdrawing water reserves from aquifers throughout the State. Of this total, approximately 45,000 or 66 percent of the producing wells were used for drinking water.

Groundwater basins have been identified by the Arizona Department of Water Resources (ADWR) and the ADEQ (Figure I-4) (Table I-2). Four of these basins have been designated as Active Management Areas (AMAs) because of critical water quantity and quality concerns. Much of the current groundwater data for the State has been collected within the AMAs. As a result, most of the identified groundwater quality problems within the State appear to be associated with the AMAs. The methodology for groundwater quality assessments is found in Appendix F and the assessments are based upon information in Appendix G. The description of groundwater quality conditions have been included into surface water basin reports (Chapter III).

Under the Safe Drinking Water Act of 1974, EPA is authorized to designate an entire aquifer or a portion as a "sole or principal source" of drinking water. The purpose of this designation is to provide assurances that ground water resources will be given protection from contamination that may result from federally financed projects. The U.S. Environmental Protection Agency has designated the Bisbee - Naco aquifer in Cochise County and the Tucson Basin in Pima County as sole sources of drinking water for those areas.

Table I-2. Arizona groundwater basins.

AGF	Aqua Fria Basin	MOR	Morenci Basin
ARA	Aravaipa Canyon Basin	PAR	Paria Basin
BIS	Big Sandy Basin	PHX	Phoenix AMA
BON	Bonito Creek Basin	PIN	Pinal AMA
BUT	Butler Valley Basin	PKB	Parker Basin
BWM	Bill Williams Basin	PRE	Prescott AMA
CCK	Cienega Creek Basin	PSC	Peach Springs Basin
COP	Coconino Plateau Basin	RAN	Ranegras Plain Basin
DET	Detrital Valley Basin	SAC	Sacramento Valley Basin
DON	Donnelly Wash Basin	SAF	Safford Basin
DOU	Douglas Basin	SBV	San Bernardino Valley Basin
DSW	Dripping Spring Wash Basin	SHV	Shivwits Plateau Basin
DUN	Duncan Valley Basin	SRB	Salt River Basin
GIL	Gila Bend Basin	SRF	San Rafael Basin
GWA	Grand Wash Basin	SSW	San Simon Wash Basin
HAR	Harquahala Basin	TIG	Tiger Wash Basin
HUA	Hualapai Valley Basin	TON	Tonto Creek Basin
KAN	Kanab Plateau Basin	TUC	Tucson AMA
LCR	Little Colorado River Plateau	UHA	Upper Hassayampa Basin
LGB	Lower Gila Basin	USP	Upper San Pedro Basin
LKH	Lake Havasu Basin	VRB	Verde River Basin
LSP	Lower San Pedro Basin	VRG	Virgin River Basin
MEA	Meadview Basin	WIL	Wilcox Basin
MHV	Lake Mohave Basin	WMD	W. Mexican Drainage Basin
MMU	McMullen Valley Basin	YUM	Yuma Basin

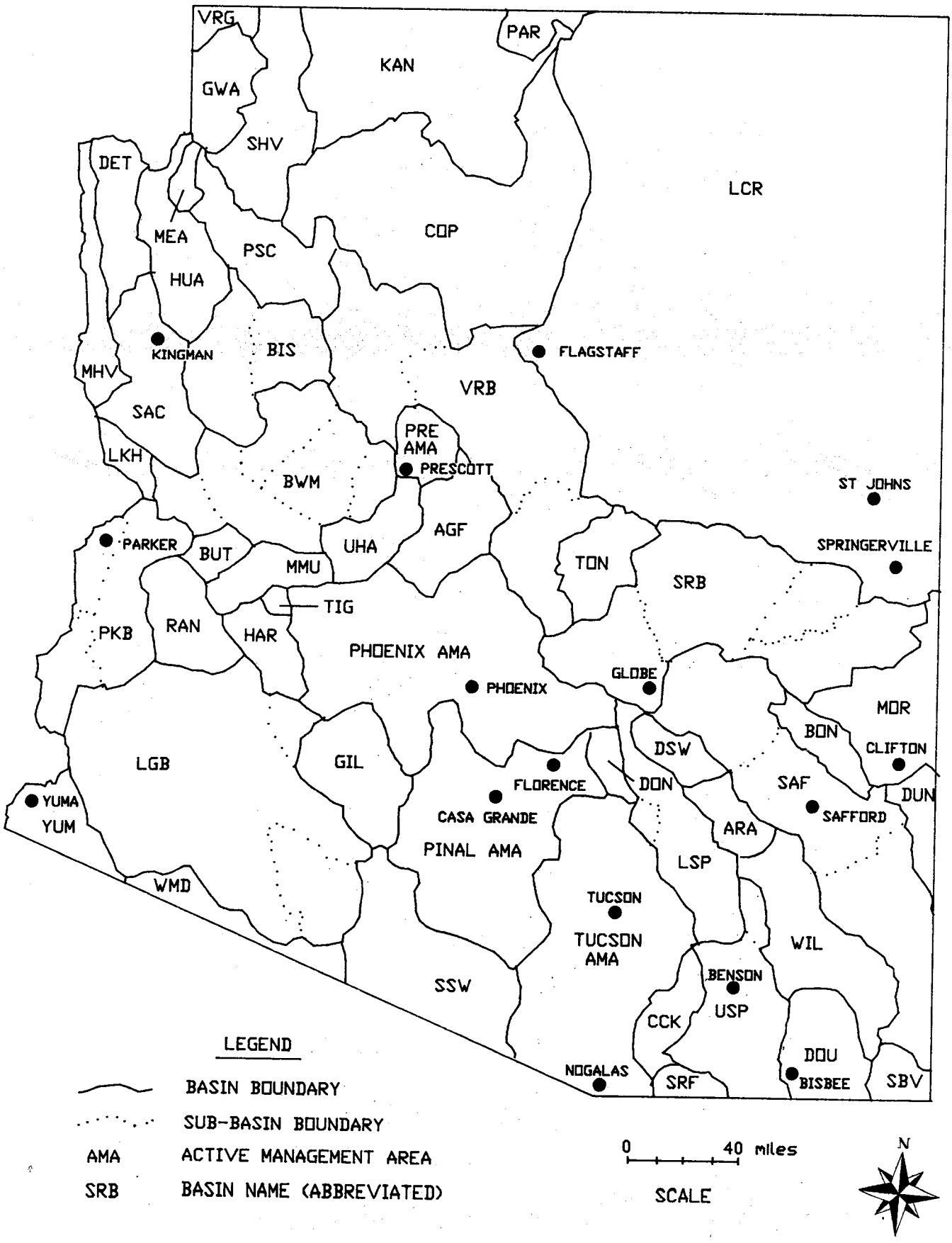


Figure I-4. Map of groundwater basins of Arizona.

Groundwater quality varies widely between provinces and is affected by inherent ionic constituents, such as calcium, sodium, bicarbonate, sulfate, and chloride. These constituents form five general water types: calcium carbonate, sodium bicarbonate, sodium sulfate, calcium sulfate, and sodium chloride. Water containing TDS concentrations of less than 500 mg/L is generally sodium sulfate, calcium sulfate, or sodium chloride. Highly mineralized water (greater than 3000 mg/L TDS) is generally a chloride-sulfate type. The recommended level for public drinking water supplies is 500 mg/L TDS, however, a content up to 1000 mg/L is considered suitable for most domestic, irrigation, and industrial uses. In addition, naturally-occurring contaminants such as chromium, arsenic and other minerals may be found in aquifers in both hardrock and alluvial basin areas.

Long term groundwater sampling (1979 to 1987) provided a sound database from which sampling and monitoring strategies are planned. Areas of known or suspected contamination within certain parameter groups can be readily identified, as well as the number of wells tested in each basin. A summary of groundwater sampling results from the ADEQ groundwater database is presented in Appendix G. Statewide, more than 350 wells have been documented as being contaminated.

Interpretation of results, from an ADEQ water quality study in 1986-87 of 40 public water system wells throughout the State, indicates that the quality of water supplies available to Arizona's citizenry from groundwater sources is generally very good. In 1987, compliance for primary and secondary drinking water contaminants in municipal and public water supplies was 98 percent. Contaminated drinking water wells are quickly phased out of production as drinking water supplies or are treated/blended to attain standards.

The ADEQ conducted a federally funded project in 1987 in coordination with ADWR to map groundwater quality in the State's four AMA's using GIS technology. The study used data documented during 1975 to 1987 from reports, national data bases such as WATSTORE and STORET, state and federal agency files, municipalities and private entities. The parameter groups selected for assessment mapping were TDS, nitrate, sulfate, metals, volatile organic compounds and pesticides.

Maps generated at 1:125,000 scale contain isopleths of water quality values as well as selected individual data points. In addition hydrographic map series and Water Resource Inventory maps are produced by ADWR and the USGS to provide information on groundwater levels, flow direction, depth to water, water level decline rates and the general chemistry characteristics of aquifers.

The Arizona Department of Environmental Quality has initiated statewide DRASTIC aquifer vulnerability mapping. DRASTIC and Pesticide Drastic maps (formerly known as General and Agricultural Drastic maps) have recently been printed of Yuma, La Paz and Maricopa Counties including a large scale insert of the Phoenix Active Management Area, and are currently being prepared for Pima and Santa Cruz Counties. A DRASTIC map displays relative groundwater pollution potentials for areas greater than 100 acres in size. The DRASTIC methodolgy is a standard system for evaluating groundwater pollution potential developed for the Environmental Protection Agency in 1986 by the National Water Well Association (EPA/600-2-87/035). The methodology uses geologic and hydrologic charcteristics of groundwater systems in a rating scheme that accounts for the relative degree to which an aquifer is vulnerable to pollution.

Seven parameters that affect groundwater pollution make up the DRASTIC acronym. These are: Depth to water; Recharge (net); Aquifer media; Soil media; Topography; Impact on the vadose zone; and Conductivity (hydraulic). Each of the seven parameters are mapped and scored using a weight determined by their relative importance to groundwater contamination and a rating determined by the particular hydrogeologic setting. The resulting DRASTIC index numbers are then used to map relative groundwater contamination potential.

The type of contaminant considered in a DRASTIC map is assumed to be introduced at the ground surface, flushed into the groundwater by precipitation, and to have the mobility of water.

Pesticide DRASTIC maps modify the weighting of the same parameters to account for conditions that influence the movement of pesticides.

The DRASTIC system is intended to function as a management tool; to be easy to use by individuals with diverse backgrounds, and to utilize readily available information. While not intended to replace site-specific investigation, the map provides a regional view of pollution potential.

The maps have a variety of uses for resource planners and administrators. DRASTIC maps can be a useful screening tool for:

- prioritizing areas for groundwater protection activities;
- identifying groundwater data needs and monitoring activities;
- allocating resources for groundwater investigations or scheduling replacement of facilities;
- planning the locations of new facilities or identifying potential problem areas; and
- providing an educational tool to communicate the fundamentals of groundwater pollution potential and resource protection.

ADEQ has initiated development of a statewide groundwater quality monitoring strategy. Monitoring networks are needed for many reasons, including the requirements to provide baseline information on groundwater quality and subsequent information on statutory mandates for water quality protection.

The design of a statewide strategy to monitor groundwater quality conditions is a formidable task which involves the selection of areas within groundwater basins to be monitored, based on a combination of administrative, physiographic, and other priority considerations. These include development of general and specific monitoring objectives based on known water quality factors. It is essential to utilize existing wells and ongoing monitoring efforts if the strategy is to be both comprehensive and cost-effective. ADEQ must also ensure that the environmental sampling and analysis efforts meet the quality assurance objectives established.

Through state and federal funding, ADEQ and ADWR will work toward a comprehensive and integrated statewide groundwater data management sysyem which addresses data collection , storage , retrieval and manipulation requirements. Improved data management is necessary in order for Arizona to meet its groundwater data needs and to meet legislative mandates for the protection of groundwater resources.

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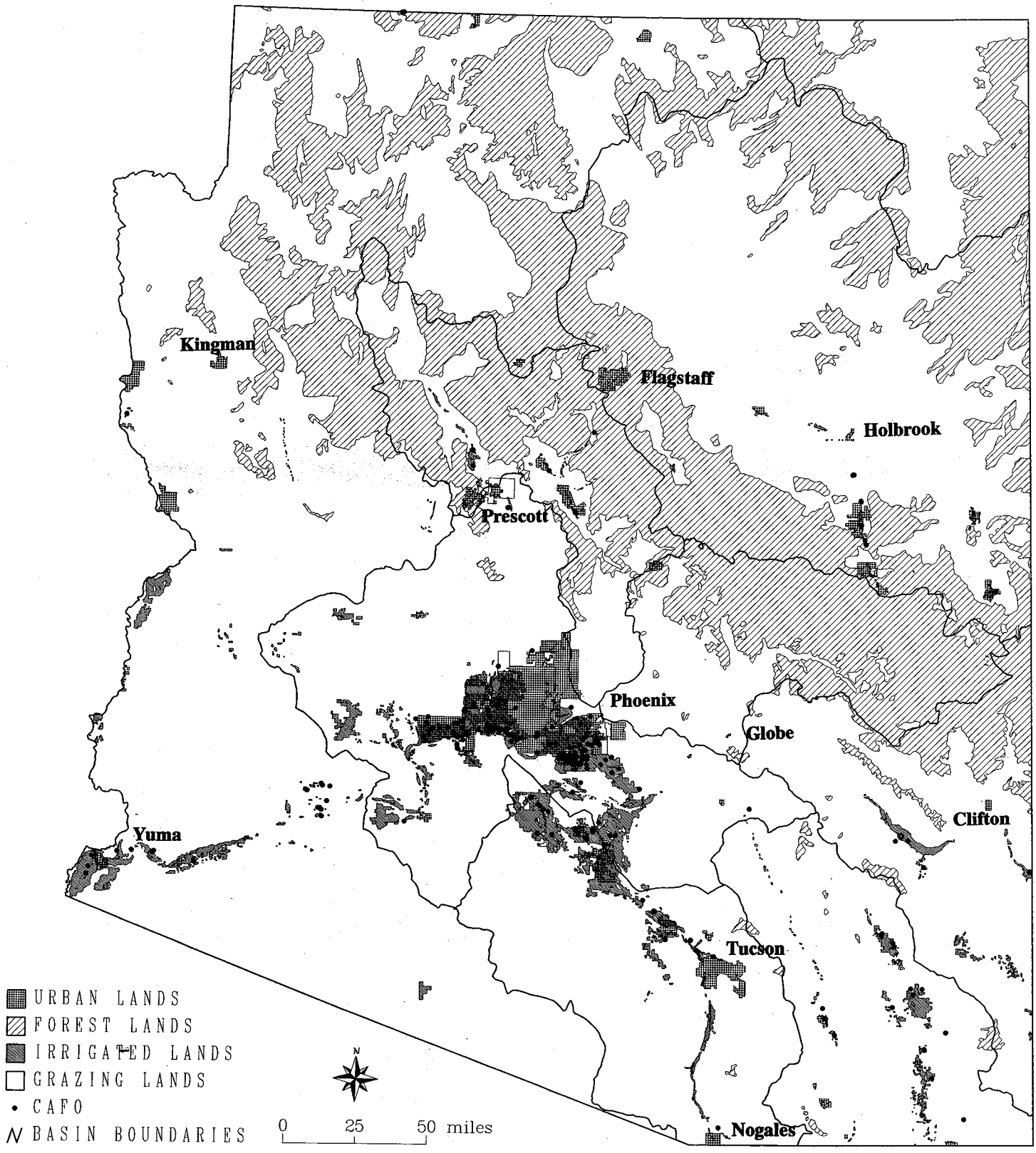

Figure II-1.

Map of the concentrated animal feeding operations (CAFOs), urban, forest, irrigated agricultural, and grazing lands in Arizona.

CHAPTER II
Nonpoint Sources of Pollution

Nonpoint source (NPS) categories and subcategories which add significantly to the pollution of waters of the State of Arizona are described in Table II-1. These NPS categories and subcategories have been modified from the original EPA list of nonpoint source categories and subcategories. This modification provides for a more accurate description of the character of NPS pollution in Arizona.

Pollutants to surface water from nonpoint sources are often generated intermittently as a result of storm or snow melt incidents. The NPS pollution episodes in an arid setting are seasonal, less frequent, and short in duration.

Therefore, NPS pollution to surface water is more difficult to quantify than continuous point source discharges.

In contrast, groundwater contamination is even more difficult to identify because of the heterogeneous nature of the aquifers and the limited sampling locations. Impacts to groundwater are not differentiated as resulting from point sources or nonpoint sources.

Surface and groundwater contamination from NPS pollution is intimately related to land use, except for a small percentage of cases due to naturally occurring constituents. A general description of types of nonpoint sources pollution and their impacts in Arizona are presented hereafter. The data in Table II-2 presents a summary of assessed stream course mileages affected by the various NPS pollution categories. Figures II-1, II-2, and II-3 present statewide land use information related to agriculture, silviculture, urban lands, minerals, and land disposal.

Table II-1. Arizona nonpoint source pollution categories

10. **Agriculture**
- Irrigated crop production/ return flows
- Rangeland
- Concentrated animal feeding operations
- Aquaculture

20. **Silviculture**
- Harvesting, reforestation, residue management
- Forest management
- Road construction and maintenance

30. **Construction**
- Highway/road/bridge
- Land development
- Military operations

40. **Urban Runoff**
- Surface runoff
- Dry wells, infiltration basins

50. **Resource Extraction**
- Copper mining, milling and refining
- Precious metal mining and processing
- Placer mining
- Uranium mining, milling and refining
- Industrial minerals mining
- Sand and gravel mining

60. **Land Disposal**
- Sludge
- Wastewater reuse
- Landfills
- Recharge
- On-site wastewater systems (septic tanks)
- Hazardous waste

70. **Hydrologic/Habitat Modification**
- Channelization/dredging
- Dam construction
- Flow regulation/hydrologic modification
- Riparian alteration
- Streambank modification/destabilization
- Canals/irrigation systems
- Stock Tanks
- Watershed yield/vegetation manipulation

80. **Other**
- Natural
- Waste storage/storage tank leaks
- Highway maintenance and runoff
- Spills
- In-place contaminants
- Utility corridors
- Motor transportation

90. **Unknown**

100. **Recreation**

TABLE II-2. Summary of nonpoint source category impacts on use attainment by stream miles.

CATEGORY	Colorado Main Stem			Little Colorado			Middle Gila River		Salt River		San Pedro		Santa Cruz		Upper Gila			Verde		Statewide Summary		
	Part	Non	Thr.	Part	Non	Thr.	Part	Non	Part	Non	Part	Non	Part	Non	Part	Non	Thr.	Part	Non	Part	Non	Thr
10. Agriculture - Grazing	40.5	--(1)	--	379.8	1727.8	59.9	17.3	--	262.1	--	92.0	--	162.9	--	281.0	7.0	--	554.3	21.9	1789.9	1749.7	59.9
-Irrigated Lands	62.3	49.5	36.0	--	--	--	132.8	18.7	--	--	72.6	--	70.0	--	100.6	7.0	--	--	--	438.3	75.2	36.0
																			Agriculture Totals	2228.2	1824.9	95.9
20. Silviculture	9.2	--	--	--	--	--	--	--	--	--	--	--	--	--	149.8	--	--	--	--	159.0	--	--
30. Construction	--	--	--	18.7	--	--	--	--	--	--	--	--	22.2	--	--	--	--	177.4	10.3	218.3	10.3	--
40. Urban Runoff	--	--	--	5.7	--	--	73.2	124.4	--	--	--	--	--	6.0	--	--	--	47.0	--	125.9	130.4	--
50. Resource Extraction	35.5	10.6	--	--	61.5	--	82.4	6.0	3.5	27.6	116.9	27.7	17.2	46.6	116.9	27.7	--	84.0	12.0	481.6	213.0	--
60. Land Disposal	45.3	--	36.0	6.0	--	--	--	124.4	--	--	77.9	12.0	5.0	6.0	--	--	8.0	188.2	--	322.4	142.4	44.0
70. Hydrologic/ Habitat Modification	415.9	16.8	36.0	121.7	90.9	--	--	49.8	57.4	--	--	--	65.6	--	3.3	--	--	38.3	--	702.2	157.5	36.0
80. Other (Natural)	83.7	--	36.0	--	--	--	34.5	--	260.6	--	13.5	--	166.4	--	15.0	--	--	--	--	573.7	--	36.0
90. Source Unknown	270.9	53.7	--	353.8	1571.8	59.9	247.5	82.5	121.9	--	206.2	--	140.6	--	116.9	7.0	8.0	490.3	11.6	1948.1	1726.6	67.9
100. Recreation	46.9	--	--	52.3	--	--	17.3	--	264.2	--	--	--	5.0	--	52.6	--	--	152.0	--	590.3	--	--

(1) -- No information on this NPS Category in the Basin

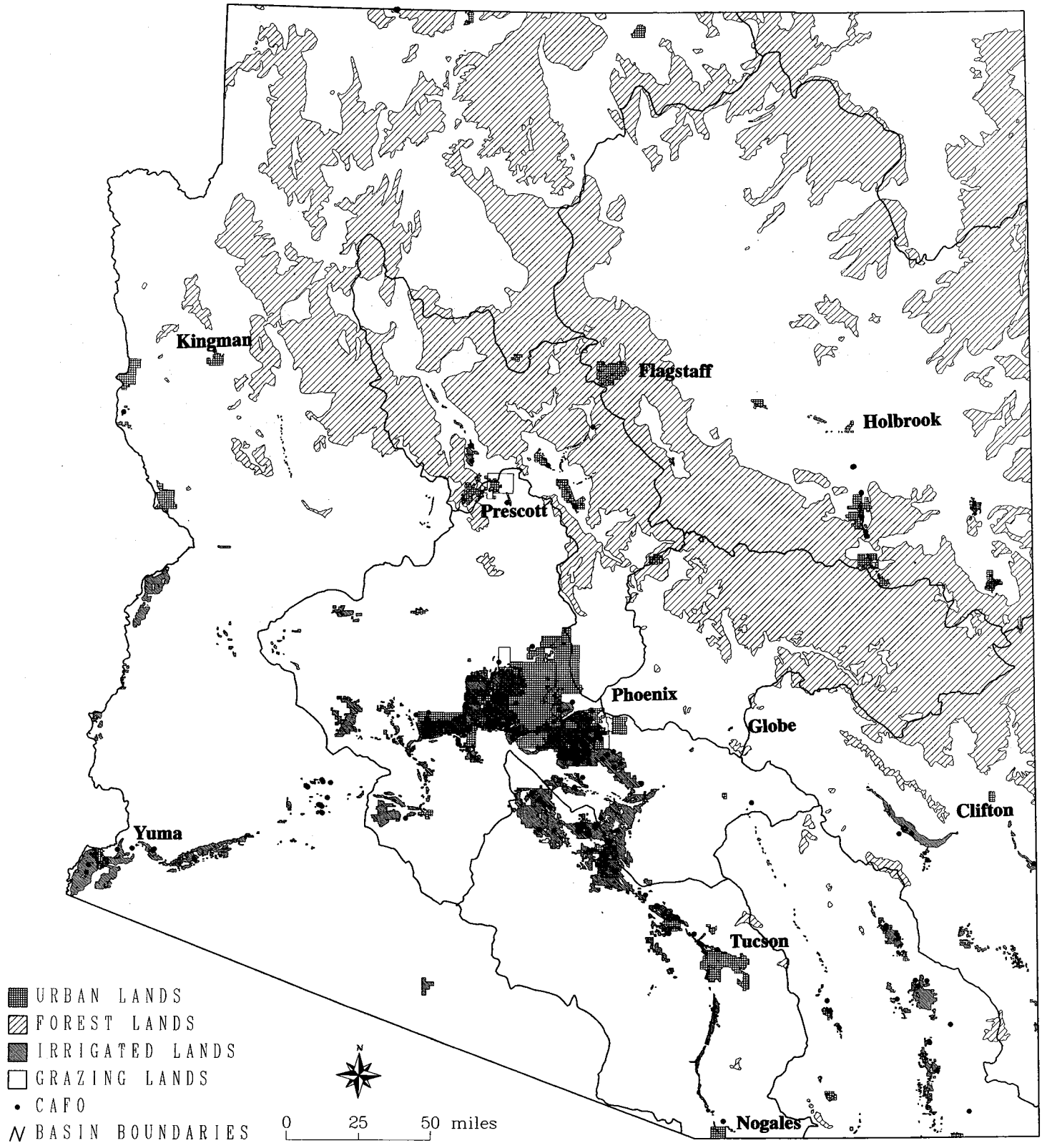

Figure II-1. Map of the concentrated animal feeding operations (CAFOs), urban, forest, irrigated agriculture, and grazing lands in Arizona.

A. Agricultural NPS (10)

The NPS pollutants from agricultural activities in Arizona include sediment, pesticides, nitrate from fertilizers, animal wastes, and total dissolved solids. The majority of cultivated lands within the State are associated with the major river drainage systems in the Basin and Range province of south central and southwestern Arizona.

Pesticide contamination is associated with chemigation, irrigation water return flow, downward percolating agricultural waters, and direct disposal at landfills. Metabolites of DDT have been reported in concentrations up to 18 parts per million from tissues of fish collected from sites along the Middle Gila River **(4)**. In addition, analyses of groundwater from the Phoenix, Chandler, Mesa and Yuma areas report the presence of the agricultural chemicals dibromochloropropane (DBCP) and ethylene dibromide (EDB). These geographical areas of contamination of groundwater appear to be most closely associated to agronomic areas where DBCP and EDB were applied by chemigation. The pesticide dinoseb has been detected in groundwater at a site in Phoenix. The contamination is the result of improper disposal at a formulation plant **(1A)**.

Nitrogen contamination of Arizona's major aquifers is due, in part, to the use of nitrogenous fertilizers, concentrated animal feeding operations and several other nonagricultural related activities. Statewide, more than 150 water supply systems registered with the ADEQ were identified as having groundwater supplies with potentially high nitrate levels. Specifically, EPA standards are exceeded throughout the historically irrigated areas of the Phoenix Metropolitan Area.

Waste products from confined animal feeding operations have been implicated as NPS contributors of nutrients, organic materials, and coliform bacteria to surface water and nitrate to groundwater. Feedlot and dairy locations correlate with nitrate groundwater contamination at multiple sites within the Santa Cruz and Middle Gila basins.

The Wellton-Mohawk Valley in the Colorado Basin is a principal site where degradation of groundwater quality due to salinity has been conclusively demonstrated. This district became agronomically unproductive in the mid-1940's as a result of salt accumulation in soils from irrigation with salt laden, poor quality groundwater. However, this area was reclaimed in the early 1950's using Colorado River water for irrigation. Drainage of salt laden effluents from agricultural fields in the Welton-Mohawk Valley are discharged into the Colorado River near Morelos Dam **(6B)**.

Private, state and federal rangelands have been identified as a source of sediment and nutrient pollution to surface water as a result of the land use activities occurring upon these rangelands. The data compiled by various state, federal and local agencies responsible for rangeland management correlate existing poor watershed quality to both historic and current rangeland management practices. Surface disruption and reduction in natural vegetative cover associated with grazing is a known factor which can increase the erodibility of rangelands.

Aquacultural facilities in Arizona are operated by both the governmental and private sectors. The U.S. Fish and Wildlife Service (USFWS) operates three fish hatchery and rearing facilities, the Arizona Game and Fish Department (AGFD) has seven hatchery/rearing/holding facilities, and private parties operate 30 licensed facilities. Fish hatcheries and rearing facilities in the State that provide flow-through environments for fish are subject to point source discharge (NPDES) permit requirements.

Pollution from aquacultural facilities is a consequence of the confined rearing and feeding of large numbers of animals. Increased concentrations of nitrates and phosphates occur from decomposition of fecal material and unutilized food as well as from artificial fertilization of pond rearing environments. Suspended and total dissolved solids, ammonia, BOD, and pH are among the water quality parameters that can also be affected by aquacultural activities.

Additional assessment of aquacultural facilities in Arizona will be necessary to determine if they are contributing to nonpoint source pollution of surface or groundwater.

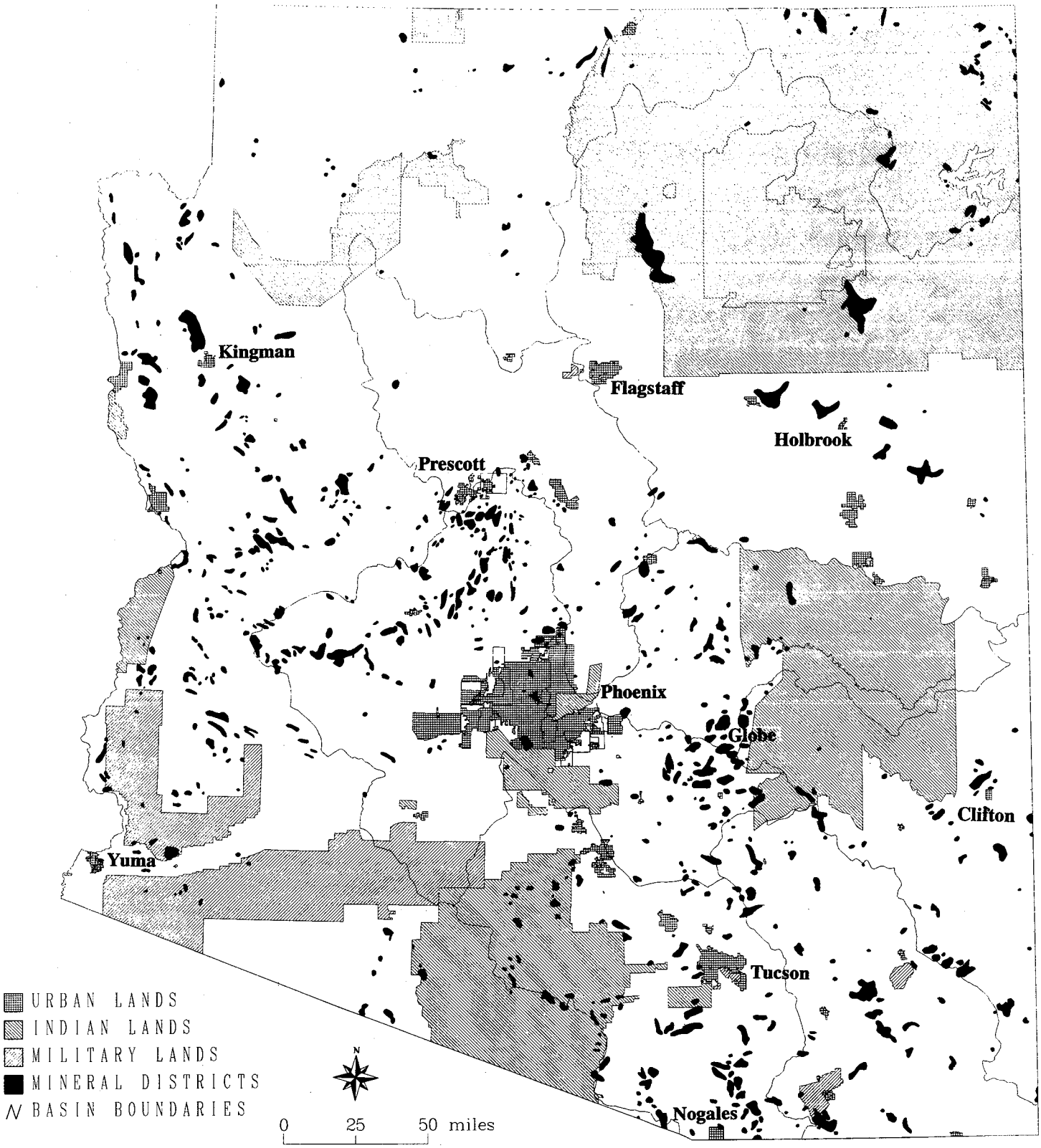

Figure II-2. Map of the mineral districts, urban, Indian, and military lands in Arizona.

B. Silvicultural NPS (20)

Interpretation of data provided by state, federal, and local forest management agencies indicates that grazing within forest areas is the primary cause of watershed degradation. The impact of timber harvesting and associated road construction is locally severe, but has a minimal overall impact on water quality within each basin.

C. Construction NPS (30)

Construction activity in the expanding metropolitan areas of Arizona has contributed to watershed degradation through vegetation removal and channelization which increases velocities of flow. Sediment, oil, and grease are the primary construction site pollutants. More rigorous erosion control by local jurisdictions will continue to improve this situation.

D. Urban Runoff NPS (40)

Urban stormwater runoff is a major contributor of pollution to receiving waters throughout the United States. However, only a few reports have discussed nonpoint urban runoff sources in Arizona. Lead, iron, magnesium, manganese and hydrocarbons associated with plasticizer and paving materials have also been detected in elevated concentrations in urban runoff and therefore may have the potential to impact groundwater **(2A,6C,6D).** In 1979, the Maricopa Association of Governments (MAG) reported that only cadmium was of concern because it was present in dissolved form at concentrations which exceeded the drinking water limit of 0.01 mg/l **(5).** It was recommended that both cadmium and hydrocarbon contamination of groundwater from urban runoff be more extensively investigated in the future. The Pima Association of Governments (PAG) also funded a study of several urban watersheds as part of their 208 planning effort. These reports are further discussed in Chapter III. Studies from the Tucson Metropolitan Area have concluded that quality of runoff from much of the urban area improves through filtration from transport along grassed waterways and percolation and infiltration along dry stream beds.

Urban runoff in Arizona is frequently discharged into dry wells or retention basins. Several municipalities require that all runoff from a storm event of less than a 10-year/24 hour magnitude be retained upon the property boundaries to prevent flooding of offsite areas. These regulations result from a concern about controlling heavy regional runoff of short duration which produce flash floods. Seasonal monitoring of dry wells commonly produces results in which variable levels of contaminants are encountered. An extensive sampling program and regulatory program is underway to deal with this potential problem.

E. Resource Extraction NPS (50)

Historical, and to a lesser extent, current mining operations in Arizona for copper, precious metals, uranium, industrial minerals and coal have impacted water quality. Of the 16 copper mines operating in Arizona in 1965, all but three, Ajo, Sacaton and Blue Bird, are still operating today. The number of operating companies have decreased and five major copper companies are operating 13 large mines.

There have been several copper mining operations that used in-situ leaching with sulfuric acid. Two are still active today, and three have completed the leaching of the in-place ore. Groundwater near the mining and milling sites show increased concentrations of sulfate as well as total dissolved solids. Smelters have also been identified as major contributors of trace metals, sulfate and acidic precipitation falling in southeastern Arizona **(1).**

Early in Arizona's history, gold and silver were produced from over 60 mining districts in Arizona. As a result of new technologies, many of the old districts, such as the historic town of Tombstone, are reopening using cyanide and sulfuric acid heap leaching methods. The waste products of precious metal processing contain elevated levels of cyanide, arsenic, cadmium, lead and sometimes mercury and selenium. Seepage and runoff from tailings piles and heap leach piles are also nonpoint sources of pollution. The main concentration of placer mined areas are in close proximity to hard rock vein deposits primarily in the Bradshaw Mountain area, Yavapai County, and the Kingman-Oatman area, Mohave County.

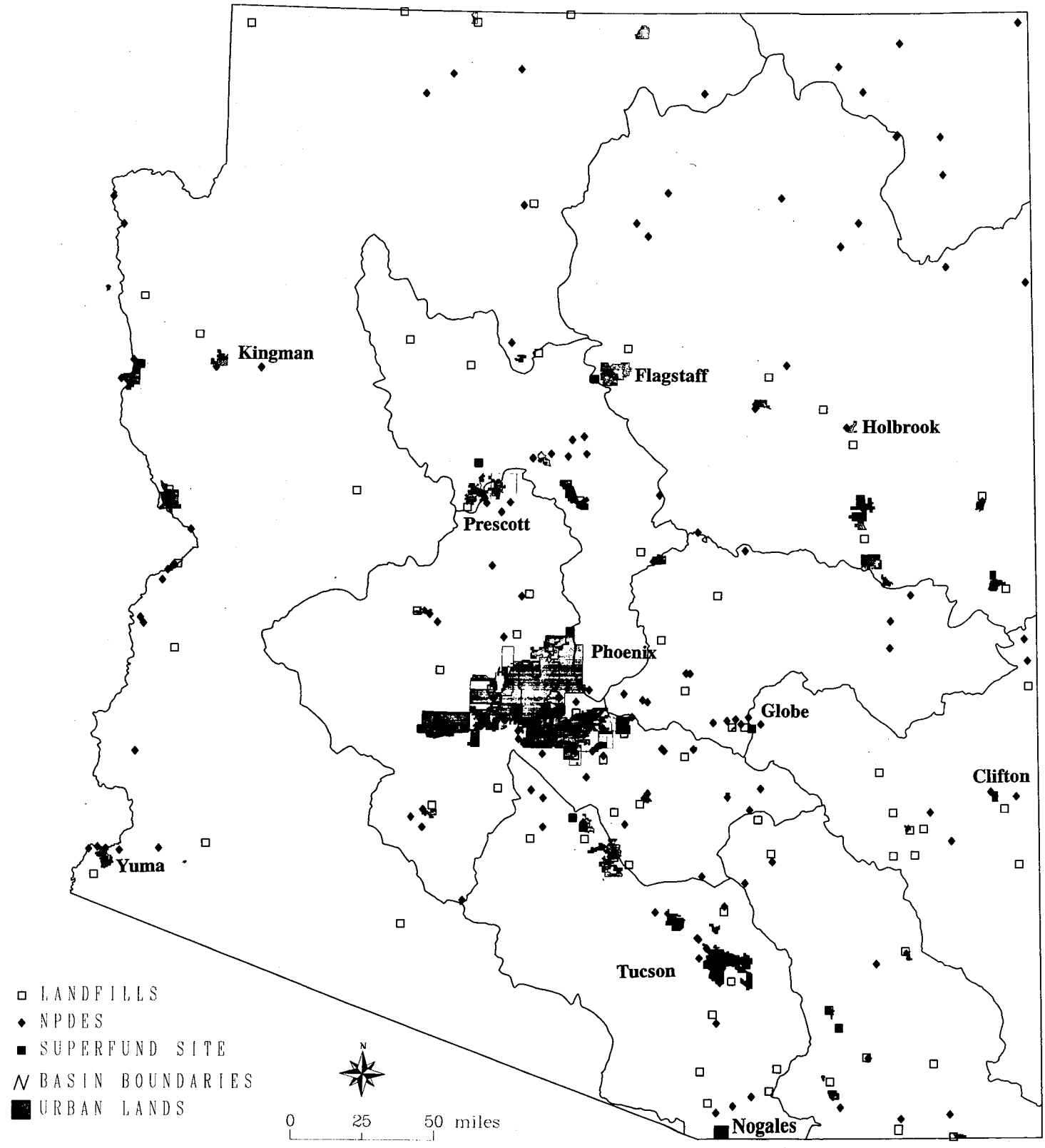

Figure II-3. Map of landfills, National Pollutant Discharge Elimination System (NPDES), and Superfund sites in Arizona.

Historic uranium and vanadium mining is concentrated largely in two main areas, one is Monument Valley in the San Juan Basin and the other near Cameron in the Valley of the Little Colorado. More recent operations are mining uranium from collapse breccia-pipe deposits found throughout the Colorado Plateau. The major uranium producer of this type was the Orphan Mine near Hopi Point in Grand Canyon National Park. Much of the ore mined in the State was shipped to mills in Utah, Colorado, and New Mexico for treatment. Only one uranium mill was ever operated in Arizona; it was located near Tuba City. This operation is discussed in more detail in the basin report for the Little Colorado.

Because sand and gravel extraction operations are usually associated with streamcourses and floodplains, these operations will generally be considered as a hydrologic/habitat modification nonpoint source of pollution. These operations have had a direct influence on riparian habitats and often change stream channel configurations.

F. Land Disposal NPS (60)

Sludge disposal, wastewater reuse, landfills, recharge, onsite wastewater systems, and hazardous wastes disposal are subcategories of NPS pollution in the land disposal category. The impact of land disposal sources in previous water quality assessments is poorly documented.

Prior to the 1970's, solid waste agencies were relatively unrestricted in the manner by which solid waste was disposed. Consequently, sites for new landfills were often selected on the basis of convenience, rather than on concern for environmental consequences (**6**). For example, abandoned gravel pits along river channels were often used. Segments of the Santa Cruz River near Tucson and the Salt River near Phoenix are noted as areas where groundwaters are contaminated and threatened by landfill leachates.

Septic tanks are responsible for surface and groundwater contamination primarily by nitrates. The 1980 census estimated that there are approximately 280,000 septic tank systems operating in Arizona, serving nearly 17 percent of the State population. Rural communities in Arizona generally depend on on-site sewage disposal systems. These systems may be in various states of disrepair and failure (**1B**). Many of these failing systems are located in older neighborhoods and were installed prior to any approval mechanism. In some rapidly growing rural areas, individual sewage systems may be of sufficient density to threaten water-supply aquifers.

Hazardous waste sites are contributors of nonpoint source pollution to groundwater at 30 identified locations, including seven of the nine sites designated or proposed for cleanup in the EPA Superfund Program. The Federal Superfund program is used to clean up sites where the responsible party has not been found or cannot clean up the hazardous waste. State funds for hazard waste site cleanup are appropriated through the State Water Quality Assurance Revolving Fund (WQARF). The State program is similiar to the federal program.

High technology industries and aviation facilities commonly use volatile organic compounds (VOCs) as degreasing solvents. Improper disposal of these solvents has resulted in most of the VOC-contaminated groundwater. The most common VOC's detected in groundwater are trichloroethylene (TCE), tetrachlorethane (PEC) and chloroform. Chromium detected in groundwater is often associated with disposal of metal finishing operations (**1B**). Modes of past disposal practices include injection of waste solvents into dry wells, disposal into surface impoundments, leachfields, dumping at unregulated landfills, and leaking underground storage tanks.

G. Hydrologic/Habitat Modification NPS (70)

Hydrologic/habitat modification, as a nonpoint source pollution category, has received little attention in the State of Arizona in the past. Concern for stream resources, wetlands, and riparian habitats has become a significant environmental issue within the last two years. This interest has culminated in Executive Order No. 89-16 issued by the Governor's office directing all State agencies to address policies, requirements, funding impacts, and implement changes to restore riparian habitats. It also

established a riparian habitat task force composed of State agencies to develop a riparian classification system, inventory riparian habitats, identify key riparian areas, consult with the public and other entities, and make legislative recommendations. Extensive diversion, impoundment and use of surface and groundwater sources has been essential to economic and community development in the arid environment of Arizona, but in the process has had a profound effect on natural water courses and habitat. Wetlands and riparian habitats in Arizona have been decimated since the late 19th century. Cienagas, which are mid-elevation (1000-2000 meters) wetlands that were abundant in the San Pedro and Santa Cruz River basins have been substantially diminished in extent. Reduction in cienaga and riparian habitats have been variously attributed to factors such as: climatic change, rangeland grazing, vegetation change, woodcutting, mining water diversions, groundwater exploitation and artifical concentration of drainage by the construction of road, ditches, bridges and railroads **(2B, 4B).** It is estimated that statewide, 90 percent of Arizona's riparian ecosystems have been lost due to human activities **(6A).**

Watersheds throughout Arizona have been altered to provide water for agricultural, domestic, municipal, and industrial uses. These developments include features such as; stock watering impoundments, canals, and dams storing and diverting water for flood control, hydroelectric power generation, irrigation, and mining. Consequently, many issues related to hydrologic/ habitat modification need to be evaluated. Among these are:

a) eutrophication and nutrient levels in reservoirs and their discharge waters;

b) bacterial contamination from rangeland and localized recreation activities and sites along watercourses and riparian areas;

c) loss of reservoir capacities and redistribution of sediment laden waters where they may have adverse impacts on beneficial uses;

d) accumulation of metals such as mercury and selenium or pesticides in reservoirs and pollutant biomagnification in biota;

e) the need for management and operation of water storage, hydroelectric, and water diversion projects to maintain water quality and instream flows for a range of beneficial uses; and

f) the effects of floodplain development, channelization and diversion, and the need to conserve, enhance or restore wetland and riparian habitats.

Water quality problems associated with secondary land use activities, which water resource development projects have fostered (recreation, irrigated agriculture, and urban development, e.g.), which may threaten many of the actual and potential benefits of these projects.

H. Other NPS (80)

This category of NPS contains several subcategories on which little information was available for the State of Arizona. Natural sources affecting water quality are recognized as being substantial in Arizona, however. Saline springs in the Little Colorado Basin and salt deposits and saline springs in the Salt Basin are all known to affect water quality. The arid climate contributes to the restriction of the natural vegetative cover, and heavy precipitation events, characterized by desert thunderstorms, result in greater potential for natural erosion and sediment hazards to water quality. Hydrothermal activity and leaching of minerals and metals from unmined mineralized soil and rock also affect natural water quality.

Although natural sources of sediment, minerals, metals and other substances may affect the use of waters for various purposes, their occurrence at natural background levels is not pollution. Pollution as it is specified in this document follows the definition in EPA's Guidelines for Specification of Disposal Sites for Dredged and Fill Material published in the Federal Register, Vol. 45. No. 249, December 24, 1980, Rules and Regulations, as follows: "The term "pollution " means the man-made or man-induced alteration of the chemical, physical, biological or radiological integrity of an aquatic ecosystem." A pollutant according to the definition in the Arizona EQA (Section 49-201.23): "means fluids, contaminants, toxic wastes, toxic pollutants, dredged spoil, solid

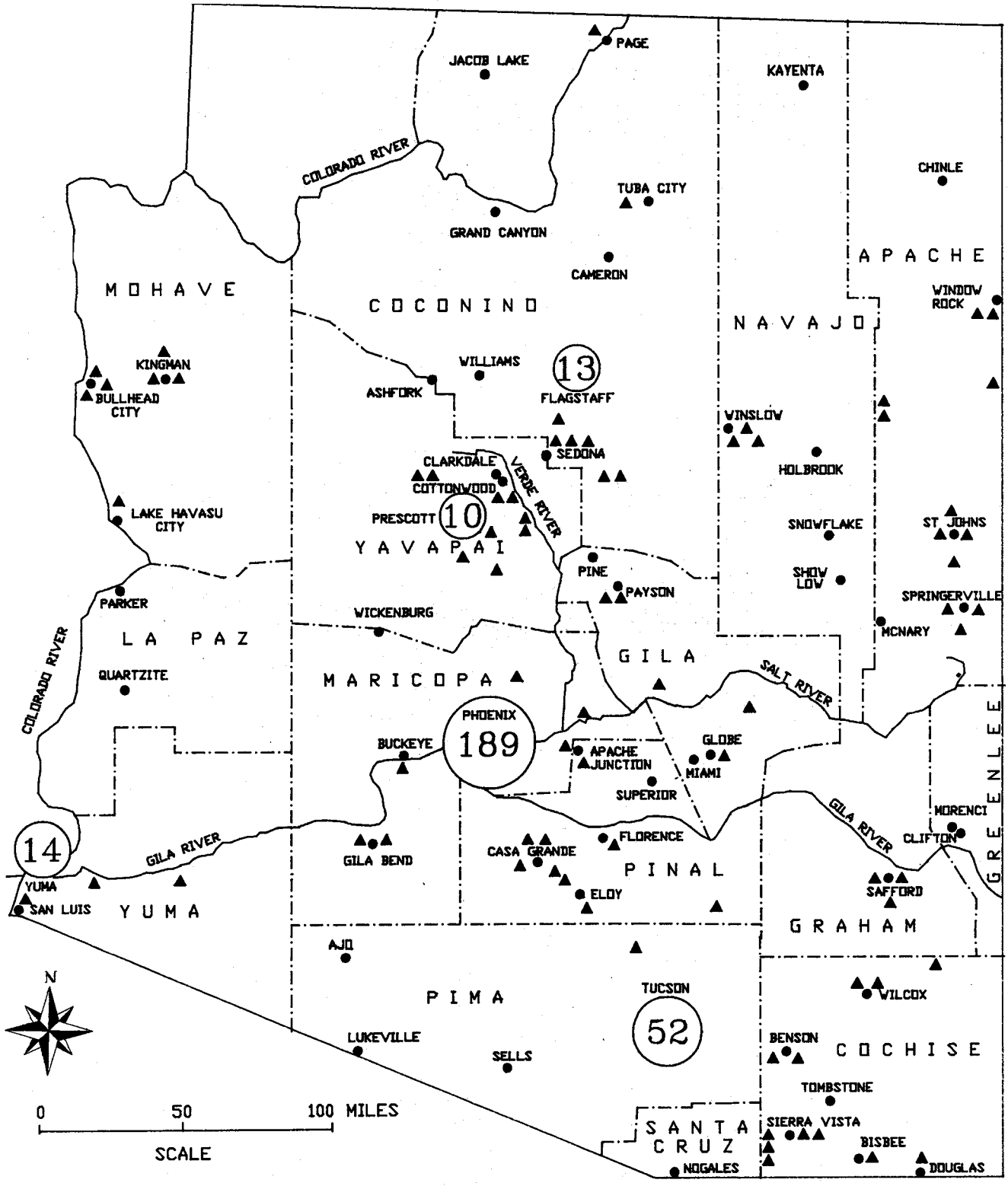

Figure II-4. Map of Underground Storage Tanks (UST) leaks in Arizona between June 1984 and June 1988.

waste, substances and chemicals, pesticides, herbicides, fertilizers and other agricultural chemicals, incineration residue, sewage, garbage, sewage sludge, munitions, petroleum products, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock sand, cellar dirt and mining, industrial wastes or any other liquid, solid, gaseous or hazardous substances."

In natural aquatic ecosystems, natural background levels of substances in water, including their periodic highs and lows in concentration or amount following natural or episodic events, may be essential to the health of those ecosystems and the growth and reproduction of organisms. Man-induced changes in water quality occurring at periods both inside and outside of natural seasonal or episodic events, on the other hand, may adversely affect aquatic ecosystems .

Among the manmade hazards of this category, underground storage tanks (UST) leaks have been reviewed by the Federal Permits Hydrology Unit of the ADEQ as mandated by EPA under the Resource Conservation and Recovery Act. This includes the review of hydrologic reports regarding UST sites, on-site inspections and the compilation of UST data. Information on UST leaks in Arizona from June 1984 to present is shown in Figure II-4.

The remaining subcategories of the Other NPS (80) category are unassessed at this time.

I. Unknown NPS (90)

Several water quality violations have been documented in the State for which a source remains unknown. In some instances, sources can be identified based upon existing land uses in the contaminated area. However, a specific land use may not be soley responsible for the identified contamination. Since a number of potential land uses may be involved it is difficult to designate a single source. In this respect, unknown sources will be undefined until specific monitoring efforts can identify the specific source and their relative contribution to the total contamination equation.

J. Recreation NPS (100)

Population growth in Arizona during the past 20 years, combined with a unique natural environment, has resulted in a substantial increase in outdoor recreation. Between 1970 and 1980, the population of the State increased by 53 percent. From 1970 to 1984, recreational visitor days on public lands in Arizona increased by about 62 percent. Recreational uses on public lands and their respective order of importance are: camping, miscellaneous day use, hiking, hunting, boating, fishing, off-road vehicles, other recreation, and winter sports (3).

Although Arizona is the fourth largest of the contiguous 48 states in land area; it has an estimated total freshwater shoreline of only 5,469 miles, a rank of 46th among these 48 states (2). The scarcity of shoreline has resulted in concentrated recreation around perennial waters. This increases the potential for serious pollution from concentrated (e.g., campgrounds) and dispersed (e.g., fishing, back country camping) recreational activities on waterbodies and in riparian habitat areas.

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CHAPTER III
Basin Reports

Each of the nine basin reports describe in table, map, and narrative form the surface and groundwater quality impacted by NPS pollution and the NPS pollution categories and subcategories contributing to this impact. Existing and readily available information on known and suspected water quality problems were collected and assembled by surface and groundwater basins.

The nine surface water basins (Figure III-1) were delineated by watershed using the U. S. Geological Survey (USGS) hydrologic unit code (HUC) system (Appendix C). On individual basin maps, crossbars depict the EPA Reach File segments of the streams. Streams and lakes on the basin maps include all waters listed in the State Water Quality Standards. Additional streams were added that have identified nonpoint source pollution problems. Groundwater basins were delineated by the Arizona Department of Water Resources for water allocation regulation.

Nonpoint source pollution information is presented in table form compatible with the Federal Water Body System and the 305(b) Report. Each basin by basin tabulation reports on the lakes and waterbodies by the segments delineated in the EPA STORET Reach File. Where the Reach File was not complete or accurate USGS 7.5 minute quadrangles were reviewed, segments added, and the mileage estimated.

Assessment of each lake or segment was conducted as described in Chapter II, using the distinctions of "monitored" and "evaluated" data. The data used in the "monitored" assessment is for the period of Water Years 1983 through October 1987. Use attainment based on an "evaluated" assessment also used ambient water quality data, but from Water Years 1965 through 1982. Information from file records, reports, and planning documents provided source material for the evaluated assessment of waters as identified in the reference section for each basin. Appendix B details the methodology for evaluated assessment.

The accompanying maps for each basin depict: 1) the use attainment of each stream segment, and 2) land uses that may contribute to nonpoint source pollution. The land use map, generated by a computerized geographic information system, was used to identify potential sources. Each land use map depicts: Irrigated lands, mineral districts, rangeland, lakes, forested lands, cities, concentrated animal feeding operations (CAFOs), Superfund sites, landfills, and National Pollution Discharge Elimination System (NPDES) permit points. Indian and military lands are also shown on these maps.

The narrative provides: a general basin description, a land use analysis, an evaluation of the water quality, and an overview by nonpoint source category of the types of impacts that have been observed or predicted for each basin. A summary of protected use attainment for all the basins, except the San Juan Basin, is shown in Table III-1.

Based on this assessment, State waters have been identified that specifically are not attaining the standards for protected uses. In addition, waters have been identified where available information does not support reliable assessment. These waters are shown on the basin maps without the color overlay used to identify use support. Strategies for surface water and groundwater monitoring have been developed by ADEQ to verify evaluated segments, identify trends in water quality, and identify additional waters to be assessed in the next annual assessment. These documents are available in ADEQ offices.

TABLE III-1. Nonpoint Source Assessment, Statewide Summary of Water Quality Standards Protected Use Attainment.

Basin	Total Reach Miles	Total Assessed	Percent Assessed	Level of Use Attainment of Miles Assessed							
				Full		Partial		Non		Threatened	
				Miles	Percent	Miles	Percent	Miles	Percent	Miles	Percent
Colorado Main Stem	5,695.6	1045.7	18.4	210.7	20.2	720.9	68.9	78.1	7.5	36.0	3.4
Little Colorado	3,448.5	2251.5	67.0	41.0	1.8	422.8	18.8	1,727.8	76.7	59.9	2.7
Middle Gila River	1,588.0	504.5	31.8	--(1)	--	368.6	73.1	135.9	26.9	--	--
Salt River	1,205.7	359.1	29.8	--	--	331.5	92.3	27.6	7.7	--	--
San Pedro River	694.5	227.2	32.7	--	--	206.2	90.8	21.0	9.2	--	--
Santa Cruz River	913.9	395.7	43.3	--	--	343.1	86.7	52.6	13.3	--	--
Upper Gila River	920.3	356.3	41.1	--	--	320.6	90.0	27.7	7.8	8.0	2.2
Verde River	1,298.6	780.7	60.1	71.5	9.2	675.3	86.5	33.9	4.3	--	--
Statewide Totals	15,765.1	5,920.7	38.1	323.2	5.5	3,389.0	57.2	2,104.6	35.5	103.9	1.8

(1) -- No data

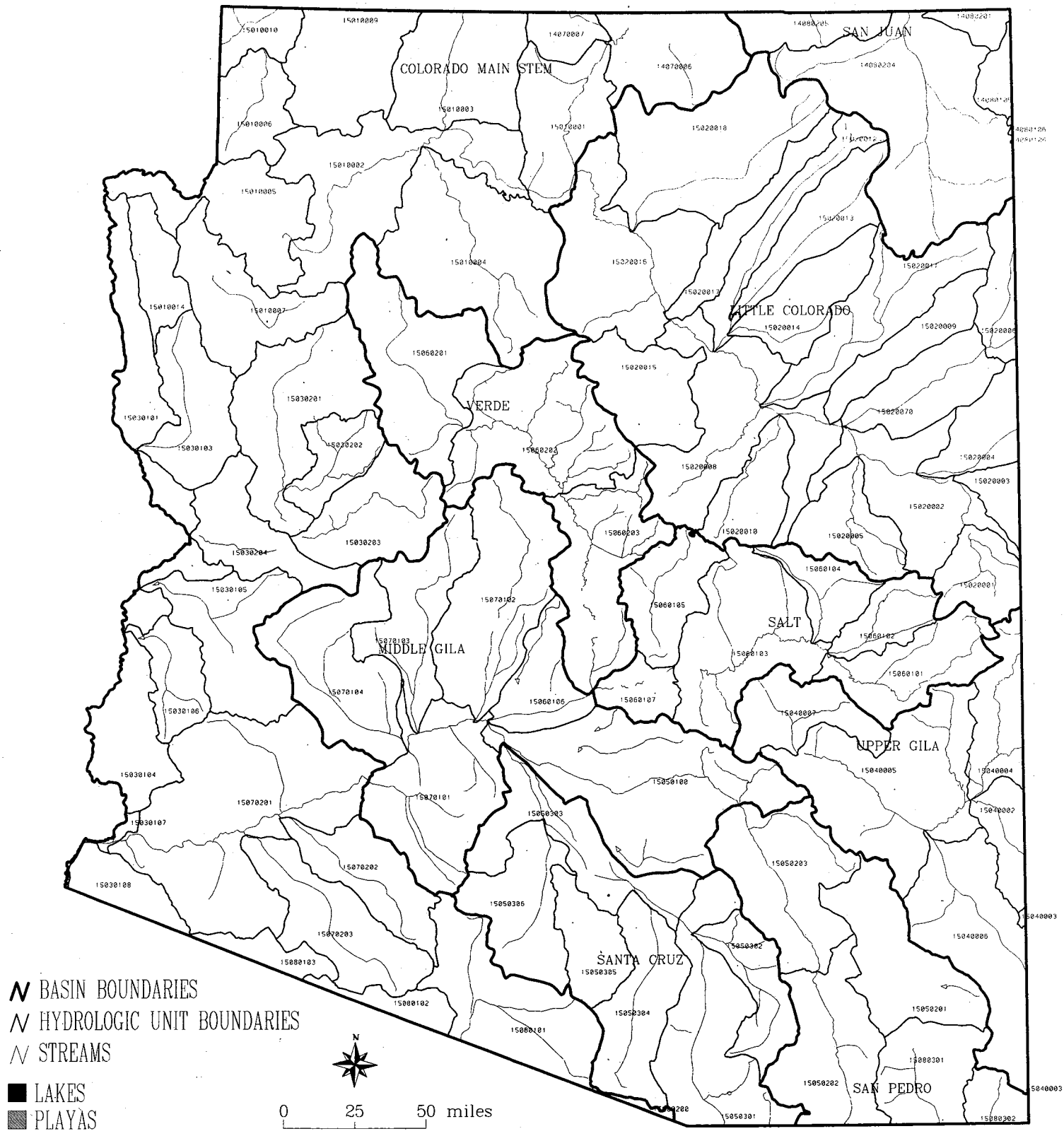

Figure III-1. Map of the nine surface water basins of Arizona with Hydrologic Unit Codes (HUC).

A. Colorado Main Stem Basin

Description

The Colorado River and its tributaries which form the Main Stem Basin are shown in Figure III-2. The Basin's USGS cataloging units are: 14070006, 14070007, 15010001 through 15010007, 15010009, 15010010, 15010014, 15030101, 15030103 through 15030108, 15030201 through 15030204, 15070201 through 15070203, 15080101 through 15080103 and 15080200.

The Colorado River begins where mountain peaks rise more than 14,000 feet in the Northwestern portion of Colorado's Rocky Mountain National Park. From its headwaters the River meanders southwest for 640 miles through the upper basin to Lee's Ferry in Arizona. The Green River which is the major tributary of the Colorado River in the upper basin arises in western Wyoming and discharges into the Colorado in southeastern Utah some 220 miles above Lee's Ferry. The Colorado Basin drains 244,000 square miles and encompasses portions of the seven western states of Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming. From the River's headwaters in Colorado and Wyoming, the Colorado meanders a total of 1400 miles and serves the needs of some 14.5 million people before discharging into the Gulf of California south of the U.S.-Mexico International Border. However, since 1964 the waters of the Colorado River have been totally consumed by users in the Upper and Lower Basin States and the Republic of Mexico and its flows no longer reach the Gulf **(15).**

In Arizona, the Colorado Main Stem Basin encompasses an area of 38,890 square miles. Lake Powell, which is located in both Arizona and Utah, is the reservoir produced by the Glen Canyon Dam on the Colorado River near the northern boundary of Arizona. From Glen Canyon Dam, the river flows in a westerly direction through the Grand Canyon to Lake Mead, the impoundment upstream of Hoover Dam on the Arizona/Nevada border. The river flows south from Hoover Dam to the international border with Mexico south of San Luis, Arizona. Additional impoundments are formed downstream of Hoover Dam, however, by Davis Dam north of Bullhead City, Parker Dam north of Parker and Imperial and the Laguna dams north of Yuma. Major diversions of the waters of the Colorado River serve irrigation and municipal needs in Arizona, California and Mexico. The majority of the diversions of water in the lower Colorado River occur below Davis Dam. The river below Morelos Dam near Yuma has zero flow when normal downstream diversion requirements are met.

The average annual flow of the Colorado River entering the State is 19.8 million acre feet per year. In Arizona, the Lower Colorado River Basin region contributes an additional annual flow of 3 million acre feet. The principal tributaries of the Colorado River in the State are the Muddy, Virgin, Bill Williams, Little Colorado and Gila rivers, Kanab, Bright Angel, Havasu, Chinle and Tapeats creeks, and Las Vegas Wash.

Primarily, the basin drainage area consists of Sonoran, Mohave desert scrub and dry grasslands with a small amount of mountain forest and meadow grassland. The Arizona sediment yield map (U.S. Soil Conservation Service) indicates this basin has a range of slight to severe erosion potential (less than 0.2 to 3.0 acre feet per square mile per year sediment yield) **(14)**. The Arizona Game & Fish Department lists 15 lakes with a total of 76,923 acres in the Arizona portion of the basin **(6)**.

The Colorado Main Stem Basin consists of 22 defined groundwater basins. Groundwater is extensively used throughout the Colorado Main Stem Basin to supply agricultural, industrial, and domestic needs. While many areas have fairly good water, others have impaired water containing high concentrations of total dissolved solids and/or minerals **(5)**.

Surface Water Quality

Extensive monitoring has been completed for salinity in surface waters of the Colorado Main Stem Basin. However, problems due to other parameters such as turbidity, total phosphates, and dissolved oxygen are not well documented.

The ADEQ assessed 1,045.7 miles (shown in Table III-2) of the 5,695.6 miles of stream segments in the Colorado Main Stem Basin in

Arizona that are listed in the EPA Reach File. Use support evaluations were as follows for this basin: 210.7 miles, fully supported; 720.9 miles partial support; 78.1 miles did not support protected uses; and 36.0 miles are threatened.

The waters of the Colorado are subject to multiple point and nonpoint pollution source impacts prior to entering the lower basin at Lee's Ferry, Arizona. Although impacts from nonpoint source categories of agriculture, silviculture, construction, urban runoff, resource extraction, land disposal, hydrologic and habitat modification, and recreation have been reported, the most significant water quality problem associated with the Colorado River is salinity.

Both monitored and evaluated data indicate that total dissolved solids (salinity) are a major concern. The salinity problems along the Main Stem can be attributed to the addition of soluble salts from natural sources, municipal/industrial sources, irrigation return waters, reservoir evaporation, and export diversions of water from the system (**11**). Natural sources of salinity include Laverkin Springs on the Virgin River in Utah which flows through Arizona and discharges into Lake Mead, and Blue Springs in the Little Colorado Basin. These springs contribute 100,000 and 550,000 tons of salt per year to the entire system (**8**).

According to the latest salinity projections, the numeric criteria of 879 mg/l at Imperial Dam will be satisfied until 1993 by the salinity control units already in operation. Projected development in the basin will cause increased water depletions reducing the flow of the river and consequently its ability to dilute saline waters. To maintain the numeric salinity criteria of 879 mg/l at Imperial Dam in the year 2010, an annual reduction of 1.5 million tons in the salt load in the Main Stem flow will be necessary to compensate for the anticipated additional diversion of water (**15**).

The United States and Mexico signed a treaty in 1944 that allotted 1.50 million (M) acre feet of water annually. Of this total 1.36 M acre feet are delivered in the section of the Colorado River upstream from the Morales Dam. The remaining 0.14 M acre feet are annually delivered in the section of the Colorado River below Morales Dam. In 1961, the Mexican Government sought protection from the increasing salinity in the Colorado River waters being delivered to Mexico. With the approval of both governments, Minute 242 was signed on August 30, 1973 as a permanent solution to the salinity problem (**15**).

Due to the extensive hydrologic modification of the Colorado River, temperatures, flow, chemistry and sediment loads have been substantially altered from natural conditions. Lake Powell is a metals and nutrient trap which has contributed to the nutrient impoverishment of Lake Mead downstream (**8,15**). The U.S. Fish and Wildlife Service (USFWS) and U.S. Geological Survey (USGS) have conducted recent investigations and tests from Davis Dam to Imperial Dam on water, sediment, birds and fish looking for metals, metalloids, organochlorine pesticides and radionuclides. The results of the work indicate that selenium was the only constituent occurring at levels of concern, particularly in backwater areas. The level of selenium in fish was three times higher than the national baseline and in some species and locations neared concentrations that would result in reproductive impairment. Values of selenium in Yuma Clapper rails were comparable to values in avian species at Kesterson National Wildlife Refuge in California where severe embryotoxicity has occurred (**12A**).

The predominant water quality violations in basin tributaries to the Colorado Mainstem, according to monitored data, are for metals, pH and turbidity. Mining and grazing lands are the most probable sources of this nonpoint source pollution. Burro, Boulder, and Francis creeks are examples of streams affected by these sources. Radiological parameters are elevated by natural sources in uraniferous regions along Kanab Creek and the lower part of the Vermillion Cliffs on the southeast side of the Paria Plateau (**16A**).

Evaluated data also indicates sediment and turbidity from rangeland and silvicultural sources occurs. These evaluations originate from U.S. Forest Service (USFS) information for watersheds in the Main Stem Basin (**12,13**). Specific data, from other public land managers such as the Arizona State Land Department (ASLD) and the U.S. Bureau of Land Management (BLM) about grazing impacts on water quality, are generally lacking.

Monitored fecal bacteria violations in the Colorado Main Stem are found at several locations, particularly below Parker, Davis and Imperial dams. Land disposal (on-site disposal) and recreational activities are the major contributing sources. The Colorado River was designated as water quality limited from Imperial Dam to the International Boundary in 1977. This classification reflected bacterial contamination, primarily due to recreational use and development, and phosphate loadings carried in from the Upper Colorado Basin (5).

Groundwater Quality

Groundwater quality in the northern province has been reported as variable with elevated levels of TDS, total hardness, sodium, calcium, iron, magnesium, chloride, fluoride, and sulfate indicated for several sites within the province. Elevated or high levels means that concentrations are above water quality standards (MCL or secondary MCL). In the north central province, groundwater quality has been largely classified good. However, reports indicating high values for TDS, nitrates, chlorides, and sulfates have been filed for the Bullhead City area and high sulfate and fluorides have been reported for Wikieup. Quality of groundwater in the south central province is reported as variable with high TDS, sodium, chloride, fluoride, nitrate, and sulfate ion values for Ehrenberg and Quartzsite and elevated TDS and fluoride values for Bouse and the Butler Valley. In the southern province, groundwater quality is also variable with elevated values of pollutants reported from wells in the Wellton-Mohawk area. Wells in the Yuma and Somerton areas often have high TDS with some problems reported due to iron and manganese. At the Yuma Marine Corp Air Station Superfund Site, groundwater contamination may have occurred as a result of disposal in dry wells or leach lines.

Industrial development within the basin is largely limited to mining. These operations currently follow a "no discharge" wastewater management program and are not considered as major contributors of pollutants to surface waters. Concern has been raised about the impact of mining on groundwaters.

Land Use

The majority of lands contained in the Colorado Main Stem Basin of Arizona are managed by federal agencies. The USFS controls portions of the Kaibab and Prescott national forests in the basin which are used respectively for rangeland grazing and recreation. Lands managed by the BLM in the basin, from the Arizona Strip to Yuma, support rangeland grazing as a primary use. The National Park Service (USNPS) controls lands along the Colorado River in National Recreation Areas associated with Lake Powell and Lake Mead, the Grand Canyon National Park, and Organ Pipe National Monument, which is a major inholding in the southern basin. The USNPS manages these areas for recreation and public enjoyment. The U.S. Fish and Wildlife Service (USFWS) manages three national wildlife refuges along the Colorado River and two in the southern half of the basin for wildlife and recreation. Also in the south, the U.S. Military controls major land areas in proving grounds, bombing, and gunnery ranges.

Private lands, not used for community development in the basin, support rangeland grazing and irrigated agriculture. Irrigated agriculture is focused along the river mostly south of Parker, Arizona, around Yuma and upstream along the Gila River.

Indian reservations in the basin support some irrigated agriculture, but are mostly utilized for rangeland grazing.

State lands are generally used for rangeland grazing, which is the dominant land use in the Colorado Main Stem Basin as shown in Figure III-3.

Agricultural NPS (10)

Although there are several natural sources of salinity which discharge into the Colorado River, the major man-made source is agriculture. In 1961, saline concentrations of almost 6000 mg/l were reported in return flows of drainage water from the Gila Project in the Wellton-Mohawk Valley. These saline return flows were designated as the principal cause of the salinity increase

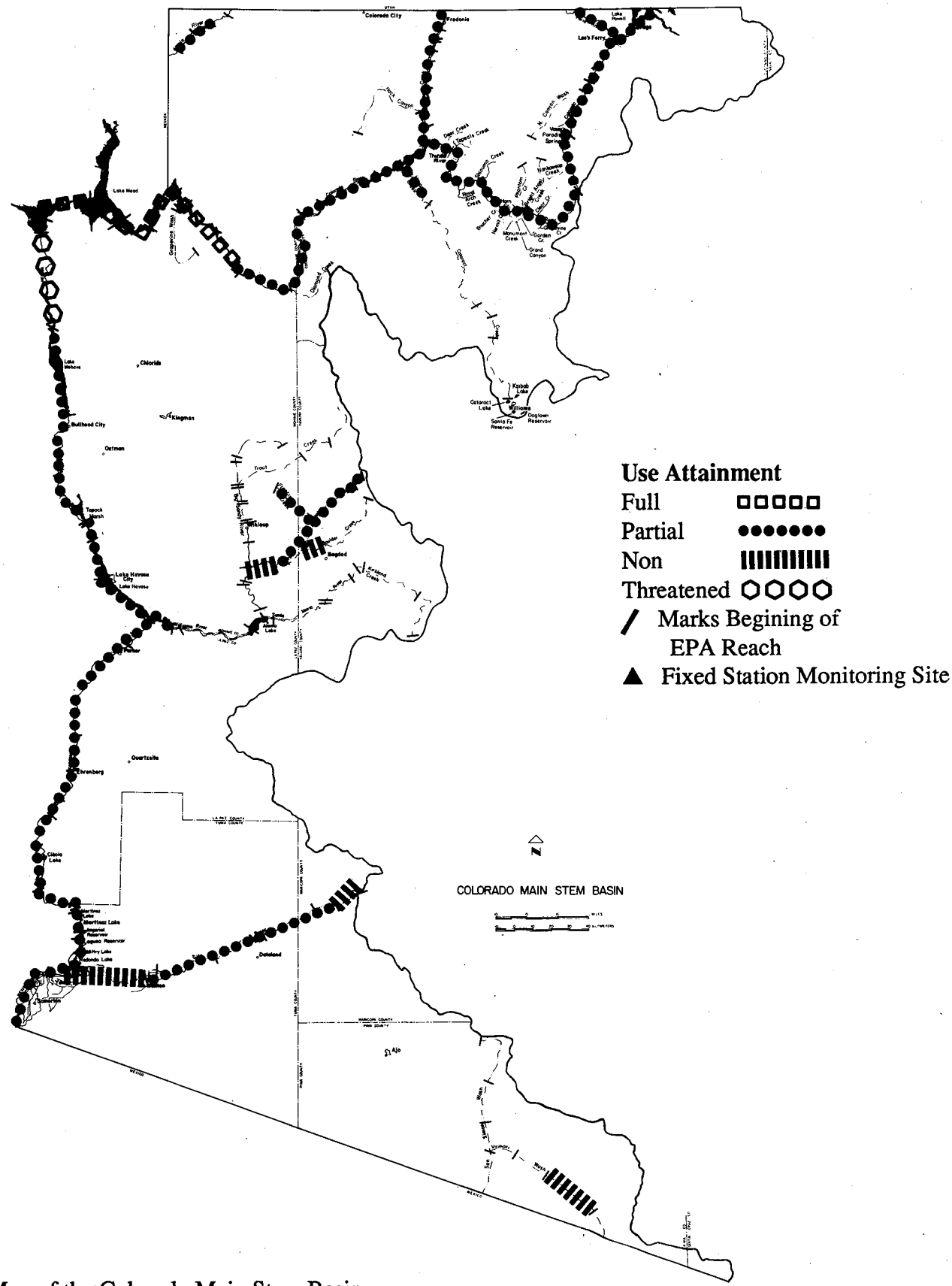

Figure III-2. Map of the Colorado Main Stem Basin.

TABLE III-2. COLORADO MAIN STEM RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
14070006-002	Colorado R. (Lake Powell)	D F C I L		4.0						TDS, Hg, Pb, Se [STA-46] TURBIDITY TDS NO3 DO Pb, Mn [STB-32] TDS PO4, Hg, Zn RADIATION	HYDROLOGIC/ HABITAT MOD.(10) NATURAL COAL FIRED POWER PLANT UNKNOWN	LAKE POWELL TERMED METALS TRAP. UP TO 600 MG/L Hg IN FISH TISSUES; HIGH LEVELS OF Se REPORTED (10). DAMS HAVE CHANGED, TEMPERATURE, CHEMISTRY, SEDIMENT LOAD, FLOW AND SCOURING PATTERNS (10)(15). [STA-46] TDS RANGE 370 - 1710 MG/L [STB-32] TDS RANGE 380 - 599 MG/L
140070006-001	Colorado R. (Glen Canyon Dam)	D F C I L		15.9						TDS TEMPERATURES TURBIDITY NUTRIENTS [STA-X] NO3, TDS [STC] DO TURBIDITY Cd, Hg	HYDROLOGIC/ HABITAT MOD.(10)	DAMS HAVE CHANGED TEMPERATURES, CHEMISTRY, SEDIMENT LOAD AND FLOW (10). LEE'S FERRY 560 MG/L TDS (5) NOTE: 1. BASED ON LIMITED DATA COLORADO R. IS NEAR OR HAS EXCEEDED TOLERANCE LEVEL FOR NUTRIENTS (5). INCREASES IN P&N COMPOUNDS CAUSING SOME RESERVOIRS TO BECOME EUTROPHIC, HOWEVER, SOME RESERVOIRS TRAPPING NUTRIENTS, AND SOME DOWNSTREAM RESERVOIRS ARE BECOMING NUTRIENT IMPOVERISHED.
14070007-001	Paria R.	D H A						24.9		[STA-63] TURBIDITY NO3, TDS	UNKNOWN	
15010001-	House Rock-Marble (USFS 5th CODE Watershed No. 92)									SEDIMENT (12)	GRAZING (12)	UNSATISFACTORY WATERSHED IN KAIBAB NATIONAL FOREST DUE TO PAST MANAGEMENT PRACTICES (12)
15010001-022	Colorado R.	D F C I L						14.9		TDS, TEMPERATURE SEDIMENT FLOW	HYDROLOGIC/ HABITAT MOD.	NOTE 1. DAMS HAVE CHANGED TEMPERATURE CHEMISTRY, SEDIMENT LOAD, FLOW AND SCOURING CHARECTERISTICS (10)(15).
15010001-012	Colorado R.	D F C I L						2.7		TDS, TEMPERATURE SEDIMENT FLOW	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-2 (cont.). COLORADO MAIN STEM RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15010001-011	Colorado R.	D F C I L						3.8		TDS, TEMPERATURE SEDIMENT FLOW	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010001-010	Colorado R.	D F C I L						4.7		TDS, TEMPERATURE SEDIMENT FLOW	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010001-008	Colorado R.	D F C I L						5.5		TDS, TEMPERATURE SEDIMENT FLOW	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010001-006	Colorado R.	D F C I L						2.4		TDS, TEMPERATURE SEDIMENT FLOW	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010001-005	Colorado R.	D F C I L						6.1		TDS, TEMPERATURE SEDIMENT FLOW	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010001-003	Colorado R.	D F C I L						27.2		TDS, TEMPERATURE SEDIMENT FLOW	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010001-002	Colorado R.	D F C I L		28.0						[STA-234] TDS [STB-213] NO3, TDS	NATURAL UNKNOWN	[STA-234] TDS RANGE 506 - 1130 MG/L [STB-213] TDS RANGE 439 - 639 MG/L.
15010001-001	Colorado R.	D F C I L						0.3		[STB-213] NO3, TDS	NATURAL UNKNOWN	[STB-213] TDS RANGE 439 - 639 MG/L.
15010003-	Kanab C. (USFS 5TH CODE Watershed No. 94)	H A L								SEDIMENT (12)	GRAZING (12)	UNSATISFACTORY WATERSHED IN KAIBAB NATIONAL FOREST DUE TO PAST MANAGEMENT PRACTICES (12)
15010003-025	Kanab C.	H A L						50.0		TDS [STA-4] TDS, NO3	UNKNOWN	TEN MILES APPROX. OF SEGMENT -025 IN ARIZONA, PARTIAL SUPPORT OF USES (2) [STA-4] TDS RANGE 969 - 1460 MG/L

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
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(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-2 (cont.). COLORADO MAIN STEM RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15010003-024	Kanab C.	H A L						3.0			UNKNOWN	BASED ON UPSTREAM SOURCES (ADEQ)
15010002-012	Colorado R.	D F C I L						15.4		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15014004-95	South Rim Colorado (USFS 5TH CODE Watershed No. 95)									SEDIMENT (12)	GRAZING (12)	UNSATISFACTORY WATERSHED IN KAIBAB NATIONAL FOREST DUE TO PAST MANAGEMENT PRACTICES (12)
15010004-003	Havasu Creek	H A I L						15.8		BACTERIA	LAND DISPOSAL	KNOWN CONTAMINATION ACCORDING TO ADEQ STAFF (ADEQ)
15010004-001	Havasu Creek	H A I L						2.7		BACTERIA	LAND DISPOSAL	KNOWN CONTAMINATION ACCORDING TO ADEQ STAFF (ADEQ)
15010002-011	Colorado R.	D F C I L						10.2		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010002-009	Colorado R.	D F C I L						5.8		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010002-007	Colorado R.	D F C I L						8.4		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010002-005	Colorado R.	D F C I L						9.6		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010002-004	Colorado R.	D F C I L						10.2		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010002-003	Colorado R.	D F C I L						29.5		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010002-001	Colorado R.	D F C I L						15.5		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-2 (cont.). COLORADO MAIN STEM RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15010005-056	Colorado R.	D F C I L						6.9		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010005-054	Colorado R.	D F C I L						2.5		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010005-027	Colorado R.	D F C I L						32.8		TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1]
15010005-026	Colorado R. (Lake Mead)	D F C I L					2.0			TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1] NOTE 2. TRADEOFFS IN RECREATION, EUTROPHICATION AND ESTHETICS DUE TO RESERVOIR OPERATION. DEPTH OF WITHDRAWALS AFFECTS TEMPERATURE AND NUTRIENT RELEASES (15). HEAVY RECREATIONAL USE IS COMPOUNDING DAM CAUSED STRESS (10). LAKE MEAD IS NUTRIENT DEFICIENT (ADEQ).
15010005-023	Colorado R. (Lake Mead)	D F C I L					6.0			TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1] [NOTE 2]
15010005-022	Colorado R. (Lake Mead)	D F C I L					15.2			TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1] [NOTE 2]
15010005-053	Colorado R. (Lake Mead)	D F C I L					11.4			TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1] [NOTE 2]
15010005-020	Colorado R. (Lake Mead)	D F C I L					9.5			TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1] [NOTE 2]
15010010-004	Virgin R.	H A I L	9.2							TDS SULFATES	UNKNOWN	PARTIAL SUPPORT (2) AVERAGE CONCENTRATIONS SULFATES AND TDS EXCEED USPHS DRINKING WATER STANDARDS (15). [STB-35] TDS RANGE 433 - 2670 MG/L
15010010-003	Virgin R.	H A I L	8.7							[STB-35] TDS NO3, PO4	UNKNOWN	

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-2 (cont.). COLORADO MAIN STEM RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15010005-019	Colorado R. (Lake Mead)	D F C I L					2.5			TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1] [NOTE 2]
15010010-017	Colorado R. (Lake Mead)	D F C I L					19.2			TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1] [NOTE 2]
15010010-001	Colorado R. (Lake Mead)	D F C I L					6.2			TDS TEMPERATURE	HYDROLOGIC/ HABITAT MOD.	[NOTE 1] [NOTE 2]
15030101-015	Colorado R. (below Hoover Dam)	D F C I L				36.0				TDS (8) TEMPERATURE SEDIMENT GEN. WATER CHEM.	HYDROLOGIC/ HABITAT MOD. LAND DISPOSAL AG. IRRIGATION NATURAL	[NOTE 1] ESTIMATED SOURCES OF INCREASED SALINITY AT HOOVER DAM ARE: MUNICIPAL/INDUSTRIAL 1% EXPORT DIVERSIONS 3% RESERVOIR EVAPORATION 12% AG. IRRIGATION 37% NATURAL 47% (8)
15030101-012	Colorado R. (Lake Mohave)	D F C I L						29.0		BACTERIA	HYDROLOGIC/ HABITAT MOD.	HEAVY RECREATIONAL USE IS COMPOUNDING DAM CAUSED STRESS (10)
15030101-011	Colorado R. (Davis Dam)	D F C I L		26.8						TEMPERATURE SEDIMENT GEN WATER CHEM. TDS	HYDROLOGIC/ HABITAT MOD. LAND DISPOSAL NATURAL AGRICULTURE	[NOTE 1] PARTIAL SUPPORT OF USES (3)
15030101-010	Colorado R.	D F C I L					18.4				HYDROLOGIC/ HABITAT MOD.	
15030101-009	Topock Marsh	D F A I L					12.0			Se [STB-22] TDS	HYDROLOGIC/ HABITAT MOD.	
15030101-007	Colorado R.	D F C I L					0.5				HYDROLOGIC/ HABITAT MOD.	

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-2 (cont.). COLORADO MAIN STEM RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15030101-006	Colorado R.	D F A I L					6.3				HYDROLOGIC/ HABITAT MOD.	[NOTE 3] NO DATA 6.3 MILES
15030101-005	Colorado R. (Lake Havasu)	D F A I L						14.0			HYDROLOGIC/ HABITAT MOD. RECREATION	[NOTE 1] HEAVY RECREATIONAL USE IS COMPOUNDING DAM CAUSED STRESS (10)
15030101-001	Colorado R. (Lake Havasu)	D F A I L						19.6			HYDROLOGIC/ HABITAT MOD. RECREATION	[NOTE 1] HEAVY RECREATIONAL USE IS COMPOUNDING DAM CAUSED STRESS (10)
15030101-018	Colorado R. (Parker Dam)	D F A I L						0.0			HYDROLOGIC/ HABITAT MOD. RECREATION	[NOTE 1]
15030201-	Trout C. Watershed (headwaters)	H A L								SEDIMENT	SILVICULTURE GRAZING	20% OF TROUT C. WATERSHED IN PRESCOTT NF IS IN UNSATISFACTORY CONDITION (13)
15030202-011	Burro C.	H A L						9.2		SEDIMENT	SILVICULTURE GRAZING	19% OF BURRO C. WATERSHED AT HEADWATERS IN PRESCOTT NF IS IN UNSATISFACTORY CONDITION (13)
15030202-009	Burro C.	H A L					13.3					[NOTE 3]
15030202-012	Francis C.	H A L		20.6						SEDIMENT [STC] pH TURBIDITY Cr, Cu, Zn, Mn	HYDROLOGIC/ HABITAT MOD. RANGELAND NATURAL (4)	WATER IMPOUNDMENT AND WITHDRAWAL MAY POTENTIALLY DECREASE STREAMFLOWS TO ZERO, THERMAL SPRINGS OCCUR(4).
15030202-008	Burro C.	H A L		10.7						SEDIMENT [STC] pH BACTERIA Cr, Cu, Zn, Mn TURBIDITY	GRAZING MINING	

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TABLE III-2 (cont.). COLORADO MAIN STEM RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	MONITORED (c) PART	EVALUATED (c) NON	EVALUATED (c) T	EVALUATED (c) FULL	EVALUATED (c) PART	EVALUATED (c) NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15030202-	Copper C.	A I L			3.0					[STC] pH Zn, Cu	MINING HYDROLOGIC/ HABITAT MOD.	[STC] SITE COPPER C. MINE SUMP PUMP
15030202-005	Boulder C.	A I L			7.6					METALS/pH SUSPENDED SOLIDS RADIOACTIVITY SULFATE (4) [STC] pH	MINING	NONSUPPORT OF USES (2) METALS EXCEEDED FOR ALL PROTECTED CRITERIA, SULFATES EXCEEDED FOR DRINKING WATER AND AQUATIC AND WILDLIFE (4)
15030202-004	Burro C.	H A L		14.7						METALS (4) [STC] pH Mn, Cu, Zn BACTERIA TURBIDITY	MINING	STANDARDS EXCEEDED FOR METALS (4)
15030202-002	Burro C.	H A L		4.1						[STB-03] TURBIDITY	MINING	STANDARDS EXCEEDED FOR DRINKING OK FOR OTHER PROTECTED USES (4)
15030202-001	Burro C.	H A L						6.0			MINING	ASSOCIATION WITH UPSTREAM SOURCES (ADEQ)
15030204-001	Bill Williams R.	H A		11.8						[STB-31] NO3, P04 [STC] DO	UNKNOWN HYDROLOGIC/ HABITAT MOD.	
15030104-020	Colorado R. (Parker Dam)	D F A I L		13.3						BACTERIA (2) [STB-15] BACTERIA [STB-5] BACTERIA	UNKNOWN RECREATION (10) HYDROLOGIC/ HABITAT MOD.	[NOTE 1] PARTIAL SUPPORT OF USES (2) HEAVY RECREATIONAL USE IS COMPOUNDING DAM CAUSED STRESS(10) [STB-15] SITE AT COLORADO R. OUTLET TO MOOVALYA KEYS [STB-5] SITE IS COLORADO R. AT SPORTS VALLEY
15030203-014	Santa Maria Watershed (headwaters)	H A I L								EROSION/ SEDIMENT	SILVICULTURE GRAZING	53% OF SANTA MARIA WATERSHED IN PRESCOTT NATIONAL FOREST IN UNSATISFACTORY CONDITION (13)

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TABLE III-2 (cont.). COLORADO MAIN STEM RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15030104-018	Colorado R.	D F A I L		46.8						[STB-35] TDS	HYDROLOGIC/ HABITAT MOD.	[STB-31] SAMPLE SITE CRIR MAIN CANAL, PARKER, TDS RANGE 672 - 764 MG/L. [STB-35] SITE IS PALO VERDE DRAIN NEAR PARKER, TDS RANGE 1180 - 1950 MG/L.
15030104-017	Colorado R.	D F A I L					12.2				HYDROLOGIC/ HABITAT MOD.	12.2 MILES RESERVOIR
15030104-015	Colorado R.	D F A I L					11.1				HYDROLOGIC/ HABITAT MOD.	11.1 MILES RESERVOIR
15030104-013	Colorado R.	D F A I L					5.3				HYDROLOGIC/ HABITAT MOD.	5.3 MILES RESERVOIR
15030104-011	Colorado R.	D F A I L					14.9				HYDROLOGIC/ HABITAT MOD.	14.9 MILES RESERVOIR
15030104-010	Colorado R.	D F A I L					7.1				HYDROLOGIC/ HABITAT MOD.	7.1 MILES RESERVOIR
15030104-009	Colorado R.	D F A I L					10.2				HYDROLOGIC/ HABITAT MOD.	10.2 MILES RESERVOIR
15030104-008	Colorado R.	D F A I L					15.3				HYDROLOGIC/ HABITAT MOD.	15.3 MILES RESERVOIR
15030104-006	Colorado R.	D F A I L					2.3				HYDROLOGIC/ HABITAT MOD.	2.3 MILES RESERVOIR
15030104-004	Colorado R.	D F A I L					0.7				HYDROLOGIC/ HABITAT MOD.	0.7 MILES RESERVOIR
15030104-002	Colorado R.	D F A I L					7.0				HYDROLOGIC/ HABITAT MOD.	

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-2 (cont.). COLORADO MAIN STEM RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15030104-001	Colorado R.	D F A I L					2.1				HYDROLOGIC/ HABITAT MOD.	2.1 MILES RESERVOIR
15030107-003	Colorado R. (below Imperial Dam)	D F A I L		13.3						NUTRIENTS/TOXICS BACTERIA (2) TDS (5) [STB-16] BACTERIA	UNKNOWN (2)	WATER QUALITY LIMITED SEGMENT, PARTIAL SUPPORT OF USES (2) TDS 875 MG/L AT IMPERIAL DAM (5)
15070201-014	Gila R.	H A I L			3.3					NUTRIENTS (3)(2) [STB-46] DO	HYDROLOGIC/ HABITAT MOD. AGRICULTURE (2)(3)	NONSUPPORT, HYPEREUTROPHIC RESERVOIR DISCHARGES (2)(3)
15070201-013	Gila R.	H A I L							10.5	NUTRIENTS	HYDROLOGIC/ HABITAT MOD. AGRICULTURE (2)(3)	NONSUPPORT, HYPEREUTROPHIC RESERVOIR DISCHARGES (2)(3)
15070201-011	Gila R.	H A I L					6.2					[NOTE 3]
15070201-010	Gila R.	H A I L					12.9					[NOTE 3]
15070201-009	Gila R.	H A I L					2.6					[NOTE 3]
15070201-008	Gila R.	H A I L					18.4					[NOTE 3]
15070201-006	Gila R.	H A I L					28.8					[NOTE 3]
15070201-005	Gila R. (Wellton vic.)	H A I L							6.3	TDS (2)	UNKNOWN (2) AG. IRR.	NONSUPPORT OF USES (2)

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TABLE III-2 (cont.). COLORADO MAIN STEM RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15070201-003	Gila R.	H A I L			29.4					[STB-10] DO NO3, PO4, Cn TDS [STC] DO B	UNKNOWN (2) AG. IRR.	NONSUPPORT OF USES (2) [STB-10] TDS RANGE 505 - 4030 MG/L
15070201-001	Gila R.	H A I L							6.6	TDS (2) [STB-9] TURBIDITY NO3, PO4 As, TDS	UNKNOWN (2)	[STB-9] TDS RANGE 643 - 2520 MG/L.
15030107-002	Colorado R.	D F A I L						5.0		NUTRIENTS TOXICS TDS	UNKNOWN IRR. AG.	WQ LIMITED SEGMENT (2). UPSTREAM SOURCES (ADEQ)
15030107-001	Colorado R. (To International Border)	D F A I L		30.5						[STB-37] TURBIDITY DO, NO3, PO4 Zn, TDS	UNKNOWN IRR. AG.	WQ LIMITED SEGMENT (2) [STB-37] TDS RANGE 659 - 1190 MG/L
15080101-003	Vamori Wash				11.4					BACTERIA DO (2) [STB-06] TURBIDITY NO3, PO4, Hg NH3, BACTERIA	UNKNOWN	NONSUPPORT OF USES (2)

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from 804 mg/l at Imperial Dam to 2700 mg/l reported at Morales Dam at the international border (**8**). Open range grazing, by both cattle and wildlife, are potential contributors of coliform bacteria, nitrate and sediments to Main Stem flow.

The intensively cultivated areas along the Colorado River in Arizona extend from Ehrenberg in the south to Parker in the north. Average annual salinity values reported at Parker and Imperial dams for the years 1974 to 1983 indicate an increase from 701 to 804 mg/l for this segment of the river. The increased salinity has been largely attributed to return flows of irrigation waters containing leached salts. Heavy use of nitrogen based fertilizers also represent a potential source for increased nitrate/nitrite levels in groundwater in the area. The impact of open range livestock operations within the basin is unknown (**5,8**).

The major agronomic area near Yuma is divided into two distinct units. The mesa above the Colorado River flood plain has, in recent years, been subject to extensive citrus orchard development. In contrast, the flood plain below the mesa continues to be devoted to intensive vegetable crop production. Although both areas utilize diverted surface water for irrigation purposes, the mesa has become increasingly more dependent upon groundwater. Results of analysis of groundwater samples for four well locations indicate levels of Ethylene Dibromide (EDB) and Dibromochloropropane (DBCP) in excess of established action levels of 10 and 25 ppb, respectively (**15**). Although the primary areas of prior usage of these compounds was on the mesa, they are now reportedly contaminating groundwater supplies in concentrations exceeding action levels at well sites near the Colorado River on the Cocopah Indian Reservation, Somerton and San Luis. TDS and nitrate/nitrite analyses were not included for wells in the Yuma area in the 1987 groundwater sampling report (**1,5,18**).

The Wellton-Mohawk Valley is the principal site within the Colorado Main Stem Basin where degradation of groundwater quality due to leached salts has been conclusively demonstrated. This district became agronomically unproductive in the mid 1940's as a result of salt accumulation in soils from irrigation with salt laden, poor quality groundwater. In the mid 1950's, the Gila Project diversion facilities at Imperial Dam began deliveries of higher quality Colorado River water containing approximately 800 mg/l total salts. Evaluation of return flows from the district in 1961 indicated they contained leached salts at a concentration of about 6000 mg/l. These saline discharges were later identified as the primary cause of the increases in salinity from approximately 800 mg/l at Imperial Dam to 2700 mg/l at Morelos Dam near the international border. In addition, the use of imported Colorado River water for irrigation in the Wellton-Mohawk Valley has resulted in a rise in groundwater levels, and an increase in the salinity of groundwater supplies from saline leachate percolating into underground aquifers (**5,8**). Runoff waters from urban and irrigation return sources in Utah add contaminants to the Virgin River before it enters Arizona (**16A**).

Range management on State Trust Land was identified as a problem by the Northern Arizona Council of Governments (NACOG) 208 plan (**9**). There are potentials for degradation of the environment resulting in increased runoff, sedimentation, and nutrient and coliform bacteria concentration as a result of grazing activities.

Silvicultural NPS (20)

The impacts of silviculture upon surface and groundwater in the Colorado Main Stem Basin are largely unknown and probably insignificant. For example, only 4000 acres of 187,000 acres in the Bill Williams River watershed in the Prescott National Forest have been logged since 1975.

Construction, Urban Runoff, Military NPS (30/40)

The impacts of construction, urban runoff, and land development upon surface and groundwater in the basin are largely unassessed. The areas of Yuma, Kingman, and Lake Havasu City are the principal areas of urban growth and development. In the Yuma Area, several VOCs were reported in the 1987 State Groundwater Quality sampling results but definition of their origin

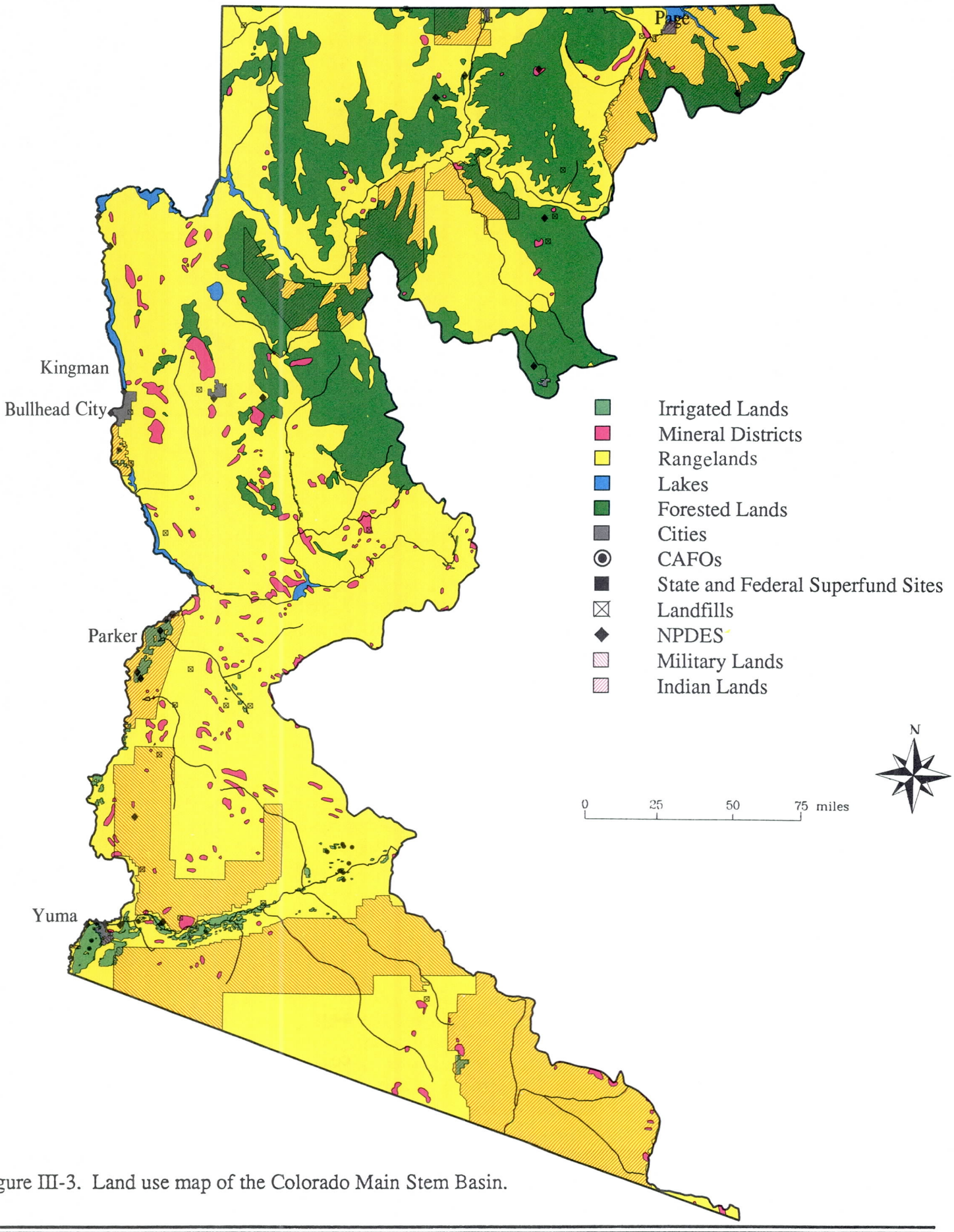

Figure III-3. Land use map of the Colorado Main Stem Basin.

awaits further investigation (**1,5**). However, groundwater contamination by solvents has occurred at a designated Superfund site, the Yuma Marine Corp Air Station.

Resource Extraction NPS (50)

Mining is the major industry in the basin. Mining activities are largely concentrated in the Bagdad, Kingman, Quartzsite, and Ajo areas and consist primarily of copper and precious metal mines, smelters, and refineries. Extensive uranium mining is taking place along the northern portion of the basin from breccia pipes along the Colorado River and from the Chinle Formation. Increased uranium mining is also projected to occur. Surface water has been impacted by inactive mines in the Boulder Creek watershed (**16**). The impact of mining and abandoned mines upon groundwater quality is largely unassessed.

Land Disposal NPS (60)

Through 1977, fifty seven wastewater treatment facilities were operating in the basin and several were overloaded and operating poorly. Activated sludge and oxidative aerated lagoon systems are the principal types of systems used. Slightly more than 50 percent of all treatment facilities use the activated sludge process, generally in the form of a package plant.

In the Parker Strip area, the existing septic tank and leachfield facilities appear to be adequate during the winter months. However, during the summer months these waste disposal systems are overloaded (**7**). These systems are not functioning satisfactorily and are impaired. Each onsite system should be designed to operate under maximum hydraulic loading on a year round basis. Based upon the increase in urban growth during winter months, and the constant recreational use over the summer, many of the systems may need to be expanded, replaced, and / or repaired to reduce contamination to the surface and groundwater. Concern has been expressed regarding septic tank - leachfield systems in the Ehrenburg, Somerton, and San Luis areas where rising groundwater levels associated with agricultural irrigation may contribute to coliform bacteria and nutrient pollution (**15**).

Most of the communities in the Parker area rely upon septic systems for waste disposal. Recent (1987-1988) sampling in Quartzsite indicates possible extensive nitrate contamination of the shallow drinking water aquifer due to over usage of septic systems and the lack of a central sewer system.

Hydrologic and Habitat Modification NPS (70)

Several major dams have been constructed along the Colorado Main Stem in Arizona. Glen Canyon and Hoover dams respectively form the major impoundments of Lake Powell and Lake Mead. Smaller impoundments, Lake Mohave and Lake Havasu, are respectively formed behind Davis and Parker dams. Imperial and Laguna dams are classed as diversion structures which do not produce impoundments. The primary purpose of Colorado River diversions in Arizona is to satisify agricultural irrigation demands.

Increases in the Colorado Main Stem salinity levels (678 mg/l at Hoover Dam to 701 mg/l at Parker Dam and 804 mg/l at Imperial Dam) have been largely attributed to the diversion of Main Stem flow. In addition, infiltration of water into groundwater basins along the Main Stem is associated with the major impoundments. Silt trapping and flow regulation by Glen Canyon Dam has altered sandbar stability and vegetation within the Grand Canyon (**17A**).

Impoundments behind Davis, Parker, Hoover and Glen Canyon dams have contributed to increased recreational utilization of the Main Stem. Increases in recreational utilization of these areas is linked with increased coliform and nutrient contamination of groundwater in the Colorado Main Stem Basin (**5**).

Recreation NPS (100)

Recreational uses along the Colorado Main Stem contribute to distinct seasonal bacterial and nutrient loading violations of standards in areas of Lake Havasu, Pai Springs, and within the Grand Canyon. Increased seasonal use of the river segment below Lee's Ferry by river rafters, campers, and fisherman will require further study to assess the degradation of water quality. The impact of recreation upon groundwater in the basin is undefined.

Colorado Main Stem Basin References

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13. U.S. Department of Agriculture, Forest Service, Southwestern Region, 11/86, Environmental Impact Statement For the Prescott National Forest Plan."

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17. Yuma Flood Control Task Force, 9/83, "Colorado River Flood of 1983, Findings and Emergency Solutions Report."

B. Little Colorado Basin

Description

The Little Colorado River and its tributaries within the States of Arizona and New Mexico drain this basin. (Figure III-4). It contributes approximately 345,000 acre feet of water to the Colorado River annually. The hydrologic cataloging units of the Little Colorado Basin in Arizona are 1502001 through 1502018. A portion of units 1502001 through 1502004 and 1502006 lie within New Mexico. Overall, the basin area in Arizona is 21,904 square miles.

Surface elevations of the basin in Arizona range from 12,633 feet above MSL, at Humphrey's Peak in the volcanic San Francisco Peaks near Flagstaff, to about 2,700 feet where the Little Colorado River joins the Colorado River. Mean annual precipitation within the Little Colorado Basin ranges between 8 and 12 inches in valleys and plateaus, to 24 inches in forested parts of the mountains. Most areas of the basin are plains and desert grassland with some mountain meadow grassland. Ponderosa pine is the dominant species between elevations of 5,500 and 8,000 feet elevation. Mixed conifer occurs from 8,000 to 12,000 feet. Spruce-fir forests are at higher elevations. A transition zone of juniper-pinyon and grasslands range in elevation from about 4,500 to 7,000 feet (**16**).

The U.S. Environmental Protection Agency's Reach File lists 3,448.5 river-miles in the watershed. Less than half of these river-miles are perennial. According to the Arizona Game and Fish Department, 44 recreation lakes totaling 5,697 acres are found in this basin within Arizona (**6**). Soil sediment yields in the basin range from negligible to severe (0.2 to 3.0 acre feet per square mile per year) in the basin (**17**).

Surface Water Quality

The ADEQ assessment of NPS pollution in the Little Colorado Basin evaluated 2,251.5 miles of the 3.448.5 miles of streams listed in the EPA Reach File for the basin in Arizona. The protected use support evaluation showed: 41.0 miles, full support; 422.8 miles, partial support; and 1,727.8 miles, nonsupport of protected uses. About 59.9 miles of water courses had their uses threatened. High sediment and turbidity levels are found throughout the basin according to monitoring and evaluated data displayed in Table III-3. Rangeland, hydrologic/habitat modification, and unknown sources contribute to the erosion causing this degradation of water quality.

Mean annual discharge from the basin to the Colorado River is approximately 345,000 acre-feet of water containing 621,900 tons of dissolved solids and 10,200,000 tons of sediment. Blue Springs and other springs near the mouth of the Little Colorado River contribute about 550,000 tons of salt per year. Erosion in the basin produces an estimated 72,000 tons of salt and 31,900,000 tons of sediment per year. About 5,300 miles of channel banks are experiencing moderate to severe erosion. Annual sheet and rill erosion rates vary from less than 0.6 to 9 tons per acre within Arizona (**16**).

High nutrient levels (NO_3, PO_4) also occur regularly in the basin. Potential sources of these nutrients are unknown, land disposal, and rangeland. Metals cause monitored violations and mining may be the principal source. The Puerco River system has metals contamination and high levels of radioactivity. The Puerco River pollution is most likely a consequence of sediment discharge from the United Nuclear Uranium Mill tailings dam break that occurred in July 1979 near Gallup, New Mexico (**3**).

Fecal bacteria violations do occur in the basin, but on a more infrequent and localized nature. Sources may be land disposal, recreation, and grazing activities.

Although water is generally suitable for most agricultural purposes, in some areas settling ponds must be used to remove sediment. This practice is necessary in the Woodruff area, where some waters also have high total dissolved solids (TDS). In the St. Johns and Joseph City areas, irrigation water has a TDS range of 1,500 to 3,000 mg/l (**16**).

High country streams and lakes of the basin support sport fishing. At lower elevations, pools of standing water in ephemeral streams often

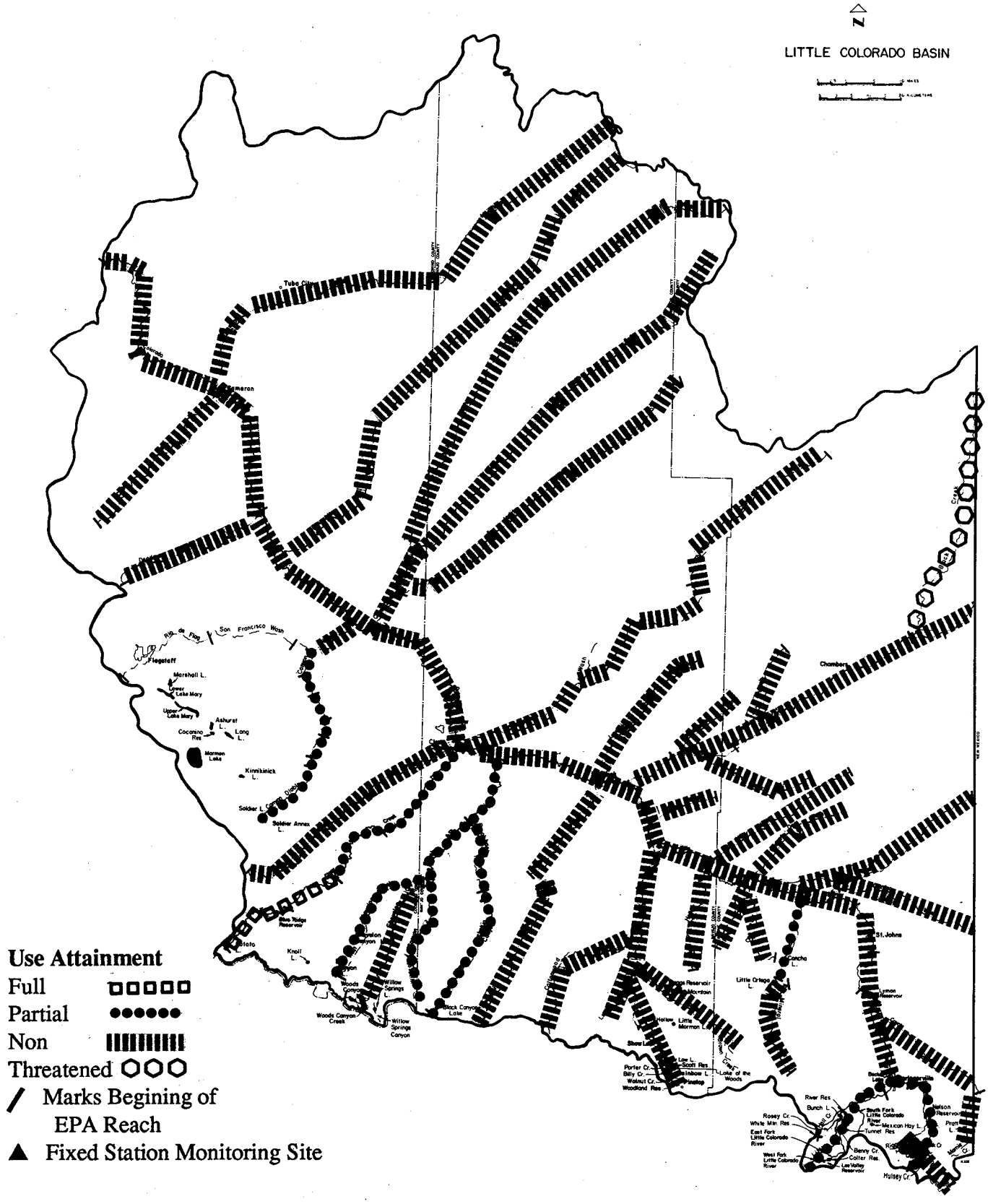

Figure III-4. Map of the Little Colorado Basin.

TABLE III-3. LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020001-	Little Colorado R. West Fork, Upper Reach	F C U						3.7		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN HABITAT MOD.	NOTE 1. SILTATION FROM HABITAT MODIFICATION, CHANNEL EROSION, RANGELAND AND UNKNOWN CAUSES (13)(14)
15020001-	Little Colorado R. West Fork, Lower Reach	F C I L		10.4						NUTRIENTS [STA-16] NO3, PO4 [STC] NO3	UNKNOWN	NUTRIENTS FROM UNKNOWN SOURCES (1)(4). DESIGNATED UNIQUE WATER OF RECREATIONAL AND ECOLOGICAL SIGNIFICANCE WITH RECREATION AND RANGELAND GRAZING AS THE PRINCIPLE USES (4)(13)
1502001-	Lee Valley C.	F C I L							2.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN HABITAT MOD.	[NOTE 1]
15020001-	Little Colorado R. East Fork	F C I L						10.0		SEDIMENT/ TURBIDITY [STA-4] BACTERIA	GRAZING UNKNOWN HABITAT MOD.	HABITAT MODIFICATION ON RANGELAND AND UNKNOWN CAUSES (13)(14)
15020001-013	Little Colorado R. (E and W Forks Confluence to Hall C.)	F C I L		6.0						SEDIMENT/ TURBIDITY BACTERIA NUTRIENTS [STA-130] PHENOLS, pH NO3, PO4 TURBIDITY [STB-3] [STC] TURBIDITY Hg, NO3, PO4 [GS 83] NO3, PO4	GRAZING LAND DISPOSAL UNKNOWN HABITAT MOD.	SILTATION FROM CHANNEL EROSION, AND HABITAT MOD. FROM RANGELAND AND UNKNOWN CAUSES (13)(14)(18) BACTERIA DUE TO FAILING ON-SITE DISPOSAL SYSTEMS (1) NUTRIENTS FROM UNKNOWN SOURCES (4).
15020001-	Benny C.	F C I L						2.0		SEDIMENT/ TURBIDITY HABITAT MOD.	GRAZING UNKNOWN	[NOTE 1]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020001-012	Little Colorado R.	F C I L						8.2		SEDIMENT/ TURBIDITY [STA-7] NO3, PO4	GRAZING UNKNOWN HABITAT MOD.	[NOTE 1]
15020001-011	Little Colorado R.	F C I L						10.0		SEDIMENT/ TURBIDITY [STA-43] TURBIDITY NO3, PO4 Hg	GRAZING UNKNOWN	[NOTE 1]
15020001-010	Hall C.	F C I L						3.7		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15020001-	Little Colorado R. South Fork	H C I L						7.6		SEDIMENT/ TURBIDITY NUTRIENTS [STA-15] NO3, PO4	GRAZING UNKNOWN HABITAT MOD.	[NOTE 1] NUTRIENTS FROM UNKNOWN SOURCES (4).
15020001-017	Nutrioso C.	H C I L						21.9		SEDIMENT/ TURBIDITY NUTRIENTS [STA-8] TDS PO4	GRAZING UNKNOWN HABITAT MOD.	SILTATION FROM CHANNEL EROSION (4)(13)(14). NUTRIENTS AND HABITAT MODIFICATION FROM RANGELAND AND UNKNOWN SOURCES (4)(5)(11)(13)(14).
15020001-	Paddy C.	H C I L							5.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN HABITAT MOD.	[NOTE 1] SILTATION FROM CHANNEL EROSION, HABITAT MODIFICATION, RANGELAND AND UNKNOWN SOURCES (13)(14).
15020001	Hulsey C.	C						3.5		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN HABITAT MOD.	[NOTE 1]

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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020001-	Colter C.	C						5.4		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN HABITAT MOD.	[NOTE 1]
15020001-	Riggs C.	H C I L						4.0		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN HABITAT MOD.	[NOTE 1]
15020001-	Benton C.	H C I L						4.0		SEDIMENT/ TURBIDITY	RECREATION GRAZING UNKNOWN	SILTATION FROM OFF ROAD VEHICLES, CHANNEL EROSION, HABITAT MOD. DUE TO OFF ROAD VEHICLES, RANGELAND AND UNKNOWN SOURCES (13)(14)
15020001-	Rudd C.	H C I L						4.0		SEDIMENT/ TURBIDITY	RECREATION GRAZING HABITAT MOD.	THREATENED SILTATION FROM OFF ROAD VEHICLES AND RANGELAND SOURCES (13)(14)
15020001-015	Nutrioso C.	H C I L						3.2		SEDIMENT/ TURBIDITY [STA-13] TDS P04, TURBIDITY	URBAN RUNOFF HABITAT MOD. UNKNOWN	SILTATION FROM HABITAT MOD., URBAN RUNOFF, RIPARIAN ALTERATION AND UNKNOWN CAUSES (4)(5)(11)(13)(14) [STA] TDS 119 - 2580 MG/L
15020001-009	Little Colorado R.	F C I L							10.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN HABITAT MOD.	SILTATION FROM RANGELAND CAUSES (4)(11)(16) NUTRIENTS FROM UNKNOWN SOURCES (4)
15020001-007	Little Colorado R.	H C I L							3.4	SEDIMENT/ TURBIDITY [STA-7] TURBIDITY P04	GRAZING	SILTATION FROM RANGELAND CAUSES (4)(11)(16)
15020001-	Mamie C.	H C I L					4.0					EVALUATION BASED ON (13)
15020001-019	Coyote C.	A I L							14.7	SEDIMENT/ TURBIDITY	GRAZING	EVALUATION BASED ON (8)(16)

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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	MONITORED (c) PART	MONITORED (c) NON	MONITORED (c) T	EVALUATED (c) FULL	EVALUATED (c) PART	EVALUATED (c) NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020001-018	Coyote C.	A I L							28.1	SEDIMENT/ TURBIDITY	GRAZING	EVALUATION BASED ON (8)(16)
15020001-006	Little Colorado R.	F C I L			2.7					SEDIMENT/ TURBIDITY NUTRIENTS [STA-76] TURBIDITY NO3, PO4 [GS 83] BACTERIA	GRAZING UNKNOWN	SILTATION FROM RANGELAND (4)(11)(16). NUTRIENTS FROM UNKNOWN AND RANGELAND CAUSES (4).
1502001-005	Little Colorado R.	F C I L			1.0					[STA-5] NO3, PO4 [STB-10] NO3, PO4 BACTERIA	GRAZING UNKNOWN	[STA-5] SITE AT LYMAN CANAL OFF LYMAN L. SILTATION FROM RANGELAND (4)(11)(16). NUTRIENTS FROM UNKNOWN AND RANGELAND CAUSES (4).
15020001-002	Little Colorado R. (Lyman L.)	F C I L							2.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	NOTE 2. PRINCIPLE LAND USE IS RANGELAND AND HIGH EROSION AND SILTATION ARE WELL DOCUMENTED IN THE REGION (10)(11)(16). CAUSES OF RECENT EROSION ARE DUE TO CURRENT RANGELAND AND UNKNOWN HISTORIC CAUSES WHICH WERE NOT PRESENT DURING THE MID-19TH CENTURY. (16)
15020001-001	Little Colorado R.	D F A I L							0.7	SEDIMENT/ TURBIDITY [STA-13] NO3, PO4	GRAZING UNKNOWN	[NOTE 2]
15020002-024	Little Colorado R.	D F A I L							11.1	SEDIMENT/ TURBIDITY [STA-13] NO3, PO4	GRAZING UNKNOWN	[NOTE 2]

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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	MONITORED (c) PART	EVALUATED (c) NON	EVALUATED (c) T	EVALUATED (c) FULL	EVALUATED (c) PART	EVALUATED (c) NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020002-023	Little Colorado R.	D F A I L			11.4					SEDIMENT/ TURBIDITY [STA-13] NO3, PO4 B, TDS [STB-7] TDS, PO4	GRAZING UNKNOWN	[NOTE 2]
15020002-021	Little Colorado R.	D F A I L			2.6					SEDIMENT/ TURBIDITY [GS 84] PO4	GRAZING UNKNOWN	[NOTE 2]
15020003-001	Carrizo Wash	D F A I L							26.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2] 26 MILES OF REACH IN ARIZONA.
15020002-020	Little Colorado R.	D F A I L							0.9	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020002-017	Little Colorado R.	D F A I L							1.1	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020002-016	Little Colorado R.	D F A I L							7.7	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020002-015	Concho C.	F A I L		18.7						NUTRIENTS SEDIMENT/ TURBIDITY [STC] pH	LAND DEVELOPMENT GRAZING UNKNOWN	PRINCIPLE LAND USES ARE RANGELAND AND DEVELOPMENT (5)(10)(16). NUTRIENTS ARE A PROBLEM IN THE UPPER SEGMENT ABOVE CONCHO LAKE DAM DUE TO RANGELAND AND UNKNOWN CAUSES (2). SILTATION DUE TO RANGELAND RUNOFF AND UNKNOWN HISTORIC CAUSES (16)
15020002-014	Little Colorado R.	D F A I L							7.2	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	NOTE 3. PRINCIPLE LAND USE IS RANGELAND (5)(10)(16). CAUSES OF SEDIMENTATION ARE DUE TO RANGELAND AND UNKNOW UNKNOWN HISTORIC CONDITIONS AFFECTING A MAJOR PART OF THE WATERSHED WHICH WERE NOT REPORTED IN THE MID 19TH

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020004-004	Zuni Wash	A I L							9.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3] 9.0 MILES IN ARIZONA REACH
15020004-002	Zuni Wash	A I L							23.8	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	
15020004-001	Zuni Wash	A I L							13.4	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-013	Little Colorado R.	D F A I L							4.1	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-028	Beaver Dam Wash	D F A I L							17.5	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-026	Beaver Dam Wash	D F A I L							6.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-012	Little Colorado R.	D F A I L							1.5	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002	Mineral C.	H C I L							3.6	SEDIMENT/ TURBIDITY HABITAT MOD.	GRAZING UNKNOWN	[NOTE 1]
15020002-011	Oso Draw	D F A I L							20.2	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-010	Little Colorado R.	D F A I L							1.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020002-009	Cheney Draw	D F A I L							16.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-008	Little Colorado R.	D F A I L							9.1	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-007	Hay Hollow Draw	D F A I L							20.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-006	Little Colorado R.	D F A I L							0.9	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-030	Milky Wash	D F A I L							28.5	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-029	Milky Wash	D F A I L							4.7	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020002-005	Little Colorado R.	D F A I L			12.2					SEDIMENT/ TURBIDITY [STA-7] pH PO4	GRAZING UNKNOWN	[NOTE 3] MONITORING DATA DEMONSTRATES EXCEPTIONALLY HIGH SEDIMENTATION (18).
15020005-016	Brown C.	F C I L							19.1	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4] SILTATION FROM UNSATISFACTORY RANGE CONDITION (14)
15020005-015	Silver C.	F C I L			5.1					SEDIMENT/ TURBIDITY [STC] pH Se	GRAZING UNKNOWN	[NOTE 4]
15020005-014	Silver C.	F C I L							0.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]

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(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020005-013	Silver C.	F C I L							3.8	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020005-	Walnut C. (Trib. to Rainbow L.)	C					4.6			SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020005-	Porter C.	C						3.7		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	SILTATION FROM RANGELAND AND UNKNOWN CAUSES (13)(14)
15020005	Billy C.	C						2.5		SEDIMENT/ TURBIDITY BACTERIA	URBAN RUNOFF RECREATION LAND DISPOSAL	BACTERIA FROM ON-SITE DISPOSAL SYSTEMS, SILTATION FROM OFF-ROAD VEHICLES (13)
15020005-012	Show Low C.	F C I L			34.0					SEDIMENT/ TURBIDITY [STC] pH TURBIDITY	RECREATION GRAZING UNKNOWN HABITAT MOD.	SILTATION FROM CHANNEL EROSION, POOR WATERSHED CONDITION AND OFF-ROAD VEHICLES (13)(14). HABITAT MODIFICATION FROM RANGELAND AND UNKNOWN CAUSES(13)(14).
15020005-011	Linden Wash	F C I L							5.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020005-010	Show Low C.	F C I L							5.5	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020005-009	Silver C. (Snowflake)	F C I L			9.6					SEDIMENT/ TURBIDITY [STC] TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020005-007	Cottonwood Wash	F C I L							15.1	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020005-005	Cottonwood Wash	F C I L							9.7	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]

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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020005-004	Cottonwood Wash	F C I L			9.1					SEDIMENT/ TURBIDITY (STB-4) TURBIDITY NO3, PO4 PHENOLS	GRAZING MINING HYDROLOGIC/ HABITAT MOD.	SILTATION FROM UNSATISFACTORY RANGE CONDITIONS, GRAVEL MINING AND STREAMBANK MODIFICATION (1)(14)(18).
15020005-003	Silver C.	F C I L							9.2	SEDIMENT/ TURBIDITY	GRAZING MINING	(NOTE 3) SAND AND GRAVEL EXTRACTION (ADEQ)
15020005-001	Silver C.	F C I L							9.3	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 3)
15020002-004	Little Colorado R.	D F A I L			6.1					SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 3) MONITORING DATA DEMONSTRATES EXCEPTIONALLY HIGH SEDIMENTATION (18).
15020002-032	Carr Wash	D F A I L							12.9	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 3)
15020002-003	Little Colorado	D F A I L							1.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 3)
15020002-001	Little Colorado R.	D F A I L							5.7	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 3)
15020006-003	Puerco R.	D A I L			10.3					SEDIMENT/ TURBIDITY METALS (STC) RADIATION As, Mn, Ra-226 Pb, Cu	GRAZING UNKNOWN	(NOTE 3) METALS (INCLUDING RADIOCHEMICALS) FROM SOURCES IN NEW MEXICO) (3)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE (STA), (STB), AND (STC) LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020006-001	Puerco R.	D A I L		6.2						SEDIMENT/ TURBIDITY METALS [STB-3] As, Mn, Pb	GRAZING UNKNOWN	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)
15020006-008	Black C.	D A I L				59.9				SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	EVALUATION BASED ON (3)(16)
15020007-012	Puerco R. (near Houck)	D A I L		14.6						SEDIMENT/ TURBIDITY METALS	GRAZING UNKNOWN	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)
15020007-011	Puerco R. (near Chambers)	D A I L		6.2						[STA-] RADIATION [STB-9] TURBIDITY DO, Hg RADIATION	GRAZING UNKNOWN	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)
15020007-009	Puerco R.	D A I L		6.8						SEDIMENT/ TURBIDITY METALS	GRAZING UNKNOWN	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)
15020007-008	Puerco R.	D A I L		18.2						SEDIMENT/ TURBIDITY METALS	GRAZING UNKNOWN UPSTREAM SOURCES	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)
15020007-015	Dead Wash	D A I L							26.8	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020007-007	Puerco R.	D A I L		0.3						SEDIMENT/ TURBIDITY METALS	GRAZING UNKNOWN UPSTREAM SOURCES	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020007-005	Puerco R. (Above Petrified Forest)	D A I L			6.6					SEDIMENT/ TURBIDITY METALS [STB-3] As, Cu, Mn, Pb RADIATION	GRAZING UNKNOWN UPSTREAM SOURCES	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)
15020007-004	Dry Wash	D A I L							25.4	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020007-003	Puerco R.	D A I L			3.1					SEDIMENT/ TURBIDITY METALS	GRAZING UNKNOWN UPSTREAM SOURCES	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)
15020007-016	Lithodendron Wash	D A I L							22.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020007-002	Puerco R.	D A I L			1.5					SEDIMENT/ TURBIDITY METALS	GRAZING UNKNOWN	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)
15020007-001	Puerco R. (near Holbrook)	D A I L			13.4					[STB-3] As, Cu, Hg Mn, Pb RADIATION	GRAZING UNKNOWN	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)
1502008-020	Little Colorado R.	D F A I L							5.5	[STB-3] As, Cu, Hg Mn, Pb RADIATION	GRAZING UNKNOWN	[NOTE 3] METALS FROM UPSTREAM SOURCES (3)
15020009-003	Leroux Wash	D F A I L							16.2	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]

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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	MONITORED (c) PART	MONITORED (c) NON	EVALUATED (c) T	EVALUATED (c) FULL	EVALUATED (c) PART	EVALUATED (c) NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020009-001	Leroux Wash	D F A I L							20.4	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020008-019	Little Colorado	D F A I L							0.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020008-022	Phoenix Park Wash	D F A I L							30.3	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	SILTATION FROM UNSATISFACTORY RANGE CONDITION (14)
15020008-018	Porter Tank Draw	D F A I L							22.3	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020008-017	Little Colorado R.	D F A I L			18.7					SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3] USGS DATA DEMONSTRATES SILTATION (18)
15020008-015	Little Colorado R.	D F A I L							4.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020008	Woods Canyon C.	C					5.7			SEDIMENT/ TURBIDITY	GRAZING UNKNOWN HABITAT MOD.	HABITAT MODIFICATION DUE TO GRAZING AND UNKNOWN CAUSES (13)
15020008	Willow Springs C.	H C I L					3.8			SEDIMENT/ TURBIDITY	GRAZING UNKNOWN HABITAT MOD.	HABITAT MODIFICATION DUE TO GRAZING AND UNKNOWN CAUSES (13)
15020010-006	Chevelon Canyon	F C I L							30.8	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN HABITAT MOD.	HIGH CHANNEL EROSION PROBLEMS (13). UNSATISFACTORY WATERSHED CONDITION IS ALSO A PROBLEM (14).
15020010-005	West Chevelon Canyon	F C I L					25.3			SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	NOTE 4. SILTATION CAUSED BY UNSATISFACTORY WATERSHED CONDITION (14)(16).

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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020010-004	Chevelon Canyon	F C I L						5.9		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020010-007	Wildcat Canyon	F C I L						22.2		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020010-002	Chevelon Canyon	F C I L						7.5		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020010-012	Black Canyon	H C I L						32.7		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020010-011	Black Canyon	H C I L						2.2		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020010-009	Black Canyon	H C I L						16.1		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020010-001	Chevelon Canyon	F C I L						18.3		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020008-014	Little Colorado R.	D F A I L							7.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020011-006	Pueblo Colorado Wash	D F A I L							8.2	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020011-004	Pueblo Colorado Wash	D F A I L							49.9	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]

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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	MONITORED (c) PART	MONITORED (c) NON	EVALUATED (c) T	EVALUATED (c) FULL	EVALUATED (c) PART	EVALUATED (c) NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020011-003	Pueblo Colorado Wash	D F A I L							34.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020011-001	Cottonwood Wash	D F A I L							31.4	SEDIMENT/ TURBIDITY [GS 83] TURBIDITY PO4, PHENOLS	GRAZING UNKNOWN	[NOTE 3]
15020008-013	Little Colorado R.	D F A I L							1.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020008-009	E. Clear C.	F C I L					18.8					FULL SUPPORT EVALUATION BASED ON (13).
15020008-008	E. Clear C.	F C I L					13.6					FULL SUPPORT EVALUATION BASED ON (13).
15020008	Bear Canyon C.	H C I L							4.3	SEDIMENT/ TURBIDITY	UNKNOWN HABITAT MOD.	SILTATION FROM CHANNEL EROSION AND HABITAT MODIFICATION BY UNKNOWN CAUSE (13)(14)
15020008	Hart Canyon C.	F C I L							7.8	SEDIMENT/ TURBIDITY	RECREATION GRAZING UNKNOWN HABITAT MOD.	SILTATION FROM CHANNEL EROSION FROM RANGELAND AND OFF-ROAD VEHICLES, AND HABITAT MODIFICATION FROM UNKNOWN CAUSES (13)(14).
15020008-011	Willow C.	F C I L							22.6	SEDIMENT/ TURBIDITY	UNKNOWN HABITAT MOD.	SILTATION FROM CHANNEL EROSION AND HABITAT MODIFICATION BY UNKNOWN CAUSES (13)(14).
15020008-007	E. Clear C.	F C I L							20.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]
15020008-006	East Clear C.	F C I L							37.1	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 4]

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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020008-005	Little Colorado R.	D F A I L							1.2	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
1520008-004	Jacks Canyon	A I L							48.6	SEDIMENT/ TURBIDITY [STA-4] PO4	GRAZING UNKNOWN	[NOTE 3]
15020008-003	Little Colorado R.	D F A I L							36.1	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020012-004	Oraibi Wash	D F A I L							14.5	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020012-003	Oraibi Wash	D F A I L							83.9	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020013-007	Polacca Wash	D F A I L							32.1	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020013-006	Polacca Wash	D F A I L							1.1	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020013-004	Polacca Wash	D F A I L							18.8	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020013-002	Polacca Wash	D F A I L							7.4	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020013-001	Polacca Wash	D F A I L							32.4	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020012-002	Corn Creek Wash	D F A I L							6.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]

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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS. Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020014-005	Jadito Wash	D F A I L							52.0	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020014-003	Jadito Wash	D F A I L							15.5	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020014-001	Jadito Wash	D F A I L							7.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020012-001	Corn Creek Wash	D F A I L							7.8	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020008-002	Little Colorado R.	D F A I L							3.5	SEDIMENT/ TURBIDITY [STA-12] TDS	GRAZING UNKNOWN	NOTE 3. [STA] TDS 164-1070 MG/L
15020015-020	Canyon Diablo	D F A I L						31.7		SEDIMENT/ TURBIDITY	GRAZING	NOTE 5. SILTATION CAUSED BY UNSATISFACTORY WATERSHED CONDITION (15)(16)
15020015-018	Canyon Diablo	D F A I L						1.6		SEDIMENT/ TURBIDITY	GRAZING	[NOTE 5]
15020015-017	Canyon Diablo	D F A I L						7.2		SEDIMENT/ TURBIDITY	GRAZING	[NOTE 5]
15020015-015	Canyon Diablo	D F A I L						4.2		SEDIMENT/ TURBIDITY	GRAZING	[NOTE 5]
15020015-013	Canyon Diablo	D F A I L						4.3		SEDIMENT/ TURBIDITY	GRAZING	[NOTE 5]
15020015-011	Canyon Diablo	D F A I L						4.4		SEDIMENT/ TURBIDITY	GRAZING	[NOTE 5]

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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020015-009	Canyon Diablo	D F A I L						4.8		SEDIMENT/ TURBIDITY	GRAZING	[NOTE 5]
15020015-001	Canyon Diablo	D F A I L							11.0	SEDIMENT/ TURBIDITY	GRAZING	[NOTE 5]
15020008-001	Little Colorado	D F A I L							20.2	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020016-013	Little Colorado	D F A I L							6.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 3]
15020017-003	Dinnebito Wash	D F A I L							16.9	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020017-002	Dinnebito Wash	D F A I L							14.8	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2]
15020017-001	Dinnebito Wash	D F A I L							89.4	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15020016-012	Little Colorado R.	D F A I L							8.3	SEDIMENT/ TURBIDITY METALS	MINING GRAZING UNKNOWN	[NOTE 3] METALS FROM ABANDONED URANIUM MINE DRAINAGE (1)(2)
15020016-011	Deadman Wash	D F A I L							33.9	SEDIMENT/ TURBIDITY	GRAZING	[NOTE 5]
15020016-010	Little Colorado R.	D F A I L							20.2	SEDIMENT/ TURBIDITY METALS	MINING GRAZING UNKNOWN	[NOTE 3] METALS FROM ABANDONED URANIUM MINE DRAINAGE (1)(2)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	MONITORED (c) PART	MONITORED (c) NON	MONITORED (c) T	EVALUATED (c) FULL	EVALUATED (c) PART	EVALUATED (c) NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020016-008	Little Colorado R. (at Cameron)	D F A I L			7.1					SEDIMENT/ TURBIDITY METALS BACTERIA [STA-X] TDS TURBIDITY NO3, PO4 Mn, Hg, Pb BACTERIA RADIATION [STB-12] TURBIDITY NO3, PO4 Cu, Pb, Zn, Hg BACTERIA RADIATION [STC] TURBIDITY BACTERIA	MINING GRAZING UNKNOWN	[NOTE 3] METALS (RADIOACTIVITY) FROM ABANDONED URANIUM MINE DRAINAGE (1)(2). USGS DATA CONFIRMS BACTERIA AND RADIOACTIVITY (18). [STA-X] LONG TERM FIXED STATION, TDS TO 1320 MG/L
15020016-007	Cedar Wash	D F A I L							38.9	SEDIMENT/ TURBIDITY	GRAZING	[NOTE 5]
15020016-005	Cedar Wash	D F A I L							7.7	SEDIMENT/ TURBIDITY	GRAZING	[NOTE 5]
15020016-004	Little Colorado R.	D F A I L							0.9	SEDIMENT/ TURBIDITY METALS BACTERIA	MINING GRAZING UNKNOWN	[NOTE 3] METALS (RADIOACTIVITY) FROM ABANDONED URANIUM MINE DRAINAGE (1)(2)(18). BACTERIA CAUSED BY RANGELAND (18).
15020018-002	Moenkopi Wash	D F A I L							90.9	SEDIMENT/ TURBIDITY METALS [STA-81] TDS, NO3	MINING GRAZING UNKNOWN	[NOTE 2] METALS THREATENED FROM UNSTABILIZED URANIUM MILL TAILINGS NEAR TUBA CITY. USGS DATA SHOWS HIGH POTENTIAL FOR NONPOINT SOURCE TRANSPORT OF MINERALIZATION (19). [STA] TDS RANGE 521 TO 4300 MG/L

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TABLE III-3 (cont.). LITTLE COLORADO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15020018-001	Moenkopi Wash	D F A I L							12.7	SEDIMENT/ TURBIDITY METALS [STA-7] PO4	MINING GRAZING UNKNOWN	[NOTE 2] METALS THREATENED FROM UNSTABILIZED URANIUM MILL MILL TAILINGS NEAR TUBA CITY. USGS DATA SHOWS HIGH POTENTIAL FOR NONPOINT SOURCE TRANSPORT OF MINERALIZATION (19).
15020016-003	Little Colorado R.	D F A I L							22.5	SEDIMENT/ TURBIDITY METALS BACTERIA	MINING GRAZING UNKNOWN	[NOTE 3] METALS (RADIOACTIVITY) FROM ABANDONED URANIUM MINE DRAINAGE (1)(2)(18). BACTERIA CAUSED BY RANGELAND (18).
15020016-001	Little Colorado R.	D F A I L							29.9	SEDIMENT/ TURBIDITY METALS BACTERIA	MINING GRAZING UNKNOWN	[NOTE 3] METALS (RADIOACTIVITY) FROM ABANDONED URANIUM MINE DRAINAGE (1)(2)(18). BACTERIA CAUSED BY RANGELAND (18).

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

provide habitat for nongame fish, other aquatic life, and wildlife. Poor bank and riparian vegetation conditions, and channel erosion often impair fishery quality (**13**). Most lakes in the watershed lie at elevations between 6,000 and 7,500 feet (**6**). Trophic conditions are typically extreme. Lakes in the vicinity of the White Mountains, Show Low, and Springerville are eutrophic, with Carlson average trophic state values from 60 to 74. Lakes along the Mogollon Rim are typically underproductive and exhibit oligotrophic characteristics (**7**).

Groundwater Quality

Groundwater is present under nearly all of the basin. However, in some areas, limited quantity, poor quality, or great depth preclude extensive use. Aquifers within the Little Colorado Basin are: a) the consolidated Coconino Sandstone aquifer, which underlies most of the basin area at various depths, b) unconsolidated alluvium which occurs in low lying stream valleys, particularly in the valley of the Little Colorado and c) the Redwall Limestone from which the Blue Springs discharges into the Little Colorado River.

In general, the salt concentration of groundwater in the Coconino Sandstone Aquifer System increases northward from the Mogollon Rim, as the groundwater flows downdip toward the center of the Black Mesa structural basin. Quality of water in the Coconino aquifer in the Rim area is primarily bicarbonate type, either calcium-bicarbonate or magnesium-bicarbonate. These waters contain less than 500 mg/l of total dissolved solids, and therefore, are of good chemical quality. Northeastward, in a downdip, down slope direction toward the Little Colorado River, the water changes to a more highly mineralized water of sodium chloride type with total dissolved solids concentrations of 500 to several thousand mg/l. Northeastward from the river the salinity increases rapidly to more than 25,000 mg/l in the lower parts of the Black Mesa structural basin (**5**).

There are several factors that are apparently responsible for the northeastward, downdip, deterioration of water quality in the Coconino aquifer. As the water moves downdip, it becomes partially confined, thus increasing the saturation of salts from overlying formations. Runoff from the relatively saline Moenkopi and Chinle formations may percolate downward and add to the salinity of the Coconino water (**5**).

Seeps and springs discharge from the Coconino Sandstone into the tributaries and main stem of the Little Colorado and thereby affect surface water flow and quality. Near the mouth of Clear Creek, the springs discharge saline water and cause the perennial low-flow in the stream to be of poor quality. Two springs in the lower reach of Clear Creek have shown total dissolved salts concentrations of 696 and 1709 parts per million at the time of sampling. Only during the normal runoff period during February is dilution by runoff from the upper reaches sufficient to produce good quality flows in the lower reach of Clear Creek (**5**).

Quality of ground water in the stream valley alluvium within the Little Colorado Basin varies with solubility of earth materials, the degree of interflow or mixing between the aquifer water and the stream water, and with the magnitude of groundwater evaporation and transpiration. The alluvial aquifer beneath the Puerco River may have been impacted by tailings pond spills at uranium milling sites upstream in New Mexico.

The Mississippian Redwall Limestone which outcrops south of the Mogollon Rim, outside of the basin, lies at great depth throughout the basin, except where intersected by the canyon of the Little Colorado River at the northwest end of the basin. Here large springs, Blue Springs and others, discharge from the formation. Discharge from Blue Springs and nearby springs along a 10-mile reach of the Little Colorado River averages 2,500 mg/l of total dissolved solids (**5**).

Land Use

Indian reservations overlay about half of the Little Colorado Basin. The largest public land owner is the federal government whose principal land managers are the USFS, BLM and USNPS. Private and state owned lands respectively complete the land ownership picture.

Population within Arizona's principal counties in the watershed has grown from 68,200 to 167,300 between 1940 and 1975 (**16**). The economy of the watershed was founded on livestock production, and forestry. Forest products, tourism, mining, and electric power generation are recent contributors to an economy which remains attached to its historic roots. Natural forces, overgrazing, and uranium mining wastes have left their mark on the landscape of the Little Colorado River watershed. Generalized land use for the basin is portrayed in Figure III-5.

Agricultural NPS (10)

Irrigated agriculture represents less than 0.2 percent of the land area within the basin. This land is being converted to urban use in the Snowflake-Taylor, Show Low, St. Johns and Springerville-Eagar areas (**16**). Unlike irrigated agriculture of the central and western Arizona valleys, crop production in the Little Colorado Basin is limited to one crop per year. The relatively small area utilized for crop production and the relative low intensity of the activity results in a limited impact by irrigated agriculture on surface water quality.

Range cattle and sheep, and concentrated swine production are the principal livestock activities. Several concentrated animal feeding operations in this basin have been notified of violations of surface water quality standards by the ADEQ.

In 1981, much of the historic rangeland was reported to be in poor condition in the basin (**16**). Nevertheless, current erosion is largely attributed to climate, soil type, vegetative cover, and trenching. During the late 1800's, widespread trenching of alluvial valleys attributed to overgrazing contributed to the lowering of the water table of adjacent land. Reduced soil moisture from the lowering of water tables appears to have deprived vegetation of a former supply of water. Reduced plant vigor, changes in vegetative type, climate and grazing appear to have contributed to the reduction in vegetative cover. Soil desiccation, trench and gully erosion, and suppressed vegetative cover in areas with erodible soils appear to have resulted in large scale streambank modification/ destabilization and altered runoff hydrograph.

The legacy of severe erosion still occurs in alluvial valleys and on valley slopes in the basin. Approximately 5,300 miles of channel banks are reported to be experiencing moderate to severe erosion. This results in further loss of land productivity, creates gullies, releases soluble salts, alters the runoff hydrograph and causes sedimentation. Sedimentation results in degraded water quality, causes loss of storage capacity in reservoirs, plugs culverts and leads to increased flooding in many areas. This is due to sediment deposition in water courses and phreatophytic growth (**16**).

The Little Colorado River near Cameron has reported bacteria violations. Rangeland activities are the only known land use in the area. However, bacterial problems from rangeland are not well documented.

Silvicultural NPS (20)

Commercial timber production occurs on approximately 8 percent of the watershed. Current timber cutting and hauling activities occur in a small percentage of this area, and impacts are typically localized. Forest roads often serve multiple cut areas and represent a potential source of siltation until improved or properly abandoned. Silviculture has not been identified as causing or contributing to impaired sport fishing in streams within the national forests (**13**). Lakes and reservoirs receiving relatively high runoff from forested lands tend to be eutrophic (**7**).

Construction NPS (30)

Highway construction in the basin conforms to state and federal construction standards to minimize pollution. Incorporated cities and towns review new construction plans to ensure that new development has adequate runoff control and retention facilities, thereby minimizing construction-related pollution and the cost of constructing stormwater handling facilities. Nonpoint source pollution from construction is currently unassessed.

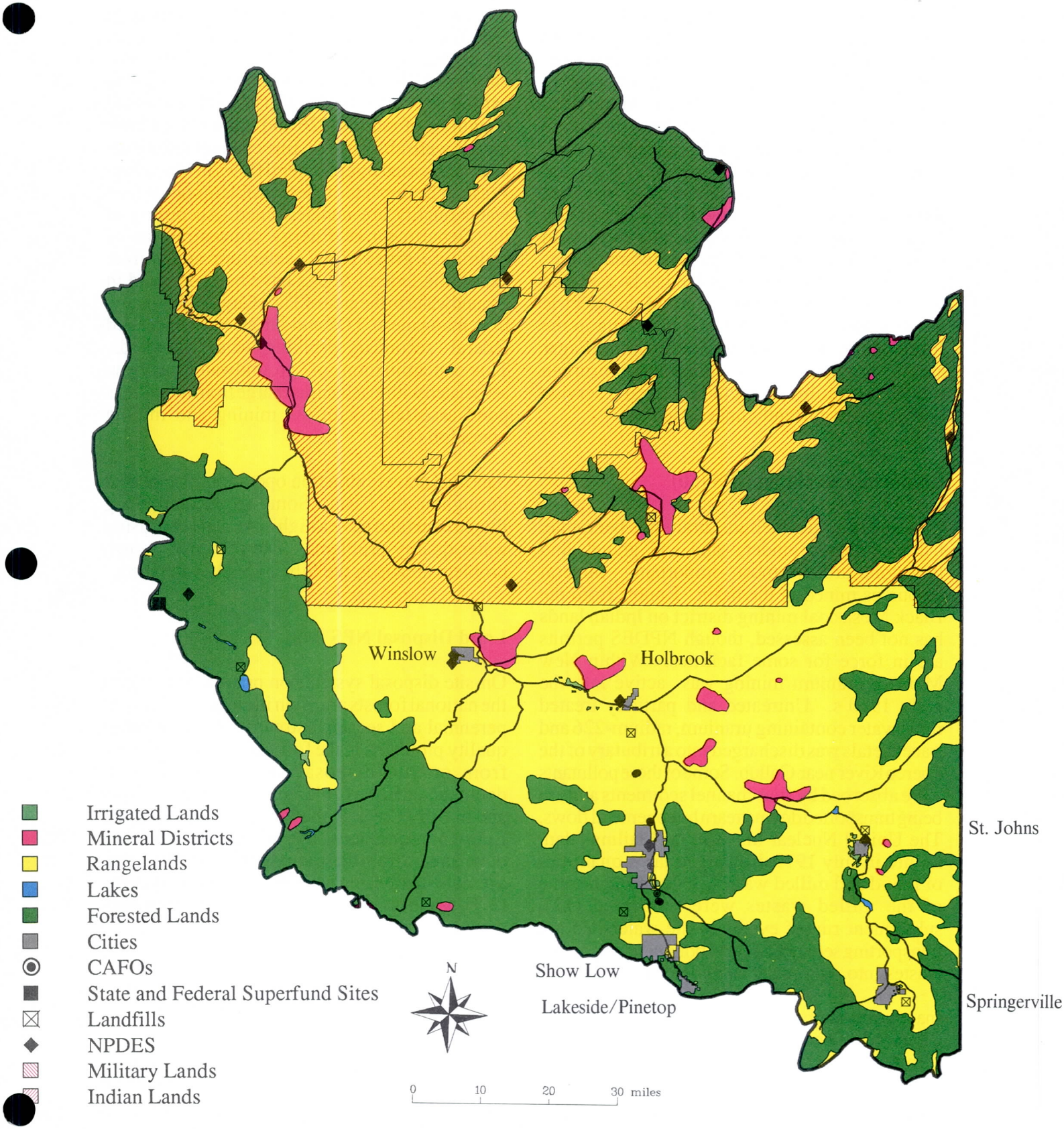

Figure III-5. Land use map of the Little Colorado Basin.

Urban Runoff NPS (40)

Lakes in the Show Low Creek watershed of the Pinetop-Lakeside area are surrounded by forested lands and urbanization and tend to be eutrophic. Urban runoff may be a contributing factor, along with forest runoff. Unincorporated communities within Navajo and Apache counties have experienced localized erosion from disturbed lands, primarily due to unpaved roads and private residences. These problems, while of localized severity, are not documented with water quality data. Because of the recent severe erosion in rangeland areas, unpaved roads and communities in erosion-prone rural areas need to be assessed for potential erosion problems. Major electric power generation facilities are operating in the Joseph City, St. Johns and Springerville-Eagar areas. Nonpoint source pollution from urban runoff and utilities, including their "service corridors", is currently unassessed.

Resource Extraction NPS (50)

Coal, natural gas, helium, uranium, bentonite, halite, volcanic cinder, sand and gravel, and limestone are the most important mineral resources mined in the basin. Runoff from the Black Mesa coal mining district on Indian lands has not been assessed, though NPDES permits are in force for some facilities. Within New Mexico, uranium mining was active into the early 1980's. Untreated and partially treated mine water containing uranium, radium-226 and trace metals was discharged into a tributary of the Puerco River near Gallup. Some of these pollutants were absorbed by fine channel sediments and are being transported downstream by ephemeral flows. The United Nuclear uranium mill tailings dam failure in July 1979 discharged large quantities of liquid and milled wastes. Even though some of the milled wastes were recovered (**12**), subsequent runoff events in the watershed are transporting sediment-bound pollutants and milled wastes into Arizona at an undetermined rate.

Inactive uranium mining along the Little Colorado River from Dinnebito Wash to Cedar Wash near Cameron is contributing trace metals and radioactivity. While in operation, the uranium mine and mill near Tuba City discharged approximately 13,000 gallons per day of tailings pond water to groundwater. Part of this seepage reached Moenkopi Wash, resulting in concentration increases of 9.5 and 26.6 pico-curies per liter for radium-226 and gross alpha particle activity, respectively (**9**). Undocumented quantities of radium-226 and unidentified trace metals were absorbed on fine channel sediments and transported by ephemeral flows in Moenkopi Wash. The impacts of these problems on surface water quality are undetermined. According to the Department of Energy concentrations of cadmium, gross alpha, selenium and nitrate exceeding federal MCLs have been detected in groundwater in the area of Tuba City. Additionally, iron, manganese, TDS and sulfate have exceeded federal secondary drinking water standards. This contamination of groundwater has been associated with leachate discharge from the tailings pond associated with the mining and milling operation (**18A**).

Sand and gravel extraction operations are located throughout the basin. Some are located along live streams and have a high potential for causing water quality problems. The principal known problem area is in the Silver Creek watershed.

Land Disposal NPS (60)

On-site disposal systems on private land within the national forests are often in close proximity to perennial and seasonal streams. Surface water quality problems in the form of elevated bacteria from on-site disposal systems have been documented in the Little Colorado River in Greer and in Billy Creek in the Pinetop-Lakeside area. Eutrophic conditions have been reported in lakes downstream from these areas and at Concho Lake, a remote subdivision with on-site disposal systems (**2,7**). Landfill impacts on surface waters within the basin are unknown.

Hydrologic and Habitat Modification NPS (70)

Habitat alterations in forest and mountain meadow areas of the Little Colorado Basin appear to be slow and not well documented. Unsatisfactory

stream bank and riparian vegetation conditions and channel erosion are impairing productivity and recreation in mountain stream fisheries (**13**). Though the cause of habitat degradation is not known conclusively, natural conditions, grazing or other causes may be responsible (**8**). Sand and gravel removal operations in Cottonwood Wash and its confluence area with Silver Creek have contributed to channel degradation, siltation, and riparian habitat modification (**1A**).

Although reservoirs, stock dams, stream diversions, and channelization occur in the basin, the impacts of these and other hydrologic modifications on waters of the Little Colorado Basin remain largely unassessed.

Other NPS (80)

One major spill in the basin in July, 1979 was caused by a mine and is discussed above in the resource extraction section. Highway maintenance accommodates sedimentation problems as discussed above. Volcanic cinder material is used on road surfaces for safety during icy periods and for other purposes. No surface water quality impairment has been documented due to cinder use for roads. Off road vehicles have impaired the productivity of mountain stream fisheries in Benton, Mineral, and Show Low creeks.

Little Colorado Basin References

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C. Middle Gila Basin

Description

The Middle Gila Basin, which covers approximately 12,152 square miles, is located in the south-central part of the State of Arizona (Figure III-6). The USGS cataloging units include: 15050100 downstream of the Ashurst-Hayden Dam, 15070101, 15070102, 15070103, 15070104, and the portion of 1506106 downstream of the Granite Reef Diversion Dam on the Salt River.

The Arizona Game and Fish Department (AG&FD) (1985) lists six lakes totaling 1,757 acres in the Basin (**8**). These do not include a growing number of urban lakes, some partially filled with sewage effluent, or the Painted Rock Reservoir which is designed solely for flood control. When full, Painted Rock Reservoir can contain more water than the six major reservoirs on the Salt and Verde rivers upstream from the Phoenix Metropolitan Area (**1**).

Much of the surface drainage in the Phoenix Metropolitan Area and in the valley bottom agricultural lands has been altered. Runoff from the Gila River and its major tributaries, the Salt, the Verde, and the Agua Fria rivers, have been dammed and channelized. The Gila River drains the entire basin from the Ashurst-Hayden Dam to the Painted Rock Borrow Pit below Painted Rock Reservoir. Because water is diverted in the upstream basins for agricultural and urban uses, the Gila River and most of the tributaries within the Middle Gila Basin are dry. The basin receives limited rainfall and the majority of the surface flow in this basin is attributable to releases from upstream impoundments, discharges from public wastewater treatment plants or agricultural return flows. Occasionally, locally severe storms will produce surface flow in the form of urban runoff.

Natural vegetation for most of this drainage basin is Sonoran Desert scrub and desert grassland. The Arizona sediment yield map indicates a range of erosion potential from negligible to moderate (less than 0.2 to 1.0 acre feet per sq. mile of sediment yield) (**18**).

Surface Water Quality

The EPA Reach File lists about 1,588.0 miles of stream segments within the Middle Gila Basin. The NPS assessment evaluated about 504.5 miles for NPS pollution as shown in Table III-4. Protected uses were supported in these assessed reaches as follows: 368.6 miles, partial support; and 135.9 miles had nonsupport of uses.

Below Coolidge Dam to the confluence of the Gila and Salt rivers, monitored and evaluated data indicate the primary water quality violations are for sediment/turbidity, fecal bacteria, and metals. Total dissolved solids are at moderate to high levels and high nutrient values (NO_3 and PO_4) occur. Unknown, natural, mining, irrigated agriculture, grazing and recreation are the apparent NPS categories contributing to this pollution.

The Salt and Middle Gila rivers, adjacent to the Phoenix urban area and downstream to the Painted Rock Dam, have some of the most severely polluted surface waters in the State from the standpoint of the number of affected water quality parameters. Bacterial, DO, nutrients, turbidity, metals, and pesticide violations are common. Urban runoff, irrigated agriculture, land disposal, hydrologic/habitat modification, and unknown sources contribute to these violations.

Based on monitored and evaluated water quality information, the conclusion is that historic land use along the Lower Salt and Middle Gila rivers, coupled with the hydrologic changes to the rivers upstream and downstream of the Phoenix urban area, have created severe environmental quality and potential public health problems.

Human exposure to the persistent organochlorine compounds continues to occur in spite of the fact that the Painted Rock Borrow Pit is posted against eating fish (**1**). Field surveys by the ADEQ reveal that turtles and fish are continually harvested for human consumption in spite of the posting. The Arizona Game and Fish Department will include an advisory against consuming fish from both the Borrow Pit and the Lower Gila River in their 1988 fishing pamphlet.

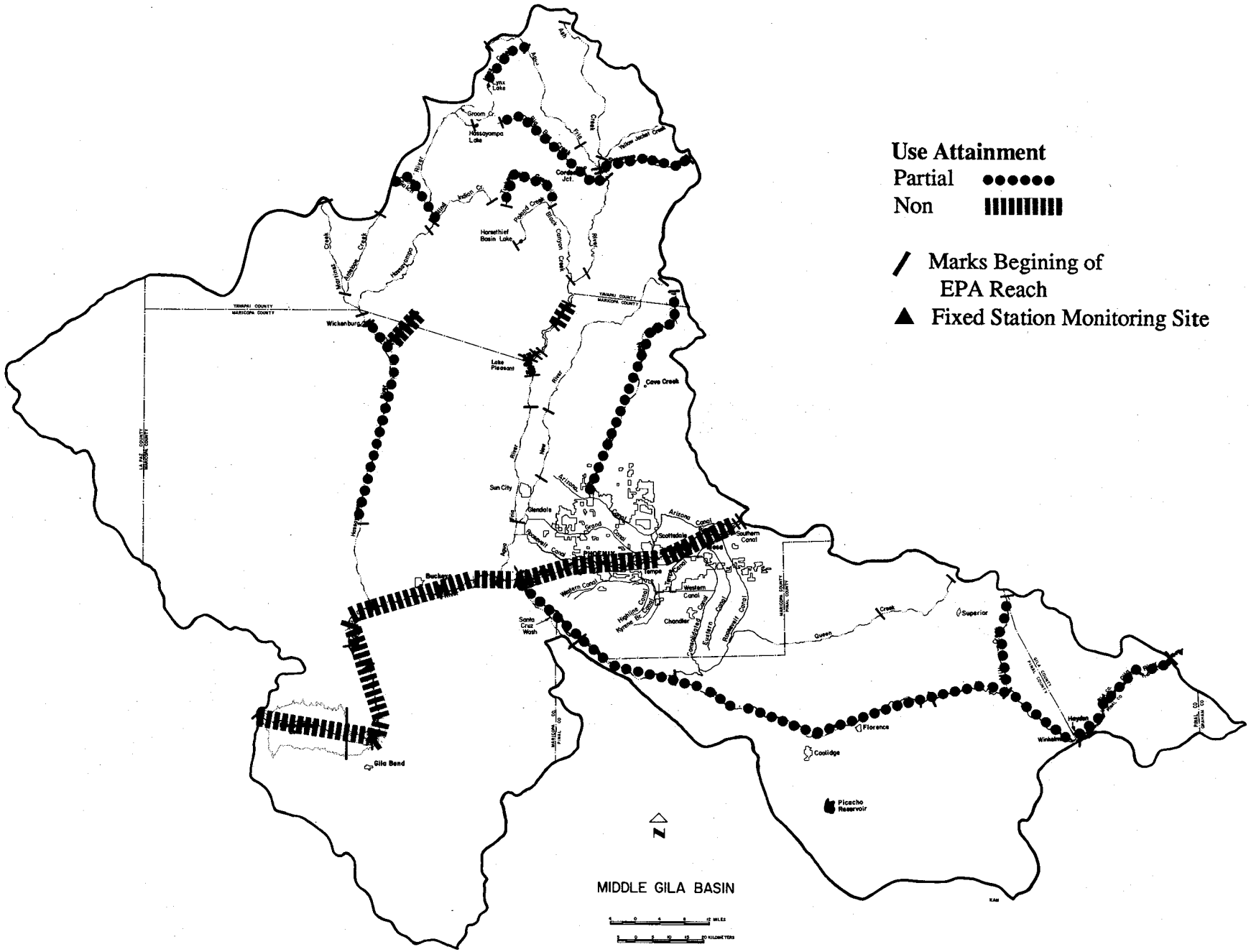

Figure III-6. Map of the Middle Gila Basin.

TABLE III-4. MIDDLE GILA RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15050100-010	Gila R. (Coolidge Dam)	F A L						16.4		DO, TURBIDITY (5)(4) METALS BACTERIA (1)	UNKNOWN (5)	PARTIAL SUPPORT OF USE (1) BELOW COOLIDGE DAM, DO AND TURBIDITY VIOLATIONS (3)(5) USE OF GILA BELOW COOLIDGE DAM IMPAIRED FOR ANY USE USE BY LARGE SEDIMENT SEDIMENT LOADS (1)
15050100-009	Gila R.	F A I L		10.6						METALS BACTERIA (1) Cu [STB-21] TDS NO3, PO4 Hg	UNKNOWN (5)	PARTIAL SUPPORT OF USES (1) BELOW DRIPPING SPRINGS WASH Cu IS A PROBLEM (5) [STB-21] TDS RANGE 471 TO 861 MG/L
15050100-008	Gila R. (San Pedro Confluence)	F A I L						18.2		TURBIDITY (5) (1) METALS BACTERIA PHENOLS TDS (6)	UNKNOWN (5)(1) MINING (1) NATURAL (6) IRR. AG. (6)	NOTE 1. 1976 VIOLATIONS (5) PARTIAL SUPPORT OF USE (1) 1964 TO 1966, TDS 380 MG/L TO 4300 MG/L, AVERAGE 900 MG/L (6)
15050100-007	Gila R. (near Kelvin)	F A I L						14.3		TURBIDITY (5) (1) METALS BACTERIA PHENOLS TDS (6)	UNKNOWN (5)(1) MINING (1) NATURAL (6) IRR. AG. (6)	[NOTE 1]
15050100-012	Mineral C. (or Milky Wash)	A I						17.3		SEDIMENT/ TURBIDITY (17)	UNKNOWN GRAZING RECREATION (17)	UNSATISFACTORY WATERSHED CONDITION DUE TO UNKNOWN CAUSES, GRAZING AND ORV'S (17).
15050100-005	Gila R.	F A I L						2.0		TURBIDITY (5) (1) METALS BACTERIA PHENOLS TDS (6)	UNKNOWN (5)(1) MINING (1) NATURAL (6) IRR. AG. (6)	1976 VIOLATIONS (5) PARTIAL SUPPORT OF USE (1) 1964 TO 1966, TDS 380 MG/L TO 4300 MG/L, AVERAGE 900 MG/L (6)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION OF HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-4 (cont.). MIDDLE GILA RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15050100-003	Gila R. (Ashurst-Hayden Dam)	H A						49.5		TURBIDITY (5) (1) METALS BACTERIA PHENOLS TDS (6)	IRR. AG. URBAN RUNOFF	[NOTE 1] 1976 VIOLATIONS (5) PARTIAL SUPPORT OF USE (1) 1964 TO 1966, TDS 380 MG/L TO 4300 MG/L, AVERAGE 900 MG/L (6)
15050100-002	Gila R.	H A						23.7		TURBIDITY (5) (1) METALS BACTERIA PHENOLS TDS (6)	IRR. AG. URBAN RUNOFF	
15050100-001	Gila R.	H A						13.0		Pb	UNKNOWN	LARGE AMOUNTS OF Pb FROM SANTA CRUZ, POOR Pb COMPLIANCE (4)
15060106-026	Cave C.	H A I L		70.1						[STC] Hg	UNKNOWN	
15060106-001	Salt R.	H A I L							41.9	ORGANICS (2) BACTERIA DO, pH (1)	UNKNOWN (2) URBAN RUNOFF LAND DISPOSAL	NONSUPPORT OF USE, 23RD AVE. TO GILA R. (1)(2) GROUNDWATER CONTAMINATION (2)
15070101-015	Gila R. (Salt R. confluence)	H A I L E							3.6	BACTERIA DO, pH (1)	URBAN RUNOFF LAND DISPOSAL	NONSUPPORT OF USES (1)
15070102	Agua Fria (USFS 5th Code Watershed No. 98)	F A I L								SEDIMENT/ TURBIDITY (16)	SILVICULTURE GRAZING (16)	WATERSHED #98, TOTAL 225,808 ACRES, 75,941 ACRES UNSATISFACTORY CONDITION (12)
15070102-036	Turkey C.	A I L						18.0		[STA-14] DO Cu BACTERIA	UNKNOWN	
15070102-037	Poland Tunnel	F A I L						8.0		[STC] Cd	UNKNOWN	

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION OF HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-4 (cont.). MIDDLE GILA RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15070102-034	Big Bug C.	H A I L						27.5		METALS (12)	MINING (12)	HIGH METALS CONCENTRATION RELATED TO MINING ACTIVITY (12)
15070102-024	Sycamore C.	F A I L						15.7		[STA-24] Cu, DO BACTERIA	UNKNOWN	
15070102-033	Lynx C.	D F C I L		15.4						METALS, pH (1) [STA-23] TURBIDITY pH, Cu BACTERIA [STC] TURBIDITY Cu, Zn, pH	MINING (1)	NONSUPPORT OF USES (1) ABANDONED MINES IN BASIN CONTRIBUTE TO DOCUMENTED WATER POLLUTION (12)
15070102-017	Agua Fria (Rock Springs)	F A I L			5.5					[STB-31] TURBIDITY NO3, PO4 Hg, Mn [STC] TURBIDITY Hg Bacteria	UNKNOWN	
15070102-009	Agua Fria R. (below Waddell Dam)	A I		4.4						[STA-5] PO4 [STB-16] As TURBIDITY NO3, PO4	UNKNOWN	
15070101-014	Gila R.	H A I L E							12.2	BACTERIA DO, pH (2) METALS (1)	URBAN RUNOFF LAND DISPOSAL UNKNOWN	NOTE 2. NONSUPPORT SALT R., 23RD AVE DOWNSTREAM TO 10 MILES BELOW PAINTED ROCK DAM (2)
15070101-010	Gila R.	H A I L E							12.4	BACTERIA DO, pH (2) METALS (1)	URBAN RUNOFF LAND DISPOSAL UNKNOWN	[NOTE 2]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION OF HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
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(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-4 (cont.). MIDDLE GILA RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15070103-	Hassayampa R. (USFS 5th Code Watershed No 99)	H A I L								SEDIMENT/ TURBIDITY (16)	SILVICULTURE GRAZING (16)	WATERSHED #99, TOTAL 122,661 ACRES, 38,435 ACRES UNSATISFACTORY CONDITION (12). SEDIMENTS REDUCE RESERVOIR CAPACITY, LIMIT FISHERY POTENTIAL, REDUCE RECREATION ATTRACTIVENESS (16)
15070103-	French Gulch	H A I L					5.0			Cu	MINING	NUMEROUS WQ VIOLATIONS (2)
15070103-	Monarch Wash	A I L			6.0					[STC] pH, TURBIDITY Cd, Hg, As Pb, Mn, Se	HYDROLOGIC/ HABITAT MOD. MINING	SAND AND GRAVEL MINING OPERATION COMPLAINT INVESTIGATIONS (ADEQ)
15070103-002	Hassayampa R.	H A I L		39.5						[STC] pH	UNKNOWN	
15070101-009	Gila R.	H A I L E							0.6	BACTERIA DO, pH (2) METALS (1)	URBAN RUNOFF LAND DISPOSAL UNKNOWN	[NOTE 2]
15070101-014	Gila R. (Buckeye vicinity)	H A I L							9.9	BACTERIA DO, pH (2) METALS (1) BORON (3) DDT METABOLITES (2)	URBAN RUNOFF LAND DISPOSAL UNKNOWN (2)	[NOTE 2] BORON VIOLATIONS POTENTIALLY INJURIOUS TO CITRUS (3) (3) DDT METABOLITES BUCKEYE TO PAINTED ROCK DAM (2)
15070101-007	Gila R. (Gillespie Dam)	H A I L E			5.9					BACTERIA DO, pH (2) METALS (1) BORON (3) DDT METABOLITES (2) ALPHA RADIATION (2) [STB-31] pH TURBIDITY NO3, PO4 DO, NH3, Hg BACTERIA RADIATION [STC] TURBIDITY	HYDROLOGIC MOD. URBAN RUNOFF LAND DISPOSAL IRR. AG.	[NOTE 2] BORON VIOLATIONS (3) DDT METABOLITES TO PAINTED ROCK(2) ALPHA RADIATION 160 PC ABOVE GILLESPIE DAM [STB-31] TDS RANGE 342-2880 MG/L

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION OF HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-4 (cont.). MIDDLE GILA RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15070101-005	Gila R.	H A I L							13.5	BACTERIA DO, pH DDT METABOLITES (2)	HYDROLOGIC MOD. URBAN RUNOFF LAND DISPOSAL IRR. AG.	[NOTE 2]
15070101-003	Gila R.	H A I							5.2	BACTERIA DO, pH DDT METABOLITES (2)	HYDROLOGIC MOD. URBAN RUNOFF LAND DISPOSAL IRR. AG.	[NOTE 2]
15070101-001	Gila R. (Painted Rock Dam)	H A I			19.2					BACTERIA DO, pH DDT METABOLITES (2) [STB-26] DO TURBIDITY NO3, PO4, NH3 BACTERIA	HYDROLOGIC MOD. URBAN RUNOFF LAND DISPOSAL IRR. AG.	[NOTE 2] [STB-26] SITE IS GILA R. CHANNEL BELOW PAINTED ROCK DAM AND BORROW PIT RECREATION AREA.

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION OF HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

In correspondences to the ADEQ, the USFWS reported that: "USFWS studies have detected elevated concentrations of toxaphene and DDT metabolites, i.e. DDE, in biota and sediment samples from the Salt/Gila confluence to Painted Rock Borrow Pit. Values for organochlorine pesticides decrease significantly below the Borrow Pit and frequently diminish to non-detect levels. DDE concentrations in starlings from the Gila River at Goodyear are the highest reported out of 129 stations nationwide (USFWS, National Contaminant Biomonitoring Program, Starling Network). Fish within the same area are 115 times greater than the DDE national-baseline value (Ibid, Freshwater Fish Network). Additionally, samples collected by USFWS for other cooperators (U.S. Environmental Protection Agency and U.S. Army Corps of Engineers) have detected heavy metals, volatile organic compounds and semi-volatile organic compounds in fish and bottom sediment. Samples collected for the Environmental Protection Agency for the National Fish Bioaccumulation Study recently detected dibenzo-p-dioxins and dibenzofurans in fish in addition to the aforementioned contaminants. We believe that this represents the first documented dioxin and furan detections in fish for Arizona."

In December 1988, ADEQ addressed the preponderance of all contaminant types in the Lower Gila River watershed and listed the area between its confluence with the Salt River downstream to and including Painted Rock Borrow Pit under State Superfund (Water Quality Assurance Revolving Fund).

Sources of organochlorine pesticide residues are attributed to precancellation applications in the Goodyear/Litchfield area. Chlorinated hydrocarbons sorb to fine sediments which are conveyed to the river via irrigated agricultural practices. The highest organochlorine values in sediment and biota samples were detected in wastewater irrigation canals, i.e. Buckeye Canal, and at the two impoundments located on the lower river, i.e. Gillespie and Painted Rock dams. The settling of pesticide-laden sediment on-site at each of the impoundments creates "contaminant sinks," thus maintaining a continual contaminated exposure to resident wildlife and humans which inhabit the area" **(20A).**

Mining is a documented cause of NPS pollution in the Hassayampa River area (Yavapai County), which is a tributary to the Middle Gila River. The primary products extracted are sand and gravel, copper, silver and gold. The most prevalant water quality violations associated with these operations are turbidity, pH, metals, sulfate and TDS **(1,3A,12)**.

In the Agua Fria River drainage, high sediment/ turbidity levels occur from suspected silvicultural and grazing sources. High nutrient levels have been monitored as well as metals and fecal bacteria violations.

Groundwater Quality

The groundwater basins associated with the Middle Gila Basin are comprised of the Phoenix AMA core with surrounding groundwater basins. The Phoenix AMA is highly urbanized and groundwater contamination consists primarily of volatile organic chemicals (VOCs), benzene-toluene-xylene (BTX), heavy metals, and pesticides as shown in Table III-5. Figure III-7 shows the general areas of groundwater contamination in Phoenix and adjacent areas. Part of the Prescott AMA is also found in this basin.

The Phoenix AMA is situated in the Basin and Range Lowlands province. Four water bearing stratigraphic units are recognized. The Upper Unit, 0-300 feet thick, consist mostly of unconsolidated gravel, sand and silt deposits which underlie the surface of the basin. The Middle Unit, 0-1200 feet thick, is the principal water-bearing unit in the basin. The Lower Unit makes up the largest volume of sedimentary deposits and is possibly as thick as 10,00 feet in the center of the basin. Finally, the oldest Red Unit consists mostly of well-cemented red beds that contain usable quantities of water in some areas.

High levels of nitrate, sulfate, and TDS occur in groundwater of the West Salt River valley

subbasin along the Gila River, and near the Palo Verde nuclear generating station. Pesticides and VOCs are found in groundwater near landfills along the Salt and Gila rivers.

The groundwater beneath the partially urbanized East Salt River valley subbasin has experienced contamination from natural and human-caused sources. The TDS levels are highest in the Mesa, Gilbert, and Chandler areas where aquifers underlie present and/or past agricultural activities. Similarly, nitrates are high in the Chandler and Gilbert areas. The VOCs in this subbasin are concentrated in the Mesa and Tempe industrial areas. Pesticides, primarily DBCP, have been detected in groundwater near Mesa and Gilbert.

In the East Salt River subbasins, metal exceedences are due to landfills and industrial waste disposal sites, however, hexavalent chromium the groundwater beneath Paradise Valley is attributed to natural geochemical conditions induced by silicate hydrolysis and oxidation of the less toxic trivalent species (**13**).

Groundwater contamination in the southern portion of the Hassayampa subbasin is due to TDS, nitrate, sulfate, metals, and VOCs associated with the Hassayampa landfill and agricultural activity. Contaminants are sometimes found to be concentrated in perched groundwater conditions. Concentrations of boron, cadmium, and chromium occur in perched zones (**6**).

The Rainbow Valley subbasin is experiencing increasing urbanization and deterioration of groundwater quality. The TDS and sulfate concentrations are elevated in the northern portion of the subbasin (**6**).

The Fountain Hills, Lake Pleasant, and Carefree subbasins are relatively undeveloped, and levels of contaminants are below standards. Natural contamination by radionuclides, floride and arsenic is present in these subbasins (**13A**).

Groundwater contamination documentation within the Middle Gila Basin predates recognition of even the surface water problems. The U.S. Army Corps of Engineers in conjunction with the Maricopa Association of Governments reported in the 1978 Urban Study that the major impacts from nonpoint pollution sources were to groundwater (**6**). Sources were grouped to include urban, industrial, agricultural, and hydrologic modifications. Urban sources identified included exfiltration from municipal sewage collection facilities, septic tank leachate in outlying unsewered communities, and in the eastern portion of the Basin (especially Apache Junction), storm water runoff. In much of the Phoenix Metropolitan Area, storm water runoff is disposed into settling basins, dry wells, and irrigation canals rather than storm sewers. Agricultural sources include animal feeding operations and irrigated agriculture. Hydrologic modifications include placement of canals, well construction, altered groundwater flow directions and imported water.

Since 1980, the Phoenix Metropolitan Area has been the focus of major efforts within the State to monitor groundwater quality. Graf presents a comprehensive survey of the volatile organic chemicals VOC's in Arizona's groundwater. Of the thirty sites listed in Arizona, twenty one of them are within the Phoenix Metropolitan Area (**9**). The Corps of Engineers/Maricopa Association of Governments reports from the 1975 through 1980 time frame are prophetic as three of the Phoenix sites involve airport industries, nine other sites are associated with industrial land use, seven sites are associated with landfills, and two sites of contamination involve industrial solvents and agricultural fumigants (**19**). Table III-5 presents information on groundwater contamination in the Phoenix AMA groundwater basins. Many of the sites mentioned above have been designated or proposed as Superfund sites or investigated using State funds or funds from other federal programs.

In 1979, the Maricopa Association of Governments (MAG) published an inventory of potential sources of groundwater pollution in Maricopa County (**10**). In the discussion of groundwater quality in the West Salt River basin, this report notes the impact of the Phoenix 91st Avenue sewage treatment facility sludge drying beds, treated wastewater discharge and pumpage for both agriculture and urban uses. In some areas, increases in salinity and nitrates are associated with agriculture and sewage effluent. In areas

TABLE III-5. PHOENIX AMA (GROUNDWATER ASSESSMENT)

SUBBASIN	SITE	LOCATION	PARAMETERS	SOURCE	COMMENTS
West Salt R.	19th Avenue Landfill	Phoenix	VOCs Pesticides Metals	Land Disposal	Contaminants have migrated off-site. (ADHS, 1986) Federal Superfund site (CERCLA)
West Salt R.	Phoenix-Goodyear Airport	Goodyear	VOCs (TCE) Chromium	Land Disposal	TCE concentrations in groundwater range from 5 to 7900 ug/l. Federal Superfund site (CERCLA)
West Salt R.	Luke Air Force Base	North of Litchfield Park	VOCs BTX	Land Disposal	Federal Superfund site. (RCRA)
West Salt R.	Horizon Investments	Buckeye	Chlorinated solvents Non-chlorinated solvents Metals Petroleum distillates	Land Disposal	Contaminants from leaking drums introduced to drainage ditches and soil in area where groundwater is near surface (3 to 4 feet). State of Arizona WQARF site.
West Salt R.	West-Central Phoenix	Phoenix	VOCs (esp. TCE)	Land Disposal	Two wells closed. Search for responsible party and remedial investigation underway. State of Arizona WQARF site (proposed priority listing).
West Salt R.	Van Buren Tank Farm (Fowler Industries)	Phoenix	VOCs BTX	Land Disposal	VOCs and BTX some of the highest concentrations recorded. 4 1/2 mile long plume. State of Arizona WQARF site.
West Salt R.	East Lake Park	Phoenix (N. Thomas Rd and 48th St.)	VOCs BTX Metals	Land Disposal	Site of past landfill, 3 mile long plume. Over 600 firms could be possible responsible parties. State of Arizona WQARF site.
West Salt R. and East Salt R.	Arcadia Area	East Central Phoenix	VOCs (TCA, TCA, PCA)		Generally low concentrations of VOCs in area of widely scattered Salt River Project (SRP) wells. State of Arizona WQARF site.
West Salt R.	Maryvale	Maryvale	VOCs (TCE, PCA)	Unknown	Principle responsible parties (PRPs) and sources unknown. Study underway.
West Salt R.	Bradley-Estes Landfill	Phoenix	VOCs BTX Metals	Land Disposal	Severe contamination and off-site migration of VOCs, BTX and heavy metals. Monitoring underway.

TABLE III-5 (cont.). PHOENIX AMA (GROUNDWATER ASSESSMENT)

SUBBASIN	SITE	LOCATION	PARAMETERS	SOURCE	COMMENTS
Hassayampa	Hassayampa Landfill	Hassayampa	VOCs	Land Disposal	Hazardous waste dumped in unlined trenches. Federal Suprefund site (CERCLA) State of Arizona WQARF site. 85 PRPs have offered to conduct remedial investigation. Superfund Federal Superfund site (CERCLA)
East Salt R.	Indian Bend Wash	Scottsdale	VOCs (esp. TCE)	Land Disposal	VOCs to 1100 feet. PRPs local industry electronics firms. Groundwater modeling underway. Federal Superfund site (CERCLA).
East Salt R.	Motorola 52nd St.	Phoenix	VOCs	Land Disposal	Sources are high tech industries. Pilot treatment plant planned, groundwater monitoring and plume delineation underway. Federal Superfund site (CERCLA)
East Salt R.	City of Mesa	Mesa	DBCP	Agriculture	Four wells are known contaminated. Proposed granular activated carbon treatment. State of Arizona WQARF site. (Proposed priority listing).
East Salt R.	South Mesa	Mesa	VOCs (TCE, PCE, TCA)	Unknown	Two SRP wells contaminated. Remedial investigation underway. State of Arizona WQARF site (proposed priority listing).
East Salt R.	Falcon Field	Mesa	VOCs (esp. TCE)	Unknown	One irrigation well confirmed contaminated. State of Arizona WQARF site.
East Salt R.	Chandler-Gilbert Area	Dodson/Gilbert Germann/Guadalupe Roads	VOCs (TCE, PCE) Nitrate DBCP	Land Disposal Agriculture	Specific point sources unknown.
East Salt R.	Intel Corp.	Rural Road/ Chandler Blvd.	VOCs (TCE, DCA) Freon	Land Disposal	Source is an industrial spill.
East Salt R.	Chandler Heights	Power Road/ Hunt Highway	DBCP	Agriculture	Two wells closed due to contamination.

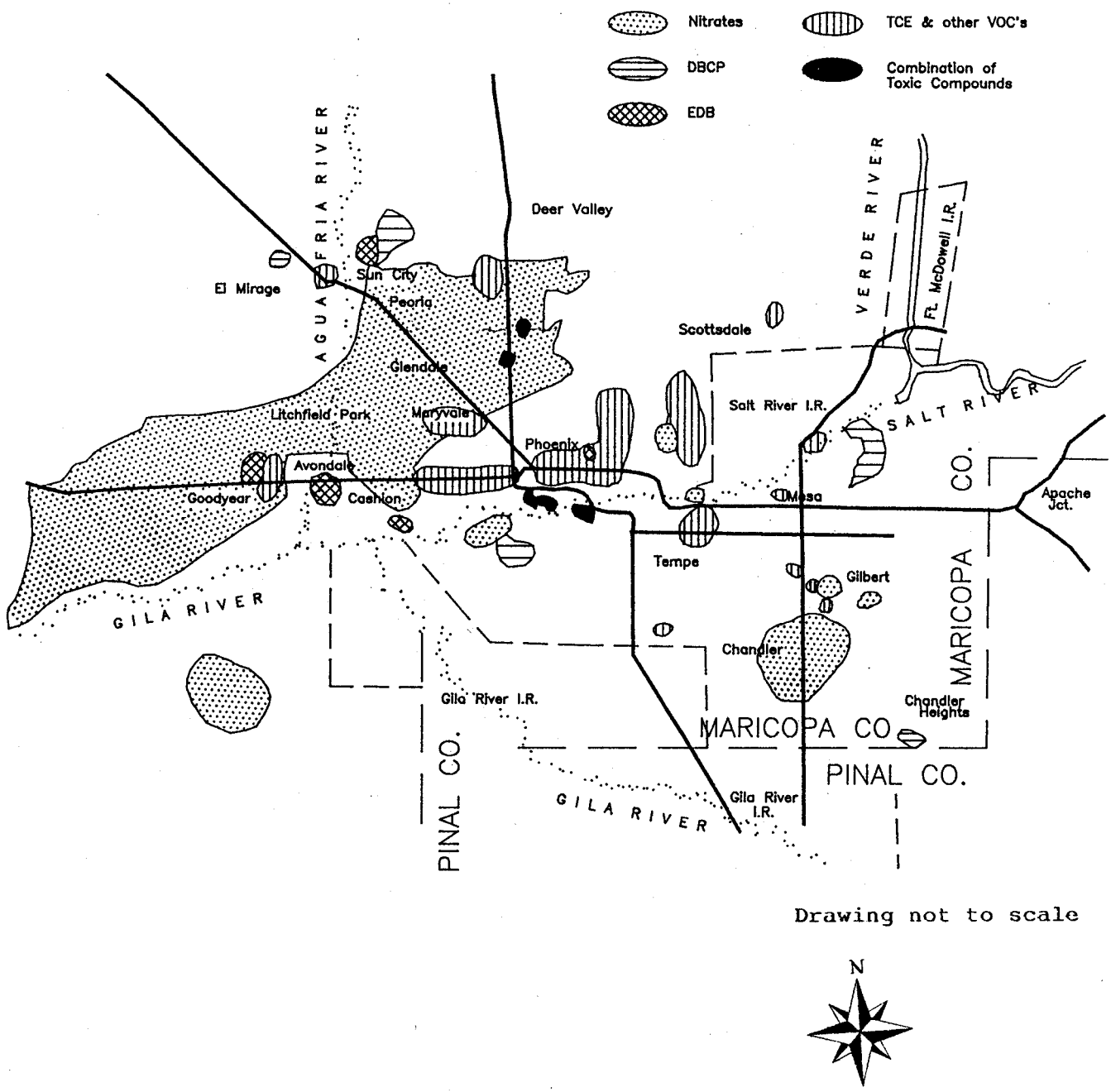

Figure III-7. Map of the groundwater contamination in the Phoenix area.

like Buckeye, where groundwaters exhibit concentrations of TDS above 1,000 mg/liter, recharging sewage effluent improves the groundwater quality for this parameter. High salinity concentrations in the groundwater along the major river channels can migrate in the direction of heavy pumpage away from the river (**10**). This has apparently occurred in the Goodyear, Liberty area. Most of the west side of the Salt River Valley that has been under cultivation exhibits nitrate concentrations in groundwater that approach or exceed drinking water standards (**10**).

The MAG report identifies potential sources of groundwater pollution as well as indications of groundwater quality problems in the Lower Harquahala Valley and the Lower Hassayampa area. In both cases, the quality of groundwater in perched zones is poor when compared to the water quality of the principal aquifers in these regions. The hypothesis proposed is that the higher salinity and nitrate content of the perched zones reflect the origin of that water as percolation from irrigated agriculture (**10**). Comprehensive groundwater surveys have not been carried out by water quality management agencies in the other valleys of the Middle Gila Basin where groundwater quality problems might be anticipated. However, sources such as irrigated agriculture, landfills, and confined animal feeding operations can be found along the Gila River near Casa Grande, along the Gila River near Gila Bend in McMullen, and near Aguila.

Land Use

The Middle Gila Basin has historically supported agricultural land use and an agricultural economy. Construction of Roosevelt Dam in 1911 and other impoundments on the Gila, Salt, and Verde rivers insured a dependable water supply for agricultural development. This development proceeded at first using the same water distribution system originally developed by the Hohokam Indians. During the last three decades, urban land uses have replaced and displaced agriculture. Active irrigation districts are losing cropland to subdivisions as areas in South and West Phoenix, Glendale, Sun City, Peoria, Tempe, Mesa, Gilbert, and Chandler urbanize. Because of the 1970 groundwater code and the continuing urbanization, new agricultural development is essentially limited to the Indian reservations north and south of the metropolitan area.

As of 1985, Maricopa County was the twenty-second largest urban market in the United States. By the year 2000, the county will have grown to the twelfth largest. The economic base of the Phoenix Metropolitan Area reflects a focus upon high technology manufacturing, regional and or national administrative services and recreation/ tourism. Growth in all three sectors is projected to continue at a rate that exceeds the national average (**11**).

The outlying portions of the Middle Gila Basin, especially cataloguing units 15070101, 15070103 and 15070104, currently exhibit rural land uses. Agriculture, including cropland irrigation, animal feeding operations, and grazing, are and will remain dominant land uses in these units. The northern half of the Agua Fria River sub-basin includes in its drainage portions of the Prescott National Forest. Silviculture, grazing, and watershed management for water production are the principal land uses in this area. Historically, mining has been important in this part of the Middle Gila Basin. The generalized land use map for the basin is shown in Figure III-8.

Agricultural NPS (10)

Agricultural activities within the basin impact groundwater, surface waters and riparian environments associated with surface waters. In most of the Basin and Range province, alluvial groundwater exhibits background nitrate concentrations below 5 mg/l. Nitrate concentrations in groundwater range between 30 to 70 mg/l NO_3 as NO_3 in broad areas of the Phoenix Metropolitan Area. These high nitrate concentrations correlate spatially with the distribution of current and historic irrigated agriculture and current distribution of highest population densities in the State. In the Lower Hassayampa Valley and in limited areas in the Harquahala Valley, perched water exhibiting high nitrates and high TDS concentrations has been attributed to percolation from irrigated agriculture (**10**).

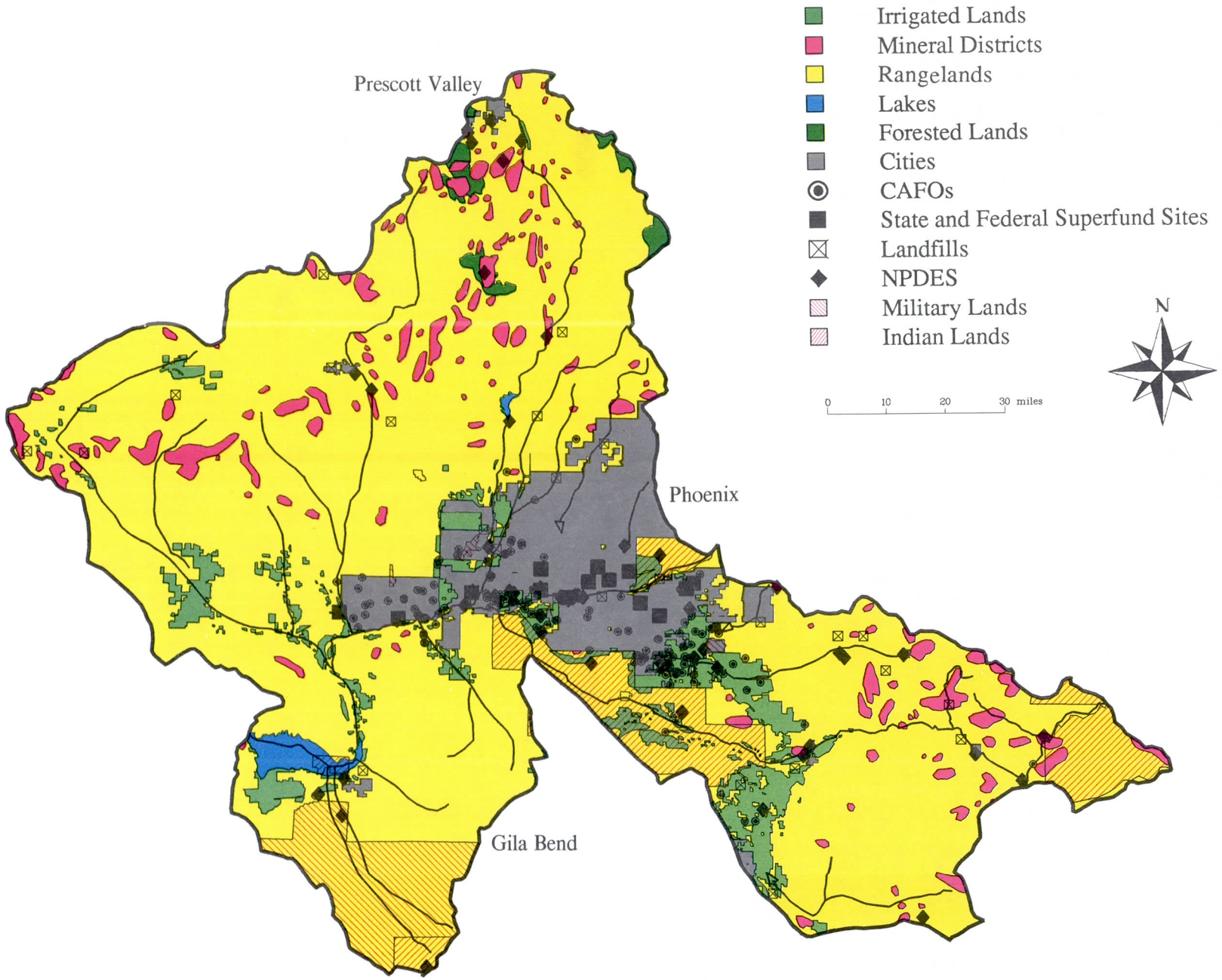

Figure III-8. Land use map of the Middle Gila Basin.

Persistent organochlorine pesticides from agricultural activities have impacted surface water and riparian habitats. There are evidently organochlorine contaminated soil residuals throughout the basin. Residual organochlorine pesticides from the State mandated pink bollworm eradication program have slowly accumulated behind the Gillespie and Painted Rock dams. Pesticide accumulation in sediments and bioaccumulation in faunal populations has resulted in contaminant levels in fish, bird, and other wildlife tissue samples that are among the highest found anywhere in the United States. The USFWS has referred their data on pesticide contamination in Gila River riparian environment to Ecology and Environment, Inc., the contractor performing identification and evaluation of potential Superfund sites for the EPA (**20**). Determining the exact relationship within the Middle Gila Basin between the sources and sinks for organochlorine pesticide residuals has been proposed as a major investigation effort by the ADEQ in future years. In addition, the pesticides EDB and DBCP have been detected in groundwater in the Mesa, Surprise, Chandler and Buckeye areas.

Grazing and animal feeding operations are common within the basin. Grazing is relegated to those portions of the basin that do not support urban land uses or irrigated agriculture. Information on surface or groundwater pollution associated with grazing activity is limited in this basin.

Confined animal feeding operations are located around the periphery of the Phoenix Metropolitan Area in regions that have traditionally supported agricultural land uses. Historically, these operations occupied a rural setting. Urban expansion has transformed many of their locations to the metropolitan fringe. Large feeding operations are also found south of the Gila Indian Reservation near Maricopa, west of the metropolitan area near Buckeye, in the southern Hassayampa drainage, and along the Gila Valley west of the confluence of the Salt and Gila Rivers. Recent data from the Phoenix Active Management Area has revealed high nitrate concentrations in groundwater associated with many of these operations. Groundwater nitrate concentrations in areas where animal feeding operations have historically operated range from 70 to 210 mg/l NO_3 as NO_3.

Dairies exhibit a distributional pattern limited to the urban fringe. The expansion of urban development to previously agricultural areas has resulted in many dairies being located proximal to residential developments. Groundwater quality in the vicinity of many dairies exhibits nitrate concentrations similar to those associated with feedlots.

Urban Areas, Construction, and Military NPS (30/40)

The Phoenix urban area contributes significantly to both surface and groundwater pollution within this basin. Urban runoff is disposed of by discharges to both surface and groundwater. Some of the metropolitan region is drained by storm sewers which eventually discharge into the Salt River. In the vicinity of the Salt River Project canals, some storm drains discharge directly into the canals. In other areas, storm drains discharge into drainage canals which then discharge to the Salt River. Disposal to groundwaters usually occurs through a drainage or dry well, however, percolation basins and basin dry well combinations are common (**14**).

Limited study of urban watersheds in the Phoenix area indicates that the quality of the City's urban runoff does not significantly differ from what has been discovered throughout the country in EPA's urban runoff studies (**15**). Given the mix of land uses, the Phoenix runoff quality is very similar to that in Sacramento, California, one of EPA's test sites. Important constituents include bacteria (all biologicals), metals (cadmium), volatile organic compounds, petroleum components, and sediment (silt and sand).

Because of the intermittent and variable nature of our rainfall and runoff, metals and some organic compounds have the largest impact upon surface waters. Eventually, these persistent contaminants may be suspended in runoff, transported some distance, deposited in the channel, and re-entrained during subsequent heavier storms. These persistent contaminants are concentrated and deposited in the sediments behind the Painted Rock Reservoir.

A limited number of investigations concerning the impact of urban runoff upon groundwater

have failed to conclusively demonstrate that groundwater quality is significantly impacted. In spite of that fact, urban runoff disposal by dry wells and percolation basins provide direct access to the vadose zone for localized chemical spills and releases and clandestine illegal disposal of liquid wastes. Several of the localized episodes of groundwater contamination listed in Table III-5 originated as spills that gained access to the aquifer through dry wells.

Construction and its associated runoff is a problem in the Middle Gila Basin as a result of the growth and expansion of the Phoenix Metropolitan Area. Sediment from construction sites presents physical problems to both natural and engineered channels and seriously impacts water quality and aquatic habitats. Significant portions of the chemical load associated with urban runoff are absorbed or adsorbed by sediments. Runoff from construction sites where farmland is being converted to urban uses is postulated as one mechanism whereby persistent chlorinated hydrocarbon pesticides absorbed/adsorbed to soil particles are re-entrained and transported to the riparian environment of the Gila River. Aggressive local control of construction related runoff would also contribute to the management of air quality particulate problems.

United States military facilities at Luke Air Force Base and Williams Air Force Base have both contributed to localized groundwater contamination. Typically the problems involved organic chemicals leaking from underground tanks and pipes, pits, lagoons, and other disposal sites such as fire training pits. These federal facilities are being evaluated through the remedial pollution management programs associated with the Resource Conservation Recovery Act (RCRA) and the Federal Superfund Program. No evaluation has been made to date of the impact of runoff from these facilities to surface or groundwater.

Resource Extraction NPS (50)

Two types of mineral production activities contribute to water quality problems within the basin. Sand and gravel operations are the largest source of sediment load and are supported by construction activities related to urban growth. Major impacts are to surface waters through hydrologic modification of river channels and through discharge of groundwater pumped to the surface to dewater the gravel pits. Sediment is the pollutant most often contributed by these sources. Indirectly, these sources contribute to increased water temperature and riparian habitat loss.

Nonferrous mining, especially production of precious metals, is the second type of mineral production. Acid mine drainage from old mines and claims have impacted Lynx Creek in the upper Agua Fria drainage (**1**). Complaints of surface water impairment have also been received on small heap leaching operations in the Cave Creek drainage. When the price of gold and silver rise, more small operations will activate and the potential for off-site contamination will increase.

Land Disposal NPS (60)

Landfills, waste disposal lagoons, septic tanks, and other waste disposal or storage practices have had demonstrated impacts on the water quality in the Middle Gila Basin. Most of the concern regarding these activities is focused upon the urban areas. However, solid waste disposal, especially disposal of pesticides containers in agricultural areas, has been identified as a potential source of surface and groundwater contamination.

Landfills in the Phoenix Metropolitan Area are, and historically have been, located along the Salt River often immediately adjacent to the low flow channel in abandoned gravel pits. In 1965, the City of Phoenix completed a study to identify all the disposal sites along the river as part of a campaign to transform the Salt River and its flood plain into a community asset for open space recreation and associated development. Groundwater and surface water problems have been identified in association with several of these facilities. Where the problems connected to leachate and landfill washout are documented, cleaning is occurring on a voluntary basis or under the Federal Superfund Program. Numerous landfills in the urban area will require remedial attention.

Septic tanks and effluent disposal through leach fields or injection wells are strong potential sources of groundwater pollution. The East Mesa, Apache Junction, Paradise Valley, Gilbert, and Chandler areas have had significant development with sewage treatment provided by septic tanks. No groundwater quality problems attributable to septic tanks have been documented in these areas possibly because of the great depth to the water table. Evidence from other areas within the State indicate that high densities of septic systems can add nitrates, dissolved solids, and organic chemicals to groundwater.

Waste disposal lagoons and other waste storage and disposal practices have been common in the Phoenix Metropolitan Area over the years. The EPA "Pits, Ponds and Lagoons Study" authorized by the Safe Drinking Water Act and completed in 1978 indicated numerous waste disposal sites associated with industrial land use in the Phoenix Metropolitan Area. Where these have been identified and investigated, they are being cleaned up or remediated through the RCRA Hazardous Waste Program or the State or Federal Superfund Programs.

Hydrologic and Habitat Modification NPS (70)

The development of stringent water quantity management programs to provide adequate water supplies for irrigated agriculture, combined with construction of flood control facilities, have produced a system of artificial, highly managed rivers throughout the Middle Gila Basin. Upstream groundwater withdrawals, combined with surface water impoundments have resulted in a situation where perennial flowing streams with associated wetlands have changed to dry-barren stream channels.

The system is not managed to enhance water quality. In fact, the intermittent irregular flows coupled with the Painted Rock Flood Control Facility exacerbates the regional problem by concentrating persistent pollutants in a confined area. Furthermore, when storage reservoirs become periodically full, releases are made causing various degrees of erosion and flood damage. Within one week in February 1980, flow in the Salt River went from zero to more than 150,000 cfs; destroying bridges, sewer lines, power transmission lines, homes and landfills.

The extraction of sand and gravel from streamcourses has caused hydrologic changes in streamcourses of the Middle Gila Basin. Studies on the Salt, Gila and Aqua Fria rivers indicate lands and structures near sand and gravel extraction operations have been threatened or damaged during floods **(15A)**.

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20. U.S. Department of the Interior, Fish and Wildlife Service, Ecological Services, 12/86, Letter from Sam F. Spiller, Field Supervisor to Douglas D. Russell, Ecology and Environment, Inc."

D. Salt Basin

Description

The Salt Basin encompasses 6,292 square miles and is composed of six sub-basins (Figure III-9). It includes USGS cataloging units 15060101, 15060102, 15060103, 15060104, 15060105 and part of 15060106 upstream of the Granite Reef Dam. The basin has been modified from previous Arizona reports in order to more closely correlate with USGS drainage basins and the EPA Reach File. The Salt River is formed by the White and Black rivers which originate in the White Mountains of east-central Arizona.

The Salt Basin supports diverse vegetative communities. Juniper pinyon woodlands, Sonoran desertscrub and chaparral - interior chaparral are predominate types. Montane-conifer forest, plains and desert grasslands, and Encinal and Mexican Oak-pine woodlands are also present. Erosion potential for the basin ranges from negligible to moderate (less than 0.2 to 1.0 acre feet per square mile per year) (**6**). The Arizona Game and Fish Department reports 33 lakes in the basin with a total area of 20,163 acres (**3**).

The Salt Project (SRP) initiated in 1904, regulates the flow of the river by Roosevelt, Horse Mesa, Morman Flat, and Stewart Mountain dams. The combined flows of the Salt and Verde rivers are diverted into the SRP Arizona Canal at the Granite Reef Dam, located 3.5 miles down stream from the confluence of the Salt and Verde rivers. Although the SRP water was originally utilized for irrigation exclusively, it has become the primary drinking water source for the Phoenix Metropolitan Area.

Surface Water Quality

Of the 1,205.7 miles of stream segments in the EPA Reach File for the Salt Basin, the ADEQ has assessed 359.1 miles. Use support on the assessed stream reaches was: 331.5 miles, partial support; and 27.6 nonsupport of protected uses. The results of this assessment are presented in Table III-6, and are discussed hereafter.

Elevated sediment and turbidity conditions are demonstrated by monitored and evaluated data throughout the assessed portions of the Salt Basin. Sources of sediment are from unknown activities or a result of rangeland grazing, recreation, mining, and hydrologic/habitat modification sources. The severity of erosion, and the consequent sediment/ turbidity problems, is largely implied from evaluated information sources, however.

Other perturbations of ambient surface water quality parameters include violations of fecal bacteria, metals, and pH in both the upper and lower Salt Basin, most likely as a result of the same nonpoint sources causing elevated turbidity and sediment mentioned above. Salinity impact on the Salt River system is traceable to a series of springs, upstream of Roosevelt Lake. Interpretation of data indicates that while nitrogen levels are not exceeding the standards; they are elevated. However, phosphate concentrations in many segments are several times the standards. The appreciable increases in concentration of phosphate in February and March may be related to heavier runoff associated with snowmelt. The source of the phosphate is unknown.

Groundwater Quality

The most significant groundwater pollution in the Salt Basin is in the Globe/Miami copper mining area. Acid mine drainage has created an acid groundwater plume containing metals and sulfates which are being transported toward Pinal Creek. These waters have the potential to impact Roosevelt Lake, a major source of drinking water for the Phoenix area.

Land Use

Approximately one-half of the Salt Basin is within the Fort Apache and San Carlos Apache Indian Reservations and slightly less than one-half consists of National Forest lands. The remaining one percent is classed as private lands. With the exception of the Miami-Globe mining district, the basin is one of Arizona's least populated. Typical densities are 1.0 to 2.5 persons per square mile.

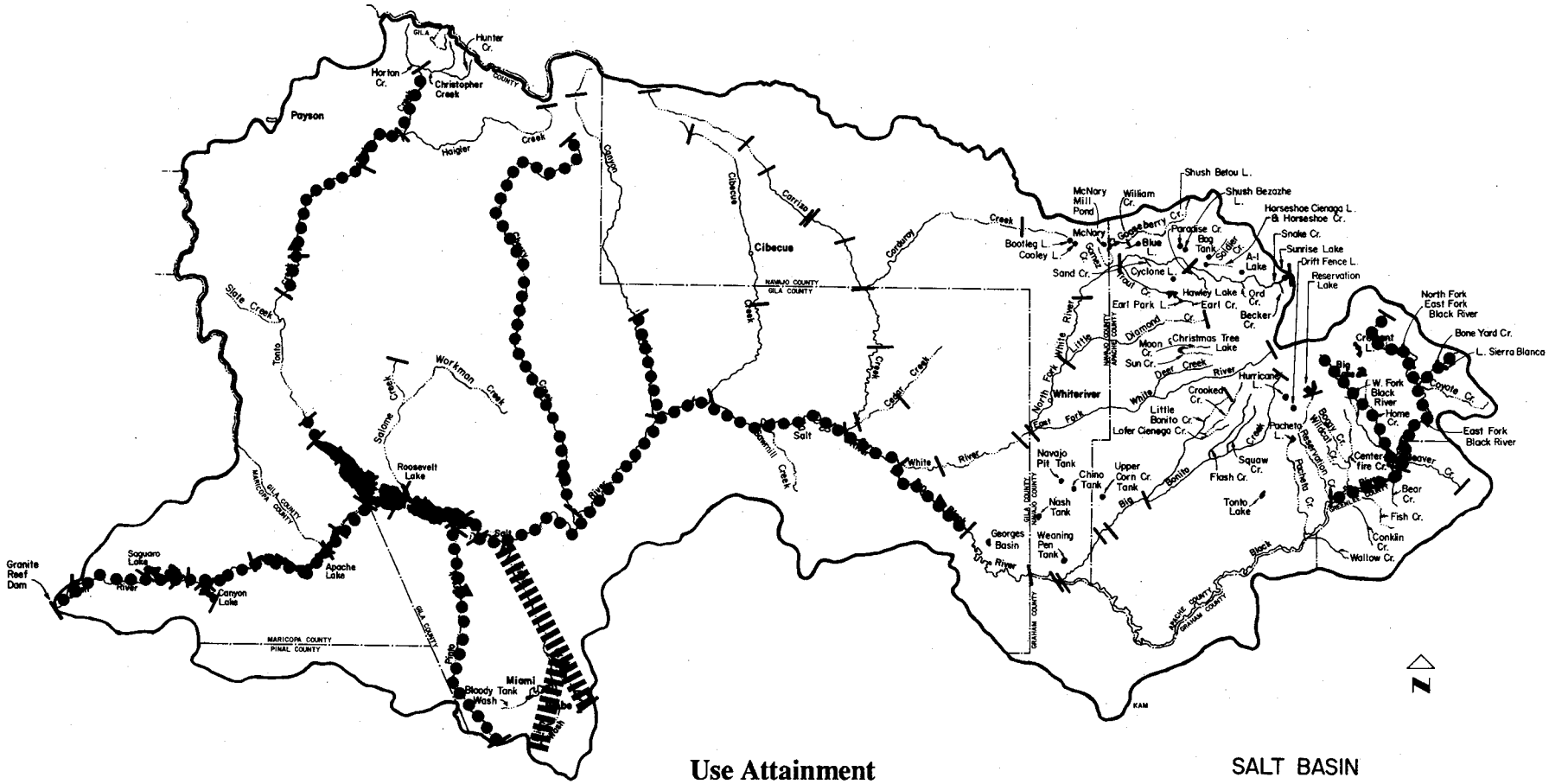


Figure III-9. Map of the Salt Basin.

TABLE III-6. SALT RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15060101-	West Fork Black R.	F C I L						15.0		[STA-19] TURBIDITY pH, Cu	UNKNOWN	
15060101-009	East Fork Black R.	F C I L						25.2		[STA-77] TURBIDITY pH, Cu DO	UNKNOWN	
15060101-	East Grassland Weir	F C I L						1.0		[STA-19] TURBIDITY DO	UNKNOWN	
15060101-	West Grassland Weir	F C I L						1.0		[STA-7] TURBIDITY	UNKNOWN	
15060101-	Boneyard C.	F C I L						6.0		[STA-10] pH, NO3, PO4	UNKNOWN	NOTE 1. EARLY INFORMATION CONCLUDES PHOSPHATES EXCEED STANDARDS THROUGHOUT THE BASIN (2), HOWEVER, NO SUBSTANTIATION OF USE IMPAIRMENT HAS BEEN MADE. EVALUATIONS OF VIOLATIONS FOR P ARE CONSERVATIVE.
15060101-001	Black R.	F C I L		14.2						[STA-23] TURBIDITY pH [STC] TURBIDITY	UNKNOWN	
15060103-010	Salt R. (White R. confluence)	F A I L						8.8		TURBIDITY (5)	NATURAL (5) GRAZING RECREATION (5)	NOTE 2. UNSATISFACTORY WATERSHED CONDITION IN BASIN ASSOCIATED WITH REACH, EROSION DUE TO NATURAL, GRAZING SOURCES AND ORV'S (5).
15060103-009	Salt R.	F A I L						23.6		TURBIDITY (5)	NATURAL (5) GRAZING RECREATION (5)	[NOTE 2]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND DEFINITIONS OF [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-6 (cont.). SALT RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15060103-008	Salt R.	F A I L					8.3			TURBIDITY (5)	NATURAL (5) GRAZING RECREATION (5)	[NOTE 2]
15060103-012	Canyon C. Watershed	F C I L					19.4			SEDIMENT/ TURBIDITY (5)	NATURAL GRAZING RECREATION (5)	[NOTE 2]
15060103-007	Salt R.	F A I L					18.4			SEDIMENT/ TURBIDITY (5)	NATURAL GRAZING RECREATION (5)	[NOTE 2]
15060103-015	Cherry C. Watershed	F C I L					51.7			SEDIMENT/ TURBIDITY (5)	NATURAL GRAZING RECREATION (5)	[NOTE 2]
15060103-006	Salt R.	F A I L					13.1			METALS BACTERIA (1) TURBIDITY (2)	UNKNOWN (1) NATURAL GRAZING RECREATION (5)	NOTE 3. PARTIAL SUPPORT OF USES (1) UNSATISFACTORY WATERSHED CONDITIONS ASSOCIATED WITH REACH (5)
15060103-	Miami Wash	A I L			10.0					pH [STB-22] DO pH, NO3, PO4 Cu, Zn, TDS	MINING (1)	[NOTE 1] NONSUPPORT OF USES (1) [STB-022] TDS RANGE 212 - 3290 MG/L. SITE IS MIAMI WASH AT HIGHWAY 88 NEAR CLAYPOOL.
15060103-005	Pinal C.	H A I L			17.6					METALS, pH (1) [STA-14] NO3, PO4 [STC] TURBIDITY Cu, Mn	MINING (1)	[NOTE 1] NONSUPPORT OF USES (1)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND DEFINITIONS OF [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-6 (cont.). SALT RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15060103-004	Salt R.	F A I L		3.5						METALS BACTERIA (1) TURBIDITY (5) TURBIDITY [STC] Hg [GS 83] TDS BACTERIA NO3, Cu	UNKNOWN (1) NATURAL GRAZING RECREATION MINING (5)	[NOTE 3] [GS 83] TDS RANGE 146 - 2070 MG/L
15060103-024	Salt R. (Roosevelt L.)	D F A I L						3.8		TURBIDITY (5)	NATURAL GRAZING RECREATION (5) HYDROLOGIC/ HABITAT MOD.	[NOTE 2]
15060103-018	Pinto-Campaign C. Watershed	H A I L						25.4		SEDIMENT/ TURBIDITY (5)	NATURAL GRAZING RECREATION (5)	[NOTE 2]
15060103-017	Pinto-Campaign C. Watershed	H A I L						2.6		SEDIMENT/ TURBIDITY (5)	NATURAL GRAZING RECREATION (5)	[NOTE 2]
15060103-016	Salt R. (Roosevelt L.)	D F A I L						5.8		TURBIDITY (5)	NATURAL GRAZING RECREATION (5) HYDROLOGIC/ HABITAT MOD.	[NOTE 2]
15060103-001	Salt R. (Roosevelt L.)	D F A I L						4.5		TURBIDITY (5)	NATURAL GRAZING RECREATION (5) HYDROLOGIC/ HABITAT MOD.	[NOTE 2]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND DEFINITIONS OF [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-6 (cont.). SALT RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15060105-013	Tonto C.	F C I L						8.5		SEDIMENT/ TURBIDITY (5)	NATURAL GRAZING ORV'S (5)	[NOTE 2]
15060105-011	Tonto C.	F C I L						8.0		SEDIMENT TURBIDITY (5)	NATURAL GRAZING ORV'S (5)	NOTE 2.
15060105-009	Tonto C.	F C I L						15.5		SEDIMENT TURBIDITY (5)	NATURAL GRAZING RECREATION	NOTE 2.
15060105-008	Tonto C. (above Gun C.)	F C I L		2.4						[STC] TURBIDITY B	UNKNOWN	
15060105-004	Tonto C.	F C I L						2.5		[STA-11] NO3, PO4	UNKNOWN	[NOTE 1]
15060105-001	Salt R. (Roosevelt L.)	D F A I L						0.0		TURBIDITY (5)	NATURAL GRAZING RECREATION (5) HYDROLOGIC/ HABITAT MOD.	[NOTE 2]
15060106-024	Salt R.	D F A I L		4.6						TURBIDITY (5) [STB-28] TDS TURBIDITY NO3, PO4 Cu, Hg BACTERIA	NATURAL GRAZING RECREATION (5) HYDROLOGIC/ HABITAT MOD.	[NOTE 1] [NOTE 2] [STB-28] TDS RANGE 128-2200 MG/L.
15060106-023	Salt R. (Apache L.)	D F A I L						2.1		BACTERIA (1)	UNKNOWN (1) RECREATION HYDROLOGIC/ HABITAT MOD.	PARTIAL SUPPORT OF USES (1)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND DEFINITIONS OF [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-6 (cont.). SALT RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15060106-017	Salt R. (Apache L.)	D F A I L					8.5			BACTERIA (1) TURBIDITY (5)	UNKNOWN NATURAL GRAZING RECREATION HYDROLOGIC/ HABITAT MOD.	[NOTE 2]
15060106-016	Salt R.	F C I L					7.6			BACTERIA (1) TURBIDITY (5)	UNKNOWN NATURAL GRAZING RECREATION HYDROLOGIC/ HABITAT MOD.	[NOTE 2]
15060106-015	Salt R. (Canyon L.)	F C I L					1.0			BACTERIA (1) TURBIDITY (5)	UNKNOWN NATURAL GRAZING RECREATION HYDROLOGIC/ HABITAT MOD.	[NOTE 2]
15060106-009	Salt R. (Canyon L.)	F C I L					0.7			BACTERIA (1) TURBIDITY (5)	UNKNOWN NATURAL GRAZING RECREATION HYDROLOGIC/ HABITAT MOD.	[NOTE 2]
15060106-008	Salt R.	F C I L					1.8			BACTERIA (1) TURBIDITY (5)	UNKNOWN NATURAL GRAZING RECREATION HYDROLOGIC/ HABITAT MOD.	[NOTE 2]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND DEFINITIONS OF [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-6 (cont.). SALT RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15060106-007	Salt R.	F C I L						1.5		TURBIDITY (5)	GRAZING RECREATION HYDROLOGIC/ HABITAT MOD.	[NOTE 3]
15060106-004	Salt R. (Saguaro L.)	D F C I L		3.3						BACTERIA (1) TURBIDITY (5) [STB-15] NO3, PO4	UNKNOWN RECREATION (1) NATURAL (2) GRAZING RECREATION HYDROLOGIC/ HABITAT MOD.	[NOTE 1] [NOTE 3]
15060106-003	Salt R.	D F C I L						9.0		TURBIDITY (5)	UNKNOWN RECREATION (1) NATURAL (2) GRAZING RECREATION HYDROLOGIC/ HABITAT MOD.	[NOTE 1] [NOTE 3]
15060106-002	Salt R. (Verde confluence)	D F C I L						4.0		TURBIDITY (5)	UNKNOWN RECREATION (1) NATURAL (2) GRAZING RECREATION (5) HYDROLOGIC/ HABITAT MOD.	[NOTE 3]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF THE MONITORED AND EVALUATED ASSESSMENT AND DEFINITIONS OF [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

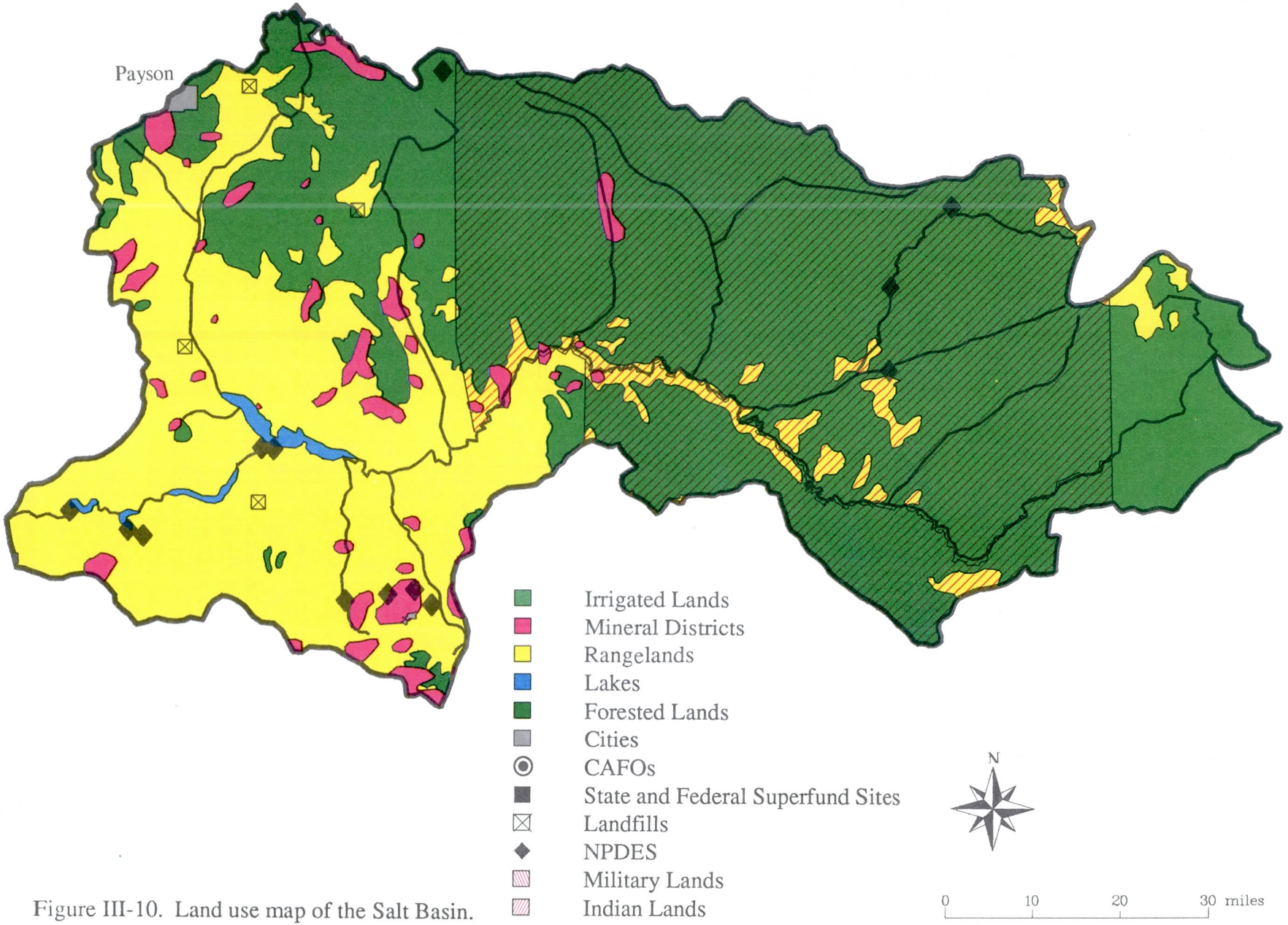


Figure III-10. Land use map of the Salt Basin.

The major land use in the Salt Basin is for recreational activities, but mining and timber production are also represented (Figure III-10). The data currently available on recreational use and its direct or indirect impact on water quality is inadequate for purposes other than speculative judgments. The long-term implications of recreational use are of major concern considering that the present accommodations serve over 3 million visitor-days of use.

Agricultural NPS (10)

Irrigated agriculture and grazing activities occur within the Salt Basin. Irrigation is limited to the riverine lowlands in the upper basin of the White River watershed on the White Mountain Apache Indian Reservation and along the lower reaches of Tonto Creek near Roosevelt Lake. The short growing season and small areas under irrigation in the basin limit the intensity of production and are not known to be causing water quality problems.

Grazing activities appear to have altered the ecosystem. Historic grazing activities have contributed to present erosion problems. Recent grazing activities appear to contribute to problems causing excessive erosion and siltation in the watershed. In the long term, siltation in the upper Salt River watershed will gradually eliminate much of the current reservoir capacity which provides a dependable water supply to the Phoenix Metropolitan area.

Silviculture NPS (20)

Logging activities occur on the Tonto and Apache Sitgreaves National Forests and on the White Mountain and San Carlos Apache Indian reservations. Current timber cutting and hauling requirements serve to minimize this source of pollution. While no definitive studies have been performed, forest roads are believed to be the most important potential source of siltation related to silvicultural activities.

Resource Extraction NPS (50)

The Globe-Miami area of the Salt Basin has supported mining and mineral processing activities since 1873. The Pinal Creek and Pinto Creek sub-basins which drain these mining districts flow into Roosevelt Lake, a significant water supply source for Phoenix. One hundred fifty-nine historic and existing mining activities have been identified within the Globe-Miami area. The principal mineral mined and processed is copper; however, various other metals are also extracted from the basin. Surface and groundwater quality in the Globe-Miami area has degraded over the past 100 years as a result of the seepage of acidic mining and milling process solutions. Overland runoff as well as groundwater discharges to surface water have also contributed to impacts upon surface water quality.

Land Disposal NPS (60)

There are no sanitary landfills or dumps in the off-reservation portion of the Salt Basin. There are several recreation sites with recreational vehicle holding tank disposal facilities managed by the Apache-Sitgreaves National Forest.

Communities currently employing septic tank systems within the Salt Basin include: Christopher Creek, Punkin Center, Young, and in the Globe-Miami area: Claypool, Central Heights, Ice House Canyon, and Sixshooter Canyon.

Recreational NPS (100)

The demand for developed recreation sites exceeds the availability of improvements, particularly around lakes and streams (7). Recreational use has increased the nutrient and bacterial loading of these water bodies. Heavy recreational use in the vicinity of Big Lake and Black River has resulted in adverse impacts. Operation of off-road vehicles is an increasing problem which has resulted in resource damage and added sediment load throughout the basin.

Salt Basin References

1. Arizona Department of Health Services, 8/86, "Water Quality Assessment Report for the State of Arizona, Water Years 1984 and 1985."

2. Arizona Department of Health Services, 1/77, "Water Quality Management Basin Plan, Salt River Basin, Arizona."

3. Arizona Game and Fish Department, 1985, "Arizona Fishin' Holes, A Guide to Popular Fishing Waters and Facilities in Arizona."

4. Central Arizona Association of Governments, Mineral Extraction Task Force, 8/83, "Northern Prototype Copper Mining Management Plan."

5. U.S. Department of Agriculture, Forest Service, Southwestern Region, 10/85, "Environmental Impact Statement for the Tonto National Forest Plan."

6. U.S. Department of Agriculture, Soil Conservation Service, 1971, Arizona Sediment Yield Map."

7. U.S. Department of Agriculture, Forest Service, Southwestern Region, 8/87, Apache-Sitgreaves National Forest Plan.

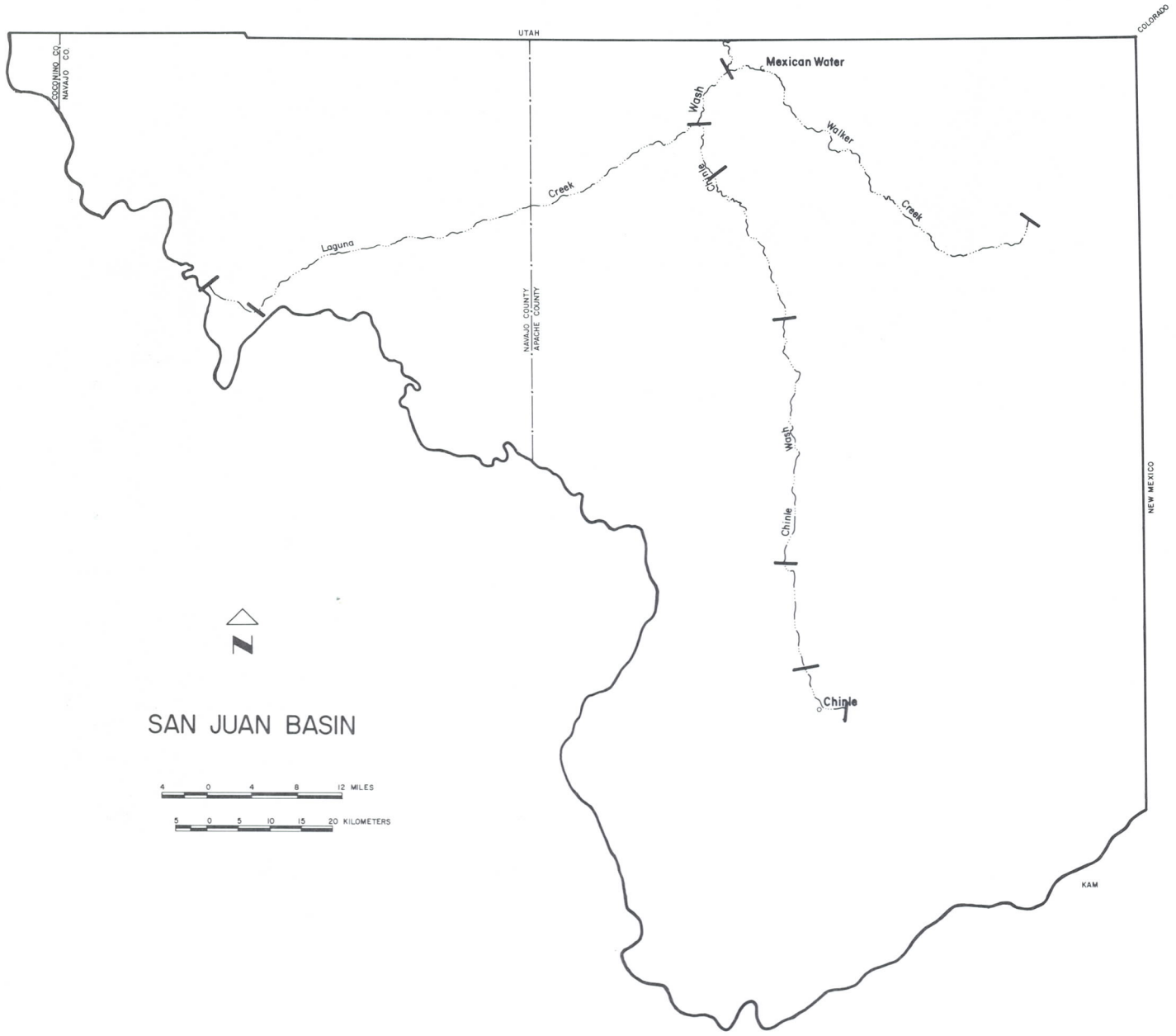
E. San Juan Basin

Description

The San Juan Basin encompasses 4,954 square miles and it consists of five sub-basins with USGS cataloging units 14080105, 14080106, 14080201, 14080204 and 14080205 (See Figure III-11). The Reach File lists 533.8 river miles. Although the drainage is named for the San Juan River, this river does not flow within Arizona. In Arizona, all of the tributaries flow northward into the San Juan River and subsequently into Lake Powell in Southern Utah. As the entire basin is within the Navajo Indian Reservation, the Resource Division of the Navajo Nation will be assessing this surface water basin.

Land Use

General land use in the San Juan Basin is portrayed in Figure III-12.



/ Marks Begining of EPA Reach

▲ Fixed Station Monitoring Site

Figure III-11. Map of the San Juan Basin.

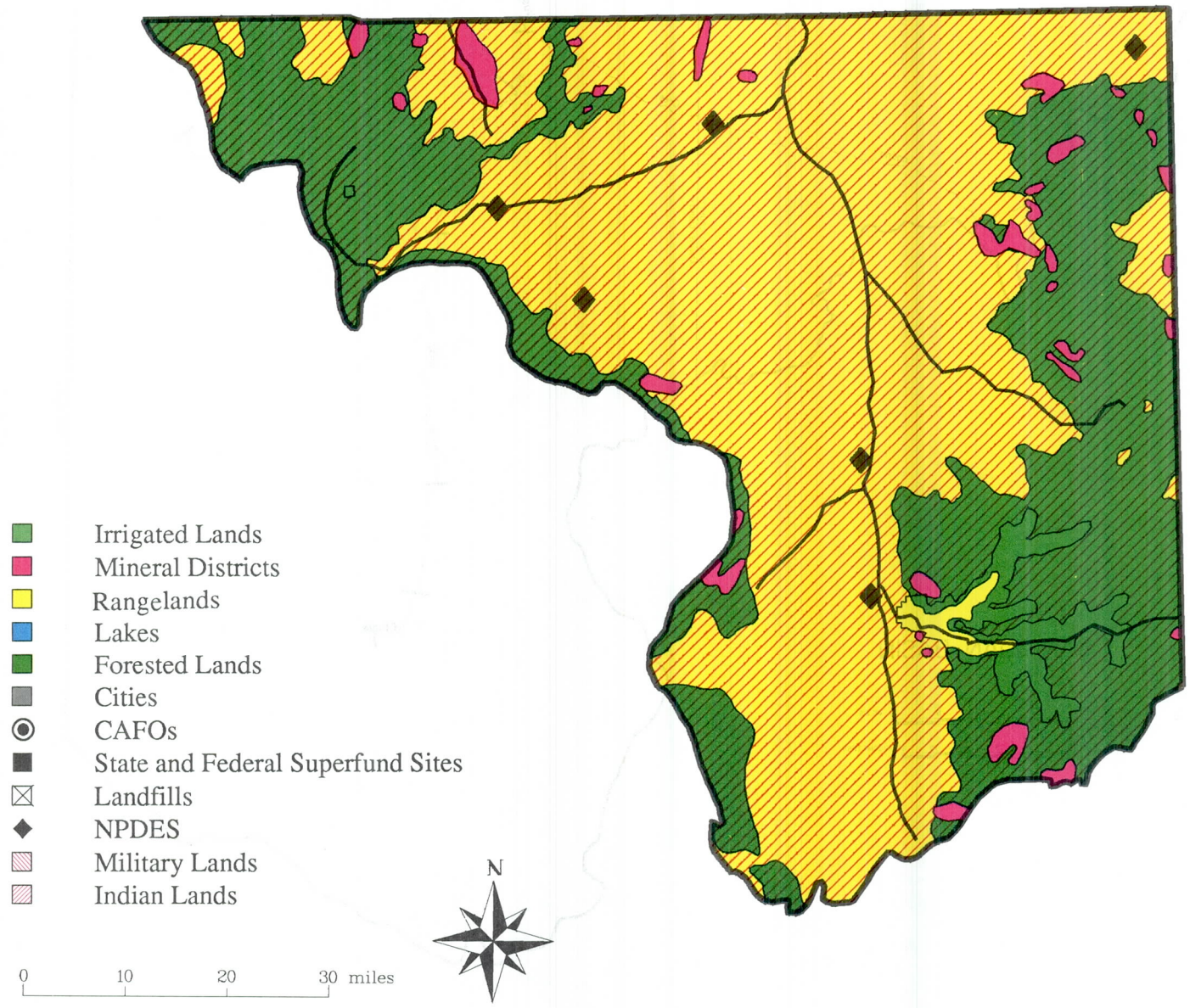


Figure III-12. Land use map of the San Juan Basin.

F. San Pedro Basin, Willcox Playa, and Whitewater Draw

Description

For this assessment, the San Pedro Basin has been combined with two smaller drainage basins in southeastern Arizona; the Willcox Playa Basin and the Whitewater Draw Basin. The San Pedro River drains the entire San Pedro Valley in Arizona (Figure III-13). Its USGS cataloging units are 15050202 and 15050203. The area of the basin in Arizona is 3,739 square miles. The San Pedro River flows north and enters the U.S. from Sonora, Mexico and with its tributaries drain the Huachuca, Dragoon, Galiuro and Santa Catalina Mountains in Arizona. The San Pedro Basin terminates at the river's confluence with the Gila River near Winkelman, Arizona.

The Willcox Playa Basin, cataloguing unit 15050201, occupies the northern half of the Hot Sulphur Springs Valley and has an area of 1,699 square miles. There are two lakes and 118.3 river-miles listed for this basin in Arizona. As it's name implies, the Willcox Playa Basin has no exterior drainage.

The southern half of the Sulphur Springs Valley has been designated the Whitewater Draw Basin, cataloguing units 15080301 and 15080302. This basin has an area of 1,504 square miles. There are no lakes within the basin, but there are 190.2 river-miles in Arizona. Whitewater Draw discharges into the Rio Yaqui in Sonora, Mexico.

Soil sediment yields for the San Pedro Basin are negligible to moderate (less than 0.2 to 1.0 acre feet per square mile per year) (**10**).

Surface Water Quality

The EPA Reach File indicates about 694.5 miles of stream reach are found in the San Pedro Basin in Arizona (including the Whitewater Draw and Willcox Playa Basins). The ADEQ has assessed 227.2 miles of these reaches as shown in Table III-7. Protected use support are as follows: 206.2 miles partial support; and 21.0 miles, nonsupport. From the international boundary with Mexico to its confluence with the Gila River, monitored and evaluated information indicates unfavorable dissolved oxygen and sediment/turbidity problems prevail. Nutrients (particularly nitrate) also occur at high levels along the mainstem of the San Pedro River (**2**). Sources of the NPS pollution are unknown or related to mining, land disposal, and grazing sources.

Monitoring data indicates fecal bacteria violations occur in the San Pedro River's most central and upper reaches. These are due to unknown and probably land disposal sources. Metals and pH violations are found throughout the basin and are generally associated with mining sources.

Total dissolved solids (TDS) attain moderate levels (from about 500 to 1,500 mg/l) in the lower reaches of the San Pedro and Whitewater Draw basins. South of the Mule Mountains, elevated TDS levels have been associated with mining activities.

Releases or runoff from an open pit copper mine and its waste or tailings piles in Mexico have periodically contributed mineralized sediment to the U.S. reach of the San Pedro (**3**). Impact from these releases and/or spills have been identified as far downstream as Benson, more than 40 miles from the U.S./Mexican Border and more than 80 miles from the source mine at Cananea in Mexico. In 1976 and 1987, acid mine drainage was documented in Mule Gulch in Bisbee and is attributed to sources at the Copper Queen operation.

Groundwater Quality

Groundwater contamination and associated surface water pollution from nitrates have been reported for more than six years in the vicinity of the Apache Powder facility which is a Federal Superfund site near Saint David. Another focus of groundwater pollution occurs near the divide between the San Pedro Basin and the Whitewater Draw Basin, south of the Mule Mountains, where salinity (TDS) increases are linked to mine tailings. Although a comprehensive groundwater quality

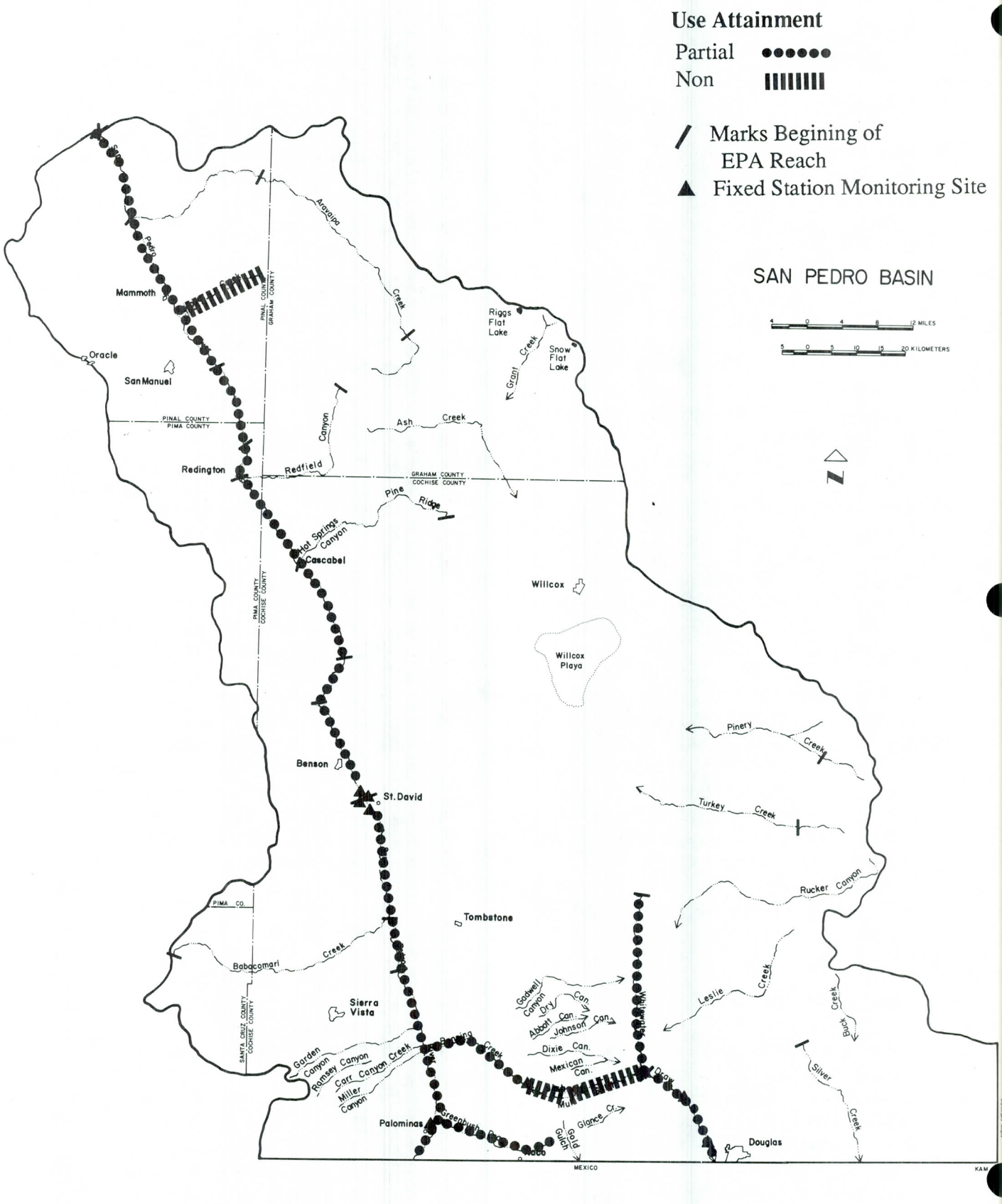


Figure III-13. Map of the San Pedro Basin.

TABLE III-7. SAN PEDRO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15050202-	Greenbush Draw							18.0		[STA-3] Ba, Cu, NO3	UNKNOWN	
15050202-	Banning C. (Bisbee Tunnel)	H A I L		12.0						[STC] B, Pb	UNKNOWN	
15050202-008	San Pedro R.	H A I L		27.3						DO, NO3 (1) TDS (5) TURBIDITY (8) (5) [STA-47] Cu, Mn, Hg, TDS, NO3, PO4, pH [STB-03] DO TURBIDITY PO4 [STC] Se, B Pb, Cu	MINING UNKNOWN (1)	PARTIAL SUPPORT OF USES (1). TDS INCREASES FROM 245 MG/L TO 640 MG/L AT GILA R. VIOLATIONS OF TURBIDITY OCCURRED MOST OFTEN SAN PEDRO R.(5). SAN PEDRO LARGEST CONTRIBUTION OF SEDIMENT TO GILA R.(2) [STC] SELENIUM VIOLATIONS REPORTED FOR THIS REACH AND OTHER REACHES REPORTED HEREAFTER ARE IN QUESTION. [STA] TDS TO 995 MG/L AT SAN PEDRO R. AND AZ 92. SEVERAL SAMPLING SITES IN THIS SEGMENT. TDS TO 1156 MG/L NEAR INTERNATIONAL BORDER.
15050202-006	San Pedro R. (Charleston)	H A I L		7.4						DO, NO3 (1) PHOSPHORUS (2) [STC] DO TURBIDITY Hg BACTERIA	MINING UNKNOWN (1)	PARTIAL SUPPORT OF USES (1) PRONOUNCED INCREASE IN P, HAS EXCEEDED PHOSPHORUS STANDARDS OF USEPA (2)
15050202-005	San Pedro R.	H A I L						0.5		NO3, DO (1) PHOSPHOROUS (2)	MINING UNKNOWN (1) LAND DISPOSAL	PARTIAL SUPPORT OF USES (1) ST DAVID AREA CONTAMINATED GROUNDWATER ENTERING SURFACE WATERS FREQUENTLY EXCEEDS 10 MG/L NO3-N (1) PRONOUNCED INCREASE IN PHOSPHOROUS HAS EXCEEDED STANDARDS OF USEPA.
15050202-003	San Pedro R. (Babocomori)	H A I L		14.9						DO, NO3 (1) [STA-14], NO3, Ba, BACTERIA [STC] DO, pH NO3, Pb, Mn, Cu, Hg Se	LAND DISPOSAL MINING UNKNOWN	NOTE 1. PARTIAL SUPPORT OF USES (1)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-7 (cont.). SAN PEDRO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	MONITORED (c) PART	MONITORED (c) NON	MONITORED (c) T	EVALUATED (c) FULL	EVALUATED (c) PART	EVALUATED (c) NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15050202	San Pedro R. (at Fairbank)	H A I L								[STA-28] Cu	UNKNOWN	REACH UNKNOWN
15050202-002	San Pedro R. (St. David)	H A I L		13.2						DO, NO3 (1) PHOSPHOROUS (2) [STA-13] TURBIDITY NO3, PO4, Cu, FE [STC] BACTERIA	MINING UNKNOWN (1) LAND DISPOSAL GRAZING	[NOTE 1] ST. DAVID AREA, CONTAMINATED GROUNDWATER ENTERING SURFACE WATERS FREQUENTLY EXCEEDS 10 MG/L NO3-N (1) PRONOUNCED INCREASE IN PHOSPHORUS HAS EXCEEDED STANDARDS OF USEPA (2)
15050202-001	San Pedro R. (Benson)	H A I L						6.2		DO, NO3 (1)	MINING UNKNOWN (1) LAND DISPOSAL GRAZING	[NOTE 1] NO3 -N REPORTED TO OVER 32 MG/L AT BENSON
15050203-012	San Pedro R.	H A I L						13.5		DO, NO3 (1)	MINING UNKNOWN (1) LAND DISPOSAL NATURAL GRAZING AG. IRR.	[NOTE 1]
15050203-011	San Pedro R.	H A I L						13.2		DO, NO3 (1) [STA-4] BACTERIA	MINING UNKNOWN (1) LAND DISPOSAL GRAZING AG. IRR.	[NOTE 1]
15050203-009	San Pedro R.	H A I L						4.6		DO, NO3 (1) [STA-4] BACTERIA	MINING UNKNOWN (1) LAND DISPOSAL GRAZING AG. IRR.	[NOTE 1]
15050203-008	San Pedro R. (Redington)	H A L						11.8		PHOSPHOROUS (2) DO, NO3 (1)	MINING UNKNOWN (1) LAND DISPOSAL GRAZING AG. IRR.	[NOTE 1] PRONOUNCED INCREASE IN P (2)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
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TABLE III-7 (cont.). SAN PEDRO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15050203-	Copper C.	H A I L							9.0	METALS, pH	MINING	NONSUPPORT OF USES (1)
15050203-003	San Pedro R.	H A L		18.4						DO, NO3 (1) [STB-03] DO TURBIDITY NO3, PO4 [GS 83] TURBIDITY NO3, PO4 Hg [GS 84] TURBIDITY NO3, PO4 Cu	MINING UNKNOWN (1) GRAZING AG. IRR.	[NOTE 1] [GS 83] TDS RANGE 326 - 960 MG/L [GS 84] TDS RANGE 345 - 900 MG/L
15050203-001	San Pedro R. (To Gila R. confluence)	H A L						11.1		SEDIMENT/ TURBIDITY (8) TDS (5) DO, NO3 (1)	MINING UNKNOWN (1) GRAZING AG. IRR.	[NOTE 1] MAJOR NPS PROBLEM OF SAN PEDRO IS SEDIMENT (8) TDS 640 MG/L AT GILA R. CONFLUENCE (5)
15080301-004	Whitewater Draw			21.4						[STC] DO Cd	UNKNOWN	
15080301-002	Whitewater Draw (Near Douglas, AZ)							12.7		[STA-10] TDS BACTERIA PO4, DO NO3, Hg	UNKNOWN	TDS TO 1490 MG/L

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-7 (cont.). SAN PEDRO RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15080301-	Mule Gulch	D F A I L			12.0					[STC] pH Pb, Zn, Cu, Cd Mn,	MINING LAND DISPOSAL	
15050203-	San Pedro Basin									SEDIMENT/ TURBIDITY (7)	NATURAL GRAZING RECREATION ROADS MINING (7)	ALL WATERSHEDS IN CORONADO NF HAVE EXCESSIVE EROSION, SEDIMENTATION A MAJOR CONCERN AND GENERALLY FOLLOWS LOCALIZED HEAVY STORMS (7) 1,280,169 ACRES OF GRAZEABLE LAND IN CORONADO NF IN THE BASIN. (ADEQ ALRIS PRINTOUT)
15050202-	San Pedro Basin											
15020201-	San Pedro Basin											
15050201-	San Pedro Basin (Willcox Playa)											

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
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monitoring program has not been carried out, concern has been expressed about possible salt water intrusion into groundwater as a result of groundwater withdrawals north and south of the Willcox Playa. Concern has also been expressed regarding contamination of groundwater from the sewage disposal ponds near Naco, and groundwater pollution associated with cyanide leaching operations near Tombstone.

Land Use

The San Pedro Basin, including the Willcox Playa and Whitewater Draw basins, is characterized by its varied land uses and small towns (Figure III-14). In almost all cases, the location and basic economies of these towns reflect a service or market relationship with the dominant varied land uses in their service areas.

The largest city in the San Pedro Basin is Sierra Vista and it is the one exception to this rule. Sierra Vista's economy is based almost exclusively upon winter visitors, retirement, and service to the Fort Huachuca military facility. Douglas at the southern end of the Hot Sulphur Springs Valley (Whitewater Draw Basin) serves as a market town and focus for trade and commerce across the international border. Bisbee, in the Mule Mountains, and Tombstone, on the western slopes of the Dragoon Mountains, are historic mining towns that have lost their economic support from that sector and are now attempting to broaden their economies to include tourism and retirement services. Mining continues to be the economic base for the communities of San Manuel and Benson. St. David and Willcox are small agricultural market towns located where water resources or transport facilities dictated.

Irrigated agriculture is limited to isolated locations along the San Pedro River (St. David, Benson and Feldman) and to major areas in the Hot Sulphur Springs Valley, north and south of the Willcox Playa. The former lands are irrigated with surface water while the latter are irrigated with groundwater. Grazing is an agricultural land use that is widespread throughout the basin. Much of the natural vegetation is grasslands and the basin ranks among the most productive forage producing areas in the State.

Commercial silviculture is not a common activity. All forest resources are limited to the national forests and none of these are classified as commercial forests. Recreational activities and wood cutting are the most significant land uses in these forests.

Mining, along with agricultural land use, has had a major impact upon landscape. The present level of mining activity reflects the current market condition for precious metals and copper. However, there is a long history of copper, silver, and gold mining in this basin. Tombstone, Bisbee, Douglas, and San Manuel are communities based upon a mining economy. Presently, the mine at San Manuel is the principal active mining operation. Copper, silver, gold, and small quantities of other minerals are produced at the San Manuel facility.

Agricultural NPS (10)

The Santa Cruz and San Pedro Basin Resource Inventory reported that limited surface and groundwater pollution are attributed to agricultural activities(**9**). Runoff from summer storms has been indicated as a minor cause of sediment loss from of the irrigated lands along the San Pedro. Grazing activity, especially in sensitive, erodible rangelands, also contributes to erosion and sedimentation and has been reported for the northern two-thirds of the San Pedro Valley. These agricultural sources contribute both directly and indirectly to the low dissolved oxygen and high sediments load in the San Pedro River. Groundwater withdrawal for irrigated agriculture in the Willcox Playa Basin, north and south of the dry lake, has been identified as a potential factor involved in salt water intrusion. Highly saline groundwater is believed to move from under the Willcox Playa and into the areas of withdrawal (**9**).

Grazing is the most widespread agricultural activity within the basin. Production of forage by natural vegetation in this region is as high as any area of the State. The 1976 resource inventory for the Santa Cruz and San Pedro basins reported that grazing has resulted in moderately accelerated soil erosion for approximately 15 percent of the grazed rangelands. Much of the erosion impacted rangeland is concentrated along the San Pedro

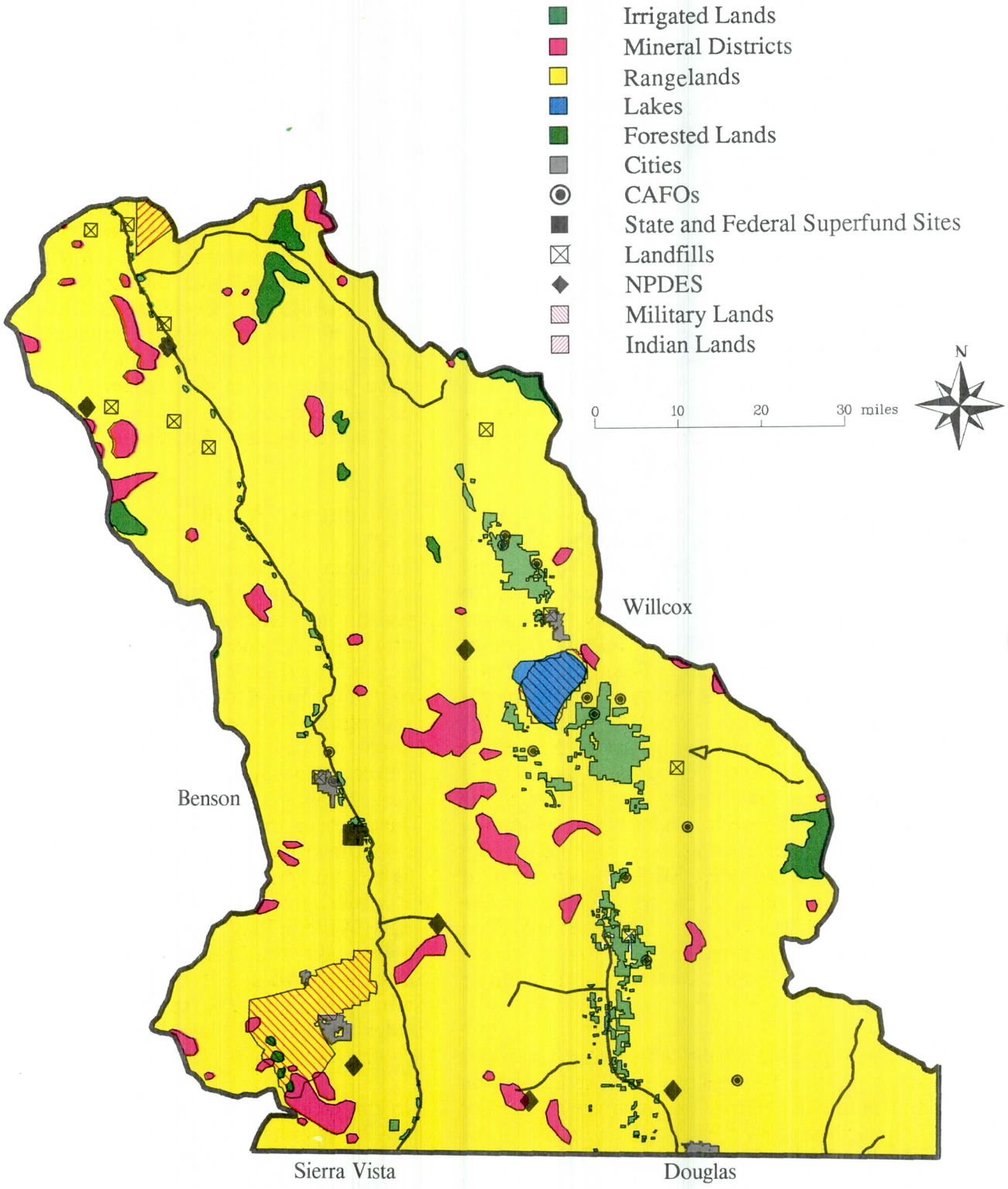

Figure III-14. Land use map of the San Pedro Basin.

Valley in the area from St. David to Mammoth (9). This area also coincides with the reach of the San Pedro that does not meet standards due to low dissolved oxygen and high sediment loads which may be attributable to irrigated agriculture (**1**).

Silvicultural NPS (20)

Commercial silviculture is not practiced within this basin. The Coronado National Forest Plan lists fuelwood, posts, poles and Christmas trees as the principal forest products (**6**). Recreation and forage production are the primary uses to be optimized in the USFS management programs. Nonpoint source water quality problems from silvicultural activities have not been identified in this basin.

Urban Runoff, Construction, and Military Reservations NPS (30/40)

Nonpoint source pollution from this category of sources has not been recorded within this basin. The City of Sierra Vista, because of it's size and growth, is the priority city in the basin for urban and construction runoff evaluation. Current data is not available to assess the impact that Fort Huachuca has upon surface and/or groundwater quality.

Resource Extraction NPS (50)

Mining is a historical activity in this part of Arizona and the present level of mining activity reflects the current market for precious metals and copper. Mining activities in the Bisbee and Tombstone areas are concentrated and the landscape has been significantly altered. Other mountainous areas also contain abandoned mining sites of varying size and age which contribute contaminants to water quality. Groundwater contamination of cyanide and metals in the Tombstone area is attributable to both current and historic mining activities. Tailings deposits from the Lavender Pit operation in Bisbee have been identified as the source of TDS increases in groundwater south of the Mule Mountains (**4**).

Copper Creek, a westward flowing tributary to the San Pedro (south of Mammoth), has documented violations for pH and metals standards (**1**).

Land Disposal NPS (60)

Historically, septic and sewage disposal systems have caused water quality problems in Bisbee, but these have been eliminated by construction of a central sewage treatment system. Records of the ADEQ identify open dumps in Benson and Mammoth; however, neither of these sites have been shown to contribute to violations of water quality standards to date. Hazardous waste sites and Superfund sites have been identified in this basin; the full nature and extent of contamination has not been evaluated or determined.

Hydrologic and Habitat Modification (70)

Contribution of NPS pollution by hydrologic and habitat modification has not been documented in the San Pedro Basin.

San Pedro Basin References

1. Arizona Department of Health Services, 8/86, "Water Quality Assessment for the State of Arizona, Water Years 1984 and 1985."

2. Arizona Department of Health Services, 9/85, "San Pedro and Santa Cruz Rivers: Nutrient Standards Review."

3. Arizona Department of Health Services, 3/83, "Water Quality Assessment for the State of Arizona, Water Year 1980 and 1981."

4. Littin, G.R., 6/87, "Groundwater Resources of the Bisbee - NACO Area Cochise County Arizona," Water Resources Investigation #87 - 4103, published by USDI, Geological Survey.

5. Southeastern Arizona Governments Organization, 10/78, "Water Quality Management Plan."

6. U.S. Department of Agriculture, Forest Service, Southwestern Region, 7/86, "Coronado National Forest Plan."

7. U.S. Department of Agriculture, Forest Service, 7/86, "Environmental Impact Statement for the Coronado National Forest Plan."

8. U.S. Department of Agriculture, Soil Conservation Service, Economic Research Service, and Forest Service, 8/77, "Santa Cruz - San Pedro River Basin, Arizona: Main Report."

9. U.S. Department of Agriculture, Soil Conservation Service, Economic Research Service, and Forest Service, 8/77, "Santa Cruz - San Pedro River Basin, Arizona: Resource Inventory."

10. U.S. Department of Agriculture, Soil Conservation Service, 1971, Arizona Sediment Yield Map."

G. Santa Cruz Basin

Description

The Santa Cruz Basin encompasses 8,195 square miles and is composed of six sub-basins, USGS cataloging units 15050301, 15050302, 15050303, 15050304, 15050305, and 15050306 (Figure III-15).

The river originates in the Patagonia and Huachuca mountains and the Canelo Hills of Arizona. It flows south into Mexico, but then turns northward and flows back into Arizona. As it flows northw ard toward Tucson, it is joined by Sonoita Creek and Sopori Wash.

Near Tucson, the river receives runoff from the Santa Catalina Mountains via Rillito Creek, Canada Del Oro, and Brawley Wash. The river subsequently flows northwest to join the Gila River south of Phoenix near Laveen (located in the Middle Gila Basin). Most streams in the basin are ephemeral except Sonoita Creek near Patagonia, Pantano Wash near Vail, and Sabino Creek on Mt. Lemmon, all sustained by groundwater flow. The Santa Cruz River channel itself is normally dry from downstream of Nogales to its confluence with the Gila River. However, perennial flows occur below Tucson from wastewater treatment plant discharges, but elsewhere flow results only in direct response to precipitation.

The basin is in the Basin and Range province which is characterized by isolated mountain blocks separated by broad alluvial-filled valleys. Most vegetation in the drainage area is Sonoran desert scrub and dry grassland. The Arizona sediment yield map illustrates that this basin has a range of negligible to slight erosion potential (less than 0.2 to 0.5 acre feet per square mile per year sediment yield) (**17**). Seven lakes with a total area of 548 acres are located in the basin (**5**).

Surface Water Quality

Since initiation of Arizona's ambient surface water quality monitoring program in 1973, violations of surface water quality standards have rarely been recorded from the Santa Cruz Basin.

Table III-8 presents the monitored and evaluated assessment information on NPS pollution and water quality for surface water in the Santa Cruz Basin. The ADEQ evaluated 395.7 miles of the 913.9 miles of watercourses listed in the EPA Reach Files for this basin in Arizona. The assessment of protected use support was as follows: 343.1 miles, partial support; and, 52.6 miles, nonsupport.

Monitoring data indicates that dissolved oxygen (DO) and metals are the parameters of water quality for which most violations occur. Monitored DO levels are low in the Santa Cruz River from near the international border with Mexico to the Tucson urban area. Monitored metals violations occur at sampling sites from the international boundary area to below the confluence of the Santa Cruz River with the Canada Del Oro north of Tucson. Most current monitoring data indicated bacterial violations only in the vicinity of Nogales Wash. Nutrient (NO_3 and PO_4) violations do not appear to be a substantive current problem based on monitoring results.

The lack of an extensive water quality sampling network, in terms of either space or time, has resulted in limited specific data on sediment and turbidity conditions throughout the Santa Cruz Basin. Evaluated information sources indicate that unknown, natural, and grazing sources of sediment may be a widespread problem in the basin. Erosion and sediment problems may also be contributed to by localized construction and land development activities, and mining and hydrologic/habitat modification sources. Other evaluated data supports the presence of metals and pH problems in tributaries to the Santa Cruz River, such as Aquirre Wash, Tinaja Wash, Harshaw and Sonoita Creeks, as a consequence of mining development (**4**).

Groundwater Quality

The groundwater basins roughly encompassed by the Santa Cruz Basin lie within the Tucson Active Management Area (AMA) and the Pinal AMA. The northeastern portion of the Pinal AMA, east of Casa Grande, is in the Middle Gila Basin but will be discussed in this section of the report because of its hydrogeologic connection and for convenience.

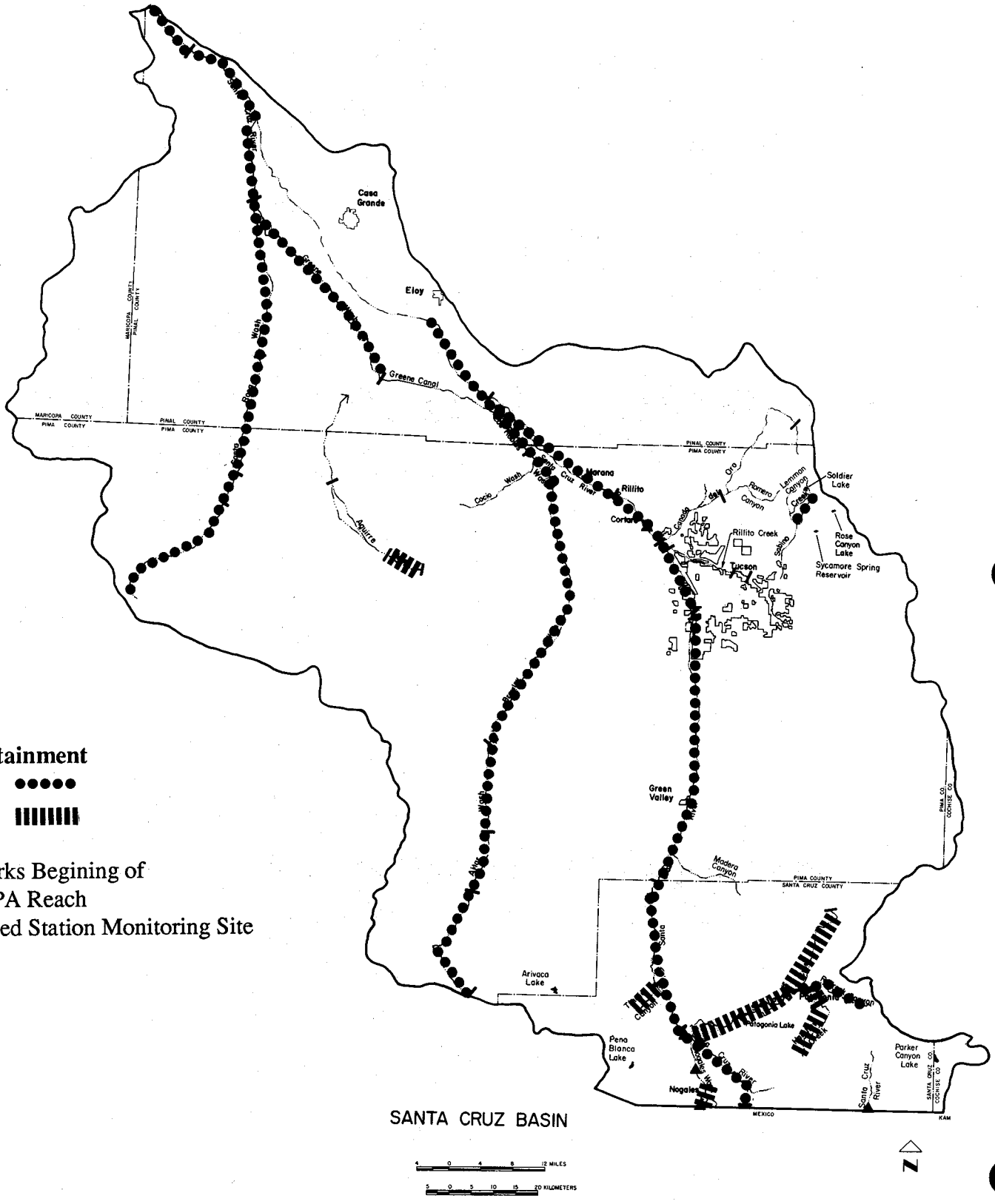

Figure III-15. Map of the Santa Cruz Basin.

TABLE III-8. SANTA CRUZ RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15050301-012	Santa Cruz R. (Kino Spring)	D H A I L		16.4						[STC] DO	UNKNOWN	
15050301-010	Santa Cruz R.	D H A I L		3.0						SEDIMENT/ TURBIDITY (16) DO (4) [STC] DO, Pb	NATURAL (16) GRAZING UNKNOWN (4)	NOTE 1. MODERATELY SEVERE EROSION, IMPACT OF NATURAL AND GRAZING DIFFICULT TO SEPARATE (16) PARTIAL SUPPORT OF USE (4)
15050301-	Nogales Wash (including E. Channel)	A I L			6.0					BACTERIA [STC] BACTERIA DO, B	LAND DISPOSAL URBAN RUNOFF	NONSUPPORT OF USES (4). RESULT OF UPSTREAM DISCHARGES FROM MEXICO.
15050301-	Red Rock Canyon	D H A I L					4.0			[STA-5] DO, NO3, PO4 TDS	UNKNOWN	TDS 400 TO 1300 MG/L
15050301-	Harshaw C.	D H A I L			7.0					METALS, pH (4) [STC] pH	MINING (15)(4)	NONSUPPORT OF USES (4)
15050301-013	Sonoita C.	D H A I L							30.2	SULFATES, Pb, Cr, Cd, As, Fe, Mn, Cu, Zn (15) METALS, pH (4)	MINING (15)(4)	WQ STANDARDS NOT MET DUE TO ACID MINE DRAINAGE (15) NONSUPPORT OF USES (4) UPSTREAM SOURCES (ADEQ)
15050301-009	Santa Cruz R. (Sonoita C. confluence)	H A I L					6.3			SEDIMENT/ TURBIDITY (16) DO (4)	NATURAL (16) GRAZING UNKNOWN (4)	[NOTE 1]
15050301-	Tinaja Wash	H A I L							5.0	METALS, pH	MINING	NONSUPPORT OF USES (4)
15050301-008	Santa Cruz R. (Josephine Canyon)	H A I L					13.6			SEDIMENT/ TURBIDITY (16) DO (4)	NATURAL (16) GRAZING UNKNOWN (4)	[NOTE 1]

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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-8 (cont.). SANTA CRUZ RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15050301-006	Santa Cruz R.	H A I L		35.8						[STC] DO Mn, Pb, Cu, Hg SEDIMENT/ TURBIDITY (16) DO (4)	UNKNOWN AG IRR.	[STC] DATA AT CONTINENTAL, AZ PARTIAL SUPPORT OF USE (4)
15050301-005	Santa Cruz R.	H A I L						1.5		SEDIMENT/ TURBIDITY (16) DO (4)	NATURAL (16) GRAZING UNKNOWN (4)	[NOTE 1]
15050301-003	Santa Cruz R.	H A I L						9.0		SEDIMENT/ TURBIDITY (16) DO (4)	NATURAL (16) GRAZING UNKNOWN (4) CONSTRUCTION MINING (11)	[NOTE 1]
15050302-	Sabino Canyon C.	H A I L						5.0		NUTRIENTS NO3, PO4 BACTERIA (11)	CONSTRUCTION LAND DISPOSAL RECREATION	NUTRIENTS VIOLATIONS IN PAST PRIMARILY DUE TO POINT SOURCE BUT ALSO CONTRIBUTED BY RECREATION, DOMESTIC ANIMALS. BACTERIA FROM SEPTIC TANKS AND RECREATION ACTIVITIES (11).
15050301-002	Santa Cruz R. (below Rillito W.)	H A I L E						1.1		SEDIMENT/ TURBIDITY (16) DO (4)	NATURAL (16) GRAZING UNKNOWN (4)	[NOTE 1]
15050301-001	Santa Cruz R. (below Canada Del Oro)	H A I L E		8.2						SEDIMENT/ TURBIDITY (16) [STC] pH Se, Hg	NATURAL (4) GRAZING CONSTRUCTION MINING (11)	[NOTE 1] SAND AND GRAVEL PITS CONTRIBUTE SEDIMENT AND CONSTRUCTION WASTES (11).
15050303-006	Santa Cruz R.	D H A I L E						19.4		SEDIMENT/ TURBIDITY (16)	HYDROLOGIC MOD. GRAZING (6) AG. IRR. (16)	LOCAL SEVERE EROSION DUE TO WATER DIVERSIONS (16)
15050304-007	Altar Wash	H A I L						14.5		SEDIMENT/ TURBIDITY (16)	NATURAL GRAZING (16)	MODERATELY SEVERE EROSION (16)

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(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-8 (cont.). SANTA CRUZ RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15050304-006	Brawley Wash	H A I L						8.7		SEDIMENT/ TURBIDITY (16)	NATURAL GRAZING (16)	MODERATELY SEVERE EROSION (16)
15050304-005	Brawley Wash	H A I L						11.1		SEDIMENT/ TURBIDITY (16)	NATURAL GRAZING (16)	MODERATELY SEVERE EROSION (16)
15050304-003	Brawley Wash	H A I L						42.5		SEDIMENT/ TURBIDITY (16)	NATURAL GRAZING (16)	MODERATELY SEVERE EROSION (16)
15050304-001	Brawley Wash	H A I L						9.2		SEDIMENT/ TURBIDITY (16)	NATURAL GRAZING (16)	MODERATELY SEVERE EROSION (16)
15050303-005	Santa Cruz R. (below Brawley Wash)	H A I L						14.8		SEDIMENT/ TURBIDITY (16)	HYDROLOGIC/ HABITAT MOD. GRAZING (6) AG. IRR. (16)	FLOWS DIVERTED TO GREEN WASH SW OF PICACHO PEAK, DEPOSITION ON IRRIGATED LANDS. LOCAL SEVERE EROSION(16)
15050305-007	Aguirre Wash	H A I L							4.4	METALS, pH	MINING	NONSUPPORT OF USE (4)
15050306-005	Santa Rosa Wash	H A I L						16.8		SEDIMENT/ TURBIDITY (16)	UNKNOWN	SIGNIFICANT EROSION (16)
15050306-004	Santa Rosa Wash	H A I L						3.4		SEDIMENT/ TURBIDITY (16)	UNKNOWN	SIGNIFICANT EROSION (16)
15050306-003	Santa Rosa Wash	H A I L						14.5		SEDIMENT/ TURBIDITY (16)	UNKNOWN	SIGNIFICANT EROSION (16)
15050306-001	Santa Rosa Wash	H A I L						23.2		SEDIMENT/ TURBIDITY (16)	UNKNOWN	SIGNIFICANT EROSION (16)
15050303-004	Green Wash	H A I L						31.4		SEDIMENT/ TURBIDITY (16)	HYDROLOGIC MOD.	TRANSPORT OF SEDIMENTS FROM DIVERTED SANTA CRUZ WATERS, DEPOSITION OF SEDIMENTS ON AG LANDS (16).

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-8 (cont.). SANTA CRUZ RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15050303-003	Santa Cruz Wash	H A I L						22.5		SEDIMENT/ TURBIDITY (16)	UNKNOWN	ADEQ ASSESSMENT BASED ON UPSTREAM SOURCES.
15050303-001	Santa Cruz Wash	H A I L						7.2		SEDIMENT/ TURBIDITY (16)	UNKNOWN	ADEQ ASSESSMENT BASED ON UPSTREAM SOURCES.

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

The Tucson AMA lies within the Basin and Range province and is divided longitudinally into two elongate north-south subbasins; Avra Altar to the west, and Upper Santa Cruz River to the east.

The hydrologic setting of the Tucson AMA is similar to that of the Phoenix AMA. Basin fill alluvial sediments are divided into three stratigraphic units. The Fort Lowell Formation, 300-900 feet thick, is the most productive water-bearing unit in the AMA. The Tinaja Beds are fluviolacustrine deposits that yield water of good quality from their coarse-grained facies near the mountains. The finer-grained facies in the center of the basin yield poor quality water. The Pantano Formation, 500-1000 feet thick has not been extremely developed for water due to its great depth though the coarser-grained facies yield good quality water.

The Pinal AMA encompasses 4140 square miles of primarily agricultural land within the Santa Cruz surface water basin. The AMA is divided into the following five subbasins: Eloy, Maricopa, Stanfield, Vekol Valley, Santa Rosa Valley, and Aguirre. The upper alluvial and primary water-bearing unit is comprised of unconsolidated gravel, sand and clay and is approximately 300-600 feet thick. The underlying unit is a series of impermeable gypsiferous and halite-bearing clay and silt beds ranging from 900-2000 feet in thickness. A lower sand and gravel unit, 200+ feet thick, yields water to wells. Nitrate and sulfate levels appear to be highest (over 45 mg/l and 500 mg/l respectively) in the Casa Grande and Florence canals and within the San Carlos irrigation district.

The Tucson AMA, as shown on Table III-9, has several discrete groundwater problem areas. Groundwater quality studies at Green Valley in the southern part of the Tucson AMA have reported salinity increases due to open pit copper mining and nitrate contamination from agricultural activities and sewage treatment ponds (**8**). A more recent study on the Green Valley Wastewater Treatment Facility indicates the facility's discharge is improving nitrate levels in comparison to ambient conditions (**7C**). A groundwater study in the Cortaro-Marana area reported high nitrate levels associated with irrigated agriculture, septic tanks, animal feeding operations and effluent disposal. In addition, the same studies identified high salinity values from the vicinity of Tucson Electric Power cooling water discharges to groundwater (**9**). These studies, as well as several which detected the presence of leachate near landfills, were conducted by the Pima Association of Governments (PAG).

In 1980, volatile organic chemicals, primarily the solvent, TCE, were discovered in the groundwater in the Tucson Basin south of the city. Much of this contamination was attributed to improper disposal from ponds, lagoons, and dry wells. However, some contamination has occurred from percolation of chemical discharges to surface drainages. The excessive concentrations of VOCs, chromium, selenium, and lead are thought to be the result of airport and aircraft facility operations. This is the most serious contamination problem in this basin and is presently the focus of a Federal Superfund remedial project. Figure III-16 shows areas of groundwater contamination within the Tucson AMA.

The Pinal AMA groundwater quality is generally good because the land is relatively underdeveloped. Agricultural land uses may increase the nitrate, sulfate, and TDS in some areas of the AMA. Lead and arsenic concentration in the mountainous areas may be due to natural causes. Table III-10 indicates areas of groundwater contamination in the Pinal AMA.

Concern has been voiced nationally and statewide regarding the impact of agricultural chemicals (both pesticides and fertilizers) on water quality. Studies and literature reviews conducted by the Central Arizona Association of Governments (CAAG) (**6**), the South Eastern Arizona Governments Organization (SEAGO) (**14**), the Pima Association of Governments (PAG) (**12**), and the Department of Health Services (ADHS) (**4**) reported little or no impact upon surface or groundwater quality from pesticides. Nitrate from agricultural fertilizer applications and confined animal feeding operations are problems identified in two PAG studies. Analysis of data from groundwater samples collected in the Tucson and Pinal AMAs have indicated a correlation between confined animal feeding operations and intensive agricultural cultivation and violations

TABLE III-9. SANTA CRUZ BASIN - TUCSON AMA (GROUNDWATER ASSESSMENT)

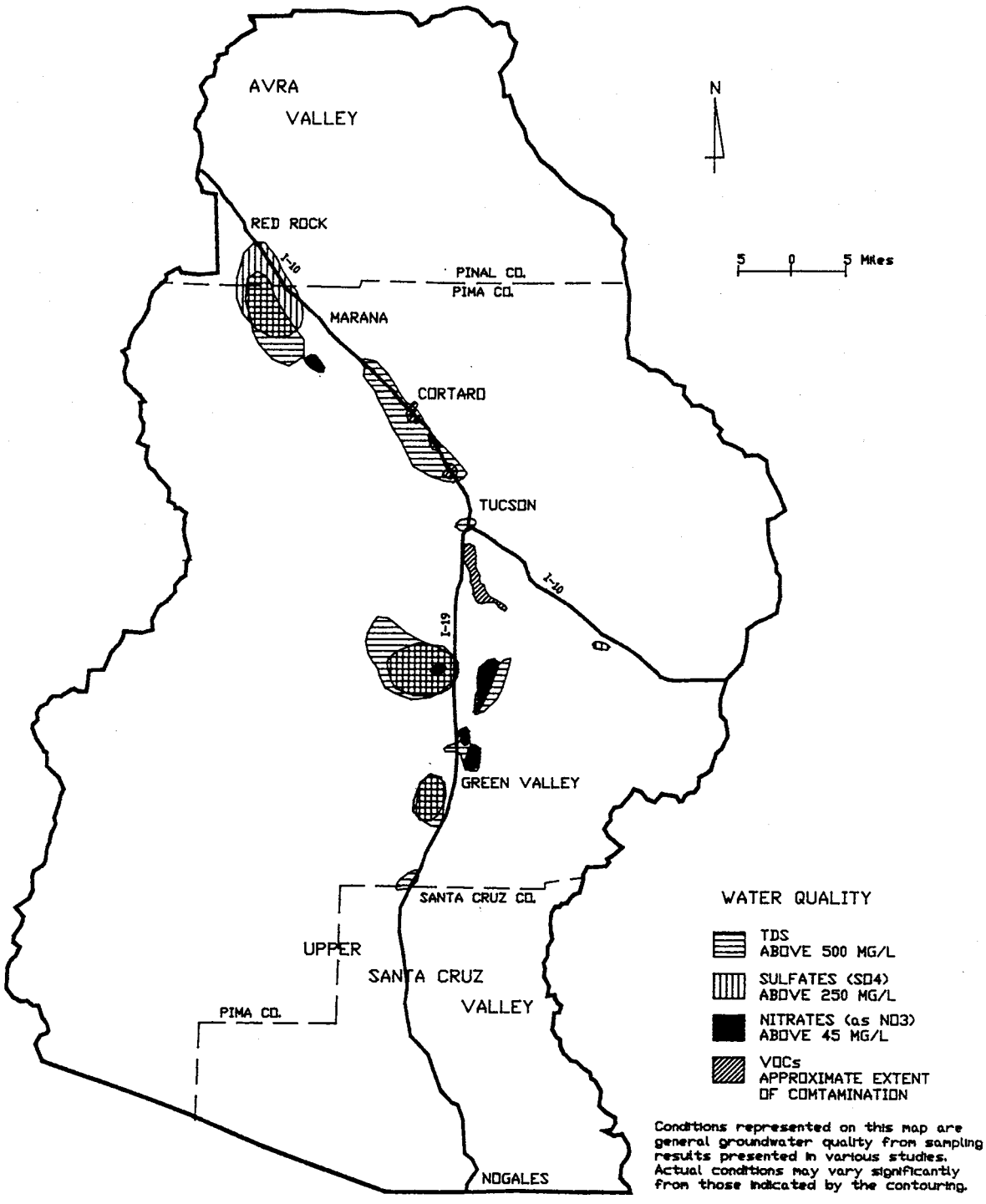
SUBBASIN	SITE	LOCATION	PARAMETERS	SOURCE	COMMENTS
Upper Santa Cruz	Hughes Aircraft	Tucson	VOCs	Land Disposal	6 mile-long plume. Current remedial activities are air stripping and ion exchange Federal Superfund site (CERCLA)
Upper Santa Cruz	Tucson Area Airport	Tucson	VOCs, BTX, Cr	Land Disposal	Monitoring underway. Federal Superfund site (CERCLA)
Upper Santa Cruz	C.G. Conn Ltd.	Nogales	VOCs, CN	Land Disposal	Musical instrument manufacturing. Hazardous material removal and air stripping. Federal site (RCRA).
Upper Santa Cruz	IBM-Rita Road	Tucson	VOCs, Metals	Land Disposal	Monitoring will be installed. Federal site (RCRA)
Upper Santa Cruz	University of Arizona Landfill	Oracle Jct.	Radionucleides	Land Disposal	Monitoring program under review. Federal Site (RCRA)
Upper Santa Cruz	Chrome Company	Tucson	Cr, Pb	Land Disposal	Contaminated soil to be removed. State of Arizona WQARF site.
Upper Santa Cruz	Miracle Mile Interchange	Tucson	VOCs	Land Disposal	Potential sources landfill and equipment yard State of Arizona WQARF site.
Upper Santa Cruz	El Camino del Cerro Landfill	Tucson	VOCs Pesticides Metals	Land Disposal	Severe groundwater contamination monitoring and remedial action underway.
Upper Santa Cruz	Nogales Wash	Nogales	VOCs	Unknown	Remedial investigation underway. Nogales drinking water source. State of Arizona

TABLE III-9 (cont.). SANTA CRUZ BASIN - TUCSON AMA (GROUNDWATER ASSESSMENT)

SUBBASIN	SITE	LOCATION	PARAMETERS	SOURCE	COMMENTS
					WQARF site.
Upper Santa Cruz	Cyprus Sierrita and Asarco Mill Tailings	Green Valley	TDS Sulfate Metals	Mining	
Upper Santa Cruz	Brawley Wash Agricultural Area	Brawley Wash	TDS, NO3, SO4	Agricultural	Northern portion of subbasin.
Upper Santa Cruz	Green Valley Wastewater Treatment Facility	Green Valley	TDS, NO3	Land Disposal	Historically received City of Tucson liquid waste.
Upper Santa Cruz	Green Valley along Santa Cruz River	Green Valley	Nitrate TDS Sulfate	Septic tanks	
Upper Santa Cruz	Cortaro along Santa Cruz River	Tucson	Nitrate TDS, VOCs Sulfate	Septic tanks Land Disposal	

TABLE III-10. SANTA CRUZ BASIN - PINAL AMA (GROUNDWATER ASSESSMENT)

SUBBASIN	SITE	LOCATION	PARAMETERS	SOURCE	COMMENTS
Maricopa-Stanfield	Gila Indian Reservation	Near the confluence Gila and Santa Cruz	TDS, Sulfate	Agriculture	1950 mg/l TDS 500 mg/l sulfate
Maricopa-Stanfield	Small Agriculture Area Irrigated Agricultural Area	Between Maricopa and Stanfield	NO3	Agricultural	
Maricopa-Stanfield	Un-named	West of Casa Grande	Arsenic	Unknown	Over 0.05 mg/l
Santa Rosa	Santa Rosa Valley	---	Pb	Natural	Over 0.05 mg/l
Aguirre Valley	Aguirre Valley	---	Pb	Natural	Over 0.05 mg/l



Exerpted from Arizona Department of Water Resources, Draft Management Plan, Second Management Period: 1990-2000, (Tucson Active Management Area, April 1988), pp 51-57.

Figure III-16. Map of the groundwater contamination in the Tucson Active Management Area.

of nitrate/nitrite standards. These correlations are further supported with similar data from the Phoenix AMA.

Land Use

Human activity is concentrated in the basin bottoms along the Santa Cruz River and in the Avra-Altar sub-basin to the west. Tucson, the largest urban center in the basin, is located at the confluence of the Santa Cruz River and Rillito Creek. The Tucson Metropolitan Area occupies much of that area of the Tucson Basin which extends from Marana, an agricultural community in the north, to Green Valley, a retirement community 45 miles to the south. Less than 475 total square miles of the Santa Cruz Basin is urbanized. Other cities and towns in the basin include Nogales at the international boundary, Oro Valley, South Tucson in the Tucson Metropolitan Area, as well as the farming communities of Eloy and Casa Grande to the north.

Most of the population in the basin is concentrated in the Tucson Metropolitan Area. Casa Grande and Nogales are smaller population centers supported economically by agriculture and border trade activities, respectively. Agricultural activities are confined to localized sites along the length of the Santa Cruz Valley, which extends from Nogales, in the south, to Stanfield, in the north. Although some of the agricultural land in the basin has been converted to urban use or retired because water rights have been purchased by mining or urban interests, pockets of active irrigated agriculture still flourish. Agricultural land use is also found south of Tucson at Green Valley and Three Points. The Cortaro-Marana Irrigation District north of Tucson continues to have acreage converted to urban uses. However, agricultural land use will continue to be dominant through the year 2000. Agriculture is also the dominant land use north of the Pima County/Pinal County line, but industrial development has broadened the economic base in the Casa Grande service area.

Like most of the lands situated in the Basin and Range Physiographic Province, the drainage area of Santa Cruz River and its tributaries is delineated by mountain ranges. These mountain ranges also support other activities such as mining, grazing, and recreation. The Sierrita, Santa Rita, Santa Catalina, and the Tucson mountains are all ranges in which these land uses are common. Generalized land use for the basin is displayed in Figure III-17.

Agricultural NPS (10)

Grazing is a widespread land use which appears to contribute to the nonpoint source discharges in the basin. Sedimentation resulting from soil erosion is the major problem associated with grazed rangelands (**16**). Poor range management and grazing activities result in soil compaction, reduced vegetative cover, and an increased surface runoff.

Since 1978, none of the areawide planning agencies or the state or federal land management agencies have identified water quality problems related to grazing other than sedimentation. Arroyo cutting within the Santa Cruz watershed may have been triggered by an imbalance between infiltration and runoff caused by a combination of climatic change and cattle grazing prior to 1895 (**18**).

Silvicultural NPS (20)

Water quality impacts from silviculture activities are usually related to timber harvest processes. Sediment is the most significant pollutant associated with road building and timber cutting. Water temperature increases due to canopy reduction can also occur. None of the sources consulted for this report cited groundwater or surface water quality problems from this activity.

Construction NPS (30)

Population growth in southern Arizona has resulted in a significant increase in construction activities causing soil loss and sedimentation. Construction in the urban areas of Tucson and Casa Grande have produced short term, localized sedimentation problems which were not reported or recorded as water quality violations. Soil may also be transported from construction sites and deposited

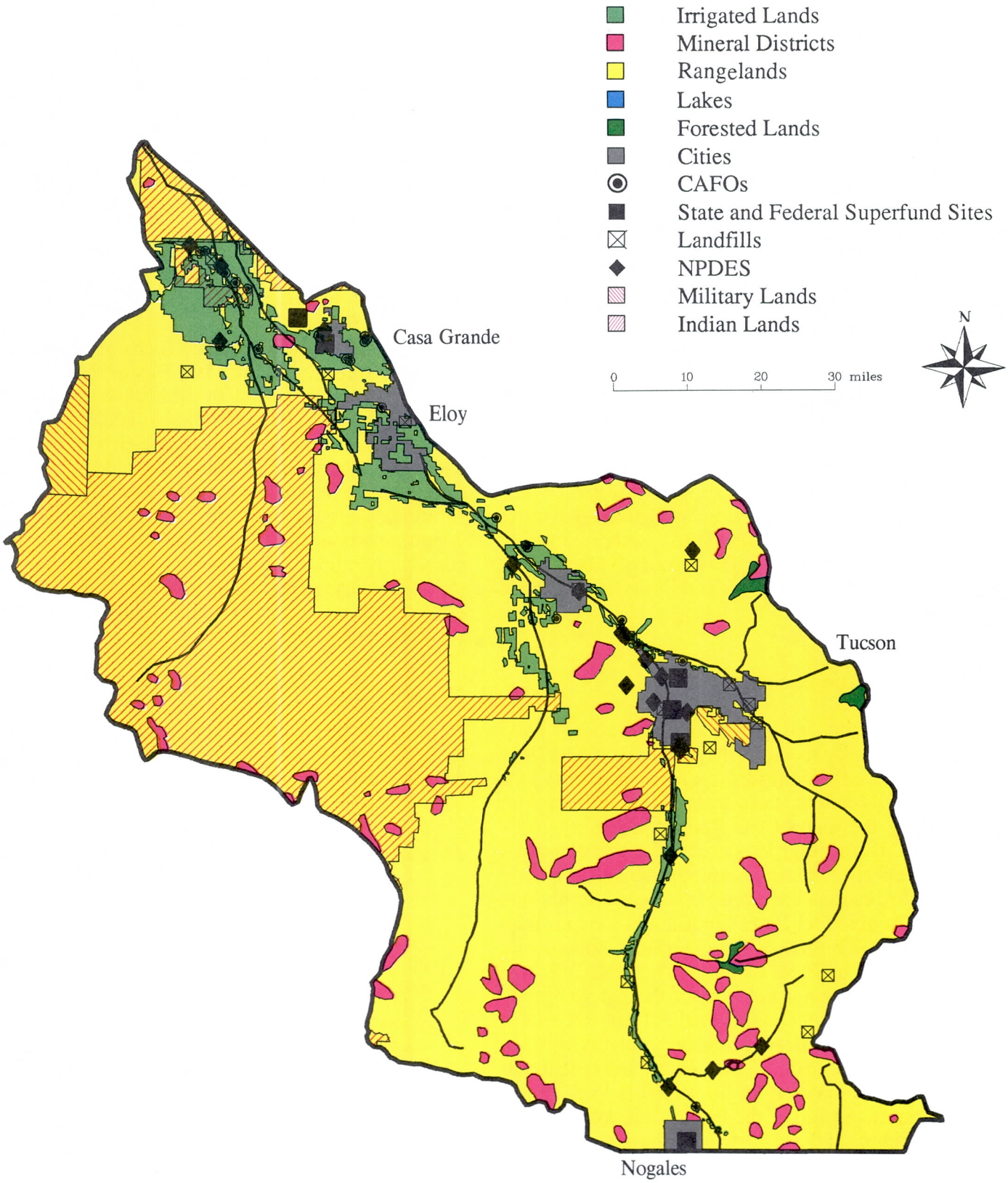


Figure III-17. Land use map of the Santa Cruz Basin.

along streets and gutters where it becomes a source of particulate air pollution as well as a potential water quality problem.

Urban Runoff NPS (40)

Pollutant studies completed in 1977 by the Pima Association of Governments evaluated nonpoint source loadings in the Tucson area attributable to urban runoff (**13**). Small scale grass and soil filtration systems (actually infiltration basins) were recommended as effective and reasonable management practices. Urban runoff monitoring has continued since 1977. The Rillito recharge project is a cooperative effort between the Arizona Department of Water Resources, the City of Tucson, and Pima County Flood Control examining the feasibility of recharge using the infiltration basin concept. The preliminary phase of this project is currently accumulating additional water quality data on urban runoff (**4A**). Little information is available regarding the impact of urban runoff in other towns (Nogales and Casa Grande) in the basin.

Land Disposal NPS (60)

Relict sand and gravel extraction sites have traditionally served as illegal landfills. The 1977 PAG study identified more than twenty-two landfills or dumps within the 100 year flood plain along the Santa Cruz River and Rillito Creek (**10**). During high flows several of these landfills have been inundated. Limited groundwater quality investigations have been conducted around the El Camino Del Cerro landfill and the Ina Road landfills. Both facilities have received remedial attention by Pima County. The PAG 208 plan identified seven other landfills that warranted additional water quality studies (**10**). Records of the ADEQ indicate possible problems with the Nogales landfill. Little or no information is available concerning the landfills in the Pinal County portion of the basin. It is worth noting that some of the historic landfills along the Santa Cruz are suspected sources of volatile organic chemicals discovered in the groundwater along the river north of Tucson.

Septic systems have been identified as having a direct impact on both surface and groundwater quality within the Santa Cruz Basin. Excess nitrates in groundwater along the flank of the Tucson Mountains were attributed in part to use of septic systems effluent disposal (**9**). Nitrates and fecal coliform bacteria violations in Sabino Creek were caused by failing septic systems on Mt. Lemmon (**11**).

Resource Extraction NPS (50)

Mining has historically been a focus of human activity within the Santa Cruz Basin. Mining operations active during the last decade exist near Green Valley on the east flanks of the Sierrita Mountains, the south flank of the Silver Bell Mountains, the west flank of the Santa Rosa and Slate Mountains, and the west flank of the Vekol Mountains. Because of the cyclic prices paid for copper, many of these mines which reduced or ceased operations are now reopening. Water quality studies and complaint investigations have documented water quality impacts due to mining in the following areas:

1. Upper Santa Cruz Basin - groundwater quality impairment due to increasing TDS and sulfate. (**4A,7B**)

2. Cocio Wash - heavy metals and sediment in surface water due to tailings runoff (**1**).

3. Sonoita Creek, which drains the south flank of the Santa Rita Mountains and the north flanks of the Patagonia Mountains-surface water impacted by violations of metals and pH standards (**4**).

4. Aguirre Wash - surface water pollution consisting of metals and acidity associated with drainage from the Silver Bell mine tailings ponds and waste dump areas (**4**).

5. Harshaw Creek, a tributary of Sonoita Wash, surface water has been impacted by acid mine drainage from abandoned inactive mines (**4**).

6. Tinaja Wash, which drains to the Santa Cruz River from the open pit copper mines along the east flanks of the Sierrita Mountains, surface water quality violations from metals and acidity (3).

Sand and gravel production can contribute to violations of the turbidity standards (sedimentation) for surface water. However, no violations of surface water quality standards have been attributed to sand and gravel operations within the Santa Cruz Basin.

Hydrologic and Habitat Modification NPS (70)

Because of extensive groundwater use throughout the basin, the Santa Cruz River has ceased perennial flows. Tributary streams still flow in the Nogales area and in the immediate vicinity of some mountain ranges, but throughout the rest of the basin surface water run-off results from wastewater discharges and major precipitation events. Early settlers found flow in the river adequate and in 1908 the water table in the Tucson area was higher than the streambed (**18**). Except in the southernmost part of the basin, riparian habitats are impoverished, but along the Santa Cruz River a riparian community has developed that is supported by effluent disposal (**7A**). From Marana north, irrigation return flows and seasonal runoff events support riparian vegetation which is a productive wildlife habitat (**7D**).

Within the city limits of Tucson, channel modification has proceeded under the guise of flood control and bridge development. Additional modification to the Rillito Wash drainage and the Santa Cruz River will occur in the Tucson area as the channel environments are developed to treat and infiltrate urban run-off, provide urban parks and open space, and perhaps serve as a major infiltration gallery for CAP water.

Recreation NPS (100)

Recreational impacts on surface water quality have been documented in the uplands away from the main stem of the Santa Cruz Basin. Nutrients, fecal coliform bacteria, and solid waste are the common pollutants of concern. Water bodies impacted by this category of activity include:

1. Sabino Creek, which flows from Mt. Lemmon to the Rillito Wash north east of Tucson - A management program implemented in the late 1970's by Pima County and the USFS has moderated the impacts on surface water quality (**11**).

2. Patagonia Lake, the largest recreational lake in the Santa Cruz Basin - Water quality problems relate to recreational use as well as sediment loss from grazing. Plasticizers and other organic chemicals have been a minor problem in this lake's immediate watershed (**2**).

Santa Cruz Basin References

1. Arizona Department of Environmental Quality, No date, "Ambient Water Quality File 540.411: Silver Bell West."

2. Arizona Department of Environmental Quality, No Date, "Ambient Water Quality File 549: Patagonia Lake Watershed."

3. Arizona Department of Environmental Quality, No Date, "Ambient Water Quality File 549.600: Complaint of Pollution in Esperanza Wash, Tinaja Wash, Pima County."

4A. Arizona Department of Water Resources, 2/89, "Comment Letter to ADEQ on the Draft 1988 NPS Assessment Report."

4. Arizona Department of Health Services, 8/86, "Water Quality Assessment for the State of Arizona: Water Years 1984 and 1985."

5. Arizona Game and Fish Department, 1985, "Arizona Fishin' Holes, A Guide to Popular Fishing Waters and Facilities in Arizona."

6. Central Arizona Association of Governments, 10/78, "Areawide Water Quality Management Plan."

7A. Harding and Lawson, 1986," Site Specific Water Quality Criteria Study fot Santa Cruz River," prepared for the Pima County Wastewater Management Department.

7B. Pima Association of Governments,5/89, "Metropolitan Tucson Basin Water Quality and Pollution Source Assessment, 208 Data Update."

7C. Pima Association of Governments, 1986, "Impacts of the Green Valley Wastewater Treatment Facility on Groundwater Quality," 205 (J) Water Quality Planning.

7D. Pima Association of Governments, 7/86,"Santa Cruz River Alignment Recharge Study."

8A. Pima Association of Governments, 9/83, "Groundwater Monitoring in the Tucson Copper Mining District,"208 Report.

8. Pima Association of Governments, 9/83, "Assessment of Nitrate in Groundwater of the Upper Santa Cruz Basin."

9. Pima Association of Governments, 4/83, "Cortaro Area Pollution Source Assessment."

10. Pima Association of Governments, 6/78, "Areawide Wastewater Management Plan."

11. Pima Association of Governments, 1/78, "Mt. Lemmon Non-Point Source Water Pollution Abatement Plan."

12. Pima Association of Governments, 12/77, "Non-Point Source Management Alternatives."

13. Pima Association of Governments, 8/77, "Land Use and Water Quality Relationship Report."

14. South Eastern Arizona Governments Organization, 10/78, "Water Quality Management Plan."

15. U.S. Department of Agriculture, Forest Service, Southwestern Region, 7/86, "Environmental Impact Statement for the Coronado National Forest Plan."

16. U.S. Department of Agriculture, Soil Conservation Service, Economic Research Services, and Forest Service, 8/77, "Santa Cruz - San Pedro River Basin, Arizona, Main Report."

17. U.S. Department of Agriculture, Soil Conservation Service, 1971, Arizona Sediment Yield Map."

18. U.S. Department of the Interior, Geological Survey, 1970, "Streamflow in the Upper Santa Cruz Basin, Santa Cruz and Pima Counties, Arizona."

H. Upper Gila Basin

Description

The Gila River originates in the alpine-conifer forests of the Mogollon Mountains in west-central New Mexico at an elevation of over 9000 feet. Flowing southwesterly, from New Mexico, the Gila River enters Arizona in the desert grasslands near Duncan. From Duncan, the river flows westward across southern Arizona to empty into the Colorado River near Yuma.

Within Arizona, the Upper Gila Basin includes the Gila River and its tributaries upstream of Coolidge Dam and its impoundment, San Carlos Reservoir (Figure III-18). The drainage area upstream from the Coolidge Dam is about 7,399 square miles. The cataloging units for the basin are: 15040002, 15040004, 15040005, and 15040007. Most of the drainage is Sonoran desert scrub with minor desert grasslands, and in the upper reach mountain grassland and forest. The Arizona Game and Fish Department lists 7 lakes totaling 851 acres in the basin (**5**). Soil sediment yields are negligible to moderate in the basin (less than 0.2 to 1.0 acre feet per square mile per year) (**8**).

A major tributary, the San Francisco River, drains the southeastern part of the White Mountains and enters the Gila River near Clifton, Arizona. The San Francisco River originates in Arizona near the town of Alpine. From its point of origin, the river then flows southeast into New Mexico, where it loops and returns to Arizona 40 miles to the south. Agricultural demands in the Safford-Gila Valley and Duncan-Virden Valley utilize a high percentage of the flow of the Gila River. The remainder of the flow through these agricultural areas impounds behind the Coolidge Dam.

Surface Water Quality

The ADEQ NPS assessment covered 356.3 miles of the 920.3 miles of stream segments shown in the EPA Reach File for the Arizona part of the Upper Gila Basin. The assessment also showed that protected use support in these stream segments was as follows: 8.0 miles, threatened; 320.6 partial support; and 27.7 miles, nonsupport. The results of this assessment are displayed in Table III-11.

Monitoring and evaluation data indicate that turbidity and sediment levels are elevated throughout the basin. Mining, grazing, agricultural irrigation, and silviculture (forest roads) are among the suspected sources of the erosion problems in the drainage.

Total dissolved solids (TDS) increase from upstream to downstream in the Upper Gila Basin, and attains levels rated as hazardous for some irrigated crops. Near Safford, Arizona, boron concentrations also attain levels potentially hazardous to irrigated crops. Natural, unknown, mining, land disposal (on-site waste disposal), and agricultural irrigation probably contribute to these water quality problems.

Bacteria violations and elevated nutrient levels also occur in the basin and the sources are not well understood. However, in the Upper Gila River near Luna Lake on-site waste disposal sources are suspected. Metal violations seem to be clearly related to mining activity in tributary watersheds to the Gila River such as Chase Creek and the San Francisco River.

Land Use

The use of the land (Figure III-19) within the Upper Gila Basin follows patterns established in territorial days. There is significant public land ownership where agriculture, mining and recreation are important land use activities.

The San Carlos Indian Reservation which occupies the northern one third of the basin, is predominantly used for livestock grazing, lumbering, and recreation. The majority of the federal land area in the Upper Gila Basin is managed by the USFS and much of the remaining land is managed by the BLM. State Trust Lands account for the other public lands in the basin. The Apache-Sitgreaves and the Coronado National Forests are predominantly used for recreation and livestock grazing by permit (FS). Some portions of the national forests are managed for timber harvest

and firewood production. Additionally, some areas of the national forests have been homesteaded and are now being subdivided for summer home use. The majority of the public lands managed by the BLM are available for livestock grazing by lease. Mining also occurs on BLM managed lands and other areas are protected in their natural state. Portions of the State Trust Lands are also leased for grazing. The San Carlos Reservoir, which falls entirely within the study area, provides water-related recreation.

Agricultural NPS (10)

An identified impact on Arizona's water quality associated with agricultural irrigation is caused by mineral or salt concentration due to evaporation and transpiration. Additional agricultural impacts upon water quality in the Safford area include nutrients from fertilizers and animal wastes and pesticides applied to crops and livestock (**4**).

Management of grazing activities appears to have contributed to the identified poor rangeland conditions in some areas of the basin (**6**). Over use of riparian areas by livestock has caused damage to the water resources.

Silvicultural NPS (20)

Of the 25 major watersheds in the Apache/ Sitgreaves National Forest, 19 are rated as satisfactory or better and 6 are rated as unsatisfactory. Unsatisfactory watersheds are those where the vegetation protecting the soil surface has been removed to the point that accelerated erosion is occurring and some peak flood flows are being affected (**6**).

Erosion on forested land is generally slight to moderate. Logging and road construction, associated with commercial timber operations on the San Carlos Indian Reservation and in the Apache-Sitgreaves National Forest, has resulted in soil loss. The most severe erosion from forest lands, and resulting sedimentation in streams, has occurred following forest fires.

Resource Extraction (50)

Mining in the Upper Gila Basin is concentrated near Morenci and Clifton. Lower Chase Creek has been historically impacted by both point and nonpoint source pollution. As a result of state and federal enforcement actions, a major mine water control program was initiated to recover all runoff from mining operations and to bypass normal stream flows around the mine. Due to the highly mineralized geology of the Clifton-Morenci area, springs believed to be of natural origin continue to discharge elevated concentrations of copper, cadmium, selenium, zinc, and sulfate to the San Francisco River and Gold Gulch.

The EPA served Newmont Mining Corporation (6186) with a "Finding of Violation" (No. IX-FY 86-80). This order required Newmont, Magma Copper's parent company at that time, to cease all discharge of acid mine drainage, to remove any remaining mineral precipitates from Saloon Gulch and Copper Creek streambeds and to monitor the water quality of Copper Creek for approximately one year. As of the present, the mineral precipitates have been removed and surface water quality with respect to copper have improved (**6A**).

Land Disposal NPS (60)

The communities which rely on septic tanks for wastewater treatment are: Alpine, Bowie, Fort Thomas, Pima and Solomon (**4**).

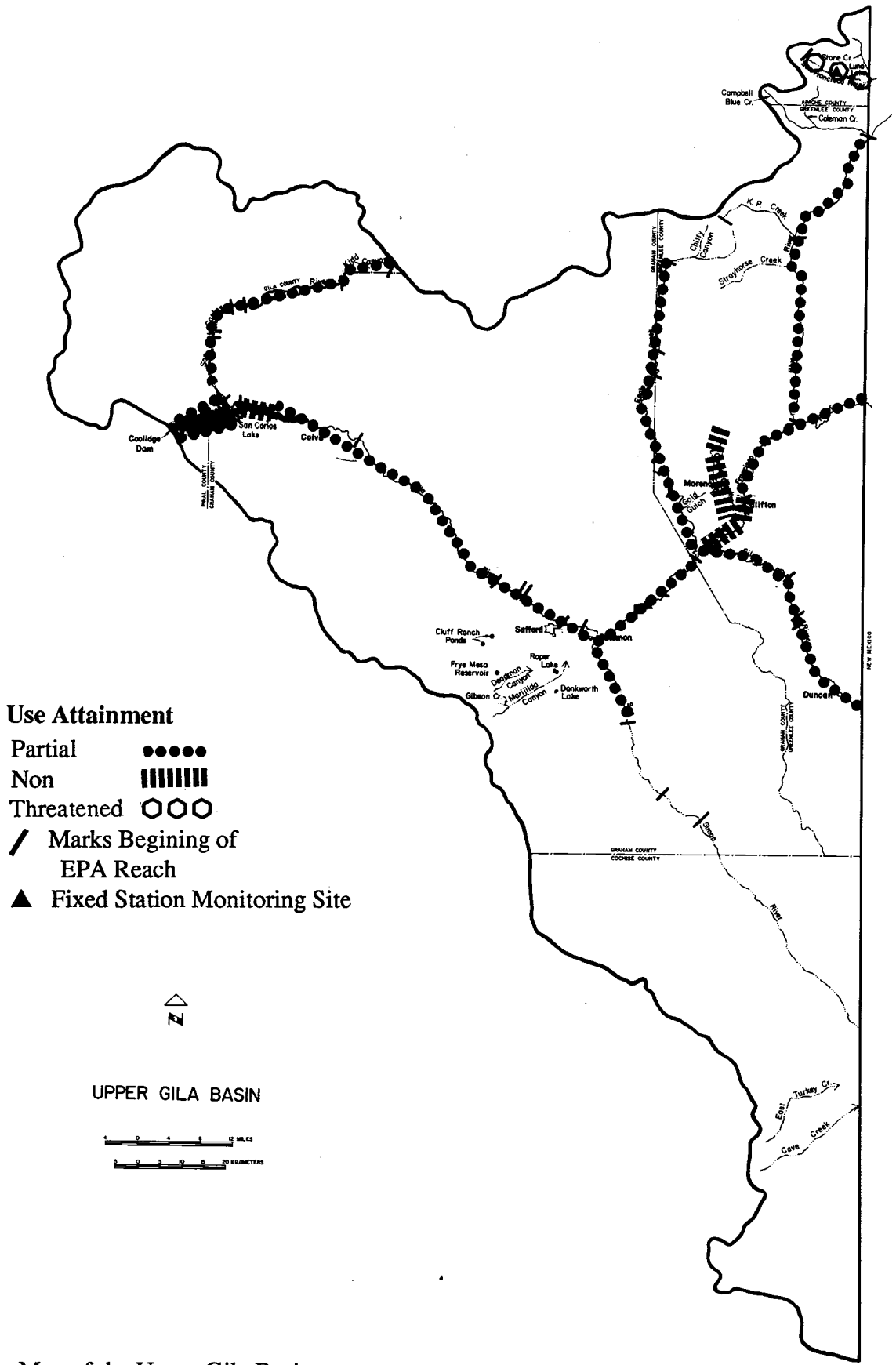


Figure III-18. Map of the Upper Gila Basin.

TABLE III-11. UPPER GILA RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATION (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15040002-004	Gila R.	H A I L						17.0		METALS, BACTERIA (2) SEDIMENT/ TURBIDITY (6)	UNKNOWN GRAZING SILVICULTURE (6) MINING (2)	PARTIAL SUPPORT OF USES (2) POOR WATERSHED CONDITIONS OCCUR ON 6,697 ACRES (6) GRAZING AND FOREST ROADS ARE SOURCES. 31.4 MILES IN SEGMENT, 17 MILES IN AZ.
15040002-003	Gila R.	H A I L						2.2		METALS BACTERIA (2)	UNKNOWN MINING	NOTE 1. PARTIAL SUPPORT OF USES (2).
15040002-002	Gila R.	H A I L						6.0		METALS BACTERIA (2)	UNKNOWN MINING	[NOTE 1]
15040002-001	Gila R.	H A I L						13.1		METALS BACTERIA (2)	UNKNOWN MINING	[NOTE 1]
15040004-023	San Francisco R.	D F C I L				8.0				DO (3)(2) NUTRIENTS (2) SEDIMENT/ TURBIDITY (6) [STA-40] NO3, PO4 DO, TURBIDITY	UNKNOWN (2) LAND DISPOSAL	NOTE 2. POOR WATERSHED CONDITION 75,648 ACRES, GRAZING AND POOR FOREST ROAD MAINTENANCE ARE SOURCES OF SEDIMENT (6). LUNA LAKE IN SEGMENT, VIOLATIONS OF A&W DUE TO LOW D.O. LUNA L. NONSUPPORT OF USES (2).
15040004-004	San Francisco R.	D F C I L						12.0		SEDIMENT/ TURBIDITY (6)	GRAZING SILVICULTURE (6)	[NOTE 2] 32.3 MILES IN SEGMENT, ABOUT 12 MILES IN AZ.
15040004-027	Blue R.	H C I L						8.1		SEDIMENT/ TURBIDITY (6)	GRAZING SILVICULTURE (6)	NOTE 3. POOR WATERSHED CONDITION 83,524 ACRES, GRAZING AND POOR FOREST ROAD LOCATION AND MAINTENANCE ARE SOURCES OF SEDIMENT (6).
15040004-026	Blue R.	H C I L						18.8		SEDIMENT/ TURBIDITY (6)	GRAZING SILVICULTURE (6)	[NOTE 3]
15040004-025	Blue R.	H C I L						28.1		SEDIMENT/ TURBIDITY (6)	GRAZING SILVICULTURE (6)	[NOTE 3]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-11 (cont.). UPPER GILA RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATION (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	MONITORED (c) PART	MONITORED (c) NON	MONITORED (c) T	EVALUATED (c) FULL	EVALUATED (c) PART	EVALUATED (c) NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15040004-003	San Francisco R. (Blue R. confluence)	D F C I L						15.0		SEDIMENT/ TURBIDITY	GRAZING SILVICULTURE	[NOTE 3]
15040004-	Chase C.	H A L							6.0	METALS (2) pH	MINING	NON SUPPORT OF USES (2).
15040004-001	San Francisco R.	D F C I L			10.7					METALS (2) pH TDS (3) [STB-18] TDS NO3, PO4, Zn BACTERIA [STC] TURBIDITY Hg	MINING	NONATTAINMENT TO 3 MILES BELOW CLIFTON; PARTIAL ATTAINMENT TO 9 MILES ABOVE GILA CONFLUENCE (2). DEGRADATION OF AQUATIC ECOSYSTEM FOR 3.8 MILES DUE TO ACID MINE DRAINAGE (3). TDS RANGE 200-1200 MG/L, CONTRIBUTES SIGNIFICANT Na AND Cl TO GILA R. (4) [STB-18] TDS RANGE 196-660 MG/L
15040005-024	Gila R.	H A I L						3.0		METALS, BACTERIA (2)	MINING GRAZING AG. IRR. UNKNOWN (2)	[NOTE 1]
15040005-023	Gila R.	H A I L		9.0						METALS, BACTERIA (2)	MINING UNKNOWN (2) AG. IRR. GRAZING	[NOTE 1]
15040005-028	Eagle C.	D H A I L						13.2		SEDIMENT/ TURBIDITY	GRAZING SILVICULTURE	NOTE 4. POOR WATERSHED CONDITION, 68,759 ACRES (6)
15040005-027	Eagle C.	D H A I L						4.6		SEDIMENT/ TURBIDITY	GRAZING SILVICULTURE	[NOTE 4]
15040005-	Gold Gulch (Trib to Eagle C.)	D H A I L							4.0	METALS, pH (2)	MINING (2)	NONSUPPORT OF USES (2).

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-11 (cont.). UPPER GILA RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATION (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15040005-025	Eagle C.	D H A I L						33.0		SEDIMENT/ TURBIDITY	GRAZING SILVICULTURE	[NOTE 4]
15040005-022	Gila R	H A I L		6.0						METALS, BACTERIA (2)	MINING UNKNOWN (2) AG. IRR. GRAZING	[NOTE 1]
15040005-020	Gila R.	H A I L		7.7						METALS, BACTERIA (2) [STC] TURBIDITY pH, Cu, B	MINING UNKNOWN (2) AG. IRR. GRAZING	[NOTE 1]
15040006-001	San Simon R.	A I L						15.0		TDS (4)	NATURAL AG. IRR. (4)	TDS RANGE 500-900 MG/L (4)
15040005-019	Gila R	H A I L		2.0						METALS, BACTERIA	MINING UNKNOWN (2) AG. IRR. GRAZING	[NOTE 1]
15040005-017	Gila R	H A I L		6.6						METALS, BACTERIA	MINING UNKNOWN (2) AG. IRR. GRAZING	[NOTE 1]
15040005-016	Gila R	H A I L		0.4						METALS, BACTERIA	MINING UNKNOWN (2) AG. IRR. GRAZING	[NOTE 1]
15040005-015	Gila R	H A I L		3.6						METALS, BACTERIA	MINING UNKNOWN (2) AG. IRR. GRAZING	[NOTE 1]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-11 (cont.). UPPER GILA RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATION (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15040005-014	Gila R	H A I L		3.8						METALS, BACTERIA	MINING UNKNOWN (2) AG. IRR. GRAZING	[NOTE 1]
15040005-012	Gila R	H A I L						21.4		METALS, BACTERIA TDS (4)	MINING UNKNOWN (2) AG. IRR. GRAZING	SIX FOLD INCREASE IN TDS FROM NEW MEXICO BORDER TO BYLAS, AZ. TDS RANGE 230 TO 1370 MG/L. DOWNSTREAM FROM THIS SEGMENT TO SAN CARLOS RATED HIGH HAZARD FOR AGRICULTURE (4).
15040005-011	Gila R. (Calva)	H A I L		15.1						METALS, BACTERIA [STB-13] TDS TURBIDITY NO3, PO4 Cu, Hg, Pb, Zn BACTERIA	MINING UNKNOWN (2) AG. IRR. GRAZING	NOTE 5. TDS RATED HIGH HAZARD FOR AGRICULTURE (4) [STB-13] TDS RANGE 300-2670 MG/L.
15040005-010	Gila R.	H A I L							7.0	METALS, BACTERIA	MINING UNKNOWN (2) AG. IRR. GRAZING	[NOTE 5]
15040005-009	Gila R. (San Carlos Res.)	F A I L						3.3		NUTRIENTS (3)	HYDROLOGIC/ HABITAT (2)	NOTE 6. CHLOROPHYLL a VALUES SOME OF HIGHEST IN AZ. FISH KILLS RELATED TO DRAWDOWNS, LOW WATER LEVELS, INCREASED TEMPS, LOW DO. (3)
15040007-007	San Carlos R.	F A I L		11.3						SEDIMENT TURBIDITY (7) [ST-14] NO3 PO4	GRAZING RECREATION (7)	NOTE 7. POOR WATERSHED CONDITION (7)
15040007-005	San Carlos R.	F A I L						16.3		SEDIMENT TURBIDITY (7)	GRAZING RECREATION (7)	[NOTE 7]
15040007-004	San Carlos R.	F A I L						1.6		SEDIMENT TURBIDITY (7)	GRAZING RECREATION (7)	[NOTE 7]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
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TABLE III-11 (cont.). UPPER GILA RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATION (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)(e)	SOURCE (d)(e)	REMARKS (e)
15040007-003	San Carlos R.	F A I L						3.8		SEDIMENT TURBIDITY (7)	GRAZING RECREATION (7)	[NOTE 7]
15040007-002	San Carlos R.	F A I L						0.7		SEDIMENT TURBIDITY (7)	GRAZING RECREATION (7)	[NOTE 7]
15040007-001	San Carlos R.	F A I L						8.2		SEDIMENT TURBIDITY (7)	GRAZING RECREATION (7)	[NOTE 7]
15040005-038	San Carlos R. (San Carlos Res.)	F A I L						3.1		SEDIMENT TURBIDITY (7)	GRAZING RECREATION (7)	[NOTE 7]
15040005-008	Gila R (San Carlos Res.)	F A I L						0.7		SEDIMENT TURBIDITY (7)	GRAZING RECREATION (7)	[NOTE 6]
15040005-001	Gila R. (San Carlos Res.)	F A I L						6.9		[STA-14] NO3, PO4	GRAZING RECREATION (7)	[NOTE 6] [STA-14] SITE BELOW COOLIDGE DAM.

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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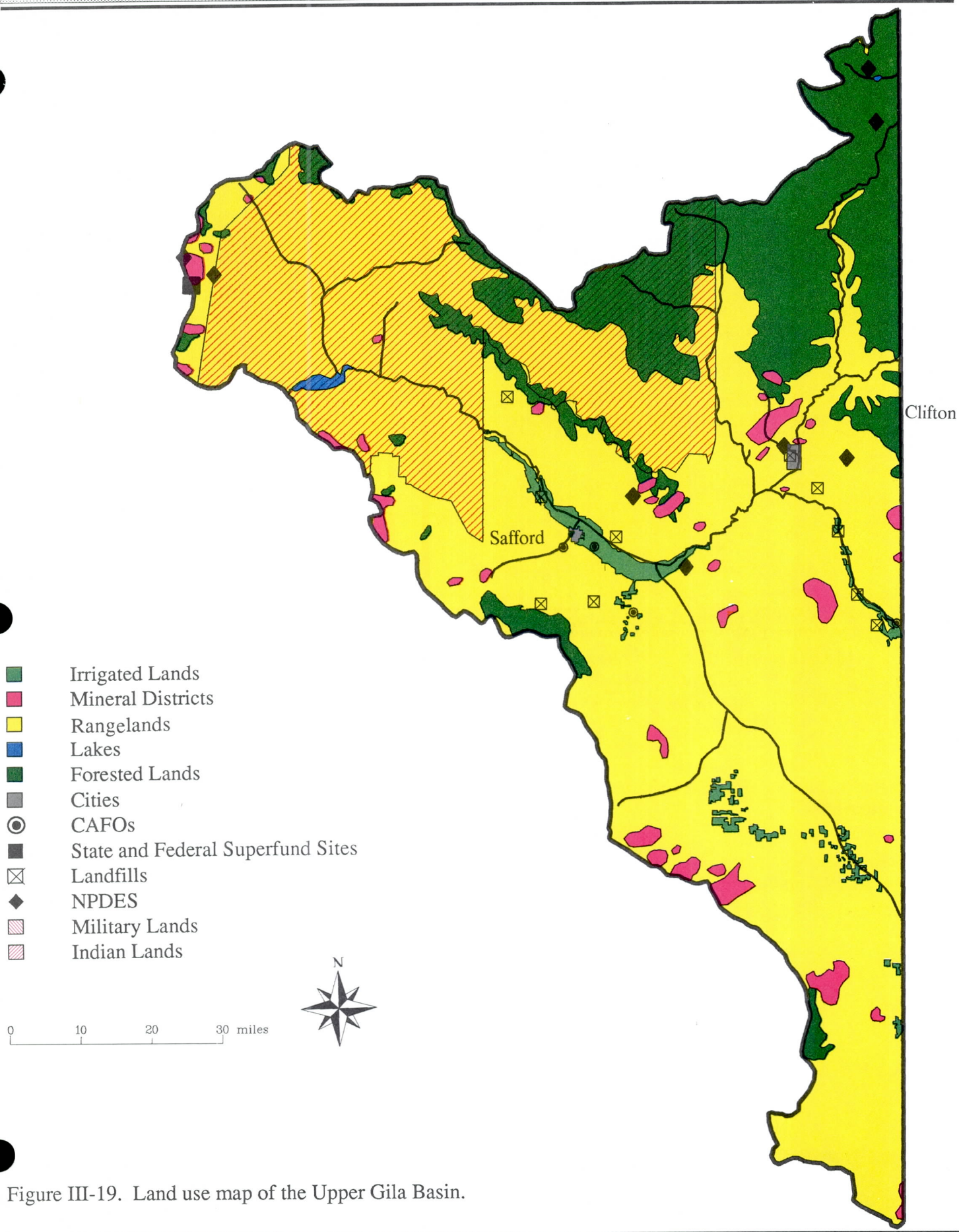

Figure III-19. Land use map of the Upper Gila Basin.

Upper Gila Basin References

1. Arizona Department of Environmental Quality, 1984-1988, "Water Assessment Section Files, File No. AWQU - 540.513, Gold Gulch.

2. Arizona Department of Health Services, 8/86, "Water Quality Assessment for the State of Arizona, Water Years 1984 and 1985."

3. Arizona Department of Health Services, 9/85, "The Upper Gila River Watershed: Nutrient Standards Review."

4. Arizona Department of Health Services, 7/77, "Upper Gila and San Pedro River Basins, Water Quality Management Plan."

5. Arizona Game and Fish Department, 1985, "Arizona Fishing Holes, A Guide to Popular Fishing Waters and Facilities in Arizona.

6. U.S. Department of Agriculture, Forest Service, Southwestern Region, 8/87, "Apache-Sitgreaves National Forest Plan."

7. U.S. Department of Agriculture, Forest Service, Southwestern Region, 10/85, "Environmental Impact Statement for the Tonto National Forest Plan."

8. U.S. Department of Agriculture, Soil Conservation Service, 1971, Arizona Sediment Yield Map."

6A. Magma Copper Corporation, 3/89. "Comment Letter to ADEQ on the Draft 1988 NPS Assessment Report."

I. Verde Basin

Description

The Verde River and its tributaries drain a basin area of 6,646 square miles (Figure III-20). The cataloging units for the basin are 15060201, 15060202 and 15060203. The Verde River originates at the confluence of the Big Chino Wash and Williamson Valley Wash north of Prescott and terminates at its confluence with the Salt River east of Phoenix. Its principal tributaries include Sycamore Creek, Oak Creek (which has Unique Waters Status), Beaver Creek, West Clear Creek, and the East Verde River. In addition, Granite and Willow Creeks in the Prescott area are of local importance.

Two impoundments are formed on the Verde River by Bartlett and Horseshoe dams which store water for agricultural and domestic uses and regulate the flow of the Verde River. They are designated as storage reservoirs and have a capacity of 309,600 acre feet and a total surface area of 1,920 acres.

The Arizona Game and Fish Department lists 15 lakes in this basin totaling 3,269 acres (**7**). From the Arizona sediment yield map (U.S. Soil Conservation Service), the basin has a range of negligible to moderate erosion potential (less than 0.2 to 1.0 acre feet per square mile per year sediment yield) (**20**). The basin vegetation consists primarily of desert grassland chaparral.

The Verde Basin is a significant recreational and water supply resource in Arizona. Recreational activities such as fishing, camping, and summer homes in the forest are the major uses of the headwaters of this basin. The water impoundments on the Verde, Bartlett, and Horseshoe reservoirs, are valuable year-round recreational areas in close proximity to the Phoenix Metropolitan Area. The Verde River supplies high quality water, low in TDS, for agricultural water and potable purposes. Because of the desirable attributes of this watershed, a high level of protection and priority is essential.

Surface Water Quality

The EPA Reach File lists 1,298.6 miles in the Verde Basin and the ADEQ assessed 780.7 miles in the NPS assessment shown in Table III-12. Protected use support in assessed stream segments of the basin was as follows: 71.5 miles, full support; 675.3 partial support; and, 33.9 miles were not supported.

Rangeland grazing, according to evaluated information, and unknown sources of activity contribute to erosion and elevated sediment/ turbidity levels in the Verde River and its tributaries. Bacteria violations occur most frequently in the Oak Creek watershed. Land disposal (on-site systems, urban runoff, land development and recreation sources) is a suspected contributor.

High nutrient levels occur in the Verde River below Sycamore Creek, in the middle basin, and in its tributaries downstream, Dry and Wet Beaver creeks and the East Verde River. The sources are unknown, land disposal (on-site waste disposal systems) or land development activities. Metals violations appear to occur as a result of mining activities.

Groundwater Quality

The Verde Basin encompasses the Big Chino, Verde River, Verde Canyon, Tonto Creek, Salt River lakes, and Prescott AMA groundwater basins. Aquifers within the Verde Basin are classified according to the specific types of rock materials. Both the quality and quantity of the groundwater derived from these basins are governed by the degree of cementation and consolidation of the sediments which form the aquifer. The surrounding igneous and metamorphic mountain blocks offer little potential for development of groundwater except in places where the rocks are fractured or solution cavities have formed.

Groundwater in the unconsolidated alluvium and consolidated sediments of the Verde Formation underlying the Verde Basin is used primarily for domestic and municipal supplies. Water withdrawn from the alluvium aquifer is generally of better quality than that from the Verde Formation aquifer.

Nevertheless, groundwater from most of the alluvium exceeds the recommended level for TDS in public water supplies. The major ions identified in water from the alluvium are magnesium, calcium, sodium and bicarbonate which correlates with the major ions in the river water used for irrigation. The alluvium on the west side of the river contain sodium sulfate and chloride salts. Arsenic, fluoride, iron, manganese and selenium have also been identified in samples of groundwater from the alluvium in this area (**9**).

Recharge to the Verde Basin alluvium and aquifer occurs as a result of infiltration of precipitation, stream flows, irrigation water, septic tank effluent, and inflow from the Verde Formation. Infiltrating water percolates into the water table and then moves downgradient toward the Verde River.

For the Prescott AMA, the TDS concentrations are generally low in the Little Chino Valley Subbasin, but appear to be higher in perched aquifer systems. Nitrate and sulfate levels do not exceed primary MCLs, although, concentrations are slightly high in perched groundwater near Del Rio Springs (northernmost portion of the subbasin). Elevated nitrate levels have been detected in two wells near the City of Prescott wastewater treatment plant. VOCs and benzene have been detected in a well in downtown Prescott. These contaminants are a result of leaking underground storage tanks.

Metals are the only parameter that threaten groundwater quality in the Upper Aqua Fria subbasin. Arsenic and manganese, associated with naturally mineralized Precambrian rocks and sulfide deposits, have been detected in wells near Black Canyon City, Groom Creek, and Crown King. Natural arsenic and chromium groundwater contamination is associated with volcanically derived fine-grained sediments.

Two State Superfund Water Quality Assurance Revolving Fund (WQARF) sites have been identified in the Verde Basin area. The first of these is in Chino Valley. One well has been found to contain VOCs including benzene. Groundwater from Chino Valley supplies drinking water to the communities of Prescott and Chino Valley. Funds have been reserved to conduct a sampling program to determine potential threats to the aquifer.

The second site is the Woody Mountain Well Field near Flagstaff. Groundwater supplies at this location (which are used by the City of Flagstaff) may be threatened by previous releases of hazardous substances from the Navajo Army Depot. Funds have been reserved to establish a monitoring well network to detect potential groundwater contamination.

Land Use

The Verde River Basin has a substantial area of its watershed under management by the USFS. Portions of four national forests, the Tonto, Coconino, Kaibab, and Prescott, overlay the basin. The majority of privately held lands are found in the upper watershed north of Prescott and up the Chino Valley. In this area, a checkerboard of State Trust Lands and private lands are found with the national forests occupying the watershed divide areas to the east and west of Chino Valley.

The lower reaches of the Verde River are principally contained in the Tonto and Coconino national forests. Private lands also encompass the area adjacent to the Verde River from Clarkdale to Camp Verde in the middle portion of the basin.

There are several small Indian reservations in the Basin. The Fort McDowell Reservation has the most property in the basin, and it surrounds the river for about 10-12 miles to its confluence with the Salt River.

The significant urban areas of the Basin are the communities of Prescott, Sedona, Camp Verde and Clarkdale - Cottonwood.

The principal contributors to the economy of the Verde Basin are lumber and wood products from the national forests, and the recreation which

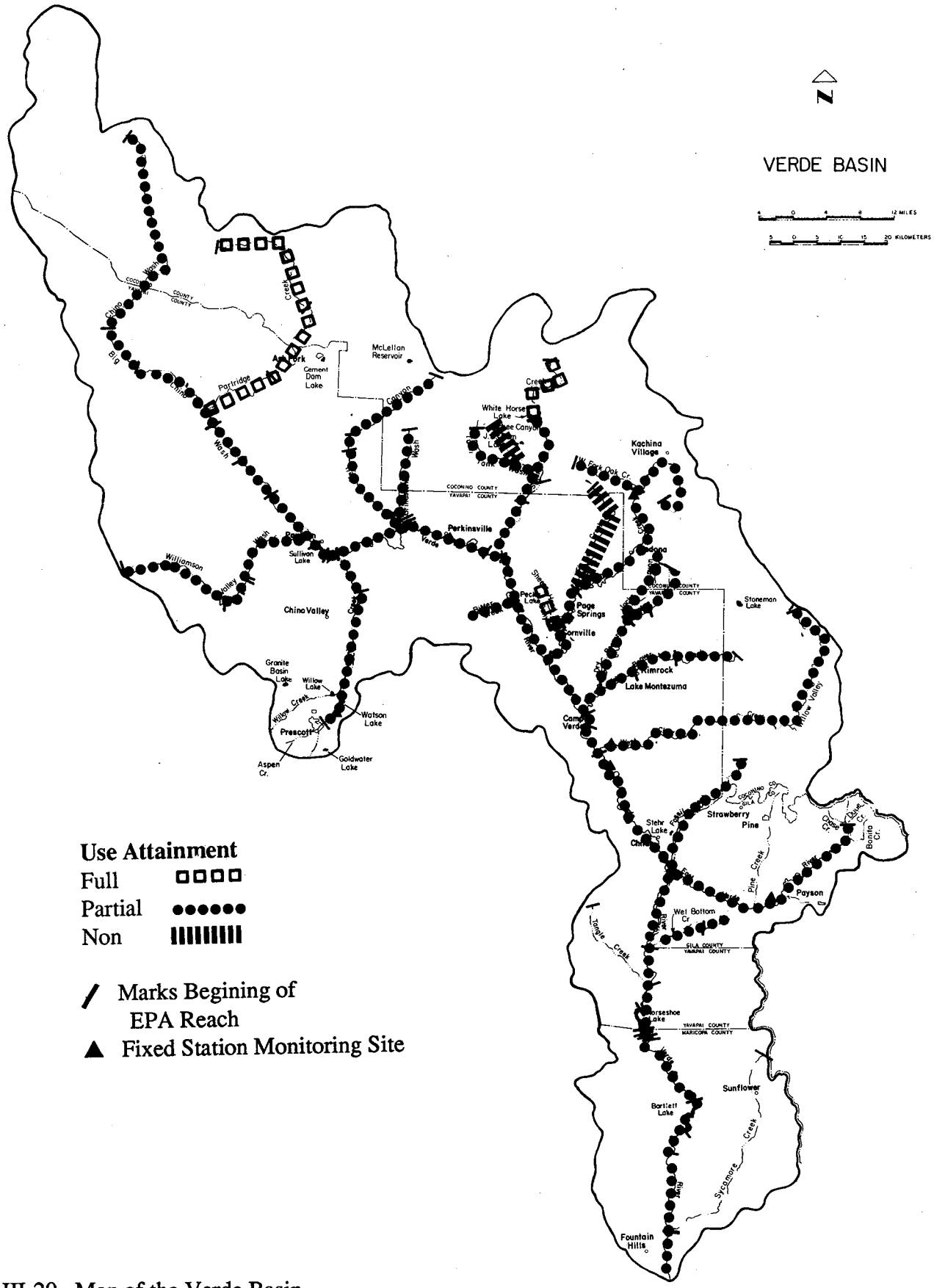

Figure III-20. Map of the Verde Basin.

TABLE III-12. VERDE RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15060201-013	Chino Wash	F A I L						27.6		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	NOTE 1. SILTATION FROM UNSATISFACTORY WATERSHED CONDITIONS (18)
15060201-012	Big Chino Wash	F A I L						6.8		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060201-011	Big Chino Wash	F A I L						13.2		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060201-009	Partridge C.	F A I L					19.2					SATISFACTORY WATERSHED CONDITIONS (18)
15060201-007	Partridge C.	F A I L					13.2					SATISFACTORY WATERSHED CONDITIONS (18)
15060201-006	Partridge C.	F A I L					13.1					SATISFACTORY WATERSHED CONDITIONS (18)
15060201-005	Big Chino Wash	F A I L						2.3		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060201-004	Big Chino Wash	F A I L						6.4		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060201-003	Big Chino Wash	F A I L						5.5		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060201-002	Big Chino Wash	F A I L						10.5		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060201-024	Williamson Valley Wash	F A I L						15.9		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060201-023	Williamson Valley Wash	F A I L						6.2		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-12 (cont.). VERDE RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15060201-021	Williamson Valley Wash	F A I L						0.3		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060201-020	Williamson Valley Wash	F A I L						13.1		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060201-001	Big Chino Wash	F A I L						1.5		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060202-054	Verde R.	F A I L						3.0		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN MINING	[NOTE 1]
15060202-053	Verde R.	F A I L						1.4		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN MINING	[NOTE 1]
15060202-059	Granite C.	H A I L		16.3						[STC] DO, B	GRAZING URBAN RUNOFF LAND DISPOSAL UNKNOWN HYDROLOGIC MOD.	[NOTE 1] ON-SITE DISPOSAL IN AREAS WITH SHALLOW SOILS (3). URBAN RUNOFF ABOVE WATSON L. WATSON L. DAM CAUSES HYDROLOGIC MODIFICATION (ADEQ).
15060203-058	Granite C.	H A I L						5.5		SEDIMENT/ TURBIDITY NUTRIENTS	GRAZING LAND DISPOSAL HYDROLOGIC MOD.	[NOTE 1]
15060203-052	Verde R.	F A I L						15.6		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060202-049	Hell Canyon	F A I L						18.1		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060202-048	Hell Canyon	F A I L						2.3		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 1]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
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(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-12 (cont.). VERDE RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15060202-047	Hell Canyon	F A I L						12.0		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 1)
15060202-045	Hell Canyon	F A I L						3.4		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 1)
15060202-044	Grindstone Wash	F A I L						14.3		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 1)
15060202-042	Grindstone Wash	F A I L						0.5		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 1)
15060202-040	Grindstone Wash	F A I L						0.6		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 1)
15060202-039	Hell Canyon	F A I L						0.2		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 1)
15060202-038	Verde R.	F A I L						5.5		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	(NOTE 1)
15060202-037	Verde R.	F A I L		9.6						SEDIMENT/ TURBIDITY (STA-26) Cu TURBIDITY (STC) B	GRAZING MINING UNKNOWN	(NOTE 1)
15060202-035	Verde R.	F A I L						2.2		SEDIMENT/ TURBIDITY	GRAZING MINING UNKNOWN	(NOTE 1)
15060202-031	Sycamore C.	F C I L					14.5			UNKNOWN	MILITARY LAND DISPOSAL	THREAT FROM MATERIALS STORAGE AND HANDLING AT NAVAJO DEPOT (3).

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE (STA), (STB), AND (STC) LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-12 (cont.). VERDE RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15060202-029	Sycamore C.	F C I L					5.5			UNKNOWN	MILITARY LAND DISPOSAL	THREAT FROM MATERIALS STORAGE AND HANDLING AT NAVAJO DEPOT (3).
15060202-028	Sycamore C.	F C I L						9.9		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2] UPSTREAM SOURCES FROM WILDERNESS AREA (ADEQ)
15060202-	Lee Canyon	F C I L							11.6	SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	NOTE 2. UNSATISFACTORY WATERSHED CONDITIONS (16)
15060202-033	Tule Tank Wash	F C I L						13.4		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	EVALUATION BASED ON SOURCES FROM LEE CANYON (ADEQ)
15060202-027	Sycamore C.	F C I L						5.8		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2] UPSTREAM SOURCES (16)
15060202-026	Sycamore C.	F C I L						19.3		SEDIMENT/ TURBIDITY	GRAZING UNKNOWN	[NOTE 2] UPSTREAM SOURCES (16)
15060202-025	Verde R.	F A I L		24.0						SEDIMENT/ TURBIDITY [STB-13] PHENOLS NO3, PO4 [STC] TURBIDITY	GRAZING UNKNOWN	[NOTE 1]
15060202-	Bitter C.	D F C I L							12.0	pH METALS	MINING	POLLUTION FROM MINING WASTES IN JEROME DISTRICT (3)(13)
15060202-019	Oak C.	D F A C I L U		17.7						[STA-43] PO4, Hg [STC] BACTERIA TURBIDITY	LAND DISPOSAL CONSTRUCTION GRAZING	SILTATION FROM LAND DEVELOPMENT, URBAN RUNOFF AND UNSATISFACTORY WATERSHED CONDITIONS (3)(5)(12)(13)(15) NUTRIENTS FROM ON-SITE DISPOSAL AND UNKNOWN SOURCES, BACTERIA FROM UNKNOWN SOURCES. (3)(17)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
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TABLE III-12 (cont.). VERDE RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15060202-020	Oak C.	D F C I L U						11.8			LAND DISPOSAL CONSTRUCTION GRAZING	EVALUATION BASEN OF UPSTREAM AND DOWNSTREAM MONITORING
15060202-018	Oak C.	D F C I L U		21.7						SEDIMENT/ TURBIDITY BACTERIA NUTRIENTS [STA-295] BACTERIA NO3 [STC] pH BACTERIA TURBIDITY P04	GRAZING LAND DISPOSAL URBAN RUNOFF CONSTRUCTION RECREATION UNKNOWN	SILTATION FROM LAND DEVELOPMENT URBAN RUNOFF AND UNSATISFACTORY WATERSHED CONDITIONS (3)(5)(12)(13)(15) NUTRIENTS FROM ON-SITE DISPOSAL AND UNKNOWN SOURCES (3)(5). BACTERIA FROM WATERBASED RECREATION. ON-SITE DISPOSAL AND UNKNOWN SOURCES (3)(5)(12)
15060202-	Sheepshead Canyon	D F C I L						6.0				EVALUATION BASED ON (17)
15060202-021	Dry C.	D F C I L							10.3	SEDIMENT/ TURBIDITY	GRAZING CONSTRUCTION	SILTATION FROM UNSATISFACTORY WATERSHED CONDITIONS (13)(15)
15060202-017	Oak C.	D F C I L U		9.0						[STC] TURBIDITY [GS 83] BACTERIA NO3	GRAZING LAND DISPOSAL CONSTRUCTION URBAN RUNOFF UNKNOWN	SILTATION, LAND DEVELOPMENT, URBAN RUNOFF AND UNSATISFACTORY WATERSHED CONDITIONS (3)(12)(15) NUTRIENTS FROM ON-SITE DISPOSAL SYSTEMS AND UNKNOWN SOURCES (3)(17) BACTERIA FROM ON-SITE DISPOSAL AND UNKNOWN (3)(17).
15060202-016	Oak C.	D F C I L U		10.4						[STC] TURBIDITY P04	GRAZING LAND DISPOSAL UNKNOWN	NUTRIENTS AND SILTATION FROM UPSTREAM SOURCES, ON-SITE DISPOSAL, UNSATISFACTORY WATERSHED CONDITIONS, AND UNKNOWN SOURCES (13)(15)(17). BACTERIA FROM ON-SITE DISPOSAL (3)(17).
15060202-015	Verde R.	F A I L						11.5		SEDIMENT/ TURBIDITY	UNKNOWN	EVALUATION BASED ON UPSTREAM SOURCES AND MONITORING.

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(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
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(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-12 (cont.). VERDE RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15060202-008	Jacks Canyon	F C I L						11.1		SEDIMENT/ TURBIDITY	RANGELAND RECREATION CONSTRUCTION	SILTATION PRIMARILY FROM UNSATISFACTORY WATERSHED CONDITIONS (15).
15060202-006	Wet Beaver C.	F C I L						9.9		SEDIMENT/ TURBIDITY	RANGELAND RECREATION CONSTRUCTION	EVALUATION BASED ON UPSTREAM SOURCES
15060202-004	Wet Beaver C.	F C I L						7.1		SEDIMENT/ TURBIDITY	GRAVEL MINING RANGELAND CONSTRUCTION HYDRAULIC/ HABITAT MOD.	NOTE 3. SILTATION FROM GRAVEL MINING, UNSATISFACTORY WATERSHED CONDITIONS AND DEVELOPMENT (3)(6)(15). LOCALIZED BACTERIA PROBLEM NOT DOCUMENTED IN 1980 STUDY (11)
15060202-003	Wet Beaver C.	F C I L						6.4		SEDIMENT/ TURBIDITY	GRAVEL MINING RANGELAND CONSTRUCTION HYDRAULIC/ HABITAT MOD.	[NOTE 3]
15060202-013	Dry Beaver C.	A I L						8.9		SEDIMENT/ TURBIDITY NUTRIENTS	GRAZING CONSTRUCTION	[NOTE 4] SILTATION FROM UNSATISFACTORY WATERSHED CONDITIONS (15) NUTRIENTS FROM LAND DEVELOPMENT AND ON-SITE DISPOSAL SYSTEMS (3)
15060202-011	Dry Beaver C.	A I L						3.3		SEDIMENT/ TURBIDITY NUTRIENTS	GRAZING CONSTRUCTION	[NOTE 4]
15060202-010	Dry Beaver C.	A I L						13.0		SEDIMENT/ TURBIDITY NUTRIENTS	GRAZING CONSTRUCTION	[NOTE 4] SILTATION FROM UNSATISFACTORY WATERSHED CONDITIONS (15) NUTRIENTS FROM LAND DEVELOPMENT AND ON-SITE DISPOSAL SYSTEMS (3)
15060202-002	Wet Beaver C.	F C I L						8.1		SEDIMENT/ TURBIDITY NUTRIENTS	GRAZING CONSTRUCTION	UPSTREAM SOURCES ON WET AND DRY BEAVER CREEKS CONTRIBUTE TO PROBLEM. UNSATISFACTORY WATERSHED CONDITIONS CONTRIBUTE TO SILTATION IN LOWER WATERSHED (15)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
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TABLE III-12 (cont.). VERDE RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	EVALUATED (c) NON	T	FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15060202-001	Verde R.	F A I L		2.4						SEDIMENT TURBIDITY NUTRIENTS	GRAZING CONSTRUCTION	[NOTE 4] EVALUATION BASED ON UPSTREAM SOURCES AND DOWNSTREAM MONITORING.
15060203-027	Verde R.	F A I L		6.2						SEDIMENT TURBIDITY NUTRIENTS	GRAZING CONSTRUCTION	[NOTE 4] EVALUATION BASED ON UPSTREAM SOURCES AND DOWNSTREAM MONITORING.
15060203-026	West Clear C.	F C I L						54.3		SEDIMENT/ TURBIDITY BACTERIA	LAND DISPOSAL MINING CONSTRUCTION GRAZING RECREATION	SILTATION DUE TO UPSTREAM SOURCES, GRAVEL MINING AND PRIVATE LAND DEVELOPMENT (6)(3)(10). BACTERIA DUE TO RECREATION AND ON-SITE SYSTEMS (6). UNASSESSED TRIBUTA WITH GRAZING CONTRIBUTE TO SILTATION AND BACTERIA (6)(10)(15). RECREATION IN WILDERNESS AREA SUSPECTED C CONTRIBUTOR OF BACTERIA (6)(10)
15060203-025	Verde R.	F A I L		20.5						[STB-13] pH NO3, PO4, Hg BACTERIA [GS 84] BACTERIA NO3, PO4 SEDIMENT/ TURBIDITY BACTERIA	UNKNOWN	
15060203-024	Fossil C.	F A I L						19.3		SEDIMENT/ TURBIDITY	GRAZING HYDROLOGIC MOD.	SILTATION FROM UNSATISFACTORY WATERSHED CONDITIONS (19) DAM AT CHILD'S (ADEQ)
15060203-023	Verde R.	F A I L						7.7		UNKNOWN	UNKNOWN	EVALUATION BASED ON UPSTREAM DATA, (ADEQ).
15060203-022	E. Verde R.	F C I L		41.5						SEDIMENT/ TURBIDITY BACTERIA NUTRIENTS BACTERIA [STC] TURBIDITY PO4	LAND DISPOSAL GRAZING RECREATION UNKNOWN	BACTERIA FROM RECREATION SITES AND SEASONAL HOME ON-SITE DISPOSAL SYSTEMS (14) SILTATION FROM UNSATISFACTORY RANGE CONDITION (19). NUTRIENTS FROM UNKNOWN SOURCES (3)(4) PARTIAL SUPPORT OF USES (5)

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-12 (cont.). VERDE RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15060203-021	Verde R.	F A I L						16.3			UNKNOWN	EVALUATION BASED ON UPSTREAM AND DOWNSTREAM MONITORING DATA, (ADEQ).
15060203-020	Wet Bottom C.	F A I L		7.4						[STA-22] DO, pH [STB-12] As [GS 83] PO4	UNKNOWN	
15060203-019	Verde R.	F A I L		7.9						[GS 83] NO3, PO4 PHENOLS [GS 84] TURBIDITY BACTERIA PO4, Hg	UNKNOWN	
15060203-018	Verde R.	F A I L						4.1			UNKNOWN	NOTE 5. PARTIAL SUPPORT EVALUATION BASED ON UPSTREAM SOURCES AND MONITORING DATA, (ADEQ).
15060203-017	Verde R. (Horseshoe Res.)	F A I L						3.5			UNKNOWN	[NOTE 5]
15060203-014	Verde R. (Horseshoe Res.)	F A I L						0.5			UNKNOWN	[NOTE 5]
15060203-009	Verde R. (Horseshoe Res.)	F A I L						0.7			UNKNOWN	[NOTE 5]
15060203-008	Verde R.	F A I L						11.7			UNKNOWN	[NOTE 5]
15060203-005	Verde R. (Bartlett Res.)	F A I L						4.7			UNKNOWN	[NOTE 5]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
(d) -- REFER TO CHAPTER II FOR DISCUSSION OF NONPOINT SOURCES OF POLLUTION
(e) -- NUMBERS IN PARENTHESES PERTAIN TO CHAPTER III BASIN REPORT REFERENCES

TABLE III-12 (cont.). VERDE RIVER BASIN (SURFACE WATER ASSESSMENT)

HUC CODE (a)	SITE	PROTECTED USES AND SPECIAL WATER QUALITY DESIGNATIONS (b) D F H A C I L E U	USE ATTAINMENT MILEAGE MONITORED (c) FULL	PART	NON	T	EVALUATED (c) FULL	PART	NON	PARAMETER (c)	SOURCE (d)	REMARKS (e)
15060203-004	Verde R.	D F A I L						5.6		[STB-12] NO3, As, Zn [GS 83] NO3	UNKNOWN	
15060203-003	Verde R.	D F A I L						12.6			UNKNOWN	[NOTE 5]
15060203-001	Verde R.	D F A I L						6.3			UNKNOWN	[NOTE 5]

(a) -- REFER TO APPENDIX C FOR MORE INFORMATION ON HUC CODES
(b) -- REFER TO APPENDIX D FOR SPECIAL WATER QUALITY DESIGNATIONS AND PROTECTED USES
(c) -- REFER TO APPENDIX B FOR PROCEDURES OF MONITORED AND EVALUATED ASSESSMENT AND THE DEFINITIONS OF THE [STA], [STB], AND [STC] LABELS.
Numerals following labels indicate numbers of samples. An x in the label indicates a long term record station.
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these forests also provide. General farming, livestock, grazing, tourism, and mining are also land uses which contribute to the economy of the basin. General land use is shown in Figure III-21.

Agricultural NPS (10)

Irrigated agriculture and rangeland grazing are the principal agricultural activities in this basin. In the uppermost part of the watershed in Chino Valley, irrigated lands utilize natural waters diverted from the Granite Creek watershed and secondary treated wastewater effluent from the City of Prescott. Smaller areas of irrigated lands are found in the Verde Valley at Cottonwood and Camp Verde and along Oak Creek. Although the impact of irrigated agriculture is not specifically assessed, bacteria, siltation and nutrients are potential pollutants. Interpretation of correlative data appears to indicate a possible relationship between agricultural use of nitrogen fertilizer and sewage disposal and levels of nitrate/nitrite contamination identified in the basin **(1,8,9).**

Silvicultural NPS (20)

Forests in the basin that are suitable for timber and fuelwood harvest lie within the Coconino, Kaibab, Prescott and Tonto National Forests and represent less than four percent of the watershed. The impact of timber harvest activities is not specifically assessed due to the small acreage involved. However, sediment is the principal pollutant anticipated **(18)**.

Construction, Urban Runoff, and Military NPS (30/40)

Land development and urban runoff are not separable in community land use patterns found in the Verde Basin. Land development and urban runoff sources cause or contribute to water quality problems, however.

Urban stormwater runoff has been recognized as a potential contributor to groundwater pollution in the basin **(2)**. Several of the 21 different volatile organic chemical (VOCs) contaminants identified in groundwater samples from the Prescott AMA and adjacent groundwater basins may be attributable to runoff from urban areas where industrial solvents are stored or utilized **(1)**.

The Navajo Army Depot near Flagstaff is a storage area for military chemicals, but no water contamination has been identified to date. The City of Flagstaff is installing monitoring wells under the WQARF program to determine if the city's water supply is affected.

Resource Extraction NPS (50)

Metals, sand and gravel mining are the principal extractive activities in the basin. Discharges from inactive mine tunnels, tailings, and dumps cause impacts to the Bitter Creek watershed. Contamination of groundwater in the Verde River Basin with low levels of lead, iron, zinc, barium, and sulfate may be associated with prior gold and silver mining operations within the basin **(9,1)**. Sand and gravel extraction operations are typically located along the Verde River or a major tributary and have not been covered by the dredge and fill permit program administered by the U.S. Army Corps of Engineers under Section 404 of the Federal Clean Water Act. Channel and riparian community alterations have caused environmental concern at some sites.

Land Disposal NPS (60)

On-site disposal systems on private land within the national forests are often in close proximity to perennial or seasonal streams, and are often reported as water pollution problems. Contamination of groundwater with coliform bacteria has been reported from one well sample from the Verde Basin groundwater basin. In addition, low levels of nitrate/nitrite contamination evidenced in samples from four well locations in the Verde Basin and ten well sites in the Prescott AMA groundwater basin appear to be related to the heavy reliance upon septic tanks for waste water disposal **(1A,1,9)**.

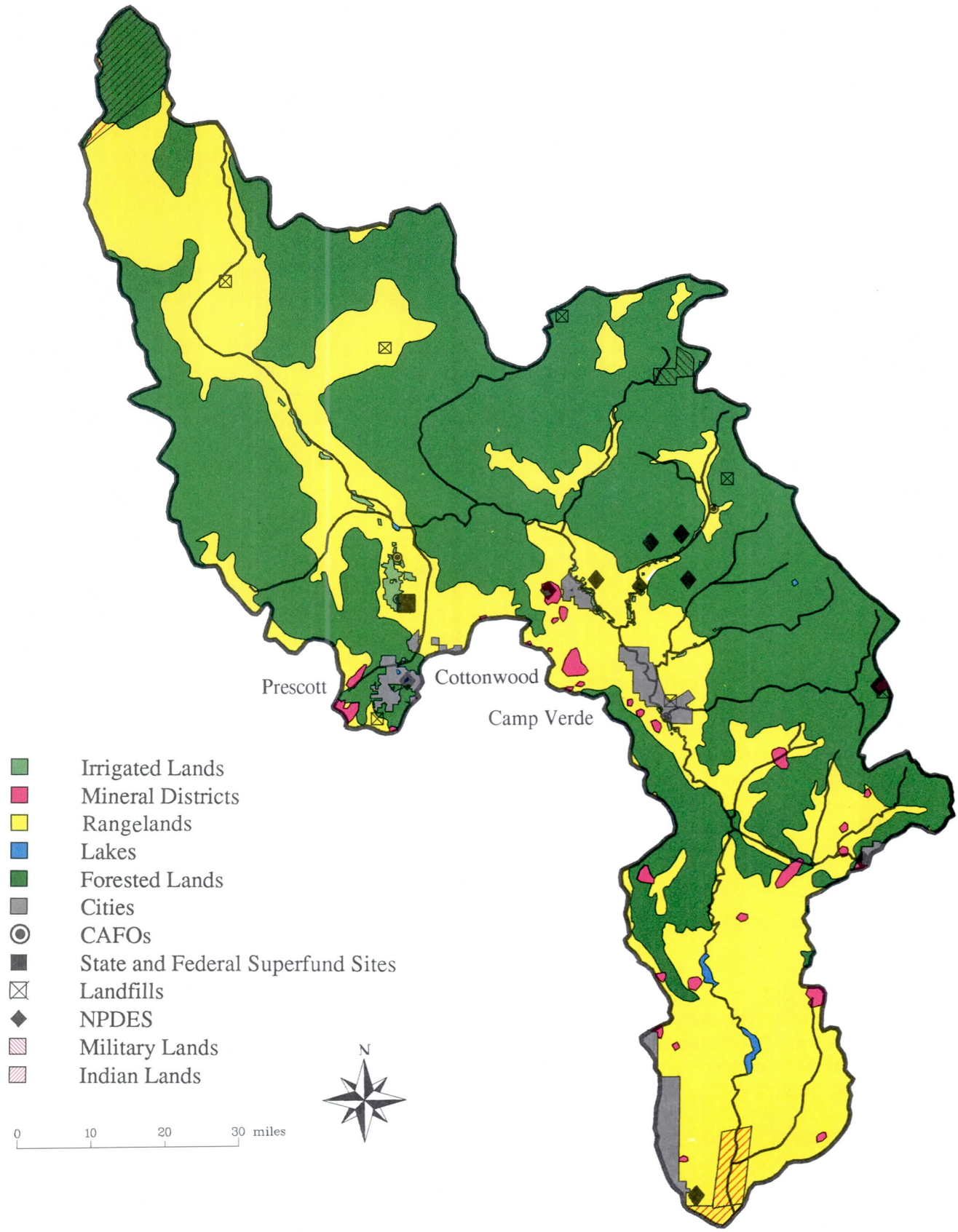

Figure III-21. Land use map of the Verde Basin.

Hydrologic and Habitat Modification NPS (70)

Dams and water diversions occur throughout the Verde Basin. Channelization of streams has been associated with sand and gravel extraction activities. Information on the impacts of hydrologic/habitat modification in the basins is limited, however, and they remain mostly unassessed.

Recreation NPS (100)

Bacteria and siltation have been correlated with campgrounds and recreation sites in the Oak Creek watershed. Campgrounds on state and federally developed recreational lands in the Prescott AMA, Verde Basin, Tonto Creek Basin and Salt Basin represent potential sites of nitrate/nitrite and coliform bacterial contamination from pit toilets and septic tanks. Less studied are the wilderness area waters in the East Verde River, West Clear Creek, Wet Beaver Creek, West Fork of Oak Creek, and Sycamore Creek which also have the potential for bacterial problems.

Verde Basin References

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18. U.S. Department of Agriculture, Forest Service, Southwestern Region, 1986, "Environmental Impact Statement for the Prescott National Forest Plan."

19. U.S. Department of Agriculture, Forest Service, Southwestern Region, 1985, "Environmental Impact Statement for the Tonto National Forest Plan."

20. U.S. Department of Agriculture, Soil Conservation Service, 1971, Arizona Sediment Yield Map."

CHAPTER IV

Nonpoint Source (NPS) Management Program

A. Introduction

This chapter of the NPS Assessment summarizes the measures to manage each category of nonpoint source pollution. Further detail relative to management of NPS pollution will be found in Arizona's NPS Water Quality Management Program. The programmatic elements discussed include planning, implementation and compliance activities. Arizona's Nonpoint Source Management Program consists of a mixture of existing and developing NPS programs operated by many agencies.

B. NPS Pollution Planning

By federal and state law, the Arizona Department of Environmental Quality (ADEQ) has the responsibility for water pollution control including the NPS Water Quality Management Program. Planning the development of the management program is a lead responsibility of the ADEQ. The purpose of planning for the NPS management program is to:

1. Identify the authorities and responsibilities of NPS managers, which are available to directly and indirectly manage NPS pollution; and

2. Establish the environmental and water quality goals, objectives, and priorities for the NPS management program in Arizona.

NPS Authorities and Responsibilities

The methods used in the management program to reduce, to the maximum extent practicable, the level of pollution resulting from each nonpoint source category will vary significantly. This variation reflects the organizational and institutional differences among agencies, including their legal authorities and resources.

The statutory authority for the Arizona NPS programs derives from two laws: the Arizona Environmental Quality Act (EQA) of 1986, and the Federal Clean Water Act (FCWA) as amended in 1987. The term "nonpoint source" is defined differently in the federal and state programs. Because this NPS assessment report is being prepared in response to the FCWA, the federal definition of nonpoint source has been followed throughout this report. However, the difference between the state and federal definitions are described, hereafter.

The federal definition of nonpoint source pollution, described in the Environmental Protection Agency (EPA) July 1987 Nonpoint Source Guidance, is more inclusive than the definition in the EQA. The EPA's definition includes categories that the EQA describes as point source discharges to aquifers. The federal definition includes discharges which do not originate from a "specific, single location such as a single pipe," or basically diffuse sources that do not require an NPDES permit.

In contrast, Arizona's NPS definition in the EQA is limited to surface water and excludes "any discernible, confined and discrete conveyance, included but not limited to, any pipe, ditch, channel, tunnel, conduit, well, fissure, container, rolling stock, concentrated animal feeding operation or vessel or other floating craft from which pollutants are or may be discharged to navigable water" (ARS 49-201). Discharges to groundwater are not differentiated into point and nonpoint sources in the EQA.

The ADEQ has taken preliminary steps to identify and evaluate existing and relevant programs of other agencies which would integrate into the nonpoint source management program. Tables IV-1 and IV-2 are a description of responsibilities of various agencies proposed for planning or management agency delegation as part of Arizona's NPS management program. The management program includes four phases: planning, implementation by rule, NPS program implementation by other means, and compliance. Implementation of the NPS management program necessitates the determination of agency authorities and resources to perform management tasks effectively. Nonpoint source management agencies, including the ADEQ, other state agencies, federal agencies, and local governments, will vary in their specific characteristics and authorities, but all, to some degree or another, will share the following characteristics:

TABLE IV-1. Nonpoint source management program for Arizona with agency responsibilities

	PLANNING		IMPLEMENTATION BY RULE						IMPLEMENTATION OTHER METHODS		COMPLIANCE				
Nonpoint Pollution Sources	State Lead and Coordination	Nonpoint Source Management Program Development	Individual Permits	General Permits	Registration/ License	Plan Approval Certification	Management Agencies	Local Ordinances	Demonstration Projects	Education Tech. Assist.	Monitoring	Management Agency Program Oversight	State Program Oversight	Enforcement	Suits
10. Agriculture Irrigated Cropland	ADEQ	ADEQ, ADWR	ADEQ	ADEQ	ADEQ Pesticide Contamination Prevention	--	--	--	U of A, NRCDs, ADWR, SCS		Facility ADEQ, USGS, USFWS,AGFD	--	Citizens Legislature & EPA	EPA, ADEQ	X
Animal Feeding	ADEQ	ADEQ, ADWR	ADEQ	ADEQ	--	--	--	--	U of A, NRCDs, SCS		Facility ADEQ & AGFD	--	Citizens Legislature & EPA	EPA, ADEQ	X
Grazing	ADEQ	USNPS, USFS ASLD, BLM, & ASP	--	--	--	ADEQ	ADEQ,ASLD, USFS, & BLM	--	USFS, BLM, ASLD NRCDs, SCS, U of A		Mgmt Agency ADEQ, AGFD, SCS	ADEQ	Citizens Legislature & EPA	EPA, ADEQ	X
Aquaculture	ADEQ	ADEQ & AGFD	--	--	--	ADEQ	ADEQ, AG&F, USF&W	--	ADEQ, AGFD, U of A, SCS		Facility ADEQ, AGFD	ADEQ	Citizens Legislature & EPA	EPA, ADEQ	X
20. Silviculture	ADEQ	USNPS,USFS, ASLD, BLM, ADEQ & ASP	--	--	--	ADEQ	ADEQ, USNPS,USFS, Mgmt Agency	--	USFS	Universities & Colleges	Mgmt Agency ADEQ, AGFD	ADEQ	Citizens Legislature & EPA	EPA, ADEQ, Mgmt Agency	X
30. Urban Runoff	ADEQ	COGs, Cities, & Counties	ADEQ	--	ADEQ Drywell Registration	ADEQ		Cities & Counties	Flood Control District, Cities & Counties		Cities, Counties, ADEQ, AGFD, FCD	ADEQ	Citizens Legislature & EPA	EPA, ADEQ, Cities, Counties	X
40. Construction	ADEQ	COGs, Cities, & Counties	ADEQ	--	--	ADEQ	ADEQ, ADOT,USNPS, USFS, BLM, Mgmt Agency	Cities & Counties	Flood Control District, Cities & Counties		Cities, Counties, ADEQ, AGFD, ADOT	ADEQ	Citizens Legislature & EPA	EPA, ADEQ, Cities, Counties, Mgmt Agency	X
50. Resource Extraction	ADEQ	ADEQ, COGs	ADEQ	ADEQ	--	ADEQ	ADEQ,ASLD, USFS, BLM, Mgmt Agency	--	USFS, BLM	--	Facility ADEQ, AGFD	--	Citizens Legislature & EPA	EPA, ADEQ Counties	X
60. Landfills	ADEQ	ADEQ, COGs	ADEQ	ADEQ	--	ADEQ	--	Cities & Counties	--	--	Facility ADEQ, AGFD	ADEQ	Citizens Legislature & EPA	EPA, ADEQ	X
Sludges	ADEQ	ADEQ, COGs	ADEQ	ADEQ	--	ADEQ	--								
On-site Wastewater	ADEQ	ADEQ, COGs	ADEQ	ADEQ	--	ADEQ	--								
Wastewater Reuse	ADEQ	ADEQ, ADWR	ADEQ	--	--	ADEQ	--								
Recharge	ADEQ	ADEQ, ADWR, BR	ADEQ	ADEQ	--	ADEQ	--								
100. Recreation	ADEQ	ASP, ASLD, BLM USNPS, BR, USFS	--	--	--	ADEQ	Mgmt Agency	--	ASP, USNPS	ASP	Mgmt Agency ADEQ, AGFD	ADEQ	Citizens Legislature & EPA	EPA, ADEQ Mgmt Agency	X

Table IV-2. Nonpoint source management program for hydrologic/habitat modification in Arizona with agency responsibilities.

	PLANNING		IMPLEMENTATION BY RULE			IMPLEMENTATION OTHER METHODS	COMPLIANCE					
Nonpoint Pollution Sources	State Lead and Coordination	Nonpoint Source Management Program Development	Individual Permits or License	Public Agency Resource Management (BMPs)	Local Ordinances (BMPs thru P&Z or Building Permits)	Educational, Technical Assistance, Demonstration Projects	Monitoring	Management Agency Program Oversight	State Program Oversight	Enforcement Approval Lease or Permit	Enforcemnt Water Quality Standards	Citizen Suits
70. Hydrologic/ Habitat Modification Channelization Dredge/Fill	ADEQ	ADEQ, COE, AGFD, BR, USFS, ADWR LMA*, & ADOT	COE, ADEQ	LMA*	Cities & Counties	LMA*, SCS, COE, & ADOT	LMA*, ADEQ, AGFD, COE, & USFWS	ADEQ, EPA, AGFD, & USFWS	Citizens Legislature & EPA	COE, LMA*	ADEQ, EPA	X
Dam Construction	ADEQ	ADEQ, COE, AGFD, BR, USFS, USNPS, ADWR, LMA*, & ADOT	FERC, COE, ADEQ	ADWR, LMA* BR, & COE	--	LMA, BR, COE, ADWR, & SCS	LMA, ADEQ, ADWR, COE, BR, & Facility	ADEQ, EPA AGFD, & USFWS	Citizens Legislature & EPA	COE, ADWR, & LMA	ADEQ, EPA	X
Flow Regulation/ Hydrologic Modification	ADEQ	ADEQ, COE AGFD, BR, ADWR, LMA, & USNPS	ADWR, COE, ADEQ	ADWR, LMA*	--	LMA, ADWR, SCS, & COE	LMA, ADWR ADEQ,AGFD, & USFWS	ADEQ, EPA AGFD, & USFWS	Citizens Legislature & EPA	COE, ADWR, Cities, & Counties	ADEQ, EPA	X
Riparian Habitat Modification	ADEQ	ADEQ, AGFD, USFWS, LMA, BR, ADOT, ADWR, & USNPS	COE, ADEQ	LMA*	Cities & Counties	LMA, NRCDs, PO*, COE, U of A	LMA, NRCDs, AGFD, USFWS ADEQ, SCS	ADEQ, EPA AGFD, & USFWS	Citizens Legislature & EPA	COE, LMA, Cities, & Counties	ADEQ, EPA	X
Streambank Modification/ Destabilization	ADEQ	ADEQ, AGFD, BR, USFWS, LMA, ADOT, ADWR, & USNPS	COE, ADEQ	LMA Cities & Counties	Cities & Counties	LMA, ADWR ADOT, PO	COE, ADOT, ADEQ, LMA, AGFD, USFWS	ADEQ, EPA AGFD, & USFWS	Citizens Legislature & EPA	ADWR, LMA, Irr. Dist.	ADEQ, EPA	X
Canals/Irrigation Systems	ADEQ	ADEQ, BR, & ADWR	ADWR	LMA	--	LMA, ADWR, SCS, Irr. Dist., NRCDs	LMA, ADEQ, ADWR, Irr. Dist.	ADEQ, EPA AGFD, & USFWS	Citizens Legislature & EPA	LMA	ADEQ, EPA	X
Stock Tanks	ADEQ	ADEQ, LMA, SCS, & AG&F	ADWR	LMA, ADWR	--	LMA, ASCS, NRCDs	LMA, ADEQ	ADEQ, EPA AGFD, & USFWS	Citizens Legislature & EPA	LMA	ADEQ, EPA	X
Watershed Yield/ Vegetation Manuipulation	ADEQ	ADEQ, ADWR, BR, LMA, SCS, USFS, AGFD	ADWR	LMA, BR, ADWR	--	LMA, SCS, PO, NRCDs	LMA, ADEQ, ADWR	ADEQ, EPA AGFD, & USFWS	Citizens Legislature & EPA	LMA	ADEQ, EPA	X

LMA* = Land Management Agency
PO* = Private Organization

1. Appropriate legal authority to carry out delegated or designated responsibilities;

2. Financial solvency including, if appropriate, the ability to raise revenue through taxes or collect fees, the ability to accept grants or funds from other sources for NPS water quality management purposes, and the ability to incur short and long-term in debtedness for nonpoint source water quality management;

3. Administrative competence with the organizational resources, personnel resources, equipment and facilities necessary to provide administrative and management support required for effective NPS water quality management programs;

4. Technical competence with the personnel resources, equipment, and facilities needed to carry out the required technical nonpoint source water quality management activities;

5. Public acceptability so that the delegated or designated management agency will be recognized and accepted as a legitimate entity with the appropriate nonpoint source water quality management mission within its management area; and

6. Political accountability so that the leadership of the management agency is accountable to the public served within the agency's management area.

- ***NPS Goals and Objectives***

The agencies (state, federal, and local) involved in NPS management all have varying degrees of statutory, regulatory, and policy mandates to address NPS pollution. These authorities will influence the overall goals and objectives for each respective agency in the development of a NPS management program. The ADEQ, as the statutory lead agency, must define, coordinate and communicate the goals and objectives of the NPS management program to the people of Arizona.

The NPS management program goal stated in the EQA is, " to increase effectiveness, efficiency, and public acceptance of the regulation of NPS water pollution." To accomplish this goal, the ADEQ must consider, accommodate, and integrate the diverse concerns and mandates of other state, local, and federal agencies into a program. And in addition, the desires and interests of the citizenry of the state must be met.

Objectives established in this process would be a reflection of the NPS management and environmental quality goals of the State. Their purpose is to define and provide a focus for NPS managers on NPS management priorities, the time frame for program implementation, and the desired environmental outcome consistent with the resources available.

The process by which goals and objectives, for the NPS management program are developed and implemented requires public participation and intergovernmental coordination. An open assessment process has been used to identify NPS impacted waters. Public participation by water quality and resource interests has been and will be a part of the process of defining the NPS water quality problem areas. State, federal, and local agencies have participated in the technical work group which advised the ADEQ on the NPS assessment report.

- ***Public Participation***

The Councils of Government, and other designated planning agencies have and will be called on for public information and as a focus for public participation and comment. Designated planning agencies have and will assist in the public participation aspects of the NPS management program by:

1. Maintaining at least one collection of documents relevant to the NPS Assessment and Management Program in a location which is accessible to the public.

2. Developing and maintaining a notification list of persons or organizations interested in, or significantly affected by the NPS Assessment and Management Program.

3. Providing and maintaining a list of the important contacts or lead program managers in the ADEQ or other agencies to address questions and directly receive comments.

4. Holding public hearings on the revisions to the NPS Assessment and Management Program pursuant to 40 CFR Part 25.5.

5. Publishing public notices 30 days before hearings.

6. Having relevant documents available at least 30 days before hearings.

7. Keeping records of public hearings.

8. Developing a responsiveness summary for each public hearing, pursuant to 40 CFR Part 25.8.

- ***Intergovernmental Coordination***

NPS pollution control requires the expertise and cooperation of many agencies and organizations. The EQA designated the ADEQ as the agency responsible for environmental management and administration of water quality. Therefore, the ADEQ's role is to integrate the new requirements of law with the results of past planning to develop updated NPS pollution management programs. The cooperation and assistance of existing and new designated planning and management agencies in developing this NPS management program is essential in achieving water quality goals and objectives.

The State must target watersheds and prioritize the management of specific categories of NPS pollution. Available technical and financial support must be focused on the areas where the water resources can be adequately treated.

- ***NPS Program Commitment***

The ADEQ's commitment to a NPS program will be by rule development, budget allocation and commitment to the public in planning documents. Examples of planning documents are "the Arizona Continuing Planning Process for Water Quality Management, 1988" (CPP) and The State Water Quality Management Plan.

Nonpoint sources of water pollution have been addressed in the State Water Quality Management Plan published in 1980 and in the Councils of Government areawide 208 plans prior to that time. Because of the history of the program, both the management system and the process used to validate that system will draw heavily upon the proposals contained in those plans and previous versions of the CPP. Over the next several years as all parts of the NPS management program are finalized , the program will be formalized as an amendment to the State Water Quality Management Plan.

Commitment by other NPS managers to the management program may involve one of the following programmatic mechanisms. The first option can be the specific delegation of NPS management responsibility. Delegation is defined as the authorization for one to act as the representative agent for another. A local environmental agency, health department or county board of health may receive delegation pursuant A.R.S. 49-107. The second option can be designation which is defined as the selection for duty or appointment. When designated responsibilities are in place, transfer of authority does not occur. The process for delegation and designation will be defined in rule. The offical transaction will be by intergovernmental agreement or memorandum of understanding.

An MOU would detail:

1. The NPS pollution management authorities of the ADEQ and the management agency;

2. The specific areas of mutual agreement including; the general NPS pollution management goals and objectives; and

3. The processes or mechanisms by which BMPs will be implemented, monitored and evaluated.

C. NPS Program Implementation by Rule

Regulation of nonpoint source discharges to surface water is required by ARS 203.A.3 of the EQA "Powers and Duties of the Director." This section states that the Director shall adopt, by rule, "a program to control nonpoint sources discharges of any pollutant or combination of pollutants into navigable waters." Through this program, Best Management Practices (BMPs)

and Best Available Demonstrated Control Technologies (BADCT) will be designed for each significant nonpoint source pollution category and incorporated in State rules that will also define the administrative program to implement the BMPs and BADCT.

During the rule development process, public participation is requested during several time periods (Figure IV-1). First the concept paper is written to solicit comments on the proposed program and rule structure. Draft rules are then developed and presented to the public through public meetings or workshops. After review by the Attorney General's office, public meetings may again be held prior to submission of the rule package to the Executive Budget Office. The formal public comment period begins with the publication of the intent to promulgate rules and lasts for at least 30 days culminating with an oral proceeding.

- ***BMPs***

The EQA (Section (49-201.3)) defines Best Management Practices as the methods, measures or practices to prevent or reduce discharges and includes structural and nonstructural controls and operation and maintenance procedures.

As shown in Table IV-3, administrative NPS management programs to deliver BMPs or requirements to implement BADCT will vary depending upon the types of facilities or pollution generating activities. A variety of programs will be a part of the BMP delivery system; including "label modifications" under the State Pesticide Contamination Prevention Program; "general permits" for Agricultural BMPs; and a system of "plan approval and annual project planning" for land or resource management agencies' programs. Best Management Practices are currently being developed in cooperation with state and federal management agencies for grazing, forestry, and road construction activities. Local governments may operate parts of the program, as designated management agencies, for urban runoff and construction sites using their own authorities.

- ***Aquifer Protection by Agricultural General Permits***

To comply with the EQA mandate for aquifer protection, regulated agricultural activities will be subject to general aquifer protection permit rules which require implementation of BMPs. Regulated agricultural activities include: the application of nitrogen fertilizers, and concentrated animal feeding operations. The criteria for selecting and adopting BMPs will include:

1. regional and hydrogeologic conditions;
2. the source and modes of pollutant transport; and
3. the effectiveness of management practices.

BMPs for regulated agricultural activities will, by definition, be those practices or combination of practices which are the most effective practical means of preventing or reducing the contributions of defined pollutants generated by nonpoint sources to a level compatible to water quality goals.

- ***Pesticides Contamination Prevention Program***

The EQA, Section 49-601 et. seq., establishes a Pesticide Contamination Prevention Program. This program is designed to control contamination of groundwater, soils, and the vadose zone from all pesticides. The program requires the submittal of data, from manufacturers of pesticides used in agricultural applications, concerning the mobility of their chemical products in the environment. The program also involves a statewide monitoring program designed to discover the presence of pesticides in groundwater and soils.

All pesticides that are determined to have the potential to pollute groundwater are included on a groundwater protection list. Listed pesticides are subjected to special studies and monitoring to verify, that when used according to the label, they do not have the potential to pollute. If it is determined that pesticide has the potential to

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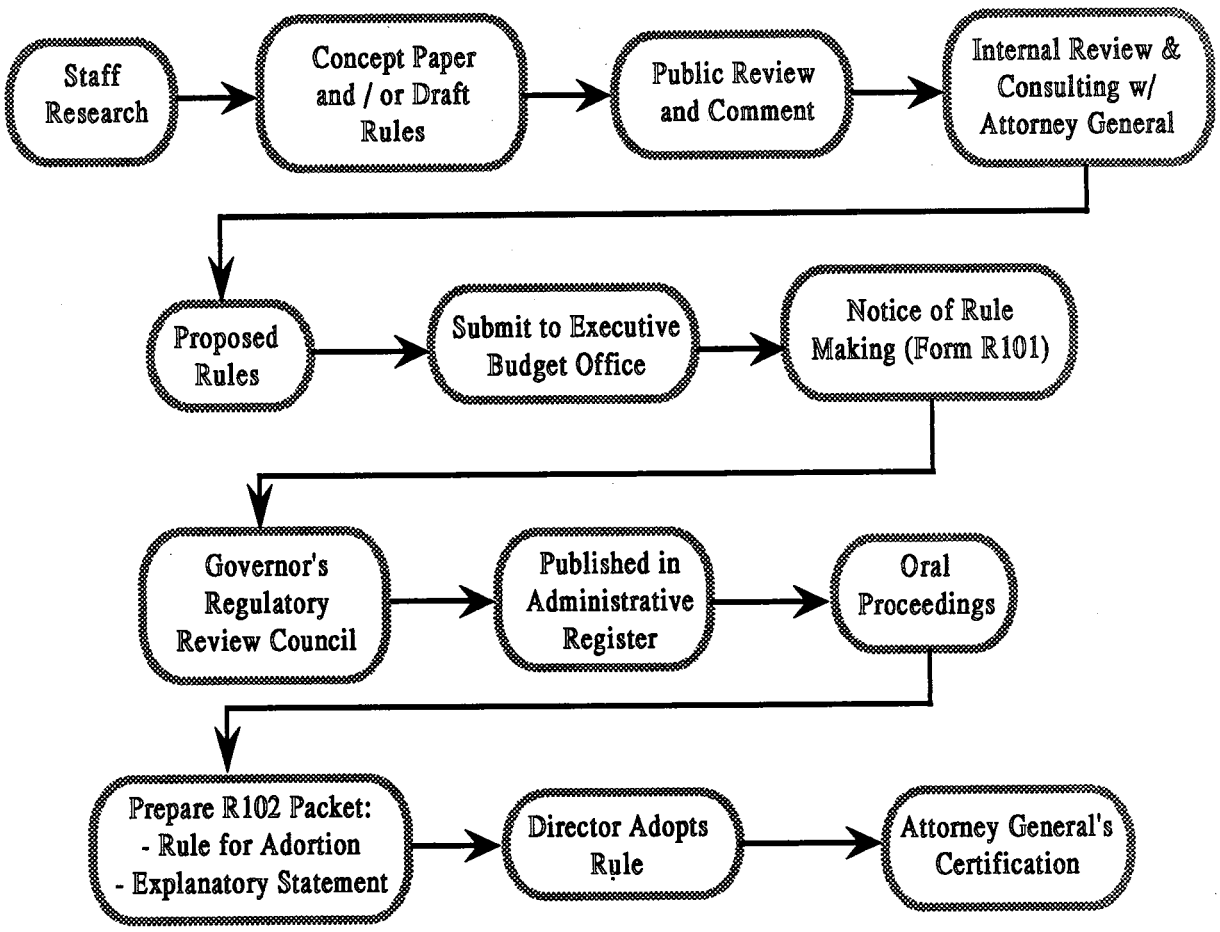

Figure IV. Chart of the Arizona Department of Environmental Quality proposed rule adoption

TABLE IV-3 ARIZONA NPS MANAGEMENT PROGRAM

	NPS Category/Subcategory	Guidance	Surface Water Program Type	Groundwater Program Type
10.	Agriculture			
	Irrigated cropland	BMPs	General permit, program int.[1]	General permit, program int.[1]
	CAFOs	BMPs	General permit, program int.[1]	General permit, program int.[1]
	Grazing	BMPs	NPS rules/possible delegation	NPS rules/program int.[1]
	Pesticide Contamination Program		Special State Program	Special State Program
20.	Silviculture	BMPs	NPS rules/possible delegation	NPS rules/program int.[1]
30.	Construction	BMPs	Local ordinances	NPS rules/program int.[1]
40.	Urban Runoff	BMPs	NPDES, Drywell rules, Local ord.	APP
50.	Resource Extraction	BMPs/BADCT	Program int.[1]	APP/Individual permit
60.	Land Disposal			
	Landfills	BADCT	Individual permits, program int.[1]	APP/Individual permit
	On-Site Wastewater	Guidance Document	Approval to construct	APP/Individual permit
	Sludge	Guidance Document	Solid waste individual permit	Solid waste individual permit
	Reuse	BMPs	NPS rules/program int.[1]	Reuse permit
	Recharge	BMPs	NPS rules/program int.[1]	APP
70.	Hydrologic/Habitat Modification	BMPs	404 Permit, 401C, State certification that WQ standards not violated	404 Permit, 401C, State certification that WQ standards not violated
80.	Other			
	Natural		None	None
	Storage Tank Leaks		LUST/UST Program	LUST/UST Program
	Highway Maintenance	BMPs	As per Construction/Urban Runoff	As per Construction/Urban Runoff
	Spills		Remedial action	Remedial Action
	Utility Corridors	BMPs	As per Construction/Urban Runoff	As per Construction/Urban Runoff
90.	Unknown		Surface Water Monitoring	Groundwater monitoring
100.	Recreation	BMPs	NPS rules/program int.[1]	NPS rules/program int.[1]

1 A.R.S. § 49-203C The Director shall integrate all programs authorized in this section and such other program affording water quality protection which are administered by the department for the purposes of administration and enforcement and shall avoid duplication and dual permitting to the maximum extent practicable.
2 Programs under development.
3 Program development process not funded.

pollute, the Director of the Department must negotiate with the registrant to change the label or to request that the State Chemist cancel the products' registration. ADEQ is currently operating this program.

- ***Surface Water Nonpoint Source Program***

Surface water nonpoint sources will be regulated by rule (ARS 49-203). The rules to be adopted under this authority will contain a definition of responsibilities, management agency designation process, BMPs, and compliance procedures as previously described.

- ***Designation of Management Agencies***

By law, state agencies, the Arizona State Land Department (ASLD), and the State Parks Department (ASP), and federal land management agencies, the U. S. Forest Service (USFS), the Bureau of Land Management (BLM), and the National Park Service (USNPS), have direct management responsibility for extensive acreages of public lands in the State. As shown in Table IV-1 and IV-2, these agencies will be asked to cooperate with the ADEQ in developing BMPs for nonpoint source controls on the lands they manage. The delegation of responsibility, to these and other agencies for nonpoint source pollution control, will be formalized through agreements as required in ADEQ rules. Best management practices for nonpoint sources of water pollution, to be incorporated into each agency's resource management program at a later time, may also be incorporated into the ADEQ rules.

- ***Delegation to Local Governments***

Construction, urban runoff, landfills, onsite disposal systems, and wastewater treatment plant sludge disposal are among the NPS categories that can be entirely or partially managed by various local governments within the State. Some of these pollution sources will be regulated by ADEQ or federal water quality permits of one kind or another, but cities and counties throughout the State will be encouraged to serve as management agencies for these sources. Local governments may operate facilities, require special design or operational performance of stormwater drainage systems, and require through local ordinance, water quality BMPs for all construction sites. Where appropriate, and with the consent of the local management agency, delegations to cities and counties will be part of the ADEQ rules.

- ***BADCT***

Best Available Demonstrated Control Technology (BADCT) is required of all facilities necessitating individual permits for aquifer protection. NPS categories that come under this process include: resource extraction (mining), and land disposal (landfills and septic tanks). The EQA (ARS 49-243.B.1) states:

"... the facility will be designed, constructed, and operated as to ensure the greatest degree of discharge reduction achievable through application of best available demonstrated control technology, processes, operating methods, or other alternatives, including, where practicable, a technology permitting no discharge of pollutants.... However, a discharge reduction to an aquifer achievable solely by means of site specific characteristics does not, in itself, constitute compliance with..." BADCT.

In other words, rather than using some minimum required control technology, operators should be using state-of-the-art design elements to eliminate discharge to groundwater. BADCT determination involves determining the "optimal" technologies as a first design. Optimal here refers to the most effective discharge controls independent of site conditions. Site characteristics may be substituted for design control technologies to arrive at a final design (BADCT for that facility and site).

In cooperation with the regulated community and other interested groups BADCT guidance documents have been developed for landfills, mining and individual discharges.

- ***Aquifer Protection by Individual Permits***

Discharges to groundwater, pursuant to the EQA, are regulated by the Arizona Aquifer Protection Permit Program although the discharge may occur

initially to surface waters. The aquifer protection program also regulates many activities considered as "nonpoint sources" under federal interpretation. These include regulation of septic tanks, reuse and dry wells, mining, landfills, agricultural, and other activities that may affect aquifers.

The principal management program for NPS control for aquifers derives from the EQA and Aquifer Protection Permits. Any person responsible for releases of a pollutant to the land surface or to the vadose zone, in such a manner that there is a reasonable probability that the pollutant will reach an aquifer, must obtain an aquifer protection permit.

Facilities which are assumed to be discharging to an aquifer are surface impoundments, including: holding, storage, settling, treatment or disposal pits, ponds, or lagoons; solid waste disposal facilities; injection wells; land treatment facilities; facilities which add a pollutant to a salt dome formation or salt bed formation, dry well or underground cave or mine; mine tailing piles and ponds; mine leaching operations, septic tank systems, groundwater recharges, and underground storage and recovery projects; point source discharges to navigable waters; sewage or sludge ponds and wastewater treatment facilities. Other activities to be regulated by general permits include concentrated animal feeding operations and nitrogen fertilizer application.

Activities exempted in the EQA from aquifer protection permit requirements include household and domestic activities, gardening, lawn watering, lawn care, landscape maintenance, the noncommercial use of consumer products generally available to the public, ponds for watering livestock and wildlife, mining overburden which has not been subjected to any chemical leaching or processing and which is returned to the excavation site, facilities for the transportation and storage of waters not containing sewage, discharge to a community sewer, facilities required to obtain a permit to reuse reclaimed wastewater, stormwater retention basins, facilities which ceased operation prior to January 1, 1986; and some other activities regulated by programs which provide equal or better protection of aquifer water quality.

Factors considered when issuing a permit include: the design of the facility; how the facility will operate; existing and proposed pollutant control measures, hydrogeologic characteristics of the discharge impact area; use of the water from the aquifers in the discharge impact area; characteristics of the pollutants' discharge by the facility; and any other relevant state or federal permits. The facility must be designed, constructed, and operated to ensure the greatest reduction of pollutant discharge achievable through the application of BADCT, processes, operating methods, or other alternatives, including, where practicable, a technology permitting no discharge of pollutants. Additionally, the discharge must not cause or contribute to a violation of aquifer water quality standards.

- ***Aquifer Protection by General Permits***

General permits may also be given in accordance with Sections 40-245 and 246 of the EQA for discharge activities that are similar, large in number, and the director is satisfied that appropriate conditions will be satisfied by BMPs or BADCT.

D. NPS Program Implementation by Other Means

Various components of the regulatory program for nonpoint source pollution control discussed in Section C will be supported by other efforts. These efforts can include: education, demonstration programs, technical assistance, and voluntary implementation of BMPs.

Educational efforts and technical assistance will be associated with the program to implement BMPs for agricultural activities, the pesticide contamination prevention program, grazing on private lands, and forestry on private lands. Agencies participating in these efforts include the USFS, the BLM, the ASLD, the U.S. Soil Conservation Service (SCS), the University of Arizona Extension Service, and the Natural Resource Conservation Districts (NRCDs) within the State.

Most grazing and silvicultural operations in the State occur on a mixture of public and private lands. These lands should be managed to meet

the environmental quality requirements of the State. Therefore, separate regulatory programs focusing only on private lands are not proposed here. The application of BMPs on leased public lands will be incorporated into the operational plans for each ranch or logging operation through the requirements of the land management agencies. Operating plans, including BMPs, are currently required by the USFS and the BLM and encouraged by the ASLD on all their leases. Details for implementation of BMPs on privately owned and managed lands for grazing and silviculture are currently under development.

At the implementation stage, the NPS management program will focus the resources of NPS managers on problem NPS pollution areas. Table IV-4 describes the proposed ranking system for demonstration projects for both surface and groundwater. This table was developed using existing State prioritization procedures for the construction grants program, and the Water Quality Assurance Revolving Fund (State Superfund).

Federally funded demonstration projects (Section 319 of the FCWA) will be available for various nonpoint source categories. These funds will be assigned to priority projects as they become available.

E. Compliance

Compliance activities for the nonpoint source water quality management program are expected to be similar to those implemented as part of other ADEQ programs. These activities include: monitoring, review of delegated programs (designated management agencies), program assessment, ADEQ and federal enforcement programs, and citizen suits.

A statewide network of monitoring stations has been established in cooperation with the U.S. Geological Survey (USGS) and other cooperators to determine compliance with water quality standards and trends, and to support the waste load analysis program. In Chapter III, the available data were utilized to assess the impact of NPS pollution on Arizona's water bodies. This assessment process has been carried out by the ADEQ and reviewed by an advisory committee. The NPS assessment and management reports of the ADEQ will be subjected to public review.

Three types of monitoring will be undertaken. These are:

1. monitoring of the ambient water quality,

2. monitoring design or operational plans, and

3. monitoring the vadose zone and groundwater.

Because the program involves permits for facilities and activity plans for extensive land uses, monitoring of both surface waters and groundwater will be utilized to assess compliance with BADCT, BMPs, and standards. Results from statewide surface and groundwater monitoring networks, and monitoring results from special studies or programs (like the pesticide program) will be combined with the results of monitoring conducted by facilities and management agencies to evaluate program compliance.

Compliance monitoring and review of the data produced will serve as the principal methods to evaluate the effectiveness of BADCT, BMPs, and performance of various management agencies. Management agency evaluations will also consider the effectiveness of the procedures and processes used to integrate BMPs into the activities of both the agencies and their cooperators. The nature and content of management agency reviews by the Department will be agreed to by both parties (ADEQ and the management agency) in advance.

Because the Arizona Nonpoint Source Management Program is designed to meet the requirements of both federal and state laws, compliance problems may be addressed in a number of ways. If environmental problems are present, planning and assessment studies may be appropriate to determine nonpoint pollution sources and to quantify the contributions of those sources. Nonpoint source pollution management planning funds can be used to support these activities. More serious compliance problems would be submitted to standard ADEQ or EPA enforcement procedures. These procedures involve negotiations between the responsible parties and designated

Table IV-4. NPS Water Quality priority ranking process.

Targeting Criteria	Possible Points
1. Public Health or Environmental Quality Problems	
(a) Existing	20
(b) Imminent	10
(c) Potential	5
2. Documented Standards Violation	
(a) Consistently exceeded	20
(b) Occasionally exceeded	10
(c) Threatened	5
3. Population Affected (including nonresident population)	
(a) >100,000	10
(b) 10,000 to 100,000	5
(c) <10,000	2
4. Area of Impacted Watershed or Groundwater Aquifer	
(a) >1,000,000 acres	10
(b) 100,000 to 1,000,000 acres	5
(c) <100,000 acres	2
5. Resource Value of Water Body (count only one of the following four)	
(a) Primary source of area drinking water	10
(b) Threatened or endangered species or designation as a Unique Water	10
(c) Interstate, International, or National Designation (Wild and Scenic River, Colorado River Salinity Forum, International Boundary and Water Commission Designation)	10
(d) Local Interest Group Nomination	10
6. Effectiveness	
(a) High potential to restore protected uses	20
(b) Moderate potential to restore protected uses	10
(c) Low potential to restore protected uses	5
(d) Unknown (project features transferable, innovative approaches or emerging technologies)	10
7. Public Support for Project	
(a) 50% local match, or	10
(b) Identified Watershed Improvement Program (Forest Service, Soil Conservation Service, Bureau of Land Management, State Land Department)	10
TOTAL MAXIMUM ALLOWABLE POINTS	100

program enforcement staff. If the problem remains unresolved, the process can escalate to legal action carried out by the State Attorney General or EPA Regional Counsel.

The 1986 Arizona EQA established a broad basis for citizen suits as a mechanism to insure that the legislation would be implemented. These suits may be filed against agencies as well as individuals. To avoid liability associated with possible citizen suits, the Department and cooperating management and planning agencies must do more than design a NPS pollution management program. They must implement the program and demonstrate its effectiveness.

F. NPS Management Program by Source Category

Arizona's proposed nonpoint source pollution management program is summarized in Tables IV-1 and IV-2, which present the responsible agencies for each program component and category of nonpoint sources. The program components, (planning, implementation by rule, implementation by other means and compliance) have been discussed previously in Section C of this Chapter. The following paragraphs present a review of the NPS management program by source category, but does not include all categories on the Arizona list of sources. The schedule for rule adoption is presented in Table IV-5.

The EQA gave priority to categories of agricultural sources by specifying the process by which BMPs would be developed. Section 49-247 of the EQA defines these regulated agricultural activities and sources as the application of nitrogen fertilizer, and concentrated animal feeding operations. In adopting BMPs, the director of ADEQ must consider the following:

1. the availability, the effectiveness, and the economic and institutional considerations of alternative technologies; and

2. the potential nature and severity of discharges from regulated agricultural activities and their affects on public health and the environment.

The EQA established two agricultural BMP advisory committees to be appointed by the Governor. Both committees contain representatives from ADEQ, the Arizona Department of Water Resources, the College of Agriculture of the University of Arizona, and the Commission on Agriculture and Horticulture. In addition, each committee contains seven members that represent the respective regulated community. The purpose of the committees is to develop and recommend BMPs to the director.

Best Management Practices to prevent pollution to both surface and groundwater are to be included in rule. The ADEQ is the agency responsible for program development and compliance. Individual farm operators will develop an operating plan which identifies the BMPs to be implemented on their farm unit. The NRCDs, SCS, and the University of Arizona Cooperative Extension Service are available to provide education and technical assistance.

The proposed BMPs for the application of nitrogen fertilizer and concentrated animal feeding operations to prevent or reduce the discharge of nitrogen pollutants to groundwater are listed as follows:

1. Nitrogen Fertilizers

   a. Application of nitrogen fertilizer shall be limited to that amount necessary to meet projected crop plant needs.

   b. Application of nitrogen fertilizer shall be timed to coincide as closely as possible to the periods of maximum crop plant uptake.

   c. Application of nitrogen fertilizer shall be by a method designed to deliver nitrogen to the area of maximum crop plant uptake.

   d. Application of irrigation water to meet crop plant needs shall be managed to minimize nitrogen loss by leaching and runoff.

   e. The application of irrigation water shall be timed to minimize nitrogen loss by leaching and runoff.

Table IV-5. Arizona Department of Environmental Quality rule adoption agenda and tentative schedule.

Rule Title	Advisory Group	Concept Paper	Preliminary Draft Rule	Public Mtgs. & Workshop	Deadline for EBO	GRRC Hearing	AD.Reg. Pub. Date	Oral Proceeding	Close of Com. Period	Draft Ready for Director	Certification Date	Comments
Water Quality Planning	WQAC	9/90	9/91		12/91							
Water Quality Standards	WQAC	9/89	10/89	6/89-10/89	11/15/89	12/05/89	1/02/90	2/90	3/90	6/90	7/90	Toxic Std. St. Deadline 1/1/90
Aquifer Boundaries	--	9/86	12/86	1/87	3/03/87	2/87	4/01/87	5/1/87	6/87	7/87	10/87	Certified
Aquifer WQ Standards	WQAC	7/89	7/89		10/89					4/90		Fed Regs Awaiting EPA Adoption
Aquifer Bound. Pub. Part.	WQAC	12/86	4/88	1/87-6/88	10/12/88	11/01/88	12/01/88	1/89	1/27/89	4/89	7/89	Certified
Aquifer WQ Standrs '88 ADEQ	--	--	--	--	12/14/88	1/03/89	2/01/89	3/89	3/09/89	3/27/89	6/89	Certified
State Revolving Fund		9/89	9/89		12/89					5/90		
Nonpoint Source BMPs	BMP	9/90	9/91		12/91							
Agricultural BMPs	BMPAC	DONE	DONE	DONE	DONE	DONE	7/03/89	8/89	8/89	10/89	12/89	Statutory Deadline 7/1/89
Pesticide Con. Prev.	--	DONE	DONE		12/89					7/90		Statutory Deadline 12/1/88
Pesticide Dispute Res.	--	1/87	1/87	1/87	3/87	4/7/87	5/87	5/87	6/87	6/87	8/87	Certified
Dredge & Fill	--	12/89	7/90		12/90					6/91		
Onsite Wastewater	--	12/88	TBA									
Wastewater Reuse	--	6/89	12/89		5/90					11/90		
Dry Wells	WQAC	DONE	3/90		9/90					3/91		
UIC	--	9/88	TBA									
UST/LUST	--	9/89	12/89		2/90					7/90	10/90	
Hazardous Waste '89	--	TBA	TBA									
Solid Waste	--	TBA	TBA									

LMA* = Land Management Agency
PO* = Private Organization

f. The operator shall use tillage practices that maximize water and nitrogen uptake by crop plants.

All persons who engage in concentrated animal feeding operations are issued an agricultural general permit and shall comply with the agricultural best management practices listed in this section. A person who operates a concentrated animal feeding operation facility pursuant to an agricultural general permit shall comply with all of the following:

2. Concentrated Animal Feeding Operations

a. Harvest, stockpile and dispose of animal manure from concentrated animal feeding operations as economically feasible to minimize discharge of nitrogen pollutants by leaching and runoff.

b. Control and dispose of nitrogen contaminated water resulting from activities associated with a concentrated animal feeding operation, up to a 25 year, 24 hour storm event equivalent, as economically feasible, to minimize the discharge of nitrogen pollutants.

c. Close facilities in a an economically feasible manner to minimize the discharge of nitrogen pollutants.

Each BMP is supported by a choice of alternative technologies as described in the Agricultural Activities BMP Handbook.

The pesticide contamination prevention program, a special regulatory system, complements the system of BMP controls for nitrogen fertilizer applications. The pesticide program uses amendments to or cancellations of the pesticide labels to prevent water pollution by these chemicals.

The management program for grazing and silviculture are comparable. Resource management agencies for public lands will accept management agency designation from the ADEQ and assume responsibility for control of NPS pollution. These agencies, including the USFS, BLM, USNPS, ASLD and the ASP, will incorporate BMPs into their resource management programs. The ADEQ will retain responsibility for compliance evaluations. In some cases, these agencies (e.g., the USFS and ASLD) will also accept planning agency designation. Requirements for BMP application, and designation or delegation of planning and management agency delegations, will be embodied in interagency agreements and in ADEQ rules.

Rangeland is the NPS pollution category that has the greatest potential for impact on surface waters of the State because of the surface area involved. The BMPs for grazing will first be proposed by the land management agencies that control this activity on rangeland, such as the USFS, BLM, and the ASLD. Consistency between federal agencies will be developed through intergovermental agreement (IGA) and the adoption of the agency delegation process in Rule.

Although specific BMPs have not been developed for grazing, some land managers have previously developed and implemented programs which may contain BMPs. Situations have been identified where selective fencing has improved rangeland and watersheds while accomplishing reduced impacts attributable to NPS pollution. Ranchers and management agencies are implementing grazing systems which permit concentration of animals upon specific grazing areas for limited periods during the year. The net effect has been increased forage production, increased livestock production, improved rangeland and decreased NPS pollution potential.

Silviculture in Arizona is primarily under the control of the USFS. Therefore, the BMP development process for this NPS category has proceeded in coordination with this agency. The USFS has proposed to utilize its thirteen step Integrated Resource Management (IRM) Process to decide which BMPs are applicable to a specific activity. The IRM document describes the points where citizens can participate in this process. Unfortunately, the BMPs to be utilized have not presently been specified. When the BMPs are developed for silviculture, they will be incorporated into Rule in a manner similar to that for the regulated agricultural activities.

Construction activities on public lands would be regulated through designation of the management program to resource management agencies. This management program will be similar to that discussed for silvicultural nonpoint sources. These agencies, including the USFS, the BLM, USNPS, ASLD and the ASP, would require the application of BMPs for all uses of the public lands. The ADEQ will retain responsibility for compliance evaluations.

Construction activities on private lands, such as subdivisions, will be managed through a program similar to that for urban runoff. The management of runoff from construction activities will depend upon application of BMPs, and will be regulated as part of the local governments' building and land development process. If treatment and disposal of the waters from a construction site are necessary, they will be regulated by federal or state permits depending upon whether the discharge is to surface or groundwater.

Urban runoff will be managed through a program that reflects both the collection and transport of stormwater on one hand, and the treatment and disposal of stormwater on the other hand. Treatment and disposal will be regulated by federal or state permits depending upon whether the discharge is to surface or groundwater. These programs are scheduled for development over the next two years. Collection and transport of stormwaters will be regulated by local governments as part of their building and land development process. The ADEQ anticipates that this part of the stormwater management program will be developed in concert with local governments and the local water quality planning agencies.

The urban runoff management program is scheduled to be completed by 1990. Where appropriate and acceptable to both parties, management and planning agency delegation to local agencies may be included in the ADEQ Rules. Responsibilities for assuring compliance with the collection and transport of urban runoff would be delegated to local governments. The EPA and the ADEQ would retain compliance responsibility for the discharges. The exact design of the portion of this program to manage stormwater discharges to surface waters will depend upon the design of the EPA program required by amendments to the FWCA.

The resource extraction management program, including mining, milling, and benefaction or smelting, will be administered by the ADEQ and responsible federal agencies. State water quality responsibilities will not be delegated to management agencies. The ADEQ is the planning agency and will be responsible for implementation and compliance. Permits for mining discharges to surface water will require BADCTs where groundwaters are the receiving waters or BMPs where nonpoint sources attributable to facility activities impact navigable waters.

Land disposal, like resource extraction, is regulated under the EQA permitting authorities. The management program for landfills, sludge, wastewater reuse, and recharge will include the implementation of BADCTs or BMPs. Local governments that operate these facilities will be required to obtain the appropriate permits from the ADEQ. Compliance verification activities will remain with the ADEQ.

The program to manage NPS pollution from recreation, including dispersed and concentrated recreation areas, requires participation by state, federal, and local government agencies. ADEQ will delegate or designate water quality responsibilities of agencies involved in recreation management.

The development of BMPs for hydrologic/habitat modification will require the participation of state, federal, and local government agencies responsibilities for land, water and fish and wildlife management. Chapter II of the March 1988 Arizona Wetlands Priority Plan (prepared by the Arizona State Parks Department), (Appendix H) defines authorities and responsibilities for wetlands and riparian habitats which could form a core of existing programs around which a hydrologic / habitat modification NPS program can be expanded and developed.

Special interest organizations may also play a role in fostering public awareness and education on hydrologic / habitat modification issues, as well as upon preservation of critical habitat areas. Examples of such organizations include the Nature Conservancy, the Arizona Riparian Council, and the Audubon Society.

Future land water development projects will require increased attention to BMP implementation as a means to mitigate hydrologic / habitat impacts upon land, water, and fish and wildlife resources. Fundamental steps in this process include: 1) pre-project planning; 2) environmental investigations, and impact evaluation; 3) construction phase mitigation and monitoring; and 4) post project mitigation implementation, monitoring, and evaluation.

Mitigation is defined in the regulations of the National Environmental Policy Act of 1969 as:

1. Avoiding the impact altogether by not taking a certain action or actions;

2. Minimizing impacts by limiting the degree or magnitude of the action and its implementation;

3. Rectifying the impact by repairing, rehabilitating, or restoring the effected environment;

4. Reducing or eliminating the impact over time by preservation operations during the life of the action; and

5. Compensating for the impact by replacing or providing substitute resources or environments.

The State of Arizona must establish its priorities and policies to mitigate developmental project impacts upon water quality and other environmental features, regardless of the NPS category. In a recent development, Executive Order No. 89-16 by the Governor of the State of Arizona on Streams and Riparian Resources has directed State agencies to address these resources as part of their programs, and formed a Riparian Habitat Task Force for the State.

The NPS program (Table IV-2) for hydrologic/ habitat modification will develop and include BMPs as for the other source categories. In addition, delegation or designation of responsibilities for planning and implementation of BMPs to land management agencies or other appropriate agencies or organizations is expected. The ADEQ would retain certain review and comment, planning, and compliance functions regarding hydrologic/habitat modifications to address wetland and riparian habitat alteration, dredge and fill in wetlands and navigable waters, and water project development. Numerous state and federal mandates allow the ADEQ to address these activities. Examples are: the protected use (R-18-11-209) and unique waters (R-18-11-303) sections of the State Water Quality Standards, review and comment on Section 404 (CWA of 1972) dredge and fill permits, review and comment on Section 10 (1899-River and Harbors Act) permits, and for any water development project or activity subject to public and agency review and comment under the National Environmental Policy Act of 1969 (NEPA).

The development of an effective Nonpoint Source Pollution Water Quality Management Program presents a challenge to the State of Arizona. The environmental, technical, institutional, and economic questions which must be addressed by participants, with responsibilities or interests in NPS management, are diverse. Nonpoint sources of pollution result from, are a consequence of, or touch on nearly every area of human activity utilizing the resources of air, land, and water in the State.

Appendix A

Clean Water Act Amendment of 1987, Section 319
Nonpoint source Management Programs

(c) Notwithstanding any other provisions of this Act, any point source of a discharge having a thermal component, the modification of which point source is commenced after the date of enactment of the Federal Water Pollution Control Act Amendments of 1972 and which, as modified, meets effluent limitations established under section 301, or if more stringent, effluent limitations established under section 303 and which effluent limitations will assure protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in or on the water into which the discharge is made, shall not be subject to any more stringent effluent limitation with respect to the thermal component of its discharge during a ten year period begining on the date of completion of such modification or during the period of depreciation or amortization of such facility for the purpose of section 167 or 169 (or both) of the Internal Revenue Code of 1954, whichever period ends first.

Financing Study

33 USC 1327

Sec. 317. (a) The Administrator shall continue to investigate and study the feasibility of alternate methods of financing the cost of preventing, controlling and abating pollution as directed in the Water Quality Improvement Act of 1970 (Public Law 91-224), including, but not limited to, the feasibility of establishing a pollution abatement trust fund. The results of such investigation and study shall be reported to the Congress not later than two years after enactment of this title, together with recommendations of the Administrator for financing the programs for preventing, controlling and abating pollution for the fiscal years beginning after fiscal year 1976, including any necessary legislation.

(b) There is authorized to be appropriated for use in carrying out this section, not to exceed $1,000,000.

Aquaculture

33 USC 1328

Sec. 318. (a) The Administrator is authorized, after public hearings, to permit the discharge of a specific pollutant or pollutants under controlled conditions associated with an approved aquaculture project under Federal and State supervision pursuant to section 402 of this Act.

(b) The Administrator shall by regulation establish any procedures and guidelines which the Administrator deems necessary to carry out this section. Such regulations shall require the application to such discharge of each criterion, factor, procedure, and requirement applicable to a permit issued under section 402 of this title, as the Administrator determines necessary to carry out the objective of this Act.

(c) Each State desiring to administer its own permit program within its jurisdiction for discharge of a specific pollutant or pollutants under controlled conditions associated with an approved aquaculture project may do so if upon submission of such program the Administrator determines such program is adequate to carry out the objective of this Act.

Nonpoint Source Management Programs

Sec. 319. (a) State Assessment Reports.—

(1) Contents.—The Governor of each State shall, after notice and opportunity for public comment, prepare and submit to the Administrator for approval, a report which—

(A) identifies those navigable waters within the State which, without additional action to control nonpoint sources of pollution, cannot reasonably be expected to attain or maintain applicable water quality standards or the goals and requirements of this Act;

(B) identifies those categories and subcategories of nonpoint sources or, where appropriate, particular nonpoint sources which add significant pollu-

tion to each portion of the navigable waters identified under subparagraph (A) in amounts which contribute to such portion not meeting such water quality standards or such goals and requirements;

(C) describes the process, including intergovernmental coordination and public participation, for identifying best management practices and measures to control each category and subcategory of nonpoint sources and, where appropriate, particular nonpoint sources identified under subparagraph (B) and to reduce, to the maximum extent practicable, the level of pollution resulting from such category, subcategory, or source; and

(D) identifies and describes State and local programs for controlling pollution added from nonpoint sources to, and improving the quality of, each such portion of the navigable waters, including but not limited to those programs which are receiving Federal assistance under subsections (h) and (i).

(2) Information Used in Preparation.—In developing the report required by this section, the State (A) may rely upon information developed pursuant to sections 208, 303(e), 304(f), 305(b), and 314, and other information as appropriate, and (B) may utilize appropriate elements of the waste treatment management plans developed pursuant to sections 208(b) and 303, to the extent such elements are consistent with and fulfill the requirements of this section.

(b) State Management Programs.—

(1) In General.—The Governor of each State, for that State or in combination with adjacent States, shall, after notice and opportunity for public comment, prepare and submit to the Administrator for approval a management program which such State proposes to implement in the first four fiscal years beginning after the date of submission of such management program for controlling pollution added from nonpoint sources to the navigable waters within the State and improving the quality of such waters.

(2) Specific Contents.—Each management program proposed for implementation under this subsection shall include each of the following:

(A) An identification of the best management practices and measures which will be undertaken to reduce pollutant loadings resulting from each category, subcategory, or particular nonpoint source designated under paragraph (1)(B), taking into account the impact of the practice on ground water quality.

(B) An identification of programs (including, as appropriate, nonregulatory or regulatory programs for enforcement, technical assistance, financial assistance, education, training, technology transfer, and demonstration projects) to achieve implementation of the best management practices by the categories, subcategories, and particular nonpoint sources designated under subparagraph (A).

(C) A schedule containing annual milestones for (i) utilization of the program implementation methods identified in subparagraph (B), and (ii) implementation of the best management practices identified in subparagraph (A) by the categories, subcategories, or particular nonpoint sources designated under paragraph (1)(B). Such schedule shall provide for utilization of the best management practices at the earliest practicable date.

(D) A certification of the attorney general of the State or States (or the chief attorney of any State water pollution control agency which has independent legal counsel) that the laws of the State or States, as the case may be, provide adequate authority to implement such management program or, if there is not such adequate authority, a list of such additional authorities as will be necessary to implement such management program. A schedule and commitment by the State or States to seek such additional authorities as expeditiously as practicable.

(E) Sources of Federal and other assistance and funding (other than assistance provided under subsections (h) and (i)) which will be available in each of such fiscal years for supporting implementation of such practices and measures and the purposes for which such assistance will be used in each of such fiscal years.

(F) An identification of Federal financial assistance programs and Federal development projects for which the State will review individual assistance applications or development projects for their effect on water quality pursuant to the procedures set forth in Executive Order 12372 as in effect on September 17, 1983, to determine whether such assistance applications or development projects would be consistent with the program prepared under this subsection; for the purposes of this subparagraph, identification shall not be limited to the assistance programs or development projects subject to Executive Order 12372 but may include any programs listed in the most recent Catalog of Federal Domestic Assistance which may have an effect on the purposes and objectives of the State's nonpoint source pollution management program.

(3) Utilization of Local and Private Experts.—In developing and implementing a management program under this subsection, a State shall, to the maximum extent practicable, involve local public and private agencies and organizations which have expertise in control of nonpoint sources of pollution.

(4) Development on Watershed Basis.—A State shall, to the maximum extent practicable, develop and implement a management program under this subsection on a watershed-by-watershed basis within such State.

(c) Administrative Provisions.—

(1) Cooperation Requirement.—Any report required by subsection (a) and any management program and report required by subsection (b) shall be developed in cooperation with local, substate, regional, and interstate entities which are actively planning for the implementation of nonpoint source pollution controls and have either been certified by the Administrator in accordance with section 208, have worked jointly with the State on water quality management planning under section 205(j), or have been designated by the State legislative body or Governor as water quality management planning agencies for their geographic areas.

(2) Time Period for Submission of Reports and Management Proposals.—Each report and management program shall be submitted to the Administrator during the 18-month period beginning on the date of the enactment of this section.

(d) Approval or Disapproval of Reports on Management Programs.—

(1) Deadline.—Subject to paragraph (2), not later than 180 days after the date of submission to the Administrator of any report or management program under this section (other than subsections (h), (i), and (k)), the Administrator shall either approve or disapprove such report or management program, as the case may be. The Administrator may approve a portion of a management program under this subsection. If the Administrator does not disapprove such a report, management program, or portion of a management program in such 180-day period, such report, management program, or portion shall be deemed approved for purposes of this section.

(2) Procedure for Disapproval.—If, after notice and opportunity for public comment and consultation with appropriate Federal and State agencies and other interested persons, the Administrator determines that—

(A) the proposed management program or any portion thereof does not meet the requirements of subsection (b)(2) of this section or is not likely to satisfy, in whole or in part, the goals and requirements of this Act;

(B) adequate authority does not exist, or adequate resources are not available, to implement such program or portion;

(C) the schedule for implementing such program or portion is not sufficiently expeditious; or

(D) the practices and measures proposed in such program or portion are not adequate to reduce the level of pollution in navigable waters in the State resulting from nonpoint sources and to improve the quality of navigable waters in the State;

the Administrator shall within 6 months of the receipt of the proposed program notify the State of any revisions or modifications necessary to obtain approval. The State shall thereupon have an additional 3 months to submit its revised man-

agement program and the Administrator shall approve or disapprove such revised program within three months of receipt.

(3) Failure of State to Submit Report.—If a Governor of a State does not submit the report required by subsection (a) within the period specified by subsection (c)(2), the Administrator shall, within 30 months after the date of the enactment of this section, prepare a report for such State which makes the identifications required by paragraph (1)(A) and (1)(B) of subsection (a). Upon completion of the requirement of the preceding sentence and after notice and opportunity for comment, the Administrator shall report to the Congress on his actions pursuant to this section.

(e) Local Management Programs; Technical Assistance.—If a State fails to submit a management program under subsection (b) or the Administrator does not approve such a management program, a local public agency or organization which has expertise in, and authority to, control water pollution resulting from nonpoint sources in any area of such State which the Administrator determines is of sufficient geographic size may, with approval of such State, request the Administrator to provide, and the Administrator shall provide, technical assistance to such agency or organization in developing for such area a management program which is described in subsection (b) and can be approved pursuant to subsection (d). After development of such management program, such agency or organization shall submit such management program to the Administrator for approval. If the Administrator approves such management program, such agency or organization shall be eligible to receive financial assistance under subsection (h) for implementation of such management program as if such agency or organization were a State for which a report submitted under subsection (a) and a management program submitted under subsection (b) were approved under this section. Such financial assistance shall be subject to the same terms and conditions as assistance provided to a State under subsection (h).

(f) Technical Assistance for States.—Upon request of a State, the Administrator may provide technical assistance to such State in developing a management program approved under subsection (b) for those portions of the navigable waters requested by such State.

(g) Interstate Management Conference.—

(1) Convening of Conference; Notification; Purpose.—If any portion of the navigable waters in any State which is implementing a management program approved under this section is not meeting applicable water quality standards or the goals and requirements of this Act as a result, in whole or in part, of pollution from nonpoint sources in another State, such State may petition the Administrator to convene, and the Administrator shall convene, a management conference of all States which contribute significant pollution resulting from nonpoint sources to such portion. If, on the basis of information available, the Administrator determines that a State is not meeting applicable water quality standards or the goals and requirements of this Act as a result, in whole or in part, of significant pollution from nonpoint sources in another State, the Administrator shall notify such States. The Administrator may convene a management conference under this paragraph not later than 180 days after giving such notification, whether or not the State which is not meeting such standards requests such conference. The purpose of such conference shall be to develop an agreement among such States to reduce the level of pollution in such portion resulting from nonpoint sources and to improve the water quality of such portion. Nothing in such agreement shall supersede or abrogate rights to quantities of water which have been established by interstate water compacts, Supreme Court decrees, or State water laws. This subsection shall not apply to any pollution which is subject to the Colorado River Basin Salinity Control Act. The requirement that the Administrator convene a management conference shall not be subject to the provisions of section 505 of this Act.

(2) State Management Program Requirement.—To the extent that the States reach agreement through such conference, the management programs of the

States which are parties to such agreements and which contribute significant pollution to the navigable waters or portions thereof not meeting applicable water quality standards or goals and requirements of this Act will be revised to reflect such agreement. Such management programs shall be consistent with Federal and State law.

(h) Grant Program.—

(1) Grants for Implementation of Management Programs.—Upon application of a State for which a report submitted under subsection (a) and a management program submitted under subsection (b) is approved under this section, the Administrator shall make grants, subject to such terms and conditions as the Administrator considers appropriate, under this subsection to such State for the purpose of assisting the State in implementing such management program. Funds reserved pursuant to section 205(j)(5) of this Act may be used to develop and implement such management programs.

(2) Applications.—An applicant for a grant under this subsection in any fiscal year shall be in such form and shall contain such other information as the Administrator may require, including an identification and description of the best management practices and measures which the State propose to assist, encourage, or require in such year with the Federal assistance to be provided under the grant.

(3) Federal Share.—The Federal share of the cost of each management program implemented with Federal assistance under this subsection in any fiscal year shall not exceed 60 percent of the cost incurred by the State in implementing such management program and shall be made on condition that the non-Federal share is provided from the non-Federal sources.

(4) Limitation on Grant Amounts.—Notwithstanding any other provision of this subsection, not more than 15 percent of the amount appropriated to carry out this subsection may be used to make grants to any one State, including any grants to any local public agency or organization with authority to control pollution from nonpoint sources in any area of such State.

(5) Priority for Effective Mechanisms.—For each fiscal year beginning after September 30, 1987, the Administrator may give priority in making grants under this subsection, and shall give consideration in determining the Federal share of any such grant, to States which have implemented or are proposing to implement management programs which will—

(A) control particularly difficult or serious nonpoint source pollution problems, including, but not limited to, problems resulting from mining activities;

(B) implement innovative methods or practices for controlling nonpoint sources of pollution, including regulatory programs where the Administrator deems appropriate;

(C) control interstate nonpoint source pollution problems; or

(D) carry out ground water quality protection activities which the Administrator determines are part of a comprehensive nonpoint source pollution control program, including research, planning, ground water assessments, demonstration programs, enforcement, technical assistance, education, and training to protect ground water quality from nonpoint sources of pollution.

(6) Availability for Obligation.—The funds granted to each State pursuant to this subsection in a fiscal year shall remain available for obligation by such State for the fiscal year for which appropriated. The amount of any such funds not obligated by the end of such fiscal year shall be available to the Administrator for granting to other States under this subsection in the next fiscal year.

(7) Limitation on Use of Funds.—States may use funds from grants made pursuant to this section for financial assistance to persons only to the extent that such assistance is related to the costs of demonstration projects.

(8) Satisfactory Progress.—No grant may be made under this subsection in any fiscal year to a State which in the preceding fiscal year received a grant under this subsection unless the Administrator determines that such State made satisfactory progress in such preceding fiscal year in meeting the schedule specified by such State under subsection (b)(2).

(9) Maintenance of Effort.—No grant may be made to a State under this subsection in any fiscal year unless such State enters into such agreements with the Administrator as the Administrator may require to ensure that such State will maintain its aggregate expenditures from all other sources for programs for controlling pollution added to the navigable waters in such State from nonpoint sources and improving the quality of such waters at or above the average level of such expenditures in its two fiscal years preceding the date of enactment of this subsection.

(10) Request for Information.—The Administrator may request such information, data, and reports as he considers necessary to make the determination of continuing eligibility for grants under this section.

(11) Reporting and Other Requirements.—Each State shall report to the Administrator on an annual basis concerning (A) its progress in meeting the schedule of milestones submitted pursuant to subsection (b)(2)(C) of this section, and (B) to the extent that appropriate information is available, reductions in nonpoint source pollutant loading and improvements in water quality for those navigable waters or watersheds within the State which were identified pursuant to subsection (a)(1)(A) of this section resulting from implementation of the management program.

(12) Limitation on Administrative Costs.—For purposes of this subsection, administrative costs in the form of salaries, overhead, or indirect costs for services provided and charged against activities and programs carried out with a grant under this subsection shall not exceed in any fiscal year 10 percent of the amount of the grant in such year, except that costs of implementing enforcement and regulatory activities, education, training, technical assistance, demonstration projects, and technology transfer programs shall not be subject to this limitation.

(i) Grants for Protecting Groundwater Quality.—

(1) Eligible Applicants and Activities.—Upon application of a State for which a report submitted under subsection (a) and a plan submitted under subsection (b) is approved under this section, the Administrator shall make grants under this subsection to such State for the purpose of assisting such State in carrying out groundwater quality protection activities which the Administrator determines will advance the State toward implementation of a comprehensive nonpoint source pollution control program. Such activities shall include, but not be limited to, research, planning, groundwater assessments, demonstration programs, enforcement, technical assistance, education and training to protect the quality of groundwater and to prevent contamination of groundwater from nonpoint sources of pollution.

(2) Applications.—An applicant for a grant under this subsection shall be in such form and shall contain such information as the Administrator may require.

(3) Federal Share: Maximum Amount.—The Federal share of the cost of assisting a State in carrying out groundwater protection activities in any fiscal year under this subsection shall be 50 percent of the costs incurred by the State in carrying out such activities, except that the maximum amount of Federal assistance which any State may receive under this subsection in any fiscal year shall not exceed $150,000.

(4) Report.—The Administrator shall include in each report transmitted under subsection (m) a report on the activities and programs implemented under this subsection during the preceding fiscal year.

(j) Authorization of Appropriations.—There is authorized to be appropriated to carry out subsections (h) and (i) not to exceed $70,000,000 for fiscal year 1988, $100,000,000 per fiscal year for each of fiscal years 1989 and 1990, and $130,000,000 for fiscal year 1991; except that for each of such fiscal years not to exceed $7,500,000 may be made available to carry out subsection (i). Sums appropriated pursuant to this subsection shall remain available until expended.

(k) Consistency of Other Programs and Projects with Management Programs.—The Administrator shall transmit to the Office of Management and Budget and the

appropriate Federal departments and agencies a list of those assistance programs and development projects identified by each State under subsection (b)(2)(F) for which individual assistance applications and projects will be reviewed pursuant to the procedures set forth in Executive Order 12372 as in effect on September 17, 1983. Beginning not later than sixty days after receiving notification by the Administrator, each Federal department and agency shall modify existing regulations to allow States to review individual development projects and assistance applications under the identified Federal assistance programs and shall accommodate, according to the requirements and definitions of Executive Order 12372, as in effect on September 17, 1983, the concerns of the State regarding the consistency of such applications or projects with the State nonpoint source pollution management program.

(l) Collection of Information.—The Administrator shall collect and make available, through publications and other appropriate means, information pertaining to management practices and implementation methods, including, but not limited to, (1) information concerning the costs and relative efficiencies of best management practices for reducing nonpoint source pollution; and (2) available data concerning the relationship between water quality and implementation of various management practices to control nonpoint sources of pollution.

(m) Reports of Administrator.—

(1) Annual Reports.—Not later than Januray 1, 1988, and each January 1 thereafter, the Administrator shall transmit to the Committee on Public Works and Transportation of the House of Representatives and the Committee on Environment and Public Works of the Senate, a report for the preceding fiscal year on the activities and programs implemented under this section and the progress made in reducing pollution in the navigable waters resulting from nonpoint sources and improving the quality of such waters.

(2) Final Report.—Not later than January 1, 1990, the Administrator shall transmit to Congress a final report on the activities carried out under this section. Such report, at a minimum, shall—

(A) describe the management programs being implemented by the States by types and amount of affected navigable waters, categories and subcategories of nonpoint sources, and types of best management practices being implemented;

(B) describe the experiences of the States in adhering to schedules and implementing best management practices;

(C) describe the amount and purpose of grants awarded pursuant to subsections (h) and (i) of this section;

(D) identify, to the extent that information is available, the progress made in reducing pollutant loads and improving water quality in the navigable waters;

(E) indicate what further actions need to be taken to attain and maintain in those navigable waters (i) applicable water quality standards , and (ii) the goals and requirements of this Act;

(F) include recommendations of the Administrator concerning future programs (including enforcement programs) for controlling pollution from nonpoint sources; and

(G) identify the activities and programs of departments, agencies, and instrumentalities of the United States which are inconsistent with the management programs submitted by the States and recommend modifications so that such activities and programs are consistent with and assist the States in implementation of such management programs.

(n) Set Aside for Administrative Personnel.—Not less than 5 percent of the funds appropriated pursuant to subsection (j) for any fiscal year shall be available to the Administrator to maintain personnel levels at the Environmental Protection Agency at levels which are adequate to carry out this section in such year.

Appendix B
Surface Water Methodology

Appendix B

Surface Water Methodology

For monitored assessments, violations were determinedto have occurred if at least one exceedence was present in a minimum of three samples taken during WY 83-87. For larger sample sizes, a violation was established if about 10 percent of the samples exceeded standards. In the tables of Chapter III, violations are detailed and reported by WY 83-85 [STB] and WY 86-87 [STC] in the parameters column. Numerals following these labels indicated the total number of samples at the sample site, and the parameters violated are listed under the labels. A [GS] label and numeral in the parameters column indicate USGS data and the WY reported. Additionally, waters were assessed as threatened if the evaluation showed potential nonpoint sources in an area, and that during special circumstances, such as precipitation events, the water quality standards may be violated although monitoring shows no problem.

In the evaluated assessment, Storet data from WYs 65-82 was inspected and reported in the Chapter III In the Chapter III Tables, STORET data for WY 65-82 is reported under an [STA] label. Water quality violations from evaluated data were determined similiar to the procedure for the monitored assessment. Inspection results of STORET data for WY 65-87, reports, literature, and file records are presented in Chapter III. In the Chapter III Basin Tables, nonpoint sources of pollution have been addressed by stream segment to include information on: level (full, part, or non-attainment, and threatened) the standards attainment assessment level (monitoring or evaluated), pollution source categories, water quality parameters of concern and references for the information presented.

Four water quality parameters shown in the Chapter III Tables are described at an evaluated rather than monitored level. These are turbidity / sediment, nitrate, phosphate and total dissolved solids (TDS).

State of Arizona Water Quality Standards tie turbidity in streams to two numeric levels, "that no person shall cause to exceed, " these are: 10 NTUs for Aquatic and Wildlife (coldwater fishery), and 50 NTUs for the protected uses of Aquatic and Wildlife, Full Body Contact, and Incidental Human Contact. STORET data indicating turbidities over 10 NTU's for all Water Years 1965 to 1987, were noted although no specific manmade problems might be indicated.

For TDS or salinity, there isn't a specific statewide water quality standard, but there are salinity standard requirements for the Colorado River. Ranges and high values of TDS were inspected in other basins. Total dissolved solids consistently over 500 mg/l were noted as well as the high range values from a site. The EPA reports the following levels of dissolved solids hazard for irrigation waters:

(a) water which no detrimental effects will usually be noticed-------500 mg/l

(b) water which can have detrimental effects on sensitive crops----------500-1,000 mg/l

(c) water that may have adverse effects on many crops and requires careful management practices--1,000-2,000 mg/l

(d) water that can be used for tolerant plants on permeable soils with careful management practices----------2,000-5,000 mg/l

Judgements concerning TDS or salinity hazards were made in relation to these criteria.

Nitrogen and phosphorus pollution potential were judged from a conservative viewpoint. Concerns were noted for concentrations of total N exceeding 1.0 mg/l and total P exceeding 0.1 mg/l, respectively.

Decisions to include these data in the tables of Chapter III were based upon review and discussion on a case specific basis.

Assessment by the evaluation method considered published technical and planning documents that are listed in Chapter III references. Utilization of these documents to determine the level of protected use attainment (full, partial or non-attainment) in waterbodies required professional judgement. Judgement calls by their nature are subjective and necessarily utilize limited information, therefore, it was necessary to consult with natural resource management experts to establish a consistent evaluation methodology for some classes of published data. These classes of data were those that did not have numeric values for the parameters specified in the State Water Quality Standards and included the following:

(a) Range Condition
(b) Riparian Habitat Condition
(c) Total Suspended Solids
(d) Erosion Rate

Range condition data are provided in many areas of the state by the various land management agencies. These data of the interpret vegetative cover, but may also characterize condition with respect to the extent of excessive sheet and gully erosion. Watercourses that were classified on the basis of "watershed condition" in the Little Colorado Basin were assessed as follows:

Use Attainment	% of Watershed reported to be in Unsatisfactory Condition	Condition
Full Support	< 10.0	Satisfactory
Partial Support	≥ 10.0 to <25.0	Unsatisfactory
Non Attainment	≥ 25.0	Poor

Riparian habitat assessments have been performed by land and fishery management agencies for many perennial, intermittent, and ephemeral watercourses. Channel, bank erosion, and habitat conditions were usually considered. Watersheds assessed on the basis of "riparian habitat condition" in the Little Colorado Basin were classified as follows:

Use Attainment	Riparian Habitat Condition	Channel Erosion
Full Support	Good or Excellent	Low
Partial Support	Fair	Low or Moderate
Non Attainment	Fair or Poor	Moderate or High

Also, when a published riparian habitat assessment identified significant impacts due to controllable anthropogenic activities or conditions, protected use attainment was specified at one level lower than when no controllable problems were reported.

Sedimentation studies have been performed by various organizations and agencies throughout the state. Water quality and quantity data are generally collected and the water samples are analysed for total suspended solids (TSS) but not turbidity. State Water Quality Standards include limitation for turbidity but not for TSS. Turbidity and TSS are related to each other and a statistical evaluation was performed on the data collected by ADEQ in Northeastern Arizona when both parameters were analyzed. Based on this analysis and a conservative comparison of the turbidity and TSS data, use attainment for streams in the Little Colorado River Basin, where turbidity values were not available, was evaluated according to TSS values as follows:

Use Attainment	Mean of Upper Decile of TSS Values or Maximum TSS Value for One to Nine Observations
Full Support	< 50 mg/l
Partial Support	≥ 50 to 200 mg/l
No Attainment	≥200 mg/l

Erosion rates are published for many areas of the state by the U.S. Department of Agriculture. These data are useful in evaluating the amount of solids carried by runoff. For purposes of this assessment, use attainment in watercourses of the Little Colorado Basin was determined by the erosion rates from the surrounding watershed as follows:

Use Attainment	Average Annual Erosion Rate acre-ft. / miles 2 / year
Full Support	< 1.0
Partial Support	≥ 1.0 to 3.0
Non Attainment	≥ 3.0

Appendix C
Hydrologic Unit Code and Reach File System

Appendix C

Hydrologic Unit Code and Reach File System

The surface water basins have been delineated utilizing the U.S. Geological Survey (USGS) Hydrologic Unit Code (HUC) system (Figure III-1). This system defines progressively smaller drainage basins, ranging from hydrologic regions to cataloging units. The HUC number system is summarized below:

USGS Hydrologic Unit Codes

Region	RR
Subregion	RRSS
Accounting Unit	RRSSAA
Cataloging Unit	RRSSAACC

The U. S. EPA Reach File utilizes the USGS cataloging unit designation to identify drainage systems and subdivides these drainage systems into "reaches". Reaches are linear sections of streams, lakes, reservoirs, wetlands, etc. that are linked to represent the branching patterns of surface water drainage systems. Each reach is characterized by similar hydrologic attributes. They are differentiated from one another by significant changes in hydrologic characteristics, for example, stream confluences, changes in sream gradient, or where streams enter or leave bodies of open water such as lakes or reservoirs. The reaches within the Reach File have been linked in hydrologic sequence in up-stream order. Individual reaches are identified by the eight digit HUC codes followed by an arbitrarily assigned three digit segment number as follows:

U.S. EPA Reach File Code

Reach	RRSSAACC-NNN

The Reach File numbers referenced in the tables of Chapter III correspond to the reaches shown on the basin maps of Chapter III. Crossbars on a stream delineate the beginning of each reach and mileage is measured downstream from this point.

Appendix D
Water Quality Standards Allowable Limits for Protected Uses

Appendix D

Water Quality Standards Allowable Limits for Protected Uses

PARAMETER	PROTECTED USES					
	D	F	H	A	I	L
FECAL COLIFORM MAXIMUM ALLOWABLE LIMITS (Colony-Forming Units, CFU/100ml)						
1. GEOMETRIC MEAN (5 Sample Minimum)	1000	200	1000	1000	1000	1000
2. 10% OF SAMPLES For 30 Day Period	2000	400	2000	2000	2000	2000
3. SINGLE SAMPLE	4000	800	4000	4000	4000	4000
pH,ALLOWABLE LIMITS (Standard Units)						
1. MAXIMUM	*NS*	9.0	9.0	9.0	9.0	9.0
2. MINIMUM	*NS*	6.5	6.5	6.5	4.5	6.4
3. MAXIMUM Change Due To The Activities Of Man	*NS*	0.5	0.5	0.5	*NS*	*NS*
TRACE SUBSTANCES (MAXIMUM ALLOWABLE LIMITS). (mg/l)						
ARSENIC (AS As)	0.050*D*	0.050*D*	*a*	0.050*D*	2.000*T*	0.200*T*
BARIUM (AS Ba)	1.000*D*	1.000*D*	*a*	*NS*	*NS*	*NS*
BORON (AS B)	*NS*	*NS*	*a*	*NS*	1.000*T*	*NS*
CADMIUM (AS Cd)	0.010*T*	0.010*T*	*a*	0.010*D*[b]	0.050*T*	0.050
CHROMIUM (AS Cr) HEXAVALENT PLUS TRIVALENT)	0.050*D*	0.050*D*	*a*	0.050*D*	1.000*T*	1.000*T*

	D	F	H	A	I	L
COPPER (AS Cu)	1.000*D*	*NS*	*a*	0.050	5.000*T*	0.500*T*
LEAD (AS Pb)	0.050*D*	0.050*D*	*a*	0.050*D*[c]	1 0.000*T*	0.100*T*
MANGANESE (AS Mn)	*NS*	*NS*	*a*	*NS*	10.000*T*	*NS*
MERCURY(AS Hg)	0.002*T*	0.002*T*	*a*	0.0002*T*[c]	*a*	0.010*T*
SELENIUM (AS Se)	0.010*D*	0.010*D*	*a*	0.050*T*	0.020*T*	0.050*T*
SILVER (AS Ag)	0.050*D*	0.050*D*	*a*	0.050*D*	*NS*	*NS*
ZINC (AS Zn)	5.000*D*	*NS*	*a*	0.500*D*	10.000*T*	25.00*T*
AMMONIA (AS UN-IONIZED NH_3)	*NS*	*NS*	*NS*	0.020	*NS*	*NS*
CYANIDES (AS CYANIDE ION & COMPLEXES)	0.200	0.200	*a*	0.020[c]	*NS*	0.200
PHENOLICS	0.005	0.005	*a*	0.005	*NS*	0.005
SULFIDES (TOTAL)	*NS*	*NS*	*NS*	0.100[c]	*NS*	*NS*

PARAMETER	**PROTECTED USE**				
	D	**F+H**	**A**	**C**	**I+L**
TEMPERATURE ALTERATION (MAXIMUM ALLOWABLE LIMIT): NO PERSON SHALL RAISE THE NATURAL AMBIENT WATER TEMPERATURE MORE THAN ____ DEGREES CELSIUS	*NS*	3.0	3.0	1.0	*NS*
TURBIDITY[g] (MAXIMUM ALLOWABLE LIMIT) NO PERSON SHALL CAUSE THE TURBIDITY TO EXCEED _____ NEPHELOMETRIC TURBIDITY UNITS (NTU) IN:					
STREAMS	*NS*	50	50	10	*NS*
LAKES	*NS*	25	25	10	*NS*
DISSOLVED OXYGEN NO PERSON SHALL LOWER THE DISSOLVED OXYGEN CONCENTRATION TO LESS THAN ____ mg/l	*NS*	6.0	6.0	6.0	*NS*

1. Abbreviations for Protected Uses in this appendix:

F = Full Body Contact	**I** = Agricultural Irrigation
H = Incidental Human Contact	**L** = Agricultural Livestock Watering
A = Aquatic and Wildlife.	**D** = Domestic Water Source
C = Aquatic and Wildlife cold water fishery.	**W** = Wastewater Treatment Plant

2. A unique water: Limits developed on a site-specific basis for each stream segment or lake. See R18-1-101 for current sites.

3. An effluent dominated water: Uses supported by limits developed on a site specific basis for each stream segment. See Section R18-1-101 for current sites.

Other abbreviations used in this appendix:

a - Too little is known about adverse health effects for this use to adequately select a number.

b - For cold water fishery protected use the maximum allowable cadmium concentration is 0.001 mg/l.

c - The allowable limit for this use is set at less than the current minimum level of detection. The limit necessary to adequately protect this use is lower. Until appropriate analytical procedures with lower detection limits are available, this particular limit is considered to be violated only when the number herein listed is reached or exceeded. Compliance requires concentrations be less than but not equal to the number listed.

NS - No Standard

T - Total Residues

D - Dissolved.

Appendix E
Use of Geographic Information System (GIS)

Appendix E

Use of the Geographic Information System (GIS)

The Arizona Department of Environmental Quality utilized the services of the Arizona Land Resources Information System (ALRIS) to develop the land use information shown in the figures of Chapters II and III. The ALRIS has been developed by the Arizona State Land Department, Resources Analysis Division. This division was established by the Arizona legislature in 1982 to provide computer mapping, digital image processing, and natural resource database services to public agencies in Arizona.

The primary hardware for ALRIS is the PRIME 9950 computer system. ARC/INFO is the geographic information system which resides on the PRIME system and which was utilized to input and retrieve the resource and land use information from the following sources:

GIS Theme Layer	Source
10. Agriculture NPS	
-Irrigated Lands	University of Arizona 1961
-Grazing	Brown and Lowe 1964
-Animal Feeding Operations	Ag BMP Program ADEQ 1988
20. Silviculture NPS	
-Forestry (includes grazing)	Brown & Lowe 1964
30/40. Construction, Urban Runoff, and Military Areas NPS	
-Urban areas (defined by incorporated boundaries)	State Land Dept. & ADEQ 1988
-Military areas & Indian lands	State Land Dept.- Land Ownership
50. Resource Extraction NPS	
-"Mineral Districts of AZ"	AZ Mines & Mineral Resources
60. Land Disposal NPS	
-Landfills in AZ	ADEQ 1983
-Superfund and WQARF sites in AZ	ADEQ 1988
70. Hydrologic & Habitat Modification NPS	
-Perennial Waters and Wetlands of Arizona	sources pending
-Regulated Flows	sources pending
-Irrigated Districts and Canals	sources pending
-Dams and Reservoirs	sources pending
-Riparian Habitats	sources pending
100. Recreation NPS	
-National Parks, State Parks, Lakes, Reservoirs, and Perennial Streams	State Land Dept.- Land Ownership 1988

Appendix F
Groundwater Assessment Methodology

Appendix F

Groundwater Assessment Methodology

Groundwater quality assessments are primarily based upon information contained in Appendix G and on data provided in documented groundwater studies. A statewide inventory of groundwater basin characteristics, sampling results , and density of pollution sources are also contained within the appendix. Groundwater basins and subbasins are grouped into groundwater planning regions which are areas that share local surface and subsurface characteristics and roughly correspond to surface water basins. Descriptive and hydrologic data are listed in the appendix and include: basin data, extent of aquifers, estimated by volume of groundwater stored above 1200 feet, average depth to water, and annual pumpage. Data for these entries were compiled by the ADWR and include estimates made by the USGS.

The extent of groundwater sampling carried out by various agencies from 1979 to 1987 are also included in Appendix G. Data sampling results are primarily from ADEQ, USGS, and ADWR. The total number of wells sampled are followed by the number of samples for a particular parameter group.

Results of sampling are included and separated by parameter group. The total number of wells in which Reference Levels (RLs) were exceeded are given. Reference Levels include Federal Primary Drinking Water Maximum Contaminant Levels (MCLs) (Table F-1), Secondary Standards and State Action Levels (ALs) The MCLs have been established by the USEPA; Secondary Standards affect aesthetic qualities of water; and ALs are health-based guidelines for allowable levels of organic contaminants but are not enforceable as standards. Results may be biased in their reflection of ambient groundwater quality in that sampling activities are often related to known or suspected sources of pollution.

The final section of the table in Appendix G entitled Sources of Contamination presents the density of known potential sources of contamination for which data was available.The density (high, medium or low) of each source was estimated for the basins and is shown last. The NPS categories include: irrigation (IR); urbanization (UR) estimated by population density and representing the threat of contamination from runoff and dry wells; leaking underground storage tanks (UST); mineral deposits (MD); active mines (AM); national pollution discharge elimination system permit sites (PP); landfills (LF); and hazardous waste sites (HZ) which include RCRA, CERCLA and Installation Restoration Program (IRP) sites.

The1987 database represents the most complete effort by any agency to date incorporating groundwater quality data collected by ADEQ, ADWR, USGS and other agencies. Results of 539 samples collected from 485 wells were reported. While the data present comprehensive results, certain biases are noteworthy:

Tabulated data represent results from production wells only, (as opposed to monitor wells)

Sampling is often conducted as a result of known or suspected contamination

About 60 percent of the data was collected from an AMA and about 35 percent in the Phoenix AMA

Samples represent wide variation in quality, parametric coverage, well characteristics and aquifer type.

Appendix G

Groundwater Sampling Results Since 1979

APPENDIX G. STATEWIDE GROUNDWATER BASIN INVENTORY

GROUNDWATER BASIN CHARACTERISTICS[1]					SUMMARY OF GROUNDWATER SAMPLING RESULTS (1979 - 1987)[2,3]																POTENTIAL SOURCES OF CONTAMINATION							
						No. Wells Sampled by Parameter Group									No. Wells Exceeding RLs by Parameter Group									Density of Source[4]							
PLANNING REGION Groundwater Basin Sub-basin	Basin Area (SQ MI)	Est. Area of aquifer (SQ MI)	Avg. Depth to water (FT)	Annual Amount Pumped (1000 AC-FT)	Total No. wells Sampled	VOC	PEST	ION	MET	BAC	NUT	RAD	PHY	TOC	Total No. Wells Exceeding RLs	VOC	PEST	ION	MET	BAC	NUT	RAD	PHY	TOC	IR	UR	UT	MD	AM	PP	LF	HZ
ACTIVE MANAGEMENT REGION	14,446	8,535	266	1,831	634	491	150	111	93		71		111	1	265	159	57	54			13		9		H	H	M	H	M	M	H	H
Phoenix AMA	5,331	3,942	263		400	300	138	58	55		46		69		194	109	56	40			13		1		H	H	H	M	M	H	H	H
Hassayampa	1,200	848	230																						M			H	M	M		
Rainbow Valley	450	367	378																						M			L				
W. Salt R. Valley	1,291	874																							H	H	H	M	L			M
E. Salt R. Valley	1,439	861																							H	H	L	M	M			M
Carefree																											L	M				
Lake Pleasant																									L			M	L			
Fountain Hills																												L				
Pinal AMA	4,022	2,279	295		47	29	7	20	25		13		16	1	17	2	1	14					1		H	M	L	M	M	M	M	
Maricopa-Stanfield																									H			M				
Vekol Valley																																
Santa Rosa Valley																												H	M			
Aguirre Valley																												M	M			
Eloy																									H		L	M	M			
Prescott AMA	509	281	216		29	27		2	1		1		2		3	3									M	H	M	M	M	H	H	
Little Chino	297	188	242																						M		H	M		H	H	
Upper Agua Fria	173	92	165																						L			H	H	H	H	
Tucson AMA	4,584	2,072	262		158	135	5	31	12		11		24		51	45							7		L	H	M	H	M	M	H	H
Avra Valley	1,542	789	295																						M			H	M	L	L	
Santa Cruz Valley	0																								L	H	M	H	L			H
BILL WILLIAMS REGION	5,191	1,579	252	19	1			1	1		1		1												L			M	M			
Big Sandy Basin	1,960				1			1	1		1		1		1			1					1		L			M				
Wikieup																									L	M		M				
Fort Rock																												L				
Bill Williams Basin	3,231																								L			H	M			
Clara Peak																												H				
Alamo Reservoir																												H				
Burro Creek																												H				
Santa Maria																												H				
Skull Valley																												M	M			
																									L			H				
COLORADO RIVER REGION	9,707	5,630	305	305	107	39	78	23	23	1	23		24		63	8	41	17							M		L	M	M	M	M	
Detrital Valley Basin	876				1			1	1		1		1															M				
Hualapai Valley Basin	1,229				1			1	1		1		1															M			H	
Lake Havasu Basin	283																									M		M		H	M	
Lake Mohave Basin	1,077				17	15		16	16		16		17		16			16							L			M	M	M		
Meadview Basin	201				1			1	1		1		1																		M	
Parker Basin	2,219				2	1		2	2		2		2												M			M	L	M		
Co. R. Indian Res.																									H			M				
Cibola Valley																									L			M				
La Posa Plains																												M	M			
Peach Springs Basin	1,427				1			1	1		1		1																M				
Sacremento Valley Basin	1,625				1	1																							M	M	L	L
Yuma Basin	770				83	22	78	1	1	1	1		1		47	8	41	1							H		M	M			H	H

APPENDIX G. STATEWIDE GROUNDWATER BASIN INVENTORY (CONT.)

GROUNDWATER BASIN CHARACTERISTICS [1]					SUMMARY OF GROUNDWATER SAMPLING RESULTS (1979 - 1987) [2,3]																POTENTIAL SOURCES OF CONTAMINATION							
PLANNING REGION Groundwater Basin Sub-basin	Basin Area (SQ MI)	Est. Area of aquifer (SQ MI)	Avg. Depth to water (FT)	Annual Amount Pumped (1000 AC-FT)	Total No. wells Sampled	No. Wells Sampled by Parameter Group								Total No. Wells Exceeding RLs	No. Wells Exceeding RLs by Parameter Group								Density of Source [4]							
						VOC	PEST	ION	MET	BAC	NUT	RAD	PHY	TOC		VOC	PEST	ION	MET	BAC	NUT	RAD	PHY	TOC	IR	UR	UT	MD	AM	PP	LF	HZ
LITTLE COLORADO REGION	26,307	26,307	400	92	13	2		11	10		10		11	2	9	1		5	5						L	L	L	M	L	L	L	
Little Colo. R. Basin	26,307				13	2		11	10		10		11	2	9	1		5	5						L		L	M	L	L	L	
Joseph City INA																									M			M				
LOWER GILA REGION	11,676	7,586	221	622	3		1		1		1		2		2			1							M			M	L	L	L	
Lower Gila Basin	7,253	5,009	94		1		1								1		1								L			M	L	L	L	
Welton-Mohawk																									L			M	L			
Childs Valley																									L			M				
Dendora																									L			M			M	
Gila Bend Basin	1,321	539	204		2				1		1		2		1			1							M				L	L		
San Simon Wash Basin	2,359	1,627	402																									M	M			
W. Mex. Drainage Basin	743	390																										M				
MIDDLE GILA REGION	4,613	2,113	357	236	6			6	5		5				2			1							M			H	L	M	L	
Agua Fria Basin	1,223																											H	H	M	M	
Butler Valley Basin	290																											H				
Harquahala V. Basin/INA	729				1			1	1		1		1		1			1							H			M				
McMullen Valley Basin	592				2			2	2		2		2		1										M			M		H		
Ranegras Basin	947				1			1					1												L			M		H		
Tiger Wash Basin	81				1			1	1		1		1															H				
Upper Hassayampa Basin	752				1			1	1		1		1															H		H	M	
N.W. PLATEAU REGION	13,697	1,000	400	8	2	1																			L			M	L	L	L	
Coconino Plateau Basin	5,849				1	1																						M		L		
Grand Wash Basin	964				1			1	1		1		1															M				
Kanab Plateau Basin	4,229																								L			M	L	M		
Paria Basin	367																											M		H	L	
Shivwits Plateau Basin	1,842																									M		M				
Virgin River Basin	447																													M		
SALT/VERDE REGION	11,672	3,428	200	14	31	6		25	24	18	23		25	2	7	2		4	3	1					L		L	M	M	L	M	L
Salt River Basin	5,177				6			6	5		4		6	2	4			4	3									M	M	L	M	
Salt River Lakes																												H	H			
Salt River Canyon																												H				
White River																																
Black River																																
Tonto Creek Basin	925																									L		H		M	M	
Verde River Basin	5,570				25	6		19	19	18	19		19		3	2				1					L		L	M	M	M	M	L
Big Chino																									L			L	M			
Verde Valley																									L		L	M			L	
Verde Canyon																												M	H			

APPENDIX G. STATEWIDE GROUNDWATER BASIN INVENTORY (CONT.)

GROUNDWATER BASIN CHARACTERISTICS [1]					SUMMARY OF GROUNDWATER SAMPLING RESULTS (1979 - 1987) [2,3]																POTENTIAL SOURCES OF CONTAMINATION
						No. Wells Sampled by Parameter Group									No. Wells Exceeding RLs by Parameter Group								Density of Source [4]
PLANNING REGION Groundwater Basin Sub-basin	Basin Area (SQ MI)	Est. Area of aquifer (SQ MI)	Avg. Depth to water (FT)	Annual Amount Pumped (1000 AC-FT)	Total No. wells Sampled	VOC	PEST	ION	MET	BAC	NUT	RAD	PHY	TOC	Total No. Wells Exceeding RLs	VOC	PEST	ION	MET	BAC	NUT	RAD	PHY	TOC	IR UR UT MD AM PP LF HZ
SAN PEDRO REGION	8,768	4,368	167	324	75	12		63	44		44		63	8	15	6		8	1					1		M L H H M M L
Aravaipa Canyon Basin	538																									M
Cieniga Creek Basin	588				6	6																				H M H
Donnelly Wash Basin	295																									H
Douglas Basin	995				18			18	12		12		18		6	6			1							L M H M M
Douglas INA																										M L H
Drip'g Spr. Wash Basin	409																									H H M
Lower San Pedro Basin	1,576				1	1																				L H H H
Mammoth																										L H H
Camp Grant Wash																										H
San Bern. Vly. Basin	379																									L
San Rafael Basin	232																									H M
Upper San Pedro Basin	1,881				15	5		10	5		5		10													L L L M L M L
Allen Flat																										L M
Sierra Vista																										L L M M L
Wilcox Basin	1,876				35			35	27		27		35	8	9				8					1		M L M M M
UPPER GILA REGION	7,340	2,600		211	22			22	22		21		22	4	9											L L M L M M
Bonita Creek Basin	464																									L
Duncan Valley Basin	529				5			5	5		5		5		3				2	2						M H M
Morenci Basin	1,613																									M M L M
Safford Basin	4,736				17			17	17		16		17	4	6				6	1				2		M L M L M L L
San Carlos Valley																										M L L L
Gila Valley																										M L M
San Simeon Valley																										M M

Notes

(1) Information on areas and volumes are estimates made by the ADWR and USGS and are subject to changes and additions when further data are available (1988).

(2) Information on sampling efforts includes sampling efforts reported to the ADEQ since 1979. Results may be biased in their reflection of ambient conditions since sampling is often related to known or suspected contamination. VOCs and Pestcides include historical data available through 1987, whereas all other parameters represent only 1987 data. A well may be sampled for more than one parameter group, and well types include private domestic and water supply wells, irrigation, and industrial wells (monitoring wells are excluded).

(3) Abbreviations of Parameter Groups are:

VOC - Volatile Organic Compunds	MET - Metals	RAD - Radiological Constituents
PEST - Pesticides	BAC - Microbiological Organisms	PHY - Physical Parameters
ION - Major Cations and Anions	NUT - Nutrients	TOC - Total Organic Carbon

Reference levels (RLs) include Federal Primary and Secondary MCLs and State Action Levels (health-based guidelines).

(4) Potential pollution sources include: Irrigation (IR); Urbanization (UR); Leaking Underground Storage Tanks (UT); Mineral Deposits (MD); Active Mines (AM); NPDES sites (PP); Landfills (LF); and Hazardous Waste Sites (HZ) including RCRA, CERCLA and IRP sites. General density of sources are described as: High (H); Medium (M); and Low (L).

Appendix H

Agencies Involved in Planning, Monitoring, and Regulating the Uses of Wetlands in Arizona and Their Effectiveness

From: Arizona Wetlands Priority Plan, March 1988.

CHAPTER II

AGENCIES INVOLVED IN PLANNING, MONITORING, AND REGULATING THE USES OF WETLANDS IN ARIZONA AND THEIR EFFECTIVENESS

Throughout the history of the United States, federal policies and actions directed toward wetlands eradication along with negative public sentiment has resulted in a 200-year siege that has contributed to the destruction of more than half of the nation's wetlands. Until recently, federal legislation and policies encouraged destruction. Wetlands use has been directly and indirectly affected by a variety of federal, state, local, and private programs that were developed, for the most part, during the past two decades. These programs have affected wetlands use through regulation, acquisition, leasing, easements, planning, and general policy guidance. The effectiveness of these programs have been both protective of and detrimental to wetlands in the nation and in particular, Arizona. At the same time, negative public sentiment has also been changing. A 1980 poll of Americans' attitudes toward the environment found a majority of the public favored protection of wetlands over development (Feirerabend, et al, 1987). Implementing existing legislation and monitoring the use of wetlands by public agencies and environmental groups will ensure that adverse environmental affects of wetlands losses in the nation and Arizona will be minimal.

An assessment of federal, state, local, and private program effectiveness in protecting wetlands in Arizona follows a summation of each of these programs.

Federal Wetlands Programs

Several federal agencies are involved in planning, monitoring, and regulating uses of wetlands in Arizona through federal policy, regulatory permitting programs, federal assistance programs, wetlands research programs, and federal conservation programs. Table 1 summarizes the main federal wetlands programs.

Federal Policy

There are two Executive Orders requiring federal agencies to consider wetlands in their actions:

- Executive Order 11990 - Most direct federal assistance for wetlands conversion was ended by Executive Order 11990 signed by President Carter in 1978. The Executive Order mandates all federal agencies when pursuing their responsibilities to "...take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands..." Agencies are specifically directed to avoid assisting or undertaking new construction in wetlands unless there is no viable alternative. All practical measures to minimize harm to wetlands in the action taken must be provided by the agency.

Table 1. Summary of the Federal Wetlands Programs

Program or Act	Effect of Program
Federal Policy	
Executive Order 11990	Minimizes impacts on wetlands from federal activities
Executive Order 11988	Minimizes impacts on floodplains from federal activities
Federal Planning	
National Forest Management Act of 1976	USFS multiple-use land management and planning
Federal Land Policy & Management Act of 1976	BLM multiple-use land management and planning and rangeland improvements
Regulatory Permitting Programs	
Rivers & Harbors Act of 1899, Section 10	Regulates activities in navigable waters
Clean Water Act of 1972, Section 404	Regulates activities that involve disposal of dredged or fill material
Federal Assistance Programs	
Grants-in-Aid	
Federal Aid to Wildlife Restoration Act of 1937 (Pittman-Robertson Act)	Monies for acquisition, restoration, and maintenance of wildlife habitat, including wetlands
Federal Aid in Fish Restoration Act of 1950 (Dingell-Johnson Act & Wallup-Breaux Act)	Monies for acquisition, restoration, and management of fish habitat, including wetlands
Land & Water Conservation Fund Act of 1965	Acquires wildlife areas
The Endangered Species Act of 1973	Acquires habitat for threatened and endangered species
Technical Assistance	
U.S. Fish & Wildlife Service	Assist in developing regulatory programs for dredge and fill materials into wetlands
U.S. Soil Conservation Service	Assist landowners with soil and water conservation
U.S. Army Corp of Engineers	Assist state and local governments with floodplain management
Financial Assistance	
National Flood Insurance Program	Provides flood insurance and assistance in planning
Wetlands Research Programs	
U.S. Fish & Wildlife Service	Wetlands evaluations and the National Wetlands Inventory
Federal Conservation Programs	
Migratory Bird Conservation Act of 1929	Acquires easements on wetlands, revenue from duck stamps
Taylor Grazing Act of 1934	Conservation and improvements of rangelands, emphasizing erosion and flood control
Wetland Loan Act of 1961	Provides federal loans for wetlands acquisitions
The Wilderness Act of 1964	Designates wilderness areas, which include wetlands
The Wild & Scenic Rivers Act of 1968	Designates rivers into system and protects wetlands
Water Bank Act of 1970	Leases wetlands and adjacent uplands from farmers for waterfowl habitat over 10-year period
Public Rangeland Improvement Act of 1978	Conservation and improvement of rangelands through direct funding for range, wildlife, and watershed improvement
The Food Security Act of 1985	Swampbuster provision denies federal agricultural subsidies
Emergency Wetlands Resources Act of 1986	National Wetlands Priority Conservation Plan

Agencies must also consider a proposal's effect on the survival and quality of the wetlands area.

- Executive Order 11988 - Floodplain Management requires each federal agency to avoid direct or indirect support of floodplain development wherever there is a practical alternative.

Executive Orders 11990 and 11988 apply to: 1) federal activities, including construction projects, acquisition, and disposal of lands; 2) grants-in-aid programs; and 3) technical assistance to states, including land and water planning, and the building of roads, sewers, and water supply systems. They do not apply to federal permitting or licensing activity on private property.

The Executive Orders, overall, give federal agencies some direction for activities and actions and have succeeded in motivating several agencies to consider wetlands values and functions during the preparation of environmental impact statements, but they are not legally binding. Therefore, their effectiveness is very limited and have not resulted in substantial on-the-ground protection of wetlands in Arizona.

Federal Planning

Federal land resource planning to protect and manage the extremely complex natural systems and their uses to satisfy a wide variety of local and national desires and needs is an immense task. Nearly one-third of the total area of the United States is in federal ownership. In Arizona, federal ownership accounts for 43 percent of the landbase. Of that, the U.S. Forest Service (USFS) manages 16 percent, the Bureau of Land Management (BLM) 17 percent, the Department of Defense 5 percent, and other federal agencies 6 percent. Two basic categories of lands are managed by these agencies. Multiple-use resource lands include the BLM lands and the National Forest System, and specially protected lands include the National Wildlife Refuge System and the National Park System (USDI, 1987). Of major concern in Arizona for protection of wetlands and riparian areas are the land resource planning efforts of the USFWS, the USFS, and the BLM.

- The Fish & Wildlife Coordination Act (16 U.S.C. 661-666c; 48 Stat. 401), as amended - The Act of March 10, 1934, as amended by the Acts of August 14, 1946 (60 Stat. 1080), August 12, 1958, Public Law 85-624 (72 Stat. 563), and July 9, 1965, Public Law 89-72 (79 Stat. 216), authorizes the Secretary of the Interior: to assist federal, state, and other agencies in development, protection, rearing, and stocking fish and wildlife on federal lands, and to study effects of pollution on fish and wildlife; provides for donating land and funds in furthering purposes of Act and for appropriation of funds; requires consultation with the USFWS and the wildlife agency of any state wherein the waters of any stream or other water body are proposed or authorized to be impounded, diverted, channelized or otherwise controlled or modified by any federal agency, or any private agency under federal permit or license, with a view to preventing loss of or damage to wildlife resources in connection with such water resource projects; authorizes federal water resource agencies to acquire lands or interests in connection with water use projects specifically for mitigation and enhancement of fish and wildlife, and provides for management of such lands by the USFWS or state agencies; excludes projects involving impoundments of less than 10 acres and Tennessee Valley Authority projects.

- The National Forest Management Act of 1976 - The National Forest Management Act guides planning and management on individual forests. Important characteristics of these plans and of the current process of planning include: 1) the forest plans are legal documents the agency must follow in managing the National Forests; 2) a rational-comprehensive planning model is followed in developing the plans; 3) analysis is done by an interdisciplinary team; and 4) the process of planning is open and responsive to public participation. A forest plan defines the direction of management for a National Forest for the next 10 to 15 years. Specifications of the plan include: 1) purposes of management and intended future physical condition of the forest; 2) the kinds of management activities and the ways they will be carried out on each portion of the forest; 3) how the basic resources of the natural system will be protected on areas that are developed; and 4) the monitoring of management activities that will be done to ensure the standard and intentions of the plan are met (USDI, 1987).

  The USFS Riparian Area Handbook (FSH 2509.23) defines riparian ecosystems as distinguished by the presence of free water within the common rooting depth of native perennial plants at least seasonally (10 percent of the time). Ephemeral and intermittent washes are included in this definition. The policy statement (FSM 2526.02) directs the agency to: 1) inventory riparian areas in the Forest Land management planning process; 2) develop and implement measures to manage and protect riparian areas; and 3) monitor the effectiveness of measures implemented for the management and protection of riparian areas.

  In Arizona, there are six National Forests: Tonto, Prescott, Coronado, Apache-Sitgreaves, Coconino, and Kaibab. Each National Forest has completed its respective Forest Plan and has provided standards and guidelines for protection of riparian habitats, which could include wetlands. There are manual policies and implementation procedures outlined in the plans. These plans are the most significant guidelines in Arizona for riparian management, which could include wetlands.

- The Federal Land Policy and Management Act of 1976 (FLPMA) - The FLPMA provided the BLM the needed guidance and charter for the agency and included requirements for land use planning to: 1) observe the principles of multiple-use and sustained yield; 2) use a systematic interdisciplinary approach; 3) give priority to areas of critical environmental concern; 4) rely on the inventory of public lands, resources, and values; 5) consider present and potential uses of the public lands; 6) consider the relative scarcity of the values involved; 7) weigh long-term against short-term benefits to the public; 8) comply with applicable pollution control laws; and 9) be consistent with state and local plans. The BLM planning process is called Resource Management Planning (RMP), which is a comprehensive plan covering all the resources in the area. The plan includes a narrative and maps showing allocations of the kinds and locations of allowable uses, levels of use, and management actions to be taken. Once a plan is adopted, all BLM resource decisions must conform to it. RMPs are completed for individual resource areas (USDI, 1987). Section 401 (6)(1) of the Act also contains a provision for rangeland improvements.

  The BLM is also responsible for designating and managing Areas of Critical Environmental Concern (ACEC). These designated areas require specific resource management practices to protect and maintain existing resource values. Areas with important historic, cultural, scenic and natural values, and areas that are hazardous to human life and property may be designated and managed as ACECs. Two criteria must be met for an area to become eligible for consideration. The first criteria "relevance," refers to the need for special management attention "...to protect and prevent irreparable damage to important historic, cultural, or

scenic values, fish and wildlife resources, or other natural systems or processes..." The second criteria, "importance," is fulfilled if the area "...has qualities that give it special worth, meaning, distinctiveness, or cause for concern, especially when compared to any like or similar resources." An ACEC must also have more-than-local significance.

In Arizona, a riparian protection policy and a riparian management handbook have been developed to protect, through wise management, riparian zones. The BLM Districts are also continuing efforts to complete their respective RMPs. Riparian zones are being mapped in the RMPs and may include wetlands areas. RMPs, when completed, will provide a significant opportunity to protect critical riparian areas and wetlands. A number of riparian areas have been proposed as ACECs and proper management of these areas will result in protection of the resource and its values. At the present time, the BLM is actively managing and restoring riparian areas through planting cottonwood and willow trees, manipulating livestock use of riparian areas, and even fencing off some riparian areas to prohibit grazing use. Another protective measure of riparian areas and wetlands that the BLM is engaged in is land exchanges to acquire important resource values for the public. Some of the major land exchanges in Arizona that have resulted in or are in negotiations for the protection of riparian areas include the San Pedro River, Burro Creek, and Cienega Creek near the Empire Ranch. The BLM is trying to establish the San Pedro River as a Riparian National Conservation Area. Legislation is pending before Congress and, if approved, the San Pedro will become BLM's first riparian conservation area.

- North American Waterfowl Management Plan (NAWMP) - The NAWMP is a plan developed jointly by waterfowl managers in the United States and Canada and concentrates primarily on the need for waterfowl habitat preservation, enhancement, and management. The current plan covers the period of 1986 through 2000 and will be reviewed at five-year intervals. In broad terms, the goal of the NAWMP is to "...maintain and manage an appropriate distribution and diversity of high quality waterfowl habitat in North America..." The NAWMP provides a broad policy framework with general guidelines for waterfowl habitat protection and management actions. A number of goals within the plan apply directly to Arizona while others apply indirectly. The Arizona Game & Fish Department is working toward meeting the goals outlined in the NAWMP.

- Department of Defense (DOD) - Each military installation is required to produce resource managment plans for fish and wildlife, recreation, and other natural and cultural resources. In Arizona, the DOD manages 5 percent of the land through its military reservations and defense facilities. A few of these lands contain or border on significant riparian lands. These include the Barry M. Goldwater Air Force Range (contains xeric riparian areas and borders the Gila River), Yuma Proving Grounds (borders the Colorado River and the Imperial National Wildlife Refuge), Fort Huachuca Military Reservation (contains several tributaries of the San Pedro River and borders the Babocomari River), and Willcox Dry Lake Bombing Range (contains most of Willcox Playa). The first plan in military history to comprehensively integrate the management of the natural and cultural resources of a DOD reservation was completed in 1987 for the Barry M. Goldwater Air Force Range (formerly known as the Luke Air Force Range). The plan provides a policy and institutional framework for addressing riparian and other natural and cultural resource issues.

Regulatory Permitting Programs

The U.S. Army Corps of Engineers administers two interrelated permit programs which regulate wetlands activities under the federal government:

- The Rivers Harbors Act of 1899, Section 10 - Under this Act, permits are required for the dredging, filling, or obstruction of navigable waters. The Corps' evaluation criteria include considerations of effects on "...navigation, fish and wildlife, conservation, pollution, aesthetics, ecology, and the general public interest." Construction in wetlands outside commercially navigable waters is unregulated. In Arizona, the Colorado River and the lower 4 miles of the Gila River fall under the jurisdiction of this Act. The USFWS reviews a number of Section 10 permits annually.

- The Clean Water Act of 1972, Section 404 - Under this Act, permits are required to be obtained for discharges of dredged and fill materials into all waters, including wetlands. Implementation of the 404 program involves three other federal agencies in addition to limited state involvement. The Environmental Protection Agency (EPA), the National Marine Fisheries Service (NMFS), and the U.S. Fish & Wildlife Service (USFWS) review permit applications and provide comments and recommendations on whether permits should be issued by the Corps. EPA has veto authority over permits involving disposal sites if impacts are considered unacceptable. EPA also develops criteria for discharges and state assumption of the 404 program. Section 404 regulations were changed in 1984 due to a national lawsuit and 404 jurisdictions now apply to tributaries of navigable waters and isolated wetlands and waters if interstate commerce is involved. With the new regulations, all washes, drainages, and tributaries of navigable waters, including ephemeral and perennial streams, are included under the 404 program in Arizona.

  The effectiveness of the 404 program nationwide has been dismal. Feierabend, et al (1987, p. 36) summarized the failure succinctly: "For many reasons, the section 404 program has failed to slow the rate of wetlands destruction. A major reason is the Corps' apparent lack of enthusiasm for protecting many wetlands under the Section 404 program. The Department of the Army and the Corps have refused to agree that Section 404 was enacted to protect wetlands, a view disputed by other federal agencies. The Corps' attitude is reflected in the agency's interpretation of Section 404, administration of the program, numerous individual permit decisions, and failure to enforce Section 404 against illegal wetlands destruction."

  States have authority under the Clean Water Act (Section 404) to veto applications for permits. Each state must certify that a permit issued by the Corps will not violate water quality standards and the Corps cannot issue a permit if the certification is denied. In Arizona, the Department of Environmental Quality (DEQ) and the Arizona Game & Fish Department has responsibility for reviewing 404 permits. The DEQ has not, however, asserted this authority while the Arizona Game & Fish Department has had formal involvement in reviewing and issuing all 404 permits in Arizona. The USFWS also reviews 404 permits; approximately 50-75 individual public notifications and approximately 100-125 predischarge notifications have been reviewed by the USFWS. The Corps has cooperated with the Arizona Game & Fish Department and the USFWS recommendations for denials of permits and mitigations for projects.

Despite the nationwide "dismal failure of the program," this program is clearly well on the way to achieving its potential in Arizona. One significant problem with the 404 program in Arizona is the lack of clearly defined criteria for denial of applications. The Arizona Game & Fish Department mitigation policy is a means toward this end, but it is not the solution. State level environmental legislation could help. Currently, the greatest problem with 404 permits is the lack of enforcement by the Corps. Only in the last few months has a Corps 404 person actually been assigned to an office in Arizona -- a very positive step. A possibility that has been discussed with the Corps by Arizona Game & Fish Department is the need for performance bonding by permit applicants. The problem that remains lies with private individuals, corporations, and some agency staff that purposefully ignore the changes in the 404 program. The largest offenders of the program are sand and gravel operators.

Federal Assistance Programs

A variety of federal statutes and programs assist state, local, and private wetlands protection efforts, either expressly or indirectly. These may be roughly divided into three categories: grants-in-aid, technical assistance, and financial assistance.

Grants-In-Aid

There are several types of grants-in-aid available and include grants-in-aid for state or local acquisition of wetlands, for land and water use planning, and for regulation.

- Federal Aid to Wildlife Restoration Act of 1937 - Better known as the Pittman-Robertson Act, it serves as the principle mechanism for providing assistance to states for acquisition, restoration, and maintenance of wildlife habitat, which include wetlands, for the management of wildlife areas and resources, and for research into problems of wildlife management. The fund is comprised of revenues generated from the federal excise taxes on the sale of firearms, shells, and cartridges. The USFWS administers the federal program and the Arizona Game & Fish Department coordinates the state program. Over the last five years, Arizona has received over $10.7 million for projects relating to wildlife habitat development, enhancement, and maintenance. Other projects benefitting from the Act include the planning and evaluation of other agency projects as to their effectiveness for wildlife habitat improvement. While this program indirectly protects and enhances wetlands and riparian areas in Arizona, its main focus is on wildlife habitat, its enhancement, management, and protection. The potential exists for allocations of some of the funds for wetlands protection projects in the future.

- The Federal Aid in Fish Restoration Act of 1950 - More commonly known as the Dingell-Johnson Act, it essentially parallels the Pittman-Robertson Act except that it provides federal assistance to states for acquisition of habitat associated with fish restoration and management programs, including wetlands. Funds derived from the federal excise tax on fishing equipment and bait are annually apportioned among the states. The USFWS administers the federal program and the Arizona Game & Fish Department coordinates the state program. As an expansion of the Dingell-Johnson Act, the Wallup-Breaux Act was created. Funds for this Act come from an expansion of the taxes on fishing related equipment, such as tackle boxes and electric motors, plus a new tax on imported boats. These funds are

allocated to the states and can be used for aquatic education, boating access, and sport fish habitat restoration. The primary emphasis on expenditure of funds is on the expansion of sport fisheries opportunities, such as building or renovating hatcheries, constructing boat ramps, creating lakes and ponds, implementing aquatic education programs, and improving sport fish habitats.

The Arizona Game & Fish Department has received over $10.4 million from the Dingell-Johnson and Wallup-Breaux Acts over the last five years. Arizona did not start receiving Wallup-Breaux monies until 1985. The monies received have been used for boating access, sport fisheries enhancements, and redevelopment of state fish hatcheries. The potential exists that some monies may be allocated for wetlands enhancement in the future.

- The Land & Water Conservation Fund (LWCF) Act of 1965 - Administered by the National Park Service (NPS), the LWCF provides funds to the USFWS for expansion of the National Wildlife Refuge System, a significant portion of which includes wetlands, and to the NPS for land acquisition. A portion of the LWCF revenues is allocated to the states. The principal purpose of the LWCF is to provide a direct federal assistance program for state and local governments for recreation. The Fund was set up to promote land acquisition and the development of new outdoor recreation facilities.

  In Arizona, only two of the seven National Wildlife Refuges have been purchased entirely with LWCF monies and include the Buenos Aires and San Bernardino National Wildlife Refuges. Only the six-acre headquarters site at Cabeza Prieta was purchased with LWCF monies. The Kofa and Cabeza Prieta were withdrawn from the public domain. Overall, the LWCF program has been a significant factor in protecting wetlands and riparian resources in Arizona through its appropriations for refuge acquisitions. Currently, over $1 million has been appropriated to create future wildlife refuges at Arivaca Creek and Leslie Springs. The Nature Conservancy is assisting in negotiations for acquisition on behalf of the USFWS. The two new areas will protect significant native fish and wildlife habitat.

  The Arizona Outdoor Recreation Coordinating Commission determines funding allocations in the state for LWCF monies for recreation purposes. Arizona State Parks provides overall administration of the LWCF program in Arizona and prepares the required SCORP. Wetlands acquisition by state and local governments has been eligible under the LWCF Act. Wetlands acquisition is now specifically highlighted under the Emergency Wetlands Resources Act of 1986 and the effectiveness of this program for wetlands and riparian area protection has not been tested as of yet.

- The Water Resources Planning Acts of 1972 and 1974 - These Acts provide several sources of matching grants to states for water and related land resources planning, including regional water and land assessments and special projects.

- The Endangered Species Act of 1973 - Recognizing that endangered species of wildlife and plants "are of esthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people," ...the Act declares the bold purpose of providing "a means whereby the ecosystems upon which [they] depend may be conserved." To accomplish this, it further declares a policy "...that all Federal departments and agencies shall seek to conserve endangered species and shall utilize their authorities in furtherance of the purposes of this

Act." To protect the ecosystems upon which endangered and threatened species depend, the Act provides both indirect and direct means of protecting wildlife habitat, including wetlands.

Direct measures include the provision of LWCF Program monies for acquisition of areas for the conservation of endangered and threatened wildlife species and plants. Section 7 of the Act imposes four clearly discrete duties: 1) to review and utilize existing programs to further the purposes of the Act; 2) to utilize authorities to further such purposes by carrying out conservation programs; 3) to "insure" that federal activities not "jeopardize" the continued existence of endangered or threatened species; and 4) to "insure" that federal activities not destroy or modify habitat determined to be "critical."

In Arizona, the San Bernardino National Wildlife Refuge was created for the protection of two endangered native fishes: the Yaqui chub and the Yaqui topminnow; the Buenos Aires National Wildlife Refuge was created for the protection of the endangered masked bobwhite.

- Clean Water Act of 1977 - Section 208 provides grants-in-aid to states and regional planning agencies to develop areawide waste management plans and implementation processes. These plans and processes include the identification and regulation of non-point pollutants from agriculture, silviculture, mining, construction activities, and other sources.

  In Arizona, there are six Councils of Government (COG) that develop regional plans. Each COG is required to update 208 plans, but are not provided any funding. The state also develops a statewide 208 plan. Within the 208 plans, critical areas needed for protection or areas that need further study on water quality issues are identified as well as areas of non-point pollution discharges. The plans are indirectly effective in protecting wetlands and riparian areas. Many suggestions in the plans have resulted in permitting systems and monies for further studies.

Technical Assistance

Technical assistance on wetlands issues and programs is provided by the U.S. Fish & Wildlife Service, the U.S. Department of Agriculture, and the U.S. Army Corps of Engineers.

- U.S. Fish & Wildlife Service - The Clean Water Act (Section 208) provides for USFWS assistance in developing regulatory programs for the discharge of dredged and fill materials into wetlands adjacent to the waters of the United States, and provides for the statutory authorization for the USFWS National Wetlands Inventory. The inventory could provide assistance to state and local governments in land use planning and in the development of zoning regulations. The USFWS has provided technical assistance to a number of agencies and communities in Arizona.

- U.S. Department of Agriculture - The Agricultural Stabilization & Conservation Service (ASCS) implements two programs: the Agricultural Conservation Program (ACP) and the Conservation Reserve Program (CRP). ACP provides farmers up to 80 percent of construction costs for a variety of conservation practices. The ACP provides funding for several farming practices, such as irrigation reservoir and land leveling, that indirectly result in wetlands conversion. The ACP has not been used in Arizona. The CRP provides farmers with payments for cropland that is eroding greater than 3 tons annually and some type of

conservation effort is attempted. The farmer enters into a 10-year contract with the ASCS County office in which his land resides. In Arizona, no landowner has entered into a contract because land bids for payment placed by the farmers have been unacceptable to ASCS.

The U.S. Soil Conservation Service (SCS) is authorized, pursuant to a number of statutes, to provide technical assistance to states, local governments, and private landowners in many aspects of resource conservation, including wetlands protection and management. The SCS also provides technical assistance for wetlands drainage; however, Conservation Planning Memorandum 15 eliminates technical and financial assistance for draining or altering wetlands. In Arizona, SCS has provided technical assistance to a number of landowners for conservation of the soil and water resources. Impact on wetlands protection has been minimal, however. SCS provides a valuable service to the state in its cooperative efforts in conducting the annual snow survey program. Each winter, measurements and assessments are made in various locations in the state and determinations are made for forecasting reservoir storage and stream flows. Adequate stream flows are very important for riparian habitat and riverine wetlands in Arizona.

- U.S. Army Corps of Engineers - The Corps' floodplain management program provides technical services to state and local governments. The program stresses regulatory approaches in controlling flood losses. Nonstructural approaches are recognized in the Council on Environmental Quality Principles & Standards for Planning Water Projects.

- National Park Service - The National Park Service provides technical assistance to states and local governments through the State & Local River Conservation Assistance Program, which is authorized under Section 11 of the National Wild & Scenic Rivers Act. The program is designed to: 1) assist state and local governments, federal agencies, private groups, and landowners in the development of river conservation and management plans; 2) encourage river conservation through local actions while maintaining private ownership of riparian lands; and 3) foster beneficial uses of rivers and their adjacent lands by promoting comprehensive decisionmaking. Projects could include statewide river assessments, river greenway plans, and river conservation workshops. Arizona State Parks is conducting a Statewide Rivers, Streams, & Wetlands Study as part of the 1989 SCORP and has applied for assistance through this program.

Financial Assistance

- Clean Water Act of 1977 - Section 205 authorizes EPA to make funding available to the states for administering pollution controls including dredged and fill programs which meet EPA standards.

- National Flood Insurance Program (NFIP) - This program is administered by the Federal Emergency Management Agency and provides flood insurance at up to 90 percent federal subsidy to homeowners and businesses where insurers are unwilling to accept the risk. To qualify for the program, state and local governments must establish land use controls over floodplain development by zoning, subdivision regulations, building codes, etc. Tight floodplain regulations may provide a considerable degree of protection for wetlands areas. Technical assistance is not available to local governments that qualify under the program.

Wetlands Research Programs

There are a number of federal agencies that are engaged in wetlands research. They include:

- U.S. Army Corps of Engineers - In 1982, the Corps' Waterways Experiment Station initiated a five-year program to develop improved techniques for defining and evaluating wetlands and to assemble a data base of regional literature on wetlands studies. The Corps is one of the federal agencies with a program that specifically addresses wetlands research.

- U.S. Fish & Wildlife Service - The USFWS research includes development of bibliographies, evaluation of wetlands assessment techniques, wastewater disposal impacts, and mapping technologies. The USFWS National Ecology Research Center, Fort Collins, Colorado, is conducting field research on the relationship between hydric soils and wetlands vegetation. The USFWS is also responsible for the National Wetlands Inventory (NWI). The NWI has been completed in Arizona, but some questions remain as to its accuracy among land managers.

- Bureau of Reclamation (BR) - The BR conducts research on water-related technologies, water quality, recreation, and flora and fauna. The BR has funded a number of wildlife and vegetation studies in the 1970s along the lower Colorado River.

- U.S. Forest Service - The USFS regional offices administratively designate Research Natural Areas (RNAs) as control sites for research studies. RNAs are incorporated into the Forest Plans and withdrawn from multiple-use status. Most RNAs are usually small in size, undisturbed with little evidence of man's impact, and have a single dominant vegetation type. Protection of a wide variety of vegetative community types, including wetlands and riparian areas, is achieved only through the overall RNA program. The Rocky Mountain Forest and Range Experiment Station has offices located on the Arizona State University and the Northern Arizona University campuses and both are actively involved in research on wetlands and riparian areas in Arizona.

- National Marine Fisheries Service (NMFS) - The NMFS has a $6 million habitat research program, approximately one-half of which is estuarine-related. No monies have been expended on wetland-related projects in Arizona under this program.

- National Science Foundation (NSF) - The NSF has funded a variety of wetland-related projects, including a study of the monitoring and enforcement of state wetlands and shoreland programs. No monies have been expended in Arizona under this program.

- U.S. Geological Survey (USGS) - The USGS, Water Resources Division, and a network of cooperative agencies, have been responsible for the systematic collection of surface water records since 1976, for groundwater levels since 1939, and for water quality records since 1969. The data are published annually and stored in the National Water Data System operated by the USGS and cooperating state and federal agencies in Arizona.

Federal Conservation Programs

Several of the laws pertaining to the conservation of wildlife indirectly protects and preserves important wetlands resources. The Emergency Wetlands Resources Act directly affects the conservation of the nation's wetlands.

- The Migratory Bird Conservation Act of 1929, as amended in 1949 and 1958 - This Act established the National Wildlife Refuge System as known today in which federal lands are managed chiefly for the conservation of wildlife. Public hunting is permitted if "...compatible with the major purposes for which such areas were established." The Act, unlike most other statutes authorizing federal acquisition of land, requires consent of the state in which the lands to be acquired are located. One source of funding for refuge acquisition under the Act is the Migratory Bird Hunting Stamp Act of 1934. Revenues generated from fees paid by hunters for duck stamps acquires or purchases easements on wetlands. The U.S. Fish & Wildlife Service is responsible for managing the National Wildlife Refuge System.

  No monies have been spent under the authority of the Migratory Bird Hunting Stamp Act in Arizona. Arizona lies within the Pacific Flyway management unit of the USFWS for migratory birds. No funds have been spent in Arizona because authorization to do so, by the state, was not granted until 1986. The USFWS has identified areas near Cibola National Wildlife Refuge that it may seek to purchase with funds from the Migratory Bird Hunting Stamp Act. Refuges found in Arizona, along the Colorado River, were created through mitigation efforts for Bureau of Reclamation activities (mostly dam construction) and include the Havasu, Cibola, and Imperial National Wildlife Refuges. These three refuges represent significant wetlands areas for wildlife habitat along the Colorado River. On the whole, the Migratory Bird Hunting Stamp Act has provided minimum value to Arizona to date.

- Taylor Grazing Act of 1934 - The Taylor Grazing Act was intended to bring about a more orderly use and regeneration of public domain lands that were being deteriorated as a result of uncontrolled grazing and adverse weather. Grazing districts were established for regulating grazing use of the areas through a system of grazing permits. Section 2 of the Act requires conservation and improvement of rangelands while emphasizing erosion and flood control through rehabilitation of the land. The BLM and USFS mainly administer the permitting under the Act in Arizona.

- Wetland Loan Act of 1961 (WLA) - The WLA was intended to accelerate federal acquisition of migratory waterfowl habitat. The law, extended through 1988, authorized additional federal appropriations as a loan against future revenues from the sale of duck stamps. As of 1985, more than $190 million had been appropriated through the WLA to acquire additional waterfowl habitat, including wetlands. The U.S. Fish & Wildlife Service administers this program. Meanwhile, federal tax laws subsidize the speculative drainage of wetlands for croplands and other developments. In Arizona, the USFWS has not used the WLA authority to acquire land because most of the wetlands now controlled by the USFWS are withdrawn public lands for which there is no cost and no projects were identified in Arizona that could compete with other migratory waterfowl projects across the nation.

- The Wilderness Act of 1964 - The Wilderness Act required the U.S. Forest Service to study primitive areas existing at the time the Act was passed for their suitability for wilderness designation and initiated a nationwide review of all federal lands for potential wilderness

designation. A wilderness area is defined in the Act as "...undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which: 1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; 2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; 3) has at least 5,000 acres or is of sufficient size as to make practical its preservation and use in an unimpaired condition; and 4) may also contain ecological, educational, scenic, or historical value." Wetlands and riparian areas found in wilderness areas would be protected in their natural state in perpetuity.

As of December 1987, Arizona has 2,059,917 acres of land designated as wilderness, 173,762 acres of land designated as a primitive area, and BLM is studying the feasibility for wilderness inclusion on over 2 million acres. Of the 2.14 million acres under study by the BLM, 1.01 million acres have been recommended as suitable for inclusion as wilderness areas. Four of the NPS National Monuments in Arizona contain lands designated as wilderness areas. These areas are located within Chiricahua, Organ Pipe, Petrified Forest, and Saguaro National Monuments. The USFS manages approximately 64 percent of all designated wilderness areas in Arizona. Wilderness areas are designated by Congress. Within each of the wilderness areas, critical riparian habitat and wetlands exist. Designation as wilderness does not guarantee protection of wetlands and riparian areas. Grazing is considered a "compatible use" in wilderness, but many examples exist in Arizona of riparian degradation caused by overgrazing in wilderness (Taubert, 1988).

- The Wild & Scenic Rivers Act of 1968 (Public Law 90-542) - The Wild & Scenic Rivers Act, as amended, declares that "...certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations." The Act establishes a National Wild & Scenic Rivers System which provides permanent protection under state or federal management for three classes of free-flowing rivers: wild, scenic, and recreational rivers. All wild, scenic, and recreational rivers require designation by Congress, or, if state administered, by the legislatures of the states through which the rivers flow and approval by the Secretary of the Interior. Once in the system, the objective of the managing agency is to preserve or enhance the qualities which qualified the river for inclusion within the system. Recreational use must be compatible with preservation. Indirectly, this Act protects those wetlands areas associated with river segments designated under the Act.

  In 1982, the NPS released the results of the Arizona component of the Nationwide Rivers Inventory which identified 14 rivers (including 17 river segments) which, because of their natural and free-flowing characters and associated resource values, would qualify as additions to the National System. To date, only one of those segments has been designated as a wild and scenic river, a 40-mile segment of the Verde River. The potential for protection of riparian areas and wetlands associated with rivers exists within the Wild & Scenic River Program. A state program should also be developed for protection of river segments and wetlands.

- Water Bank Act of 1970 - The USDA Agriculture Stabilization & Conservation Service administers this program. Under the Water Bank Program for Wetlands Preservation, the Secretary of Agriculture may enter into 10-year renewable agreements with private

landowners and operators in important migratory waterfowl nesting and breeding areas. In return for payment, the participating landowner or operator agrees "...not to drain, burn, fill, or otherwise destroy the wetlands character" of areas included in the program, or "...to use such areas for agricultural purposes."

This program has not received much money in recent years. As of April 1987, the Water Bank Program had funded 4,615 lease agreements, protecting 153,073 acres of wetlands and 332,861 acres of adjacent uplands (Feierabend, et al, 1987). In Arizona, this Act has not protected any wetlands or adjacent areas due to the lack of major migratory waterfowl routes.

- Public Range and Improvement Act of 1978 - Sections 2 (b) (2) and 5 (a) of the Act provide for not only conservation and improvement of rangelands, but also direct funding to be used specifically for range, wildlife, and watershed improvement.

- The Food Security Act of 1985 (Farm Bill) - The Food Security Act of 1985 encourages removal of marginal agricultural lands from production and provides various opportunities for wetlands habitat protection and restoration while reducing federal subsidy costs. The "swampbuster" provision denies federal agricultural payments or other benefits to farmers who produce an agricultural commodity in any crop year on converted wetlands. This provision was the first real attempt to slow the rate of wetlands lost to agricultural conversion. It is not, however, a wetlands protection statute and does not prohibit drainage or modification of wetlands. The effectiveness of the swampbuster depends on how diligently the statute is enforced by the USDA. Preliminary indications are that the enforcement dimension of the program is not of first-order interest to USDA officials. When farm prices recover and it again becomes profitable to convert wetlands to produce more crops, swampbuster will get its greatest test as a deterrent against wetlands conversion (Feierabend, et al, 1987). In Arizona, this program has had little effect on agricultural practices.

- Emergency Wetlands Resources Act of 1986 (Public Law 99 - 645) - The purpose of this Act is to promote, in concert with other state and federal statutes and programs, the conservation of wetlands in order to maintain the public benefits they provide. Section 301 of the Act directs the Department of the Interior to develop a National Wetlands Priority Conservation Plan (NWPCP) that identifies the locations and types of wetlands that should receive priority for federal and state acquisition. The USFWS has the responsibility for preparing the plan. Section 303 of the Act requires, beginning in fiscal year 1988 and thereafter, that each SCORP must specifically address wetlands as an important outdoor recreation resource, and that each state plan must be consistent with the National Wetlands Priority Conservation Plan. The National Park Service has the responsibility of assuring SCORP consistency with the national plan. Section 304 of the Act authorizes the Department of the Interior to acquire wetlands based on broad consideration of their multiple public values. Section 401 of the Act provides for the USFWS to continue the National Wetlands Inventory Project. The effectiveness of this Act remains untested and is dependent upon appropriations by Congress to the Land & Water Conservation Fund Program and local entities applying for grants.

State Wetlands Programs

The State of Arizona, through a number of direct and indirect regulatory and nonregulatory measures, plans, monitors, and regulates the use of wetlands and riparian areas, and protects and acquires wetlands and riparian areas. Table 2 summarizes the state wetlands programs.

Direct Regulatory Programs

- A.R.S. Title 17-237 - Pollution of Waters - The Arizona Game & Fish Commission is authorized to bring suit and/or restrain any person, corporation, or government agency from discharging or dumping into a stream or body of water in the state any deleterious substance which is injurious to wildlife. No suits have occurred under this statute, but the Game & Fish Department regularly sends a water quality analyst to assist at all water pollution spills. The Game & Fish Department is a member of an interagency task force that works with the responsible party to develop solutions to the spills. In most cases, mitigation for the spill has occurred. The Department assists in these activities a number of times per year. It has been a very effective tool to entice the responsible parties to cleanup water pollution spills.

- Water Quality Regulation - The Arizona Department of Environmental Quality (DEQ) is responsible for setting, monitoring, and enforcing water quality standards for all navigable waters, the major tributaries, and all groundwaters of the state. The DEQ must preserve and protect the quality of those waters for all present and reasonably foreseeable future uses by regulating discharges into state waters. State surface water quality standards identify management objectives and allowable limits for biological, chemical constituents, and physical characteristics in water bodies. The agency administers two types of surface water quality programs that directly influence the quality of surface waters for recreation or fish and wildlife habitat: 1) the standards for protected uses; and 2) the standards for designated unique waters. The DEQ has authority to regulate both point and non-point pollution sources to maintain and enforce these surface water quality standards. Groundwater quality standards are more general; groundwater, with few exceptions, must be maintained at a quality sufficient for human consumption.

  Standards for Protected Uses of Surface Waters. Water quality standards for surface water segments are set according to the "protected uses" of the water surface area, as defined by the Arizona Water Quality Control Council (Chapter 21, Article 2, R9-21-207). Protected uses relating directly to recreation and fish and wildlife include: 1) full body contact; 2) incidental human contact; and 3) aquatic and wildlife. Full body contact includes "...swimming, water skiing, skin diving, and other similar activities, during which the water may be ingested accidentally and certain sensitive body organs, such as the eyes, ears, nose, etc., may be exposed to water." Incidental human contact includes fishing, hunting, trapping, boating, wading, and other activities during which it is very unlikely that the water will be ingested or come in contact with eyes, ears, nose, and other body organs. Standards for protected uses for aquatic and wildlife purposes are set to allow the growth and propagation of fish, waterfowl, fur-bearers, other aquatic life, semiaquatic life, or other wildlife. This includes surface water used for a cold water fishery, warm water fishery, wildlife habitat, or other fish or wildlife uses. Allowable limits for contaminants for these uses have been

Table 2. Summary of State Wetlands Programs

Program	Effect of Program
Direct Regulatory Programs	
ARS Title 17-237 - Pollution of Waters	Cease or assist in pollution spills, clean-up, and mitigation
ARS Title 49 - Water Quality Control	Maintain and regulate water quality standards
Indirect Regulatory Programs	
Commission on the Arizona Environment	Clearinghouse of environmental issues
ARS Title 45 - Water Quantity Control	Water rights and instream flow rights
ARS Title 9-21-303 - Unique Waters	Unique Waters Program
ARS Tiltle 9-21 - Water Pollution Control	Regulates water quality for pollution
Non-Regulatory Measures	
Game, Non-Game, Fish & Endangered Species Fund (Non-Game State Income Tax Checkoff Program)	Funds activities related to game, non-game, fish , and endangered species, including acquisition of wetlands
Waterfowl Conservation Fund	Funds activities for developing waterfowl habitat, including wetlands
Conservation Development Fund	Funds acquisition of game and fish facilities, habitat, and preservation or propagation of wildlife
Matching Aid to Restore States Habitat	Funds for waterfowl habitat projects
Arizona State Natural Areas Program	Voluntary recognition program for unique/critical natural areas, including wetlands
Natural Resource Conservation Districts	Program to provide education and assistance to landowners and organizations for conservation practices

determined. DEQ classifies surface water segments as being effluent dominated if the flow in that stream segment consists primarily of treated wastewater for at least 75 percent of a typical year. Seven stream segments in Arizona are classified as effluent dominated: two parts of the Salt River, Santa Cruz River, Gila River, American Gulch, Granite Creek, and Rio De Flag. Effluent dominated streams provide the needed water to create riparian vegetation and wetlands. Certain standards must be met on the streams and they must be monitored regularly.

Unique Waters Program. Designated unique waters are high quality waters that "constitute an outstanding public resource," are "of exceptional recreational or ecological significance," or that are "critical habitat for a threatened or endangered species which historically or is presently known to be associated with such waters" (Chapter 21, Article 2, R9-21-202). Surface water segments classified as unique waters are protected by water quality standards determined on a site-specific basis.

To be classified as a unique water under the program, a surface water segment must meet at least three of the following criteria: 1) public recreational use of the surface water segment exceeds the average annual use taken on a national or regional basis of similar waters; 2) it provides exceptional and valuable recreational or educational opportunities; 3) it has been included or proposed for inclusion in the national land system; 4) it comprises essential habitat for fish and wildlife species and such species are recognized as having national or state significance by virtue of state or federal actions; 5) it contributes substantially to natural ecosystem cycling; 6) it possesses outstanding scientific or educational value; 7) it is susceptible to irreparable or irretrievable loss due to its ecological fragility or its location; 8) it supports unusual or unique ecological systems; 9) it meets or exceeds the water quality standards set forth in Arizona; and 10) the classification does not conflict with present or anticipated necessary and important economic social development in the area.

Arizona has designated two surface water segments as being unique: the West Fork of the Little Colorado River and the Oak Creek Canyon, including the West Fork of Oak Creek. Three stream segments are scheduled to be promulgated early in 1989 and include Peoples Canyon, Francis Creek, and Burro Creek. All research is complete on the stream segments and rules and standards need to be developed for each segment. Two other nominations are being prepared for Cienega Creek near Vail, and Bonita Creek near Safford. A relatively new program since August 1986, the opportunity exists within the Unique Waters Program to protect many more surface water segments and, indirectly, riparian areas and wetlands. The complete process to nominate a stream segment takes approximately three years.

Standards for Groundwater. Standards for groundwater quality are much more stringent than those for surface waters in that the state prohibits the discharges of any pollutants or disposal of wastes that will impair any existing or future uses of the water (Chapter 21, Article 4, R9-21-403). Hence, all groundwater must be kept at a quality suitable for human consumption. An aquifer may be exempt from this general standard if it meets certain criteria established by the Arizona Water Quality Control Council (R9-21-404). Pollutant discharges and waste diposals to groundwater may not directly or indirectly cause violation of the surface water quality standards. DEQ sets standards and regulates facilities affecting groundwater quality, including hazardous waste storage, treatment, or disposal; solid waste disposal; agricultural wastes; mining discharges; and wastewater treatment discharges.

The effectiveness of the water pollution control laws is difficult to determine. Regulation has only been as effective as the enforcement of the law and collection of evidence to convict pollutors. It is difficult at times to provide personnel to adequately monitor the quality of the waters in all areas of Arizona. The DEQ is a relatively new agency, created in 1987.

Indirect Regulatory Programs

- A.R.S. Title 45 - Under Title 45, the Arizona Department of Water Resources (DWR) receives its authority for general control and supervision of the waters in Arizona and the appropriation and distribution of such waters, including interstate streams, dams and reservoirs, agricultural improvement districts, drainage districts, irrigation districts and delivery systems, soil conservation districts, flood control, and weather control and cloud modification. Some of DWR's most important duties are issuing water rights for surface and groundwaters and issuing instream flow permits.

  Instream Flow Permitting. The term, instream flow, refers to the non-consumptive, in situ uses of water in a stream channel for fish, wildlife, recreation, aesthetic, or other purposes. Instream flows are one of the major uses of surface water on public lands, as non-diverted streamflow is critical to fulfilling some of the multiple-uses and special purposes of the land and resource management agencies.

  In December 1986, the DWR formed a task force of interested individuals and agency representatives to recommend appropriate guidelines for evaluating instream flow applications. Two technical subgroups from within the task force were formed, a biological subgroup and a hydrological subgroup, to evaluate methods and make recommendations to DWR. The DWR is expected to promulgate formal rules for instream flow permitting in 1988. As of January 1988, 39 minimum instream flow permit applications have been submitted to DWR. Two of these applications have been permitted, both to The Arizona Nature Conservancy (for Ramsey and O'Donnell Creeks). The USFWS has been the lead agency for determining what minimum instream flows are, and it has been conducting studies on a number of streams in Arizona.

  Permitting for Other In Situ Uses. Water rights for in situ waters that do not flow in a stream channel (such as seeps, springs, cienegas, or marshes) for recreation or fish and wildlife purposes are filed for under the normal surface water right application procedures.

- A.R.S. Title 37 - Under Title 37, the State Land Department (SLD) receives its authority to administer State Trust Land in order to produce the highest revenue yields for its beneficiaries. The vast majority of lands under state jurisdiction is administered by the SLD. The SLD deals with a multitude of agencies and individuals in leasing, acquiring by trade, and selling lands for a variety of purposes including agriculture, timber, commercial uses, grazing, homesites, rights-of-way, mineral extraction, and recreation. The SLD recognizes the unique resource values associated with riparian habitats and considers these values in its actions. When major conflicts have occurred between these values, the SLD has attempted to exchange the environmentally sensitive lands into federal ownership. Examples of this action can be found in Burro Creek, Aravaipa Canyon, and the Kofa National Wildlife Refuge. The SLD is required to file for water rights just as any landowner with the DWR. It has consistently included a wildlife use factor in its surface water rights filings. Over the years, the SLD has participated in many other water rights programs.

These include well registration, establishment of grandfathered groundwater rights, surface water adjudications, irrigation and special district participation, Central Arizona Project contracts, water sales, identification of sovereign lands along the Colorado River, working with water resources for urban and rural lands, recharge, and water quality issues. While these programs indirectly affect wetlands, their effectiveness of wetlands protection is minimal (SLD, 1987).

Non-Regulatory Measures

- Commission on the Arizona Environment (CAE) - The CAE, originally formed by Executive Order in 1965, was established as a state agency in 1986 to: 1) provide forums for the discussion of environmental issues; 2) conduct public education programs; 3) facilitate the coordination of public awareness programs; and 4) communicate with a broad range of the citizens of Arizona. Riparian habitat protection has been a concern of the CAE for more than eight years, and is currently being addressed by the CAE through its Ad Hoc Commitee on Riparian Habitat. The Ad Hoc Committee has a workplan that has been adopted by the CAE which calls for the development of two reports by 1989; one dealing with the inventory of riparian habitat and the second addressing riparian issues in Arizona.

- A.R.S. Title 17-268 - Game, Non-Game, Fish & Endangered Species Fund - This fund has been established to be used by the Arizona Game & Fish Commission for any activities related to game, non-game, fish, and endangered species, including wetlands habitat acquisition. In 1983, the State Legislature authorized the establishment of a voluntary program to allow taxpayers to specify the donation of all or part of their state income tax refunds to benefit Arizona Game & Fish nongame wildlife programs. The goal of the program is to preserve, protect, and effectively manage nongame wildlife populations and their habitats and to provide opportunities for public enjoyment of all wildlife species, consistent with sound management practices for the species. Funds generated through the Non-game State Income Tax Checkoff Program are deposited into the Game, Non-Game, Fish & Endangered Species Fund. Expenditures for the fund are subject to annual legislative appropriations. Monies to date have been spent for endangered species protection and research on protective techniques for various species. If the endangered species habitat is associated with wetlands, protection of the habitat for the species will occur. The fund receives approximately $230,000 annually and expends approximately $300,000. The balance of the fund is approximately $300,000. Income and donors to this program have leveled off over the years.

- A.R.S. Title 17-270 - Waterfowl Conservation Fund - This fund is established from monies received from selling waterfowl stamps for waterfowl hunting, artwork, gifts, grants, and contributions received for such purposes. Monies in the fund are legislatively appropriated and may be expended for developing migratory waterfowl habitat and associated research and management to increase the number of migratory waterfowl in Arizona. The Arizona Game & Fish Department administers this fund. Since it was initiated in 1987, estimated first year revenues should be approximately $590,000. Subsequent years' print sales are estimated at $180,000. Monies of this fund will be used for waterfowl habitat development and acquisition and may include wetlands.

- A.R.S. Title 17-345 - Conservation Development Fund Surcharge - The Conservation Development Fund was established for the acquisition and construction of game and fish facilities, including the preservation or propagation of wildlife and the preservation or development of habitat. A surcharge of up to two dollars exists on the general fishing license, general hunting license, or the combination general hunting and fishing license, and on a trout stamp to be deposited in the Conservation Development Fund. The Surcharge Fund is used for matching money for renovation of the state fish hatcheries which is received through the Dingell-Johnson Act. Future projects could include habitat protection, including wetlands.

- Matching Aid to Restore States Habitat (MARSH) - In 1984, Ducks Unlimited, Inc. (DU) initiated the MARSH program whereby 7.5 percent of funds raised by DU in each state is available to the state for waterfowl habitat projects. The ratio of matching funds required from each state is graduated based on the state's contributions to DU. Arizona is required to have a 1:1 match. This program is administered by the Arizona Game & Fish Department. Approximately $78,000 is available to Arizona under this program. DU's 1987 fund raising efforts resulted in an additional $40,000 which became available January 1, 1988. These monies will be used for waterfowl habitat acquisition and development, including wetlands.

- The Arizona State Natural Areas Program - In 1975, a study of natural areas was completed in Arizona, which resulted in the establishment of the Natural Areas Program administered by the Arizona State Parks Board (ASPB). To assist in administering the program, the ASPB established a Natural Areas Advisory Council consisting of ten volunteer members with expertise in applicable scientific fields. The main purpose of the program is to identify and evaluate potential natural areas of unique importance, including wetlands and riparian areas, for inclusion on the Natural Areas Register, and to recognize beneficial land stewardship. A recognition plaque is provided and an agreement is entered into with the landowner/manager to protect the site's natural values and significant resources through proper management. Over the years, the program has suffered from negative landowner stigmas and perceptions of the state administered program. A new Natural Areas Study is near completion under the 1989 SCORP planning process which will hopefully give new direction and public support for the program. The potential exists for considerable public awareness and protection of wetlands and riparian areas in Arizona under this program.

- Natural Resource Conservation Districts (NRCD) - The State Land Department is responsible for the administration of Arizona's 32 Natural Resource Conservation Districts. The Districts have a unique organizational structure in that they combine the efforts of private landowners, and state and federal governments. The program provides educational programs for private landowners, conservation groups, and civic groups concerning environmental issues, land use practices, and conservation techniques. Policies and procedures for each District are determined by a board governing each District. In the past, some of the Districts have been very active in protecting Arizona's environment. The potential exists for each District to take an active role in protecting Arizona's wetlands and riparian areas through protective measures with the landowners, educational efforts, and wise land use practices.

Local Wetlands Programs

A survey of the county governments and the major municipalities was undertaken to determine local measures for protection of wetlands and riparian resources. None of the counties or major municipalities surveyed, with the exception of Pima County and the Cities of Scottsdale and Tucson, had any ordinances or written policies specifically protecting wetlands and riparian areas. However, all counties and municipalities indirectly protect wetlands and riparian areas as they relate to the National Flood Insurance Program. Land use controls over floodplain development included zoning ordinances that either restrict the density of development or prohibit development altogether. Another indirect protective measure was the sensitivity of the boards, commissions, and staffs to wetlands and riparian areas when reviewing plans to limit development in these areas.

County Programs

Maricopa, Cochise, and Coconino Counties have adopted comprehensive general plans that identify sensitive areas designated to remain as open space or natural areas and limit the type of development within those zones. The sensitive areas usually contain washes, wetlands, riparian areas, unique plant communities, and steep slopes.

Pima County has been the leader of local governments in the protection of wetlands and riparian areas by both direct and indirect means. One of the first measures taken was the development of a map for the critical and sensitive habitats found in the county. It was the first study that identified areas as being sensitive - open water, wetlands, and riparian habitats. The County Board of Supervisors adopted the recommendations of the map in principal and is implementing the regional goals and objectives. The map is used in zoning reviews of development projects on a site by site analysis to protect critical and sensitive wildlife habitat. The five jurisdictions within Pima County follow standardized environmental goals when planning.

The second measure undertaken by Pima County was the Urban Design Committee Study which developed recommendations to protect the aesthetic qualities of washes throughout the region. The County Board of Supervisors adopted the recommendations of the study, as did the City of Tucson.

Pima County is in the process of adopting a Buffer Overlay Zoning Ordinance which would provide buffer zones around critical and sensitive environments. It would also take the policy of undertaking site analysis for critical and sensitive habitat to a required process. Tucson is also expected to adopt this ordinance.

Another measure of protection used by Pima County is through the National Flood Insurance Program. The County has also developed a Flood Control District which continually updates information on washes within the county. The National Flood Insurance Program is relatively neutral on riparian habitat protection. In some cases, public health and safety issues directly conflict with floodplain preservation. This is also true of local floodplain management ordinances. For instance, Pima County's Floodplain Management Ordinance requires that buildings be set back from natural channel banks unless bank protection is constructed. While the building setback provision sometimes means that a riparian habitat is preserved, it also can encourage construction of bank protection along watercourses where a preservation policy may not exist.

Pima County's real success with riparian habitat preservation has stemmed local initiatives, such as the Floodprone Lands Acquisition Program, in which it is possible to mitigate existing or potential future flood hazards through acquisition while at the same time preventing development of sensitive riparian habitat. The La Puerta del Norte land acquisition is an example where flood hazards were mitigated without protecting riparian habitat, while the Cienega Creek Nature Preserve is the most notable example of how multiple objectives can be facilitated. Funds under this program will also be used to acquire lands identified for inclusion in the Pima County Interim Official Regional Trail & River Park System. The proposed system includes the Rillito and Santa Cruz Rivers, and the Alamo, Tanque Verde, and Agua Caliente Washes. Tanque Verde and Agua Caliente Washes are particularly noted for their sensitive riparian habitats.

The other program which focuses on acquisition of critical and sensitive habitat and protection of open space is the Pima County Open Space Plan, which is still in draft form. A committee of individuals representing interdisciplinary expertise, intergovernmental responsibilities, and citizens interested in open space issues has inventoried and classified open space in Pima County and made recommendations for acquisition. This inventory includes all types of open space needs, including riparian areas. The report is designed to serve as the basis for the open space element of the Pima County Comprehensive Plan. One of the more significant components of the report is a recommendation that a desert belt, centered on a wash, provide an open space of low density to buffer development to the south of the City. This open space would define the future southern boundary of metropolitan Tucson.

Open space bonds, approved by voters in 1986, were used for acquisition for Tortolita Mountain Park which includes sensitive riparian areas, and are proposed to be used for the upland area of the Empire Cienega Ranch. Negotiations are underway for the acquisition of the Empire Ranch Cienega through a land exchange with the BLM.

Municipality Programs

The major municipalities contacted included Phoenix, Scottsdale, Tempe, Mesa, Glendale, Flagstaff, Yuma, and Lake Havasu City. Scottsdale, Prescott, and Tucson were the only municipalities that have programs for protection of wetlands or riparian areas.

Scottsdale also has an adopted general plan that includes a provision for vista corridors. Protection of the larger natural washes under the vista corridors keeps them in their natural state and protects the riparian habitat and wetlands associated with them. There is also a policy to preserve the smaller washes on a site by site planning basis. Two ordinances further protect wetlands and xero-riparian areas within Scottsdale: the Hillside Ordinance and the Native Plant Ordinance. The Hillside Ordinance mandates developers to set aside a certain percentage of land to be preserved in its natural state as an open area. The percentage of dedication increases with the steepness of the slope. The Native Plant Ordinance protects all native plant species, especially trees four inches in caliper and larger, and cacti six feet or more. These two ordinances directly and indirectly protect wetlands and riparian area habitat and have been very effective to date.

The City of Prescott and the Economic Development Committee have been studying the Granite Creek system, which runs through Prescott, to determine appropriate land uses adjacent to Granite Creek and recreational use levels. They have also conducted an inventory of the resources on which to base recommendations and develop policies for the City Council. The study process has raised the sensitivity of

the community for protection of this riparian corridor and its potential for drawing economic development and tourism to Prescott.

The City of Tucson has followed Pima County in implementing a number of recommendations and policies that have been adopted by the Pima County Board of Supervisors.

Indian Tribal Programs

Generations of Native Americans have developed lifestyles, cultures, religious beliefs, and customs around their relationships with fish and wildlife resources. Historically, these resources provided food, shelter, clothing, and tools and they were also traded for a variety of goods. These resources continue to provide a base of sustenance, cultural enrichment, and economic support for many tribes. Arizona Indian tribes contribute significantly toward meeting the growing demand for outdoor recreation, including such activities as fishing, hunting, camping, whitewater rafting, and skiing. Indian reservations provide critical habitat for threatened and endangered species and habitat necessary for the conservation of significant fish, big game, migratory birds, and other populations. Many of the tribes in Arizona have developed professional staffs with the capabilities to manage, conserve, and develop fish, wildlife, and outdoor resources.

Responsibilities and roles of tribes in managing fish and wildlife resources emanate from treaties signed with the federal government through which tribes, in exchange for ceding to the United States vast tracts of lands, reserved to themselves rights to hunt and fish on established reservations and on certain ceded areas in perpetuity. The primary mechanism through which the federal government funds programs to fulfill tribal fish and wildlife management responsibilities is the Fish, Wildlife, & Recreation Program administered by the Bureau of Indian Affairs (BIA). The goal of the Program is to fulfill and execute the federal government's trust responsibility relating to fish, wildlife, and recreational resources and to promote the conservation, development, and utilization of these resources for the maximum benefit of Indians now and in the future. This goal is carried out primarily through the Indian Self-Determination Act of 1975, which allows tribes and inter-tribal organizations to contract with the BIA to carry out programs that would otherwise be performed by federal agency personnel (BIA, 1987).

Tribes located in Arizona have developed a broad array of fish, wildlife, and outdoor recreation programs. Many of the tribes have natural resources divisions to help guide these programs. Some of the more active natural resources divisions include the White Mountain Apache Tribe, the San Carlos Apache Tribe, the Colorado River Indian Tribes, and the Navajo Tribe. For example, the White Mountain Apache Game & Fish Department manages 25 lakes and over 400 miles of streams, and it issues camping, fishing, hunting, cross-country skiing, and backpacking permits on the Fort Apache Indian Reservation. Significant wetlands and riparian areas can be found on most of the reservations. The majority of Arizona's wetlands and riverine resources begin in or flow through the Fort Apache Indian Reservation. Major riverine resources found on the Fort Apache Indian Reservation include the White, Salt, and Black Rivers, and a significant number of tributaries flowing into the Salt and Gila Rivers. A significant number of high elevation wet meadows are also found. The San Carlos Indian Reservation includes the Gila, Black, San Carlos, and Bonita Rivers, and a significant number of tributaries flowing into the Salt and Gila Rivers. Located on or adjacent to the Colorado, Fort Mohave, Hualapai, Havasupai, and the Navajo Indian Reservations is the Colorado River. Other important riverine resources are associated with the Salt River (Salt River) and Fort McDowell (Verde River) Indian Reservations.

Cooperative efforts between the tribes and the State of Arizona for preserving wetlands and riparian areas should be pursued to provide overall protection of Arizona's resources.

Private Wetlands Programs

There are several private foundations and organizations in Arizona interested in protecting and preserving Arizona's wetlands and riparian resources. Their efforts range from providing a clearinghouse of information and a forum for the discussion of riparian resources issues to lobbying for protection to actually protecting resources and rehabilitating resources. A brief summary of their efforts are provided below.

- The Nature Conservancy (TNC) - TNC has taken the lead in Arizona to protect the state's remaining wetlands through acquisition and launched an ambitious three-year campaign in 1987 called "Streams of Life." Within the next three years, TNC goals are to raise between three and a half to four million dollars to ensure the future of 19 significant natural areas, found both in the private sector and on public lands. TNC continues to be extremely active in Arizona with five permanent, staffed preserves and numerous temporary holdings, eight full-time office employees, and a very active Public Lands Program. They also continue to purchase critical areas with the intent of eventually turning the sites over to protected ownership.

  TNC, with the cooperation of the Non-Game Branch of the Arizona Game & Fish Department, is responsible for initiating and maintaining Arizona's Natural Heritage Data Center. One of a network of numerous databases throughout the United States and in a few locations in Latin America, the Heritage Data Centers provide information on the range of natural biological diversity within a state, nation, or on the planet. The biological elements stored in the Data Center are ranked according to: the number of occurrences (rarity), vulnerability, distribution, numbers of individuals, number of protected occurrences, threats, and ecological fragility. Each of these variables is rated for its level of significance from a global, national, or state perspective.

- Whittell Trust - The Whittell Trust is a non-profit trust/organization whose main purpose is the protection of riparian and wildlife habitat within Aravaipa Canyon. The Trust was initially instrumental in protecting the San Pedro River.

- Trust for Public Lands - The Trust for Public Lands has been active in Arizona in the protection of open space for recreational purposes and has assisted the City of Tucson in protection and design of several open space areas. The Trust also assisted in the protection of the San Pedro River.

- The Arizona Riparian Council (ARC) - The ARC officially began in the fall of 1986 "...to provide for the exchange and transmittal of information on the status, protection, and management of riparian systems in Arizona." Primary objectives of the ARC are: 1) to stimulate and support studies in all phases of ecology, management and protection, and related intrinsic values of riparian areas; 2) to provide a clearinghouse of information among all agencies, organizations, and individuals engaged in work on riparian systems; 3) to function in an advisory capacity on questions involving management, conservation, and

protection of riparian systems; 4) to establish educational programs for public awareness of the importance of riparian systems; and 5) to publish symposium proceedings and transactions of meetings in order to present current information on problems relating to the preservation of riparian systems.

- Desert Fishes Council - The Desert Fishes Council was established in 1967 primarily to rescue the Desert Hole Pupfish in California. The Council's actions resulted in a Supreme Court decision and the creation of a new national monument for the sole purpose of protecting the population of Desert Hole Pupfish. The Council is composed of over 400 members whose prime interest is the preservation of desert aquatic ecosystems. Identification of research and management needs and publications of relevant materials are its primary objectives. The Council is also concerned with protecting the habitat of native desert fishes in the Southwestern United States.

- The Sierra Club of Arizona - The Sierra Club has been very active in lobbying for the protection of riparian areas in Arizona and was instrumental in the protection of the San Pedro River.

- The Audubon Society - The Maricopa County Chapter has been involved in protecting riparian habitat for the bald eagle in central Arizona and the Tucson Chapter has developed an excellent educational program on riparian areas. Other chapters within Arizona have also been involved in many local environmental issues.

- The Arizona Wildlife Federation - The Arizona Wildlife Federation is a nonprofit conservation education organization comprised of a consortium of sportsmen clubs and rod and gun clubs concerned with protecting the natural resources and, in particular, the wildlife resources of Arizona.

- The Wilderness Society - The Wilderness Society in Arizona has been instrumental in protecting unique natural environments in Arizona for wilderness designation, including many wetlands and riparian areas.

- Ducks Unlimited, Inc. - In 1984, Ducks Unlimited, Inc., (DU) initiated a program called the Matching Aid to Restore States Habitat (MARSH) whereby 7.5 percent of funds raised by DU in each state is available to the state for waterfowl habitat projects. This program is administered by the Arizona Game & Fish Department. Approximately $78,000 is available to Arizona under this program. DU's 1987 fund raising efforts resulted in an additional $40,000 available to Arizona January 1, 1988.

- Trout Unlimited - Trout Unlimited (TU) has been very active in Arizona in attempting to protect riparian areas from cattle grazing and degradation. TU has been working cooperatively with the Arizona Game & Fish Department and the U.S. Forest Service .in the rehabilitation of several cold water fisheries streams and in the protection of these habitats from cattle grazing.

A listing of the federal and state agencies, and the private organizations are found in Appendix B.

Conclusion

Prior to the Emergency Wetlands Resources Act of 1986, no federal law specifically addressed the protection of wetlands resources. Some protection has occurred indirectly under the various federal and state laws, but there has not been a coordinated effort for wetlands protection and the record for protection has been dismal. Local interest groups have set an example by rallying together for protection of areas of local interest. Through the Emergency Wetlands Resources Act, the U.S. Fish & Wildlife Service is mandated to coordinate all state planning efforts into a national plan for protection of wetlands resources. This Act and required planning has great potential for reducing the rate of loss of wetlands.