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Flood Control District of Maricopa County

Comprehensive Plan 2002

Flood Control Program Report

for
Maricopa County, Arizona

Mona Merkevicius - FCDX

From: Kelli Sertich - FCDX
Sent: Tuesday, July 02, 2002 9:35 AM
To: Division Managers - FCDX; FCD Branch Managers - FCDX; PPM - FCDX; PIO - FCDX; FCD Library
Subject: Comprehensive Plan 2002

The revised draft of the Comprehensive Plan, incorporating comments from the review period, is available on the Share Drive (*S:\Comp Plan 2002 - NEW)* and on the District's new web page under "About the District". I will not be printing out new copies of this draft at this time. I will print new copies for everyone after it is adopted by the Board of Directors. **Save your notebooks for your final copy.**

A complete copy (maps, appendices) will be in the Library in Engineering for your use.

Please review the revised draft and let me know if you have any additional comments (positive ones will also be accepted). The 11 x 17 maps are not included in the electronic versions so please save your existing maps. I am copying the appendices information which I will distribute by next Monday.

Please pass this information on to others in your groups that may need to use or which to review the Plan.

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Flood Control Program Report

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Adopted on September 18, 2002

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EXECUTIVE SUMMARY

Introduction

In response to increasing growth and flood hazards in rapidly urbanizing areas across the State, Arizona lawmakers saw a need for regional flood management and enacted legislation for the creation of flood control districts. The Flood Control District of Maricopa County (District) was organized under Title 5, Chapter 10, Article 4, §45-2351 to §45-2371, Arizona Revised Statutes (ARS) in August 1959. This statute was repealed in 1985 and replaced by Title 48, Chapter 21, Article 1, ARS. The District is governed by federal, state, county and local mandates.

ARS §48-3616 states that a "..... report shall be prepared at least every five years beginning in 1985 and shall indicate the past efforts of the district in eliminating or minimizing flood control problems and state the planned future work of the district to eliminate or minimize flood control problems." This report requirement is in addition to the Capital Improvement Program that must be prepared annually. The latest District Comprehensive Plan was prepared in 1997. The Comprehensive Plan 2002 – Flood Control Program Report (Plan) is an update to the 1997 plan. For the 2002 Plan, District staff has expanded on the report requirements of the Statutes to include aspects of the Growing Smarter Plus legislation (2000) and requirements of the Community Rating System – National Flood Insurance Program (NFIP). Adding these elements makes the Plan more compatible with other comprehensive planning documents for guiding future development. The Plan looks at all of the District's activities for providing flood control and floodplain management – from structural to non-structural solutions, education, and regulation.

The purpose of this Comprehensive Plan is to achieve the following objectives:

- ✗ Provide Public Information and Education
- ✗ Comply with State of Arizona Revised Statutes
- ✗ Comply with the National Flood Insurance Program - Community Rating System Requirements
- ✗ Identify Project and Program Activity Prioritization for Watersheds
- ✗ Determine Level of Future Fiscal Responsibilities for Flood Mitigation

The 2002 Comprehensive Plan is intended to be used as a general guide for future decision making in determining the progression of project activity that the District should undertake. This Plan strives to present adequate background information to the reader so general conclusions can be drawn to aide District staff in prioritizing areas for future studies and projects. In addition, this Plan serves as a tool to help anticipate future revenue needs and may be used for policy making during the budgeting process. The Comprehensive Plan is the first step in the overall planning process, providing the information on area problems and needs, and allowing the District to develop appropriate goals and objectives to move forward. The intent and goals of this Plan are implemented through tools such as the District Strategic Plan, Business and Financial Plans, Planning Studies, Capital Improvement Program, and adopted regulations and policy documents.

Plan Organization (CRS 510.a)

The Comprehensive Plan has five chapters that take the reader from the inception of the District through to future objectives.

- Chapter 1 introduces the reader to the planning process, the creation of the District, and the District's authority and purpose. This Chapter also lists the regulations that authorize or impact the District's mission. An overview of past comprehensive plans, the history of flooding in the County, and implementation of regional flood control structures set the stage for the next chapters.
- Chapter 2 details the physical and socioeconomic characteristics of the County, which are then used to make assumptions for future District activity. Physical characteristics include: size and topography, soils, climate, hydrology, geology, geomorphology, vegetation, riparian habitat, and landscape character. Socioeconomic factors include: population, land ownership and land use, potential developable land, and development in the floodplain and floodway.

*The **mission** of the District is to provide flood hazard programs benefiting Maricopa County that prevent loss of life or injury to residents and the elimination or reduction of damages to real and personal property from flooding while enjoying the natural and beneficial values served by floodplains.*

- Chapter 3 covers the District organization, funding, and programs. Organization includes the division and branch breakdown and current funding sources. Revenues and expenditures for the District's current fiscal year are noted, and a comparison is presented with other flood control districts that includes population, land area, budget, and primary revenue source is given. The District programs are broken down into the four core programs established in the District's 2002 Strategic Plan: Flood Hazard Remediation, Flood Hazard Regulation, Flood Hazard Education, and Flood Hazard Identification.
- Chapter 4 provides an update on all the District's structural projects constructed since the first report was prepared in 1963. The remainder of the Chapter discusses the status of the watersheds, within or contributing to the County, which have been grouped into four regions. This discussion includes background information on the regions, structural projects and studies completed, hazard and problem assessment, and future activities (structural and non-structural) planned to mitigate these hazards.
- Chapter 5 – This Chapter gives a quick overview of the purpose of the previous chapters and lists the areas the Plan must address in order for the County to receive credit through the National Flood Insurance Program (NFIP). A review of the hazards and problems is discussed in order to explain the goals included in the District Strategic Plan and County Comprehensive Plan – Eye to the Future that guide the District in providing programs and projects for floodplain management. As a follow-up to the goals, action plan items are identified to indicate the next steps for District activity. Additionally, new District initiatives are described. The Chapter concludes with an implementation process for the Plan.

Plan Summary

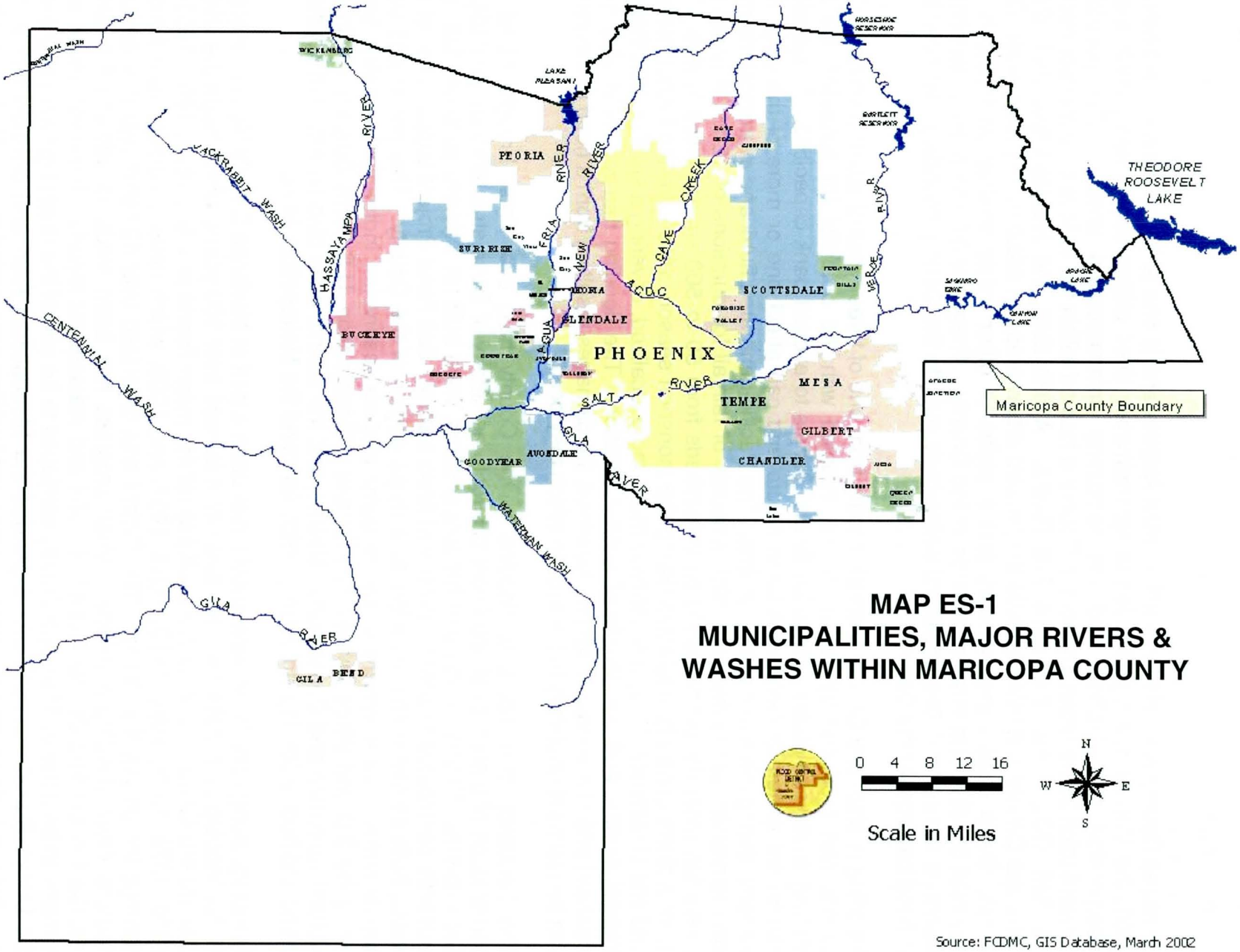
Introduction

Maricopa County is located in south central Arizona and is one of 15 counties in the State. In 2001, the County had a population of approximately three million people living within the 24 incorporated municipalities and the remaining unincorporated areas. The population concentration in the urban area of the County is located within the valleys of four major rivers – the Salt, Gila, Verde, and Agua Fria Rivers. A fifth river, the Hassayampa, that affects Maricopa County is located outside the present urban area. In addition, the New River, Cave Creek, Skunk Creek, Indian Bend, and a series of other major washes contribute to the potential flooding and erosion hazards in the County. There are 37 watersheds identified in Maricopa County with two additional watersheds outside the County boundary that contribute to flood hazards for the District. (Map ES-1)

Flooding in Maricopa County normally occurs from one of three types of storm conditions. The excess rain produced by winter storms, coupled with the potential for saturated soil and melting snow, can cause stream levels and canals to exceed bank capacities. These winter storms are generally more regional in nature and can affect one or more of the large river systems during the same period of time. The Pacific-generated hurricane or tropical storm, or their remnants, can deliver very high amounts of rainfall for durations of 12 to 36 hours and cause the most damaging floods on watersheds from 50 to 500 square miles in size. The thunderstorm generally originates during the monsoon season, which are the higher humidity portions of summer. They are normally much more localized, covering a smaller area than the tropical storms, and are usually of shorter duration. The flooding that results is also more localized and of a shorter duration. However, the damages resulting from a flood of this nature can be just as devastating to the area in which they occur.

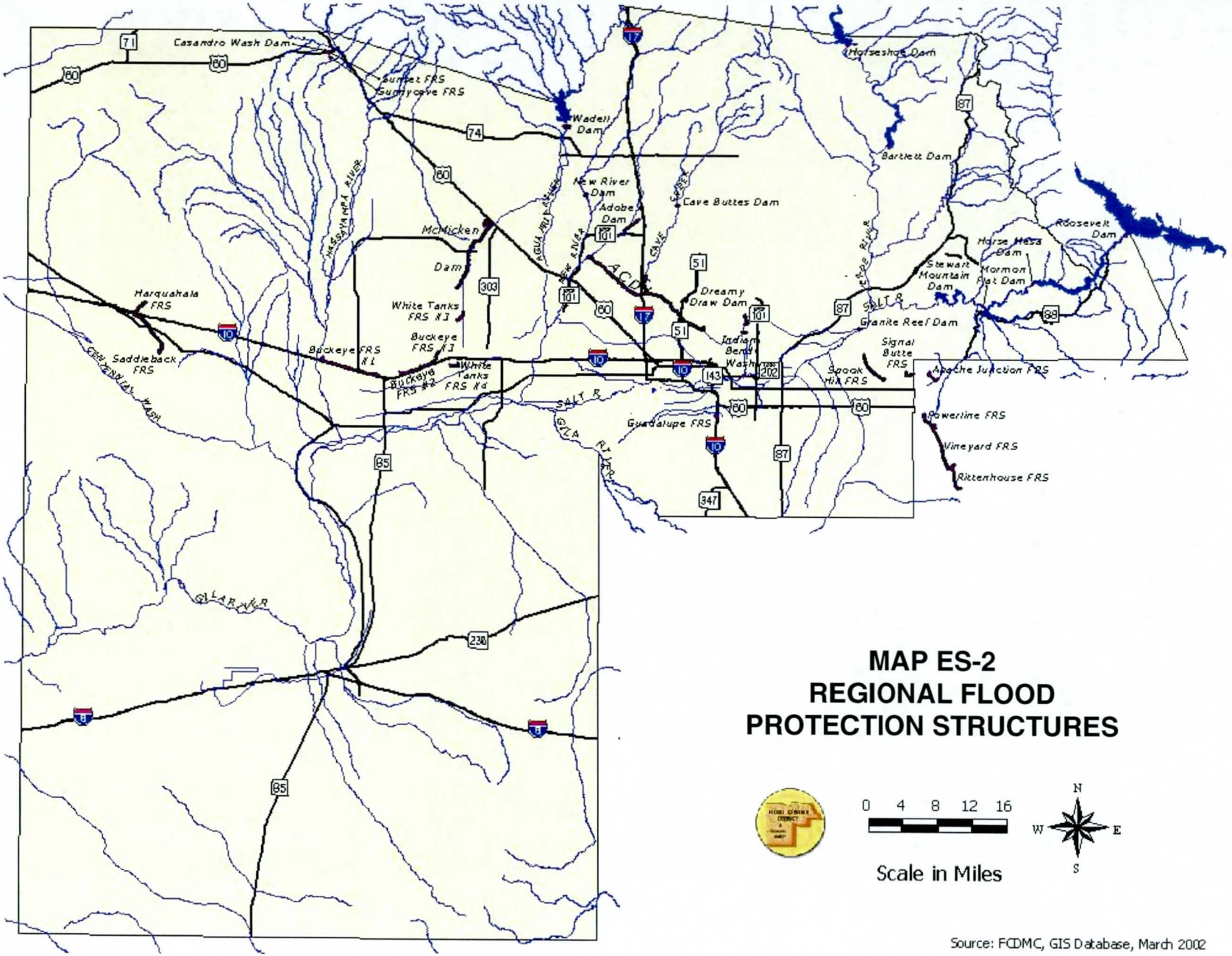
The frequency and extent of flooding in the County has, over time, brought about the construction of a number of flood control structures. Many of these structures are primarily for flood control. Others, such as water supply dams, were built for different purposes but have indirectly contributed to some measure of flood control. Salt River Project supplies power and water, both domestic and irrigation, to a major portion of the County. This power and water supply come from a system of seven dams and six reservoirs, indirectly controlling floods along the Salt and Verde Rivers. The Bureau of Reclamation, U.S. Army Corps of Engineers, Natural Resource and Conservation District, and the District have also constructed additional dams and flood retarding structures, which surround the Metropolitan Area. (Map ES-2)

Flooding, along with its adverse effects, has been a part of Maricopa County history. Records of the flooding and problems have been kept for well over 100 years, which helps the District plan for the future. Records are available for the major floods in 1891, 1921, 1963, 1965-66, 1970, 1972, 1978, 1980, 1983, 1993, 1997, and 2000, which caused considerable flooding damage throughout the County. The District was organized over 40 years ago to specifically address these flooding problems. Much progress has been made to address the issues identified in the first District Report of 1963 and subsequent reports. However, much work remains to be done as Maricopa County continues to be one of the fastest growing counties in the United States. Growth has expanded the Metropolitan Area and development is now occurring outside of the flood control dams and facilities constructed in the 1950's through the 1970's.



MAP ES-1
MUNICIPALITIES, MAJOR RIVERS & WASHES WITHIN MARICOPA COUNTY

Source: FCDMC, GIS Database, March 2002



MAP ES-2
REGIONAL FLOOD PROTECTION STRUCTURES

Source: FCDMC, GIS Database, March 2002

Characteristics

To adequately understand the problems and opportunities of a region, one must understand the physical conditions, and the environmental and socio-economic forces of that area. These characteristics for Maricopa County are separated into two broad categories entitled physical and socioeconomic characteristics. Physical characteristics include topography, soils, climate, hydrology, geomorphology, vegetation, and riparian habitat. The physical characteristics describe pre-development conditions of the region. Human interaction with these conditions can contribute to flooding problems. Socioeconomic factors are those that identify the human variables that influence the physical space. This category includes population figures, land ownership, and development trends.

Physical

Maricopa County is located in south central Arizona, within the Sonoran Desert. The County is approximately 103 miles long (north to south) and 130 miles wide (east to west) at its most extreme locations. It has a land area of 9,226 square miles, of which 1,441 square miles (15.6 percent) are incorporated and 7,785 square miles (84.4 percent) are unincorporated.

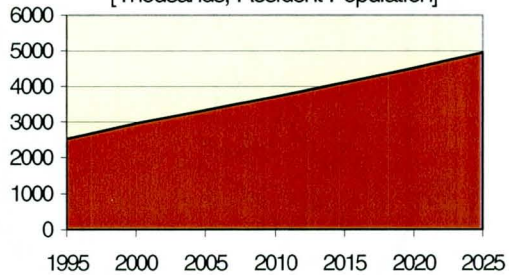
The five major river systems flowing through Maricopa County drain an area of approximately 57,000 square miles, including areas of New Mexico and Mexico. This drainage area is approximately six times as large as Maricopa County. Storms as far away as Mexico can influence the probability of floodwaters causing damage somewhere within the County. Many of the most damaging floods have occurred when winter storms have extended well outside of the County boundary.

The majority of the watercourses in the County are ephemeral (flow in direct response to rainfall); yet, due to the presence of intermittent seasonal run-off, or groundwater, riparian vegetation exists along many of the rivers. Riparian vegetation varies depending upon both groundwater and surface water levels. Perennial streams (flow year round), especially along the Salt and Gila Rivers, often exhibit the cottonwood and willow association that was once typical along these rivers. Mesquite bosques are also found in these areas. Small pockets of cottonwood-willow association also occur in other areas that have a perennial or intermittent water source.

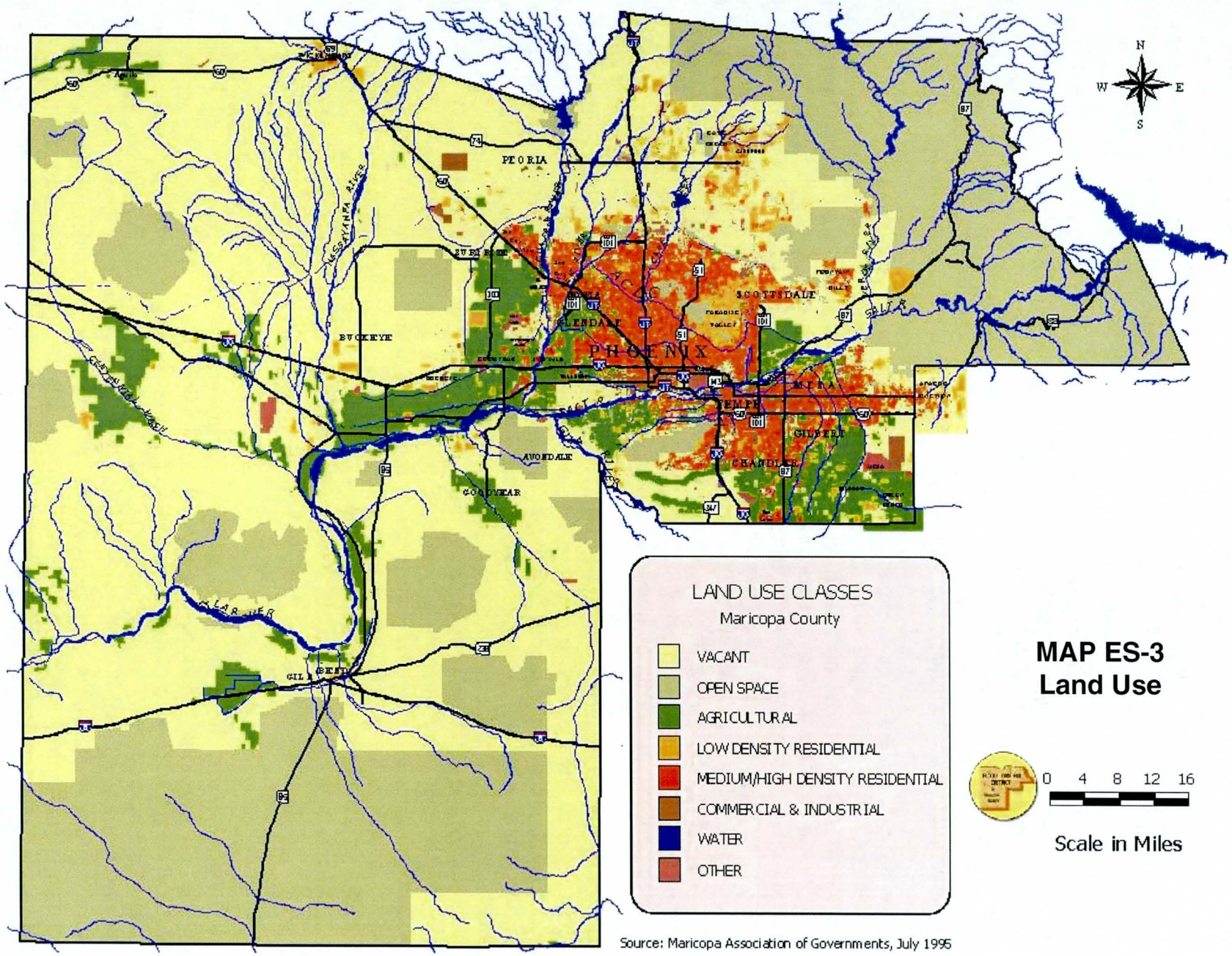
Socioeconomic

Maricopa County population is projected to increase from 2,528,700 people in 1995 to 4,948,400 people in 2025, an increase of over 2.4 million people. This growth over the 30-year period equates to nearly a 96 percent increase or about a 3.2 percent growth rate on an annual basis. The significance of this growth rate is that Maricopa County will have a net average increase in population of 80,656 people each year over the 30-year period. There will be implications for the District if this rate of growth continues to take place in the County. The population data assists the District in identifying where future flooding, erosion, and sedimentation problems may impact people.

Figure ES-1 Maricopa County Growth 1995 - 2025
[Thousands, Resident Population]



Source: MAG for the years 1995-2000, DES for 2025



MAP ES-3
Land Use

Source: Maricopa Association of Governments, July 1995

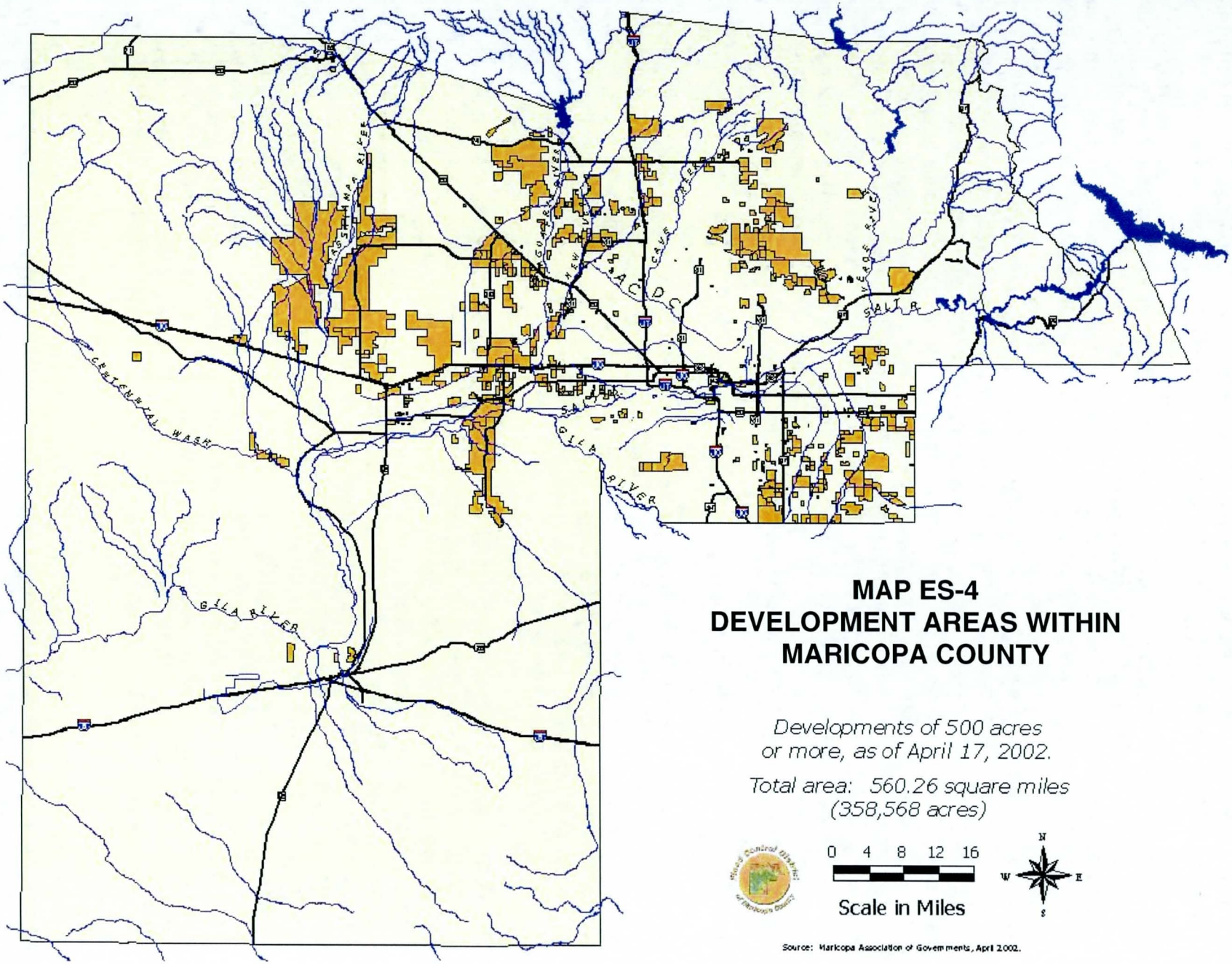
Future development is predicted to be most heavily concentrated in the west and north sections of the Metropolitan Area. The southeast and east sections of the County have approved development master plans and are actively developing to the boundaries of the Gila River, Salt River Pima-Maricopa and Fort McDowell Mohave-Apache Native American Communities.

Most of the remaining potentially developable land lies to the north and west. The recently completed western section of Loop 101 creates a transportation link within the Metropolitan Area between Interstate 17 on the north and Interstate 10 on the west. Future plans for the continuation of State Route Loop 303 located to the west and north of Loop 101 will also increase the likelihood of development in these areas. These links will be a stimulus for development in the west and northwest sections of the Metropolitan Area. (Map ES-3)

There is 1,625 square miles of developable land area within a 20-mile radius of the Phoenix city limits. This 1,625 square miles is reduced to exclude previously developed land, geologic constraints, federally held lands, and preserve areas leaving about 1,240 square miles of land in the urbanized area available for development. The active, planned, and proposed master planned development projects in Maricopa County as of July 1, 2001 total about 356,000 acres, more than enough land to take care of the projected population needs through the year 2025. Of this total, 130,000 acres are actively being developed, 85,740 acres are planned, and 139,418 acres are proposed. Over half of the 356,000 acres is in the western and northern sections where most of the future development is projected to take place. Development will also occur on non-master planned areas or as infill. (Map ES-4)

There are approximately 8,700 linear miles, per the 100,000 scale USGS Hydrography, of stream courses with drainage areas of greater than one square mile in Maricopa County. About 1,780 miles or only about 21 percent of the total have detailed floodplain and floodway delineations completed. Approximately 65 percent of the County's present population and about 49 percent of the projected population for 2025 will live within the watersheds where just over half of the floodplains and floodways are already delineated. Population projections indicate about 51 percent of the projected growth will take place in the watersheds where only 17 percent of watercourses have been delineated. If a projected rate of 1,000 linear miles of stream course were studied per year, most watersheds will have delineated floodplains and floodways for all of the identified watercourses within seven years. However, the District has been conducting an average of 350 linear miles per year to date. Prioritization of watercourse delineations will be needed to stay ahead of development to avoid development in currently undesignated hazard areas.

Delineation studies have not always been completed ahead of development, which has resulted in buildings being constructed in floodplains and/or floodways. Prior to 1978, floodplain mapping was not available for most areas of the County. Constructing buildings within a floodway is now prohibited under the current Floodplain Regulations for Maricopa County (adopted August 4, 1986, and subsequently amended). The 430 buildings identified within the floodways were constructed prior to completion of studies that document the floodway. Therefore, future construction within currently designated floodways is not a serious concern. Until floodplains are defined for all of the watercourses in Maricopa County,



MAP ES-4
DEVELOPMENT AREAS WITHIN MARICOPA COUNTY

Developments of 500 acres or more, as of April 17, 2002.

Total area: 560.26 square miles (358,568 acres)

0 4 8 12 16

Scale in Miles

N W E S

Source: Maricopa Association of Governments, April 2002.

additional buildings could be constructed in undelineated floodprone areas and in areas that could eventually be determined as a floodway once delineations are completed.

The District must anticipate where future development will be in order to protect County residents from flood hazards, so assumptions are made based on data presented in this Comprehensive Plan. This data is used to determine development trends and amount of land needed for future growth, which will then be used for analysis of watersheds for flooding risks.

Although the individual watersheds within the County will develop with different densities and land use patterns based on geographical and regulatory constraints, averages determined from background data serve as a guide when analyzing each watershed for flood hazard risk and prioritization for future study. The combination of physical characteristics, plus a large and continuing growth in population, has placed Maricopa County residents in areas susceptible to flooding and/or erosion and sediment damages. The physical characteristics demonstrate the complexity of the vast area under the District's jurisdiction. In conjunction with differing physical characteristics across the County, population will be expanding in both existing urbanized areas and more remote unincorporated areas. The District faces challenges in providing the solutions for floodplain management for these diverse needs.

District Organization and Programs

Organization

The Flood Control District of Maricopa County is a political taxing subdivision of the State of Arizona. By statute, the District is managed by the Flood Control District Chief Engineer and General Manager. The District is organized into an executive branch and seven divisions. The executive branch includes the Chief Engineer and General Manager, the executive secretary, and the public information section. The seven divisions are sub-divided into 33 branches along functional lines.

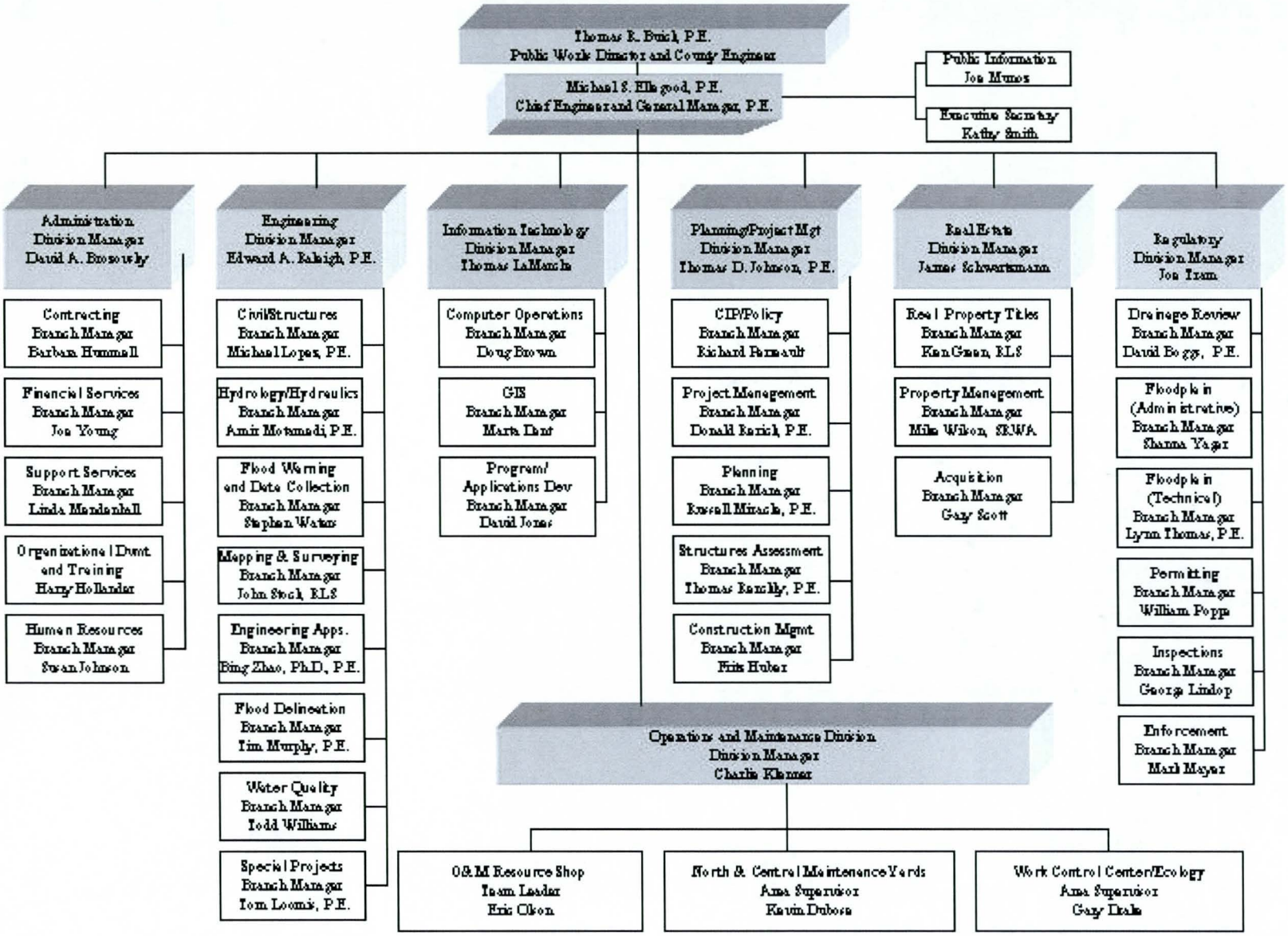
The District spent the first years establishing programs and staffing to meet the needs for designing and constructing flood control structures that were identified in the 1963 Report. By the late 1990's approximately 80 projects had been completed, including 21 structures the District took over which were completed in cooperation with other agencies. Having completed a majority of the structural projects identified in the 1963 Report, the focus today is to identify more non-structural solutions that would eliminate or reduce flooding problems in Maricopa County. The District began, during the late 1990's, to rely more on programs, such as floodplain management and drainage ordinances, to keep people and structures out of areas that were prone to flooding rather than providing solutions once a problem developed.

*The **vision** of the District is that the people of Maricopa County and future generations will have the maximum amount of protection from the effects of flooding through fiscally responsible flood control actions and multiple-use facilities that complement or enhance the beauty of our desert environment.*

Finance

The Board of Directors approved a secondary property tax to fund the District capital improvement and operational functions. The majority of the District's revenue is derived from

Figure ES-2 Flood Control District Org Chart



the secondary property tax for flood control placed on each parcel in Maricopa County. The County Board of Supervisors sets the rate of this tax and the assessed real property valuation to which the tax is applied on an annual basis. This rate has been steadily declining and was set at 23.2 cents per $100 valuation for Fiscal Year 2001-2002. Additional sources of revenue for the District include the following: Licenses and permits; Intergovernmental participation; Payments in lieu of taxes; Interest on fund balance; Building rentals; and Grants.

The District's Total Budget for Fiscal Year 2002 is approximately $80 million. About $58 million of this is dedicated to the Capital Improvement Program, and $22 million to Operations, with a $12 million carry over. The following figures break down the revenues and expenditures for the District by percent.

Figure ES-3
FY 2002 District Revenues

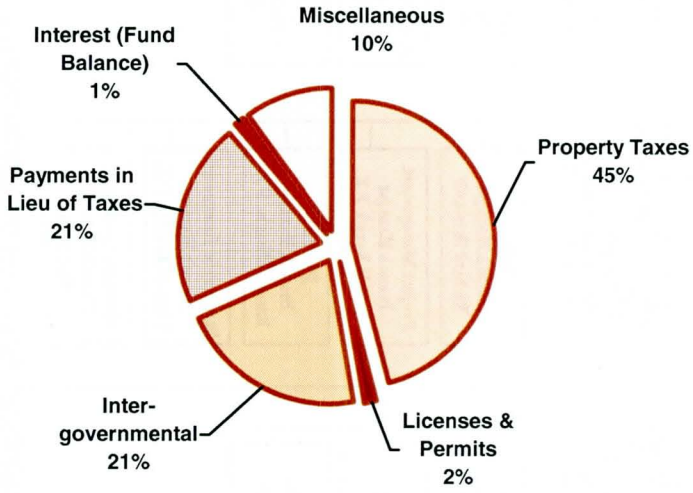


Figure ES-4
FY 2002 Budgeted Expenses

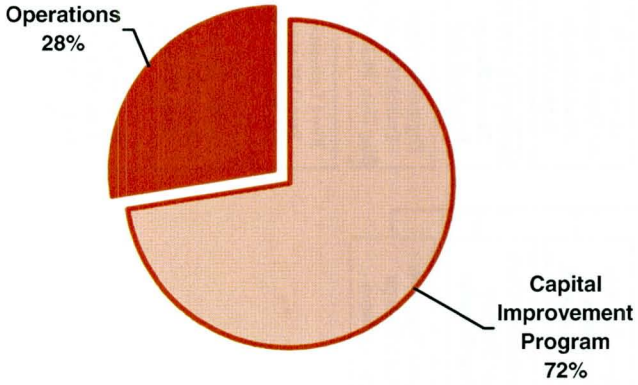
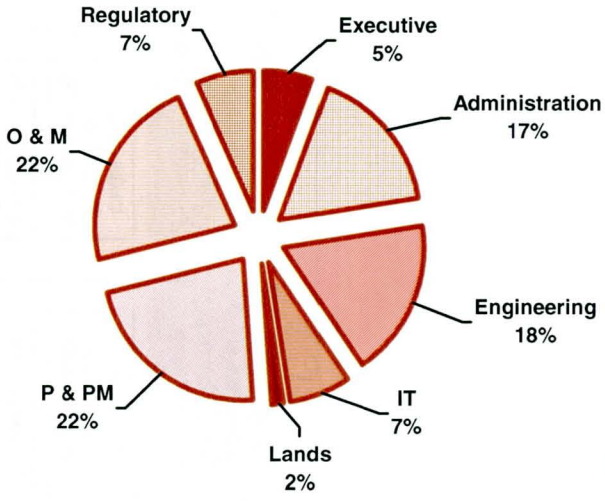


Figure ES-5
Operating Expenditures
FY 2002 – Full District



Programs

The core functions of the District are divided into the following four main programs:

- **Flood Hazard Remediation** provides flood protection using structural and non-structural mitigation of flood hazards so that the public can live with minimal risk of loss of life or property damage due to flooding. This program includes: design, construction, operation, maintenance, land acquisition, management of flood control infrastructure, and environmental activities. It is managed and staffed by the Planning and Project Management (PPM) and the Operations and Maintenance (O & M) Divisions, with support from the Lands, Engineering, and Information Technology (IT) Divisions.

- **Flood Hazard Regulation** provides guidance for floodplain and drainage compliance; direction; and enforcement for the public so that they can use their property safely and in compliance with applicable state and federal laws. This program includes: floodplain, drainage, stormwater quality, and sand and gravel mining administration. It is managed and staffed by the Regulatory Division with technical support from the Engineering Division. The Water Quality Branch of the Engineering Division manages and monitors storm water quality.

- **Flood Hazard Education** provides information collection and dissemination of flood hazard information, technical data, and flood safety guidance to public agencies and the public so that they are aware of and can respond to flood hazards. This program includes: public outreach, project public involvement, flood hazard preparedness, and warning and hydrometeorology information. It is managed and staffed by the Public Information Office with input from the Planning and Project Management, Regulatory, and Engineering Divisions. Flood Hazard preparedness and warning are managed by the Flood Warning Data Collection Branch of the Engineering Division.

- **Flood Hazard Identification** provides flood and erosion hazard information and documentation to the public so that they can be knowledgeable about the dangers of erosion and flooding, the areas in which they occur, and the future remediation measures. This program includes: development of drainage master plans, watercourse master plans, floodplain delineations, landscape aesthetics/recreation multi-use, integration of projects into the natural environment, and strategic and comprehensive plans. It is managed and staffed by the Floodplain Delineation Branch of the Engineering Division and the Planning Branch of the Planning and Project Management Division.

Flood Control Program Report

The District was divided into watersheds for study purposes. There are 37 watersheds now identified within the boundaries of Maricopa County and two outside the County boundary, but within the District's jurisdiction, that are analyzed in this Plan (39 total). A number of the 37 watersheds are partially outside the County boundary. This Plan concentrates on the land area that is within Maricopa County. These watershed boundaries were generally determined by major drainage areas and are usually named for watercourses or other significant features within the watershed boundary. In this Report the watersheds are divided into four regions for ease of mapping and discussion. The regions are labeled as follows:

- Southeast Region
- Northeast Region
- Northwest Region
- Southwest Region

A broad summary of each Region includes specific lists by each watershed for the District's completed and planned projects. The physical conditions of Maricopa County range from rugged mountains to flat valleys with a variety of soils and vegetation types. Development trends and patterns are also varied across the County. These vast differences make it necessary to study watersheds individually in order to determine what the appropriate solutions are for flood management in those areas. In addition, these watersheds are at varying stages of urbanization, which requires different levels of activity on the District's part.

The District cannot fund programs, studies, and projects for the entire County all at once, nor is there a need to do so. The five-year Area Drainage Master Plan and Capital Improvement Programs allow the District to plan ahead and budget these projects over a reasonable time frame based on highest need. Prioritization of District activities for flooding problem mitigation starts at a very broad level through the Planning and Project Management (PPM) Division. A process has been established, through a committee of District staff led by the PPM Division, to evaluate all of the watersheds based on critical elements that assess area risk and are tied to the District's core programs and activities. This ranking of watersheds for risk assessment is a preliminary look at where the greater problems appear to exist and therefore where Area Drainage Master Studies/Plans or Water Course Master Plans need to be conducted or updated.

There are several levels of review needed to fully address the issues across the County and identify appropriate projects. Preliminary prioritization looks at area, expected population growth, linear miles of delineations, County road closure statistics, remaining land to be developed, structures in the floodplain and erosion hazard zones, and floodplain and drainage permits issued. A more detailed risk assessment includes soil types, slopes, type of future development, projects underway, solutions already planned for the next five years, and the District's flood management responsibilities within each watershed.

With this preliminary risk assessment phase, there are two levels to consider when deciding in what order areas should be evaluated: 1) addressing existing urban areas and people currently at risk where solutions have not yet been completed and 2) getting ahead of development to prevent current and costly problems from occurring in urbanizing areas.

At the same time these assessments and prioritizations are in process, each watershed needs to be looked at in terms of individual District programs. The PPM Division, in coordination with the other Divisions, identifies future problems. But, at the same time, each Division is also moving forward with activities under their programs. Examples of this would be as follows:

- ✗ A study may not be scheduled for several years for a watershed, however development is occurring. The Regulatory Branch would continue to provide floodplain management through its activities. The District staff can anticipate issuing approximately 20,000 drainage clearance permits Countywide each year.

- ✗ Independent of a study being underway, the Delineations Branch will move forward on approximate or detailed floodplain delineations for watercourses where there are identified risks and floodplain management is needed. The Floodplain Delineation Branch has 1,375 miles of new delineations planned for the next 4 years (02-05).
- ✗ Flood Hazard Education is an ongoing process in conjunction with all other District programs and activities.
- ✗ Placement of flood warning and data collection devises continues to grow and are prioritized on risk assessment. This program contributes to the District's floodplain management efforts either as a recommended solution to a study, to prevent possible lost lives, or to prevent flood damages prior to future solutions being developed.
- ✗ Evaluation of the District's 22 dams and flood retarding structures by the Structures Assessment Branch is done on a quarterly basis. Structures are spread throughout the County.

The early years of District operations concentrated on capital improvement projects to protect the existing urbanized area from flooding hazards. During the last five years, the District has diversified its approaches. The summary by region in this Plan lists the capital improvement projects; non-structural projects; studies; structural assessment and retrofit projects; and landscape aesthetics and recreational multi-use projects for each watershed. Table ES-1 lists the number of past and proposed structural projects completed or planned for each watershed.

Table ES-1 Summary of Capital Improvement Projects by Watershed

Region	Watershed	Projects
Southeast	Lower ACDC	8 past structural projects constructed, 9 planned in CIP FY01/02 - 05/06
	Lower East Maricopa Floodway ***	I past structural project constructed, 10 planned in CIP FY01/02 - 05/06
	South Mountain	2 past structural projects constructed, 6 planned in CIP FY01/02 - 05/06
	Upper East Maricopa Floodway **	12 past structural projects constructed, 9 planned in CIP FY01/02 - 05/06
	Upper Queen Creek *	Watershed outside of County boundary
Northeast	Cave Creek ***	2 past structural projects constructed, 1 planned in CIP FY01/02 - 05/06
	Evergreen	
	Lower Indian Bend	0 past structural projects constructed, 2 planned in CIP FY01/02 - 05/06
	Lower New River	2 past structural projects constructed, 3 planned in CIP FY01/02 - 05/06
	Lower Verde	7 past structural projects constructed, 2 planned in CIP FY01/02 - 05/06
	Middle Indian Bend	2 past structural projects constructed, 2 planned in CIP FY01/02 - 05/06
	Skunk Creek	2 past structural projects constructed
	Upper ACDC	6 past structural projects constructed, 1 planned in CIP FY01/02 - 05/06
	Upper Agua Fria **	
	Upper Indian Bend	
	Upper New River ***	
	Upper Verde **	
	Upper Salt River **	

Table ES-1 Summary of Capital Improvement Projects by Watershed (con't)		
Northwest	Arlington	
	Buckeye Hills	
	Buckeye Valley	1 past structural project constructed
	Lower Agua Fria	
	Lower Centennial ***	3 past structural projects constructed
	Lower Hassayampa ***	2 past structural projects constructed
	Trilby (Wittmann) ***	1 past structural projects constructed
	Upper Centennial ***	0 past structural projects constructed, 2 planned in CIP FY01/02 - 05/06
	White Tank A	5 past structural projects constructed
	White Tank B	3 past structural projects constructed, 1 planned in CIP FY01/02 - 05/06
	Upper Hassayampa *	Watershed outside of County boundary
Southwest	Ajo ***	
	Gila Bend	
	Gillespie	
	Lower Gila ***	
	Painted Rock	
	Santa Rosa ***	
	Sentinel ***	
	Theba ***	
	Vekol ***	
	Waterman ***	
* Watershed completely outside of Maricopa County boundary. (2) ** 90% of Watershed outside of Maricopa County boundary. (3) *** A portion of the Watershed outside of Maricopa County boundary. (12)		

The **Southeast Region** is more heavily populated than the other three regions. Population projections show the largest 30-year increase in total numbers of people among the four regions. The population is expected to increase an additional 1.2 million over the 30-year period. There are 279 square miles of area still available for development to hold this population. However, 229 linear miles of delineations out of 440 still remain to be done so that these new residents will not develop in flood and erosion hazard areas. There are 59 buildings that have been constructed in delineated floodways and 10,852 buildings that have been constructed in delineated floodplains. The majority of these (10,515 buildings) are also in a moderate or severe erosion hazard zone. In addition, due to flooding there were 86 County road closures from 1996-2000, which were roughly equally split between South Mountain, Lower ACDC, and the Lower East Maricopa Floodway. No County road closures were reported in the Upper East Maricopa Floodway Watershed. This Region also contains the County's only area where buildings with repetitive flood insurance damage claims paid by the U.S. government (repetitive loss) are located. There are currently 34 residences in the repetitive loss area.

The **Northeast Region** is presently not as populated as the Southeast Region. However, the rate of growth for the Northeast Region is 30 percent greater per year than the Southeast Region. The population is expected to increase an additional 767,400 over the 30-year period. There are 355 square miles of area still available for development to hold this population. Areas that could be developed are not as extensive in this Region as private land is less than

the County average. Approximately 2,316 linear miles of delineations out of 2,803 still remain to be done so that these new residents will not develop in flood and erosion hazard areas. The low population and high percentage of government held land have potentially caused studies and delineation work to be directed to more urbanized areas. This has resulted in 198 buildings that have been constructed in delineated floodways and 9,228 buildings that have been constructed in delineated floodplains. Approximately 3,400 of these buildings are also in a moderate or severe erosion hazard zone. In addition, due to flooding there were 157 County road closures from 1996-2000, which were concentrated in the Cave Creek, Lower New River, Lower Verde, Skunk Creek, and Upper New River Watersheds.

The **Northwest Region** is presently not nearly as populated as either of the eastern regions in the County. However, the rate of growth for the Northwest Region is projected to be much greater than for either of the more populated eastern regions over the next 30 years. This percentage increase is primarily due to the smaller population base in this region in 1995. There is a potential population increase of 416,352 over the 30-year period. There are 1,458.26 square miles of area still available for development to hold this population. Areas that are developing rapidly are those watersheds that border on the western edge of the Phoenix Metropolitan Area. Approximately 2,168 linear miles of delineations out of 3,023 still remain to be done so that these new residents will not develop in flood and erosion hazard areas. There are 154 buildings that have been constructed in delineated floodways and 795 buildings that have been constructed in delineated floodplains. The majority (524 buildings) are also in a moderate or severe erosion hazard zone. In addition, due to flooding there were 566 County road closures from 1996-2000 which were concentrated in the White Tank A, Lower Centennial, Lower Hassayampa, and the White Tank B Watersheds. Major flooding occurred along the Centennial Wash in the winter of 2000 causing severe flood damage.

The **Southwest Region** has considerable acres of land under federal control (Barry Goldwater Gunnery Range, BLM, Conservation Areas) with few people living in the remaining area in comparison to the other regions. However, there are 538.84 square miles of area still available for development to hold the projected population. The population is expected to increase by 56,300 over the 30-year period. The percentage rate of growth over the next 30 years will far exceed that for the County as a whole. But, by 2025, the total population in this Region will still be just one-ninth of the next least populated region. Areas where development is projected include Goodyear and Avondale, which are located in the far northeastern corner of the Region. However, 3,349.3 linear miles of delineations out of 3,575.2 still remain to be done so that these new residents can develop outside of flood and erosion hazard areas. There are currently 12 buildings that have been constructed in delineated floodways and 148 buildings that have been constructed in delineated floodplains. Only 18 of these structures are also in a moderate or severe erosion hazard zone. In addition, there were 78 County road closures from 1996-2000 which were mostly in the Waterman Wash Watershed.

Considerable measures have been taken to minimize or eliminate flood control hazards throughout the County. But with the rapid and continuing growth Maricopa County has experienced, in conjunction with funding limitations, there is considerable work left to be done. The best approach is to first assess risk through a prioritization process for each watershed and then establish a schedule to complete needed projects over time. This has been done for the most part through the Capital Improvement Program (CIP) process.

Approximately 40 additional projects have been constructed through the CIP program since the 1963 Report. Many of the urban area problems have already been addressed. However, many areas of concern remain to be addressed in the heavily developed portions of the Metropolitan Area. Also, now the District, through the ADMP program, has the opportunity to get ahead of development in identifying flooding hazards, and to prevent similar situations from happening in the future. The upcoming ADMP studies will look at implementation of both structural and non-structural solutions, as well as low-impact measures. The recently completed (February 2002) North Peoria Area Drainage Master Plan for the Lower Agua Fria Watershed demonstrates the use of non-structural principles using a "Rules of Development" approach, and was the first ADMS/ADMP to contain this element. Future flood management for the District will employ a combination of these principles as well as structural solutions.

Hazard and Problem Identification

Regional Overview

Problems that need to be addressed per the District's programs in the **Southeast Region** Watersheds (that are inside the County's boundary) include the following:

- ADMP's need to be completed for those areas not yet studied and those studies completed need to be reviewed.
- A number of stormwater drainage and channel projects need to be completed for this Region. Several of them have been identified in recent ADMP's.
- Some of the dams and flood retarding structures were built approximately 30 years ago. Remedies identified by the Structures Assessment Branch will need to be implemented.
- The 229 linear miles of watercourses need to be prioritized for delineation.
- A buy-out program needs to be considered for the properties with buildings that have been constructed in delineated floodways, with priority given to residential homes in the highest hazard category.
- A more detailed look at the approximate 10,800 buildings that have been constructed in delineated floodplains and severe erosion hazard areas needs to be done.

Problems that need to be addressed per the District's programs in the **Northeast Region** Watersheds (that are inside the County's boundary) include the following:

- ADMP's need to be completed for those areas not yet studied and those studies completed need to be reviewed.
- About 83 percent of the watercourses are not yet delineated. Evaluation of the remaining 2,316 linear miles of watercourses needs to be done to determine additional delineations.
- The 12 dams and flood retarding structures were built from 1973 to 1988. Some are reaching the end of their design lives. Remedies identified by the Structures Assessment Branch will need to be implemented.

- A buy-out program needs to be considered for the 198 property owners with buildings that were constructed in delineated floodways, with priority given to residential homes in the highest hazard category. A number of them have been identified in recent ADMP's.
- A more detailed look at the approximate 9,200 buildings at risk in delineated floodplains and severe erosion hazard areas needs to be done.

Problems that need to be addressed per the District's programs in the **Northwest Region** Watersheds (that are inside the County's boundary) include the following:

- ADMP's need to be completed for those areas not yet studied and those studies completed need to be reviewed.
- A number of storm water drainage and channel projects need to be completed for this Region. A number of them have been identified in recent ADMP's.
- About 72 percent of the watercourses are not yet delineated. Evaluation of the remaining 2,168 linear miles of watercourses needs to be done to determine additional delineations to be done and priority.
- A buy-out program needs to be considered for the 154 property owners with buildings in delineated floodways, with priority given to residential homes in the highest hazard category.
- A more detailed look at the approximately 795 buildings at risk in delineated floodplains and severe erosion hazard areas needs to be done.
- Some of the dams and flood retarding structures were built approximately 30 years ago. McMicken Dam is being evaluation for fissures. Remedies identified by the Structures Assessment Branch will need to be implemented.
- A study of the various road crossings that have been closed due to flooding should be done.

Problems that need to be addressed per the District's programs in the **Southwest Region** Watersheds (that are inside the County's boundary) include the following:

- ADMP's need to be completed for those areas not yet studied and those studies completed need to be reviewed.
- Evaluation of the remaining 2,118 linear miles of watercourses needs to be done to determine prioritization for additional delineation.
- A buy-out program needs to be considered for the property owners with buildings in delineated floodways, with priority given to residential homes in the highest hazard category.
- A more detailed look at the approximately 148 buildings at risk in delineated floodplains needs to be done.

Each of the above issues needs to now be evaluated and prioritized through the various different District programs. The District is responsible for the Floodplain Management for the

majority of this area and, as the lead agency, has done several studies to identify the hazards and solutions for these watersheds. The FY 01/02 to 05/06 Capital Improvement Program describes the ongoing and/or upcoming flood control projects to mitigate flooding hazards for the watersheds.

Plan Conclusions

County Overview

Maricopa County is too vast in size to determine all of the flood hazard problems in a short time frame and the focus has been in the rapidly developing watersheds. Approximately 1,400 square miles of the County are within municipal boundaries, leaving the District responsible for regulating development within 7,785 of the 9,226 square miles within the County boundary.

About 30 percent of the area within the County is still available for development. Approximately 64 percent of the land within the County may never urbanize, such as the National Forest, Gunnery Range, and steep slopes, but still contributes to the flood hazards and must be addressed. Population is expected to increase by about 2.4 million people by 2025, expanding further out in the County, beyond the flood control infrastructure, which provides protection within the Metropolitan Area. It is likely that future residents will locate in these outlying areas. Although attention will need to be directed to the new growth areas, there are still urbanized areas that have not been completely protected or delineated. Many proposed projects and anticipated future projects, to be identified through the planning process, are many years away from being completed.

Because of Maricopa County's vast size, assessment of the remaining hazards and problems will be done by watershed through the ADMS/ADMP program. An ADMP may cover one or more watersheds. Eight of these studies were begun in the last two years, with five of these studies recently being completed. Anticipated projects, resulting from these studies, are identified in the 2002 Comprehensive Plan and are detailed in the District's current Five Year CIP. District studies include: environmental hazards identification, environmental characteristics evaluation, multi-use opportunities, public involvement, and the development and evaluation of alternatives. Studies within watersheds where flooding hazards will not be adequately addressed by current drainage regulations, will have "Rules of Development" developed for the area. The Adobe Dam and Rio Verde ADMP's are underway, with these studies being modeled after the North Peoria ADMP.

In the 42 years that the District has been in existence considerable progress has been made to study and resolve the flooding problems in Maricopa County. However, there is still much to be done. A general list of issues is as follows:

- 11 of the 37 watersheds within the District's boundary have not yet been studied,
- Of the remaining 26, approximately 12 of these studies are over ten years old,
- 6,950 of 8,730 linear miles of 100,000 scale USGS Hydrography remain to be done,
- An estimated 423 buildings have been constructed in delineated floodways and 22,000 buildings constructed in delineated floodplains with 14,511 of these in moderate or severe erosion hazard zones (incorporated and unincorporated). Of the 22,000

buildings countywide, about 60 percent are within municipal boundaries beyond District regulatory authority,

- The dams and flood retarding structures under the District's jurisdiction were built approximately 30 years ago. Remedies identified by the Structures Assessment Branch will need to be implemented,
- Development pressure on the order of 2,500 – 3,600 new residential starts are expected per month, and are spreading into areas not yet delineated or studied and areas outside of the existing flood control infrastructure,
- Not all flood problems have been addressed in the existing urbanized areas.

Newer Initiatives

The District is also moving forward on several newer initiatives that are shifting from the study or strategy direction stage into implementation. These activities are not addressed in detail with current programs, as they are not fully implemented yet. Newer Initiatives are the following:

- Multi-Use and Recreation/Structures Retrofit – The implementation of the District's Landscaping and Aesthetic Treatment Policy (adopted May 1999) has been a major program thrust for the past several years. There will be continued emphasis on landscape aesthetics and multi-use opportunities through the preparation of the Flood Control Structures Analysis to preserve natural desert open space, enhance local community image, and provide opportunities for desert greenbelts and new parklands in conjunction with flood control measures.
- Erosion Hazard Ordinance – Under ARS § 48-3605, the District is including delineation of erosion hazard areas in recently completed ADMP's and will continue to analyze these areas in future studies. In conjunction with identifying and mapping the erosion hazard areas, the District will be looking at its current regulations and need for additional policy or action items.
- Floodprone Properties Acquisition or Floodproofing – The *Alternative Flood Control Works Program* (Resolution FCD 95-01) was developed to provide another mechanism through which the District could achieve it's mission of protecting the public from hazards due to flooding. Through implementation of the Program, the District will provide limited funding for the use of voluntary, non-structural flood mitigation measures. These measures, such as property acquisition or floodproofing, will assist residents of flood or erosion prone properties in areas where large-scale structural or non-structural CIP projects are determined to be unfeasible.
- Structure Rehabilitation – The District owns and operates 22 flood control dams, which provide highly beneficial flood protection for significant portions of Maricopa County. To maintain the flood protection function provided by these dams, significant issues of aging infrastructure and increasing urbanization must be addressed. Site-specific dam safety issues and potential dam safety issues are being identified, investigated and repaired or corrected as needed.

- Watercourse Master Plans/Riparian Conservation – The District staff has been actively participating in expanding the potential for river management and restoration to link the urban, urban/rural fringe with the rural rivers of the region. The District is working with the Corps of Engineers, municipalities, sand and gravel operations and private non-profit corporations, to pursue within its authority, the management of river resources for restoration opportunities through the Watercourse Master Plans. This effort includes development of tools that help to quantify the risk associated with the problems that restoring vegetation presents to flood control measures and establishing maintenance guidelines that allow for better risk management.

Public Involvement (CRS 510.b)

The District uses an Area Drainage Master Studies and Plans program to assess and recommend solutions for the hazards and problems by watershed because of the County's large area. These studies give a more localized view of issues and solutions to flooding problems for the citizens to participate in. There were eight of these ADMP's prepared in the last two years where public meetings were held to give additional information on specific areas that has been summarized in this Plan. This Plan is a culmination of the Area Drainage Master Studies/Plans (ADMS/ADMP), Delineation Studies, and Capital Improvement Program, which involve numerous meetings where the public is invited to attend, review these plans, and offer input.

After compiling background information to supplement the summary information from the above documents for this Comprehensive Plan, an information meeting was held before the Flood Control Advisory Board in June 2002. The required public hearings per Arizona Revised Statutes and the CRS Program were held by the District Board of Directors. This Report was posted for public review on the District web page beginning in June 2002. In addition, advertisements inviting the public to review the 2002 Comprehensive Plan were placed in a number of the key newspapers that circulate throughout the County.

Coordination with Other Agencies (CRS 510.c)

Other agencies are offered the opportunity to participate in the Comprehensive Plan development on two levels. First, this Plan was distributed to all municipalities and affected agencies for external review in June 2002 in order for them to provide comment. Secondly, throughout the year agency representatives sat on technical advisory teams for the various ADMP's that were prepared by the District in partnership with these agencies. In addition, the County's Planning and Development, Parks and Recreation, Transportation, and Environmental Services Departments provided input on the ADMP's and received a copy of the 2002 Comprehensive Plan for their review and comment.

Plan Adoption (CRS 510.i)

This Comprehensive Plan was endorsed by the Flood Control Advisory Board on August 28, 2002, recommending that the Board of Directors adopt this Plan. The Board adopted the Plan on September 18, 2002 by Resolution FCD 2002R010. This Plan will be updated and revised annually in conjunction with the District's Strategic Plan, Capital Improvement Program, and budget process. The District staff will analyze the success of its programs through the measurement process established by the County-wide Managing for Results program, but

more importantly, by the overall reduction in lives and property being protected from harms way caused by flooding and erosion hazards.

Implementation (CRS 510.j)

Implementation of all activities identified in this Plan is underway. The District staff will further evaluate both the plan and the level of reduction in flood related problems through records and public feedback. The evaluation of both program success and determining flood hazards is a continual process throughout the year. The District staff will also look at its programs and revise them as needed to meet the demands and changes of the needs in the County for flood hazard remediation.

The objectives of this Plan identified in the Introduction of this Executive Summary are to be implemented as noted below.

- Public information and education as it relates to this Plan will be achieved by making the full "Comprehensive Plan 2002 – Flood Control Program Report" available to the public.
- The District will comply with ARS through preparation and adoption of the Plan and follow through in implementation of the flood protection projects identified in the Plan.
- The District will comply with the NFIP Community Rating System Program through adoption of the Plan and continued implementation of the structural and non-structural measures identified for each watershed.
- The presentation in the Plan of characteristics that shape the County and affect flooding combined with the brief summaries of problem and hazard identification by region will aid staff in identifying project and program activity necessary to provide flood hazard mitigation by watershed.
- Additionally, the above information will aide staff in determine the longer-term level of fiscal need to provide complete flood protection to County residents.

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Table ES-2 Watershed Summary by Region with Critical Elements Information

Watershed	Area (square miles) inside County Boundary	Population (1995)	Projected Population (2025)	Population Change (1995-2025)	100,000 scale USGS Hydrography (linear miles)	Approximate & Detailed Delineations (linear miles)[1]	Delineations remaining to be done (linear miles)[2]	County Road Closures (1996-2000)	Potential Developable Land (square miles)[3]	Structures in the Floodway	Structures in the Floodplain	Structures in a Moderate or Severe Erosion Hazard Zone	Flodplain Use Permits Issued (1990 - 1999)	Drainage Clearance Permits Issued (1990 - 1999)
Southeast Region														
Upper Queen Creek *	[143]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper East Maricopa Floodway **	132	96,565	299,706	203,141	118.0	27.0	91.0	196	68.00	0	70	70	16	16,600
South Mountain	245	226,051	409,043	182,992	167.0	36.0	131.0	29	46.90	1	453	449	12	17,000
Lower ACDC	235	772,467	1,134,100	361,633	83.0	80.0	3.0	26	77.31	58	6,370	6,235	50	20,000
Lower East Maricopa Floodway ***	265	556,096	986,188	430,092	72.0	68.0	4.0	31	87.00	0	3,959	3,761	39	57,600
TOTAL	877	1,651,179	2,829,037	1,177,858	440.0	211.0	229.0	282	279.21	59	10,852	10,515	117	111,200
Northeast Region														
Cave Creek ***	194	16,669	105,000	88,331	280.3	109.9	170.4	37	63.00	52	2,173	370	402	9,392
Evergreen	40	1,969	14,377	12,408	60.0	9.6	50.4	0	2.15	0	0	10	0	1,195
Lower Indian Bend	43	94,551	103,704	9,153	27.0	18.2	8.8	3	0.50	1	692	1	5	694
Lower New River	42	61,321	143,475	82,154	28.0	15.7	12.3	35	16.93	2	40	42	N/A	14,038
Lower Verde	560	23,556	111,277	87,721	996.5	76.6	919.9	24	55.20	3	11	1	8	6,950
Middle Indian Bend	95	184,042	236,070	52,028	54.6	16.5	38.0	0	11.17	2	330	279	2	16,307
Skunk Creek	89	11,814	79,628	67,814	105.3	53.6	51.7	46	41.10	85	155	148	93	3,123
Upper ACDC	120	341,822	462,706	120,884	89.8	62.8	27.0	0	25.00	51	1,661	1,595	18	20,722
Upper Agua Fria **	62	11	1,771	1,760	66.4	22.0	44.4	0	7.23	0	0	0	N/A	2
Upper Indian Bend	99	13,165	185,240	172,075	144.7	41.8	102.9	0	63.99	0	4,818	1,000	72	12,525
Upper New River ***	143	2,984	76,017	73,033	160.8	60.7	100.2	15	68.58	3	40	19	17	360
Upper Verde **	168	N/A	N/A	N/A	242.0	0.0	242.0	0	0.20	0	0	0	0	0
Upper Salt River **	358	N/A	N/A	N/A	547.9	0.0	547.9	0	0.00	0	0	0	0	0
TOTAL	2,012	751,904	1,519,265	767,361	2,803.2	487.4	2,315.7	160	355.05	199	9,920	3,465	617	85,308
Northwest Region														
Arlington	66	606	5,011	4,405	66.9	13.0	53.9	21	59.40	9	4	13	6	162
Buckeye Hills	58	78	5,640	5,562	52.3	10.0	42.3	0	3.78	0	0	0	1	9
Buckeye Valley	70	8,440	39,983	31,543	43.0	37.0	6.0	32	57.91	0	37	37	7	497
Lower Agua Fria	106	20,882	68,698	47,816	118.4	65.0	53.4	18	47.70	1	13	13	2	3,561
Lower Centennial ***	990	1,589	16,993	15,404	1,073.0	97.0	976.0	103	347.03	4	42	35	17	130
Lower Hassayampa ***	800	9,691	32,457	22,766	927.5	294.5	633.0	79	390.82	122	252	246	18	677
Trilby (Wittmann) ***	290	3,474	27,623	24,149	372.6	177.0	195.6	77	210.36	4	28	31	60	530
Upper Centennial ***	231	257	9,017	8,760	194.3	22.0	172.3	20	172.20	11	131	141	24	106
White Tank A	132	60,138	206,924	146,786	86.7	72.9	13.8	138	92.25	0	270	270	26	16,751
White Tank B	110	14,192	123,353	109,161	88.1	66.3	21.8	78	76.81	4	17	21	25	271
Upper Hassayampa *	[600]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	2,851	119,347	535,699	416,352	3,022.8	854.7	2,168.1	566	1,458.26	155	794	807	186	22,694
Southwest Region														
Ajo ***	418	4	59	55	320.9	0.0	320.9	0	5.14	0	0	0	0	0
Gila Bend	350	1,095	1,752	657	468.0	19.0	449.0	12	24.93	12	116	14	0	40
Gillespie	322	379	10,220	9,841	409.0	38.0	371.0	11	84.70	0	0	0	0	29
Lower Gila ***	380	195	2,000	1,805	440.7	29.0	411.7	11	62.90	0	4	3	1	4
Painted Rock	188	91	663	572	205.9	40.8	165.1	3	16.20	0	0	0	0	0
Santa Rosa ***	107	N/A	N/A	N/A	108.3	0.0	108.3	0	0.00	0	0	0	0	0
Sentinel ***	627	134	1,426	1,292	446.0	25.0	421.0	0	55.23	0	3	3	0	2
Theba ***	433	608	2,220	1,612	429.0	50.0	379.0	10	125.65	0	28	12	0	3
Vekol ***	190	12	1,149	1,137	225.9	0.0	225.9	0	25.06	0	0	0	0	2
Waterman ***	462	2,982	41,302	38,320	521.5	24.0	497.5	45	144.17	0	1	1	15	1,100
TOTAL	3,476	5,500	60,791	55,291	3,575.1	225.8	3,349.3	92	543.98	12	152	33	16	1,180
COUNTY TOTAL	**9,217**	**2,527,930**	**4,944,792**	**2,416,862**	**9,841.0**	**1,778.8**	**8,062.0**	**1,100**	**2,637.05**	**425**	**21,718**	**14,820**	**936**	**220,382**

* Watershed completely outside of Maricopa County boundary. 2

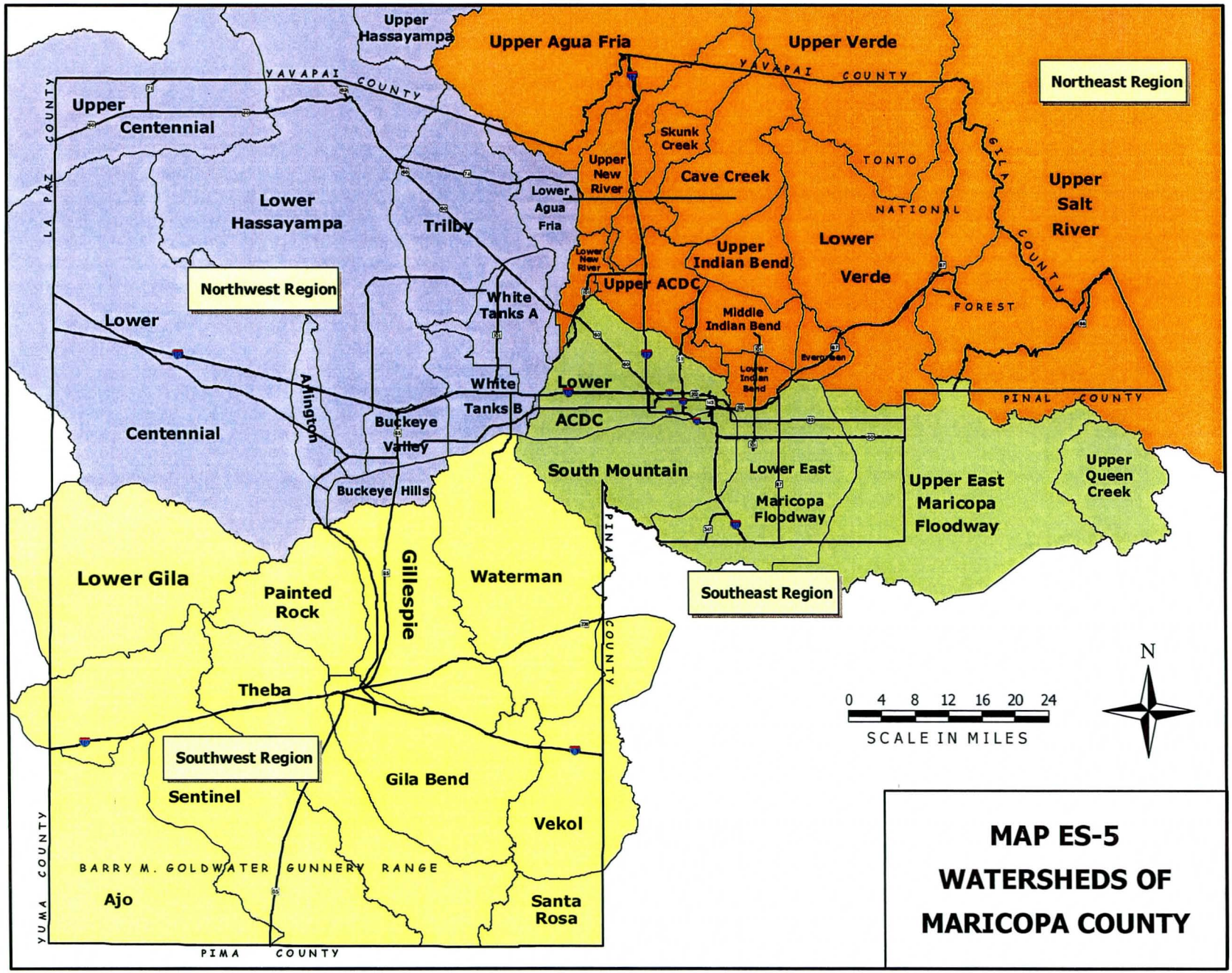
** 90% of Watershed outside of Maricopa County Boundary. 3

*** A portion of the Watershed outside of Maricopa County Boundary. 12

[1] Linear miles of floodplain already delineated. Based on 100-year floodplains and floodways. 100,000 scale USGS hydrography used as well as "lineal miles" digitized by hand.

[2] Estimate of linear miles yet to be delineated within each watershed. Developed by subtracting 100,000 scale USGS hydrography from delineated floodplains and tabulating the remainder for each watershed.

[3] Estimate of land area remaining to be developed within a watershed. Estimated by subtracting areas with 15% or more slope (based on USGS digital elevation model data) and also subtracting areas already developed(based on 1995 MAG landuse data) from state trust land and private land (based on ALRIS's land coverage). Also subtracted from the totals was areas within FEMA 100-year floodways, the Tonto National Forest, & Gunnery Range.



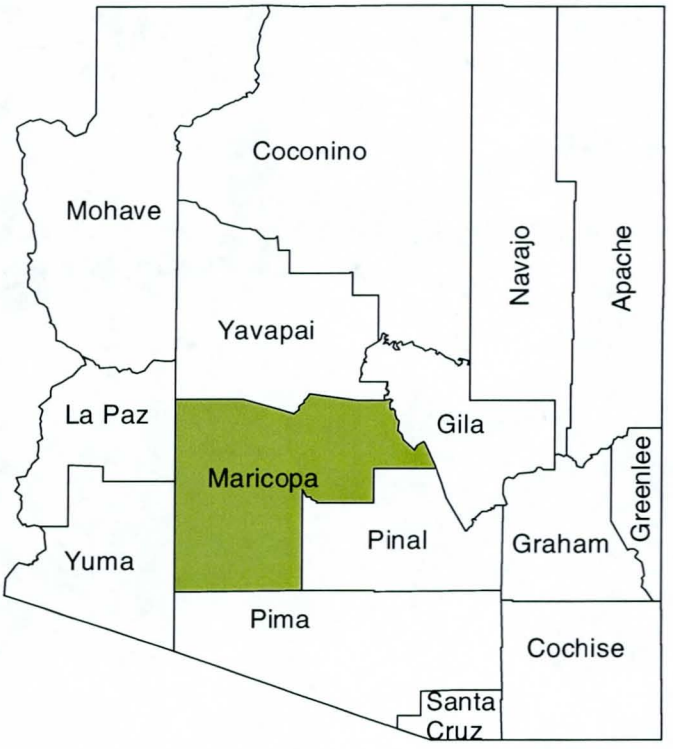
MAP ES-5
WATERSHEDS OF MARICOPA COUNTY

CHAPTER 1. INTRODUCTION

1.1. County Overview

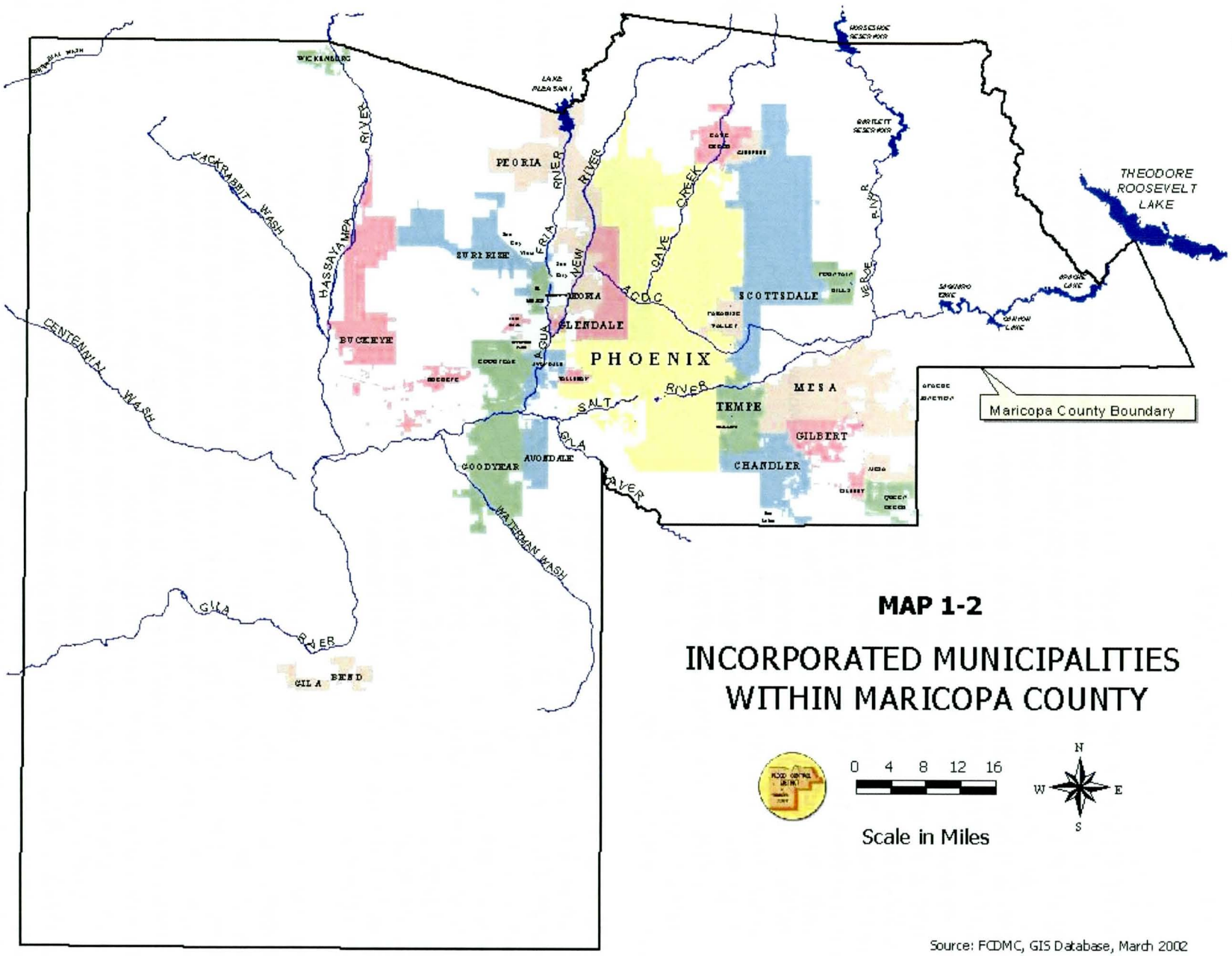
Maricopa County is located in south central Arizona and is one of 15 counties in the State (Map 1-1). In 2001, Maricopa County had a population of approximately three million people living within the 24 incorporated municipalities and the remaining unincorporated areas (Map 1-2). The population concentration in the urban area (Phoenix Metropolitan Area) of the County is located within the valleys of four major rivers. The Salt River enters from the east side of the County and flows through the southern third of the Metropolitan Area moving in an east to west direction. The Verde River is located to the east of the Metropolitan Area and flows to the Salt River just north of the City of Mesa. The Agua Fria River is to the west and flows to the Gila River which runs through the southern end of the City of Avondale. The Gila River, running in a westerly direction, bisects the north and south portions of the Metropolitan Area. The Gila River is the final depository for all floodwater originating in and passing through Maricopa County.

A fifth river, the Hassayampa, that affects Maricopa County is located outside the present Phoenix Metropolitan Area and passes the towns of Wickenburg and Buckeye before entering the Gila River north of Gillespie Dam. In addition, the New River, Cave Creek, Skunk Creek, and a series of other major washes contribute to the potential flooding and erosion hazards in the County.



Map 1-1 Location of Maricopa County

The first permanent dwellers in the area, the Hohokam Indians, utilized these rivers and created a canal system for survival. The formation of the Arizona Territory followed centuries later in 1863 and was the beginning period of more intense development. The natural environment was affected by this early development and settlers became prone to flooding hazards. Farmers wanting to prevent fields from flooding had to create their own dams or diversion channels. Assistance was provided through federal programs. Some of these structures are described later in this chapter. New residents were not aware of flood and erosion hazards until studies were done identifying flood hazards and floodplains. Problems were handled individually and solutions possibly jeopardized other's remedies if they were not coordinated. Regional efforts were needed for planning and/or coordinating projects to keep residents and property safe from flood and erosion hazards. Development in Maricopa County is still occurring at a rapid pace, prompting the need for continued regional flood hazard and floodplain management.



MAP 1-2

INCORPORATED MUNICIPALITIES WITHIN MAPICOPA COUNTY

Source: FCDMC, GIS Database, March 2002

1.2. Need for a Comprehensive Plan

The Flood Control District of Maricopa County (District) developed the latest Comprehensive Plan in 1997. Regular updates to the plan are necessary to reflect the changes that have taken place physically and through completed projects. The latest update process started in 2000 with extensive background data collection and research efforts done by an internal team. For the new 2002 Plan, District staff has expanded on the report requirements in the Arizona Revised Statutes to include aspects of the Growing Smarter Plus legislation and Community Rating System – National Flood Insurance Program (NFIP) requirements which make the District's Flood Control Program Report more compatible with other comprehensive planning documents for guiding future development. This Plan looks at all of the District's activity for providing flood control and floodplain management – from structural to non-structural solutions, education, and regulation. The five chapters in this Comprehensive Plan take the reader from the inception of the District through future objectives.

The 2002 Comprehensive Plan is intended to be used as a general guide for future decision making in determining the progression of project activity that the District should undertake. An objective of this Plan is to present adequate background information to the reader so that general conclusions can be drawn to aide District staff in prioritizing areas for future studies and projects. In addition, this Plan serves as a tool to help anticipate future revenue needs and may be used for policy making during the budgeting process. The Comprehensive Plan is the first step in the overall planning process, providing the information on area problems and needs, and allowing the District to develop appropriate goals and objectives to move forward. The intent and goals of this Plan are implemented by tools such as the Strategic Plan, Business and Financial Plans, Planning Studies, Capital Improvement Program, and adopted regulations and policy documents.

The Strategic Plan sets the direction for the District by determining what programs and goals will be accomplished. The Business Plan breaks the District's work functions into programs and measurable activities. This is done to better track performance and public benefit. The Financial Plan addresses specific goals and objectives and defines how available financial resources support the Strategic and Business Plans. Planning Studies provide more detailed information on watersheds and watercourses and are important for determining flood management solutions for areas. The Capital Improvement Program prioritizes and sets a financial schedule for completion of these solutions. Adopted regulations and policies provide flood management guidance beyond or in place of structural solutions.

1.3. Authority

State of Arizona lawmakers saw a need for regional flood management in response to increasing growth and flood hazards in rapidly urbanizing areas across the State, enacting legislation for the creation of flood control districts. The Flood Control District of Maricopa County was organized under Title 5, Chapter 10, Article 4, §45-2351 to §45-2371 Arizona Revised Statutes in August of 1959. Upon formation of the District, a survey and subsequent report of flood control problems were required of the District. The above statute was repealed in 1985 and replaced by Title 48, Chapter 21, Article 1, Arizona Revised Statutes (ARS). One of the features of ARS §48-3616 is preparation of a comprehensive program for flood hazard mitigation based on recommendations from the required report. A goal of the District's

Comprehensive Plans is to continually update this original report describing the flooding problems and the status of existing flood control programs in Maricopa County. ARS §48-3616 states "the report shall be prepared at least every five years beginning in 1985 and shall indicate the past efforts of the district in eliminating or minimizing flood control problems and state the planned future work of the district to eliminate or minimize flood control problems." The Plan (report) must be approved by both the Flood Control Advisory Board (FCAB) and the Flood Control District Board of Directors (BOD).

The District has jurisdiction over incorporated and unincorporated areas within the boundaries of Maricopa County and those areas outside the County that contribute to flooding problems within the County boundary. Municipalities may declare by resolution that they will assume the powers and duties, including the adoption of floodplain management regulations, from the District for the areas within their jurisdiction. When the District submits this Plan to the NFIP, however, only the areas in unincorporated County are considered in the review and insurance credits. Each municipality is responsible for their own planning process and submittal to the NFIP.

On July 11, 1988, the Board of Directors (County Supervisors) for the District adopted Resolution FCD 88-08, *General Policies Concerning the Allocation of Fiscal Resources to Accomplish the District's Functions and Responsibilities*, to support implementation of ARS §48-3616. This Resolution defined and delineated District policies for allocating fiscal resources. This Resolution was updated and amended on September 7, 1993 (FCD 88-08A). This Plan is part of the process for the allocation of fiscal resources to accomplish the District's mission. A copy of ARS Title 48, Chapter 21, Article 1 and the Resolutions are in Appendix A.

The recent Growing Smarter Plus legislation (2000), which built upon the 1998 Growing Smarter Act, placed additional emphasis on comprehensive planning. The bulk of these legislative changes dealt with issues related to counties, cities, and towns concerning changes to planning requirements, additional growth management, and private property rights for development of comprehensive plans. The purpose of comprehensive plans is to bring about coordinated physical development in accordance with the present and future needs of the county. ARS states that a "comprehensive plan shall be developed so as to conserve the natural resources of the county, to insure efficient expenditure of public funds, and to promote the health, safety, convenience, and general welfare of the public. Such comprehensive plan may include but not be limited to, among other things, studies and recommendations relative to the location, character and extent of highways, railroads, bus and other transportation routes, bicycle facilities, bridges, public buildings, public services, schools, parks, open space, housing quality, variety and affordability, parkways, hiking and riding trails, airports, forests, wildlife areas, dams, projects affecting conservation of natural resources, air quality, water quality and floodplain zoning. Such comprehensive plan shall be a public record, but its purpose and effect shall be primarily as an aid to the county planning and zoning commission in the performance of its duties."

1.4. Purpose

The District's 2002 Strategic Plan identifies the following vision and mission statements for the District:

*The **vision** of the District is that the people of Maricopa County and future generations will have the maximum amount of protection from the effects of flooding through fiscally responsible flood control actions and multiple-use facilities that complement or enhance the beauty of our desert environment.*

*The **mission** of the District is to provide flood hazard programs benefiting Maricopa County that prevent loss of life or injury to residents and the elimination or reduction of damages to real and personal property from flooding while enjoying the natural and beneficial values served by floodplains.*

The District accomplishes its mission through a number of activities under various programs by the construction of dams and channels, by the implementation of regulatory tools, and through multi-use opportunities as part of floodplain management. The need and demand for these programs has continually been much greater than the District could provide in any given year beginning in the 1960's as population growth accelerated. Due to the enormity of the problem, rate of development, and limited resources, the District is forced to stretch program implementation over a number of years and determine which programs and projects were the most critical for implementation at any given point in time.

The District faces many external forces that drive decision-making and therefore, must continually assess its programs and funding availability to develop measures that meet the safety needs for the citizens of Maricopa County. This Plan presented herein gives the overview and guidance needed to prioritize and implement these activities and programs.

1.5. Regulatory Governance

The District is governed by federal, state, county and local mandates. Rules and regulations that influence the District's decision-making process include the following:

1.5.1. Federal

- 29CFR Ch XVII (7-1-88). Occupational Safety and Health Act (OSHA).
- 33CFR Title 33 Title 2, Chapter II-Corps of Engineers, Department of the Army, Part 208, Flood Control Maintenance & Operations of Flood Control Works.
- 40CFR Part 122, 123, 124. National Pollutant Discharge Elimination System (NPDES). 33USC Section 1344 (a), (b), and (e). Wetlands or Dredge and Fill Program (a.k.a. Section 404 of the Clean Water Act). 42USC 9601(35)(A)(B) and 9607(a). Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).
- National Flood Insurance Act of 1968 (PL 90-448, Title XIII). Flood Disaster Protection Act of 1973.

1.5.2. State

- A.R.S. §33-1324. Requires the District to maintain owned facilities that are rented in a clean and safe condition in full compliance with the applicable building codes.
- A.R.S. §45-1212. Requires the State to inspect dams in order to ensure proper maintenance.

- A.R.S. §45-1423. Requires the District to operate in accordance with Federal guidance that is normally issued in the form of structure Operating and Maintenance Manuals.
- A.R.S. §48-3609. Directs the Board of Directors to "...adopt and enforce regulations governing floodplains and floodplain management in its area of jurisdiction...."
- A.R.S. §48-3610. Requires the District to perform floodplain responsibilities for all jurisdictions within the District boundaries unless an incorporated city or town declares by resolution that it will manage its own floodplain.
- A.R.S. §48-3613. Requires the District to evaluate and when appropriate grant written authorization to construct within the floodplain.
- A.R.S. §48-3616. Directs the Board of Directors to require the Chief Engineer and General Manager to present "...recommendations and a preliminary plan for the construction or other acquisition of facilities to carry out the purpose of the district...."
- A.R.S. §48-3616. Requires the preparation of and approval by the Flood Control Advisory Board and the Board of Directors of a comprehensive plan to "...eliminate or minimize flood control problems
- State of Arizona Executive Order 77-6, dated September 27, 1977, directs each state agency to "...provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare and to restore and preserve the natural and beneficial values served by floodplains carrying out is responsibilities...."

1.5.3. County

The Drainage Regulation for the Unincorporated Area of Maricopa County, adopted September 26, 1988, provides for the regulation and drainage review for unincorporated areas of Maricopa County and defines requirements for drainage retention and grading plans.

1.5.4. Local

Local codes or ordinances require the District to maintain property to certain minimum standards (no weeds, debris, etc.).

1.6. Previous Comprehensive Plans

Comprehensive Flood Control Program Reports have played a major role in the District's operations since 1963 when the first survey of flood control problems and report was published. The 1963 report served as a blueprint for District activities for the next 25 years. There have been additional draft reports prepared over the years. Only the 1963 and 1991 Comprehensive Flood Control Program Reports were presented and received approval from the FCAB and the Flood Control District BOD.

The Comprehensive Flood Control Program, Status Report Interim Update, 1963-1989, was completed in 1989. This report gave an update on the status of all the projects recommended for implementation in the 1963 Comprehensive Plan. It also reprioritized all of the 1963 projects that had not yet been built. Also in 1989, a Draft Comprehensive Flood Control

Program Report was developed. This draft added more detail to each of the projects described in the Status Report, reported on projects by other agencies, and explained the Area Drainage Master Study Program. This draft culminated in the publication of the 1991 Comprehensive Flood Control Program Report.

The 1991 Comprehensive Flood Control Program Report took the data from the 1989 Draft and updated it to 1991 figures. This report also included more comprehensive tables and maps than the 1989 Draft. A Draft Comprehensive Flood Control Report/Plan was developed in 1997. This report updated projects completed since 1991 and took a more comprehensive look at non-structural program activities such as floodplain and drainage administration.

1.6.1. Comprehensive Flood Control Program Report of 1963

The 1963 Report was the culmination of several general area studies that identified flooding problems in Maricopa County. The basic purpose of this report was to summarize all pertinent information on Maricopa County flood control problems and to make recommendations for their solutions. The report divided Maricopa County into 35 watersheds that generally conformed to major drainage areas. Flooding problems were defined and potential structural solutions were proposed for each as needed. Table 1-1 shows projects with costs and benefits as they were evaluated in 1963. All these projects included structural elements such as dams, channels or levees, alone or in combination. This report was the guiding force behind most of the Flood Control District Programs during a 25-year period. The present status of these projects is noted in Chapter 4, Table 4-1 along with additional projects since added.

1.6.2. Comprehensive Flood Control Program Report of 1991

The 1991 Comprehensive Report summarized what had been accomplished and what was still needed based on more current information. Approximately 15 of the 40 projects identified in 1963 were in construction or had been completed at the time of the 1991 Report. Five of these 40 projects were incorporated into other projects or eliminated. This report also listed projects that were being constructed in cooperation with the Arizona Department of Transportation (ADOT), various municipalities, and the Soil Conservation Service, an agency in the United States Department of Agriculture. By 1991, the District was operating and maintaining 29 flood control facilities. The 1991 Report documented the District's non-structural flood control programs such as Floodplain Management, Drainage Administration and Flood Warning. This report pointed out the need for additional planning in many areas of the County and explained the Area Drainage Master Study Program.

1.7. Past Floods

Flooding in the desert? Isn't the problem not enough water? Not always. In fact some areas of Maricopa County generally experience flooding problems at least once, and on many occasions, more often during a calendar year. What conditions cause flooding in the desert? Major clues are found in the following quote from Jim Patton's work.[1] "The first settlers to Maricopa County found a natural system of washes, streams and rivers that adequately carried off natural drainage water. As population growth continued the increased growth of agriculture and urban development disrupted this system. Streets, roads, farms and subdivisions in many

cases were developed with little regard to the natural drainage system. As urban development takes place buildings, homes and pavements do not absorb water as did the natural ground and vegetation they replaced."

Flooding in Maricopa County normally occurs from one of three types of storm conditions. The general winter storm generally offers the greatest potential to cause the most damage. Originating in the Pacific Ocean, these storms are normally the cause of winter flooding and cover a large area. The excess rain produced by these storms, coupled with the potential for saturated soil, rising freezing levels and melting snow, can cause stream levels and canals to exceed bank capacities. These storms are generally more regional in nature and can affect one or more of the large river systems during the same period of time.

Table 1-1 Projects by Group from the 1963 Program Report
Group No. I

Group No. I - Projects Recommended for Immediate Construction

Drainage Area	Location	Job Description	COSTS			Annual Benefits	Annual Costs	Benefit-Cost Ratio	Remarks
			FCD	Other	Total				
1	Gillespie Dam to 107th Ave.	Channel Clearing	250,000	1,000,000	1,250,000	141,600	80,800	1.75 to 1.00	Approved by U.S. Army Corps of Engineers
27	Lower Indian Bend	Floodway Channel	1,770,000	7,250,000	9,020,000	530,000	348,000	1.52 to 1.00	Approved by U.S. Army Corps of Engineers
19-23	Agua Fria, New River, and Skunk Cr.	Channel Clearing	250,000	1,000,000	1,250,000				Deer Valley Group
22	Arizona Canal-Cave Cr. To Skunk Cr.	Divert flood water North of Canal	944,000	7,060,000	8,004,000				Deer Valley Group
25	Dreamy Draw	Earth Dam	150,000	300,000	450,000				Deer Valley Group
22	North Mt.-Arizona Canal, 20th St. to 23rd Avenue	Construct Channel	1,400,000	1,926,000	3,326,000				Deer Valley Group
22	New River NW of Glendale	Earth Dam	2,770,000	2,002,000	4,772,000				Deer Valley Group
22	NW of Adobe	Earth Dam	832,000	2,301,000	3,133,000				Deer Valley Group
22	Lower Cave Cr. Dam Site	Earth Dam	871,000	5,824,000	6,695,000				Deer Valley Group
22	Union Hills Diversion	Lined Channel	500,000	1,500,000	2,000,000				Deer Valley Group
22	64th St. to New River	**Total Deer Valley**	7,717,000	21,913,000	29,630,000	2,232,000	1,296,000	1.72 to 1.00	
22	Maryvale-Glendale Drain	Lined Channel	320,000	1,462,000	1,782,000	99,000	68,000	1.46 to 1.00	Moved to Group 1 (1963 Flood)
22	Glendale-Peoria Drain	Lined Channel	426,000	2,552,000	2,978,000	166,000	113,000	1.46 to 1.00	Moved to Group 1
7	Casandro Wash	Earth Dam	60,000	0	60,000	4,500	2,500	1.80 to 1.00	FCD Project
7	Sunset & Sunny Cove Washes	Earth Dams	79,000	0	79,000	6,200	3,500	1.77 to 1.00	FCD Project
32	Buckborn-Mesa	Levees & Channels	3,574,000	3,855,000	7,429,000	500,000	281,000	1.78 to 1.00	Under SCS Study
12	Bender & Sand Tanks Washes, Gila Bend	Levees	152,000	114,000	266,000	12,500	10,700	1.16 to 1.00	Under Study by Corps of Engineers
	TOTAL - GROUP I		14,348,000	38,146,000	52,494,000	3,691,800	2,203,500	1.68 to 1.00	

Table 1-1 Projects by Group from the 1963 Program Report (con't)
Group No. II, III, & IV

Recommended Projects Group II - Subject to Availability of Funds

32	Apache Junction-Gilbert	Levees & Channels	1,209,000	3,803,000	5,012,000	276,700	198,000	1.40 to 1.00	Under SCS Study
32	Mesa-Chandler-Gilbert	Channel	3,000,000	0	3,000,000	259,500	122,400	2.11 to 1.00	Urban Storm Drain
32	Williams-Chandler	Levees & Channels	837,000	3,738,000	4,575,000	326,000	189,000	1.73 to 1.00	Under SCS Study
9	Buckeye-Palo Verde	Levees & Channels	776,000	2,986,000	3,762,000	175,000	128,000	1.40 to 1.00	Under SCS Study
22	W. Phoenix-Maryvale	Channel	337,000	2,205,000	2,542,000	141,000	97,000	1.46 to 1.00	Moved (1963 Rain)
22	North Phx. Mt.-Old Cross-Cut Canal	Channel	966,000	2,360,000	3,326,000	232,000	136,000	1.72 to 1.00	Held Back (Group II)
	TOTAL - GROUP II		7,125,000	15,092,000	22,217,000	1,410,200	870,400	1.62 to 1.00	

Recommended Projects Group III - Subject to Availability of Funds

7	Sols Wash	Channel Alignment & Protection	40,000	0	40,000	2,500	2,000	1.25 to 1.00	FCD Project
7	Powder House Wash	Earth Dam	50,000	82,000	132,000	10,000	5,600	1.79 to 1.00	Studied by Corps of Engineers
7	Cave Creek Town	Earth Levee	3,000	12,000	15,000	1,000	840	1.19 to 1.00	Studied by Corps of Engineers
31	Maxwell Dam (Flood Control)	Earth Dam	650,000	5,050,000	5,700,000	369,000	276,000	1.34 to 1.00	Cost of Flood Control
24	Cave Creek Dam (Old)	Levee	65,000	91,000	156,000	10,200	8,200	1.24 to 1.00	Studied by the Corps of Engineers
33	Queen Creek	Channel	920,000	880,000	1,800,000	90,000	72,000	1.25 to 1.00	FCD Project-Aid expected from U.S. Bureau of Indian Affairs
	TOTAL - GROUP III		4,407,000	36,376,000	40,783,000	2,282,700	1,664,640	1.37 to 1.00	

Group IV - Projects Deferred as Not Feasible at this time

7	Flying "E" Wash Wickenburg	Earth Dam	0	183,000	183,000	4,500	7,200	0.62 to 1.00	Financing a question
26	Guadalupe Watershed	Levees & Channels	519,000	660,000	1,179,000	45,450	60,600	0.75 to 1.00	To be referred to SCS
26	South Mountain, 40th St. to 75th Ave.	Levees & Channels	2,652,000	6,251,000	8,903,000	253,000	351,000	0.72 to 1.00	To be studies by Corps of Engineers
28	Indian Bend Wash Above Arizona Canal	Channels	1,217,000	1,701,000	2,918,000	76,000	124,400	0.61 to 1.00	To be studied by Corps of Engineers
33	Santan Watershed	Levees & Channels	895,000	2,678,000	3,573,000	100,000	145,000	0.70 to 1.00	To be studied by SCS
4	Harquahala Valley	Levees & Channels	400,000	3,770,000	4,170,000	70,000	171,000	0.41 to 1.00	To be studied by SCS
6	Box Canyon	Earth Dam	652,000	6,948,000	7,600,000	290,000	325,000	0.90 to 1.00	To be studied by Corps of Engineers
7	Sols Wash (Matthie Dam)	Earth Dam	500,000	556,000	1,056,000	11,000	43,000	0.26 to 1.00	Studied for recreation
8	Upper New River	Earth Dam & Channel	50,000	450,000	500,000				Studied for recreation

The second flood-producing storm is a Pacific-generated hurricane or tropical storm. These storms, or their remnants, can deliver very high amounts of rainfall for durations of 12 to 36 hours and cause the most damaging floods on watersheds from 50 to 500 square miles.

The final type of storm condition is the thunderstorm. These storms generally originate during the monsoon season, which are the higher humidity portions of summer. They are normally much more localized, covering a smaller area than the tropical storms, and are usually of shorter duration. The flooding that results is also more localized and of a shorter duration. However, the damages resulting from a flood of this nature can be just as devastating to the area in which they occur. Table 1-2 lists some of the more significant flooding events that Maricopa County has experienced in recent years. [2]

Table 1-2 Major Floods and Past Flooding Damage 1891 to Present

Date	Remarks
February 18-26, 1891	First record of major flood in Phoenix area. Salt River estimated to have a peak flow of 300,000 cubic feet per second.
August 21, 1921	Approximately 4,000 acres flooded including the state capital. Damages estimated at $240,000.
August 1963	Damages for Phoenix (Maryvale) and Glendale equal $2,900,000.
December 22, 1965 - January 2, 1966	First large flow through Phoenix since reservoirs were built on the Verde River (1939). Damages equal $10,000,000.
September 5-7, 1970	Eight lives lost. Damages equal $5,800,000.
June 1972	Damages for Phoenix Metro area equals $10,588,000.
March 1978	Salt River has a peak flow of 122,000 cubic feet per second. Damages estimated at $33,138,000.
December 1978	Salt River has a peak flow of 140,000 cubic feet per second. Damages estimated at $51,800,000.
February 1980	Salt River has a peak flow of 170,000 cubic feet per second. Damages estimated at $63,700,000.
September 27 - October 3, 1983	Flooding is attributed to Tropical storm Octave off the coast of Baja California. Although Maricopa County was not one of the eight counties in Arizona to be declared a major disaster, damage was done to residences, agricultural areas and roads.
January 7-8, 1993	Salt River has a peak flow of 124,000 cubic feet per second. Two lives were lost (kayaking on river) and over 200 families throughout the County were evacuated from their homes because of flooding.
September 25-26, 1997	Flooding from Hurricane Nora results in the breaching of Narrows Dam. The calculated 24-hour, 100-year rainfall amount in NW Maricopa County was exceeded at six ALERT measuring sites.
October 21, 2000	Rain described as heavy and destructive fell in western Maricopa County. Centennial Wash was hit especially hard.

Table 1-2 indicates that the most damaging floods are normally in the November through March time frame. These winter storms are more regional in nature, usually affect a larger area of Maricopa County, and take longer to move out of the area than thunderstorms. These factors combined tend to make for greater flood damage. However, summer storms should not be excluded when considering overall flood damage. These storms are localized and records may not be kept of monetary damages. The dollar value of damages has increased with each flood event, sometimes very significantly. Some of this increase could be attributed to larger flood flows or to inflation of the dollar. However, a significant percentage of the increase is due to the ever-growing number of people who are living in Maricopa County. The rapid population growth creates the likelihood of improved property being located in the floodplain and therefore susceptible to flood damage.

1.8. Regional Flood Control Structures

The frequency and extent of flooding in Maricopa County has, over time, brought about the construction of a number of flood control structures. Many of these structures are primarily for flood control. Others were built for different purposes but have indirectly contributed to some measure of flood control. Map 1-2 shows these major structures and their locations within Maricopa County.

1.8.1. Salt River Project Dams

Salt River Project supplies power and water, both domestic and irrigation, to a major portion of Maricopa County. Power and water supply come from a total of seven dams and six reservoirs. Four of these are located on the Salt River and two on the Verde River.

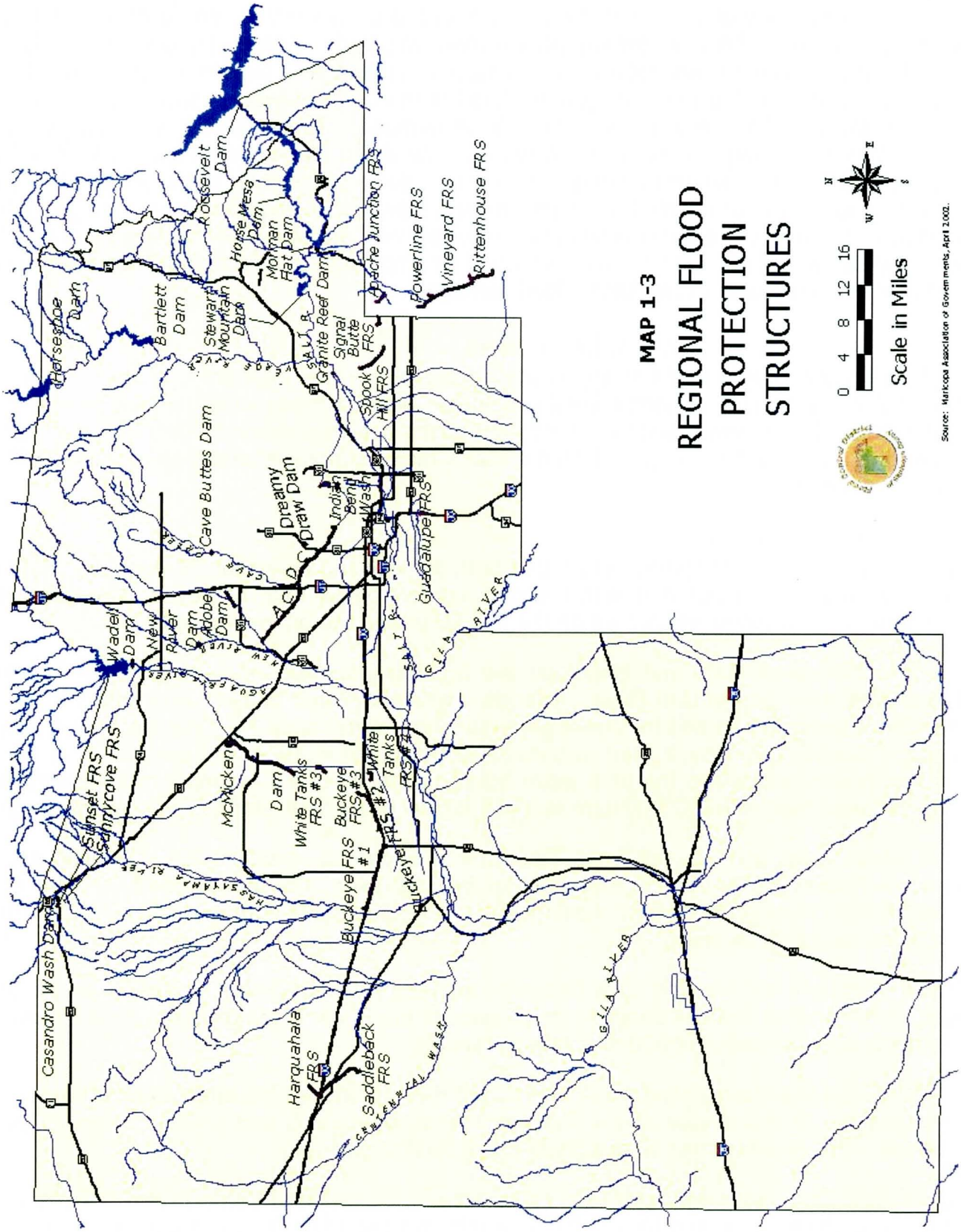
Theodore Roosevelt Dam and Reservoir are approximately 80 miles east of the Phoenix Metropolitan Area on the Salt River. This dam was completed in 1911 and held 1,382,000 acre-feet of water to be used for power generation and water supply.[3] Only the dam is within Maricopa County. Roosevelt Dam was modified beginning in 1989 with completion in 1996. This modification increased the total water holding capacity of the reservoir to approximately 2,209,000 acre-feet, with 557,000 acre-feet of this total being dedicated to floodwater storage.[4]

Horse Mesa Dam and Apache Lake Reservoir are located approximately 15 miles below Theodore Roosevelt Dam on the main stem of the Salt River. The dam is about 65 miles east of the Phoenix Metropolitan Area. Apache Lake holds about 245,000 acre-feet of water when filled to its maximum capacity.

Mormon Flat Dam and Canyon Lake Reservoir are third in line moving downstream on the Salt River. Mormon Flat Dam is about 51 miles east of the Phoenix Metropolitan Area. Canyon Lake holds approximately 58,000 acre-feet at capacity.

The fourth and final dam storing water on the Salt River is Stewart Mountain Dam. This dam is approximately 41 miles east of the Phoenix Metropolitan Area and creates Saguaro Lake Reservoir. This reservoir has a capacity of about 70,000 acre-feet.

Granite Reef Dam is located below the confluence of the Salt and Verde Rivers. The dam is not used to store water, but diverts the flow into the two main irrigation canals serving the Phoenix Metropolitan Area. Also, the dam has no floodwater storage capacity.


MAP 1-3
REGIONAL FLOOD PROTECTION STRUCTURES
0 4 8 12 16
Scale in Miles
Source: Maricopa Association of Governments, April 2002.
Roosevelt Dam
Horse Mesa Dam
Mormon Flat Dam
Apache Junction FRS
Powerline FRS
Vineyard FRS
Rittenhouse FRS
Horsesheoe Dam
Bartlett Dam
Stewart Mountain Dam
Granite Reef Dam
Signal Butte FRS
Spook Hill FRS
Cave Buttes Dam
Drainy Draw Dam
Indian Bend Wash
Guadalupe FRS
Wadell Dam
New River Dam
Adobe Dam
Sunset FRS
Sunnycove FRS
McMicken Dam
White Tanks FRS #3
Buckeye FRS #3
White Tanks FRS #2
Buckeye FRS #1
Buckeye FRS #2
Casandro Wash Dam
Harquahala FRS
Saddleback FRS
SALT R.
GILA RIVER
AGUA FRIA RIVER
NEW RIVER
HASSAYAMPA RIVER
CENTRAL WASH

Bartlett Dam and Reservoir are on the Verde River about 46 miles north of the Phoenix Metropolitan Area. The dam creates a reservoir of approximately 180,000 acre-feet.

Horseshoe Dam and Reservoir is located on the Verde River about 58 miles north of the Phoenix Metropolitan Area. The dam and about 40 percent of the reservoir are located in Maricopa County with the remainder in Yavapai County. The reservoir has a capacity of nearly 143,000 acre-feet.

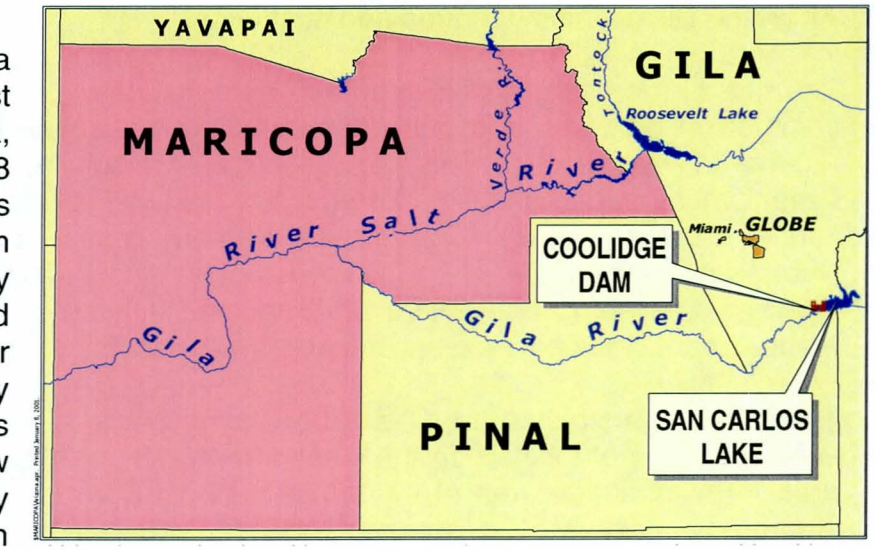
The previously noted volumes for all six of the reservoirs are for water conservation. Only Modified Roosevelt Dam has flood storage as an identified purpose. How much can be stored at any given time is a function of several factors, such as: amount of available capacity in the reservoir at the time of the storm, warning time before peak runoff reaches the reservoir, allowing some draw down in advance of high flows and the timing of peak flows from the various river systems. An example of this timing would be if the Verde and Salt River systems peaked at the same time leaving no opportunity to store one of the system's flows. The effect of coincident peaks is that available storage in one system cannot be used to reduce the impact of high flows from the other system on the Phoenix Metropolitan Area.

All six reservoirs are used for boating, fishing and other water-based recreational activities.

1.8.2. Bureau of Reclamation Dams

The New Waddell Dam[5] was built by the United States Bureau of Reclamation (USBoR) in 1992 to replace the smaller Waddell Dam on the Agua Fria River. The purposes of the New Waddell Dam and Lake Pleasant Reservoir are water supply, regulatory storage of the Central Arizona Project (CAP) water, and recreation. The reservoir has a maximum capacity of 1,101,000 acre-feet with 811,800 acre-feet dedicated to water supply. There is no dedicated flood control storage within the reservoir. However, just as with the Salt River Project dams and reservoirs, there is incidental flood storage available. Flood storage capacity is dependent upon the operation of the CAP system, the runoff from the basin upstream of the dam, and the operation of the dam itself.

Coolidge Dam, located on the Gila River about 100 miles southeast of the Phoenix Metropolitan Area, was built by the USBoR in 1928 (See Map 1-4). The San Carlos Reservoir behind Coolidge Dam originally had a storage capacity of 1,206,000 acre-feet[6] to be used for irrigation and power production. This storage capacity has been reduced over the years due to sediment buildup and now has a capacity of approximately 850,000 acre-feet.[7] The San Carlos Reservoir has had excess



Map 1-4 Coolidge Dam in relation to Maricopa County

capacity for the majority of its useful life and has stored flood flows from the Gila River. This storage has benefited Maricopa County in the past by essentially eliminating floodwater contributions from the Upper Gila River that would otherwise reach a portion of the Phoenix Metro Area. Coolidge Dam originally had flood control gates on the emergency spillway, but became inoperable soon after construction. USBoR prepared designs for new gates that have not been installed. Gate installations at the Coolidge Dam, with proper operation, could have the potential to provide significant added flood protection.

1.8.3. US Army Corps of Engineers Structures

The U.S. Army Corps of Engineers (USACE) was created in the 1770's to build fortifications. The USACE's mission (as it relates to flood control) is to provide quality, responsive engineering services to the nation including: Planning, designing, building and operating water resources and other civil works projects (Navigation, Flood Control, Environmental Protection, Disaster Response, etc.) The USACE constructed McMicken, New River, Adobe, Cave Butte and Dreamy Draw Dams as well as the Arizona Canal Diversion Channel (ACDC) and the Indian Bend Wash flood conveyance channel.

1.8.4. Soil Conservation Service Floodwater Retarding Structures

The Soil Conservation Service (Natural Resources Conservation Service - NRCS) an agency in the United States Department of Agriculture constructed sixteen flood control dams known as floodwater retarding structures (FRS). In addition, the NRCS has built a number of floodways or flood conveyance systems that work in conjunction with the FRS's.

1.8.5. Flood Control District of Maricopa County

1.8.5.1. Dams and Flood Retarding Structures

There are 22 dams and floodwater retarding structures owned and operated by the District dedicated to flood control. The five dams were taken over from USACE and the sixteen FRS's from NRCS. See Table 1-3 for list of dams and FRS's. The District is responsible for the operation and maintenance of the five USACE and the sixteen FRS's from NRCS. In addition, the District had Casandro Wash Dam designed and constructed as a flood control structure, which the District also operates and maintains.

The role of the dams and FRS's have been to protect downstream cropland, residential and commercial property, and public infrastructure from floodwater damages and to reduce the number of lives at risk. This protection has not only been more than adequate for existing development, but it has also allowed many historic floodplains to be developed for a variety of intensive uses. These intensive uses, in many cases, require protection levels in excess of what many of these structures were designed to provide, which has created added risk and liability. The dams and FRS's are impacted in varying degrees by dynamic conditions of embankment cracking, land subsidence, earth fissuring, and collapsible soils.

The District constructed the Casandro Wash Dam and outlet in 1996. This facility is a small flood control dam located on the Casandro Wash north of US Highway 60 in the Wickenburg area. The drainage area of the thirty foot high Dam is three square miles with a maximum storage capacity of 150 acre-feet. Casandro Dam is homogenous embankment with a chimney drain. The principal outlet is a 36-inch reinforced concrete pipe 147 feet in length.

The construction of the Dam removed the majority of the floodplain and removed approximately 100 structures out of the 100-year floodplain.

Table 1-3
Flood Control District Structures

	STRUCTURE			DAM BREAK		SPILLWAY	
	Name	Built By	Year Completed	Report Done By	Year	Report Done By	Year
1	ADOBE DAM	Corps	1982	FCD	1987	Hoskin (Task 3)	1998
2	APACHE	SCS	1988	SCS/EBASCO	1986	Baker (Task 1)	1998
3	BUCKEYE #1	SCS	1975	Dames Moore	88-63	Stanley	1995
4	BUCKEYE #2	SCS	1975	Dames Moore	88-63	Stanley	1995
5	BUCKEYE #3	SCS	1975	Dames Moore	88-63	Stanley	1995
6	CASANDRO DAM	FCD	1996	CH2MHill		FCD	
7	CAVE BUTTES DAM	Corps	1980	Woodward Clyde		Baker	1995
8	DREAMY DRAW	Corps	1974	FCD	1987	Kimley Horn	1998
9	GUADALUPE	SCS	1975	Greiner	88-65	Lowry	1985
10	HARQUAHALA	SCS	1991	Carter	88-66	Entellus/Dibble	1997
11	McMICKEN DAM	Corps	1956	FCD	1987	Hoskin (Task 2)	1998
12	NEW RIVER DAM	Corps	1985	FCD	1987	Stantec	1997
13	POWERLINE	SCS	1967	James Montgomery	88-37	Baker (Task 2)	1998
14	RITTENHOUSE	SCS	1969	James Montgomery	88-37	Baker (Task 2)	1998
15	SADDLEBACK	SCS	1982	Carter	88-66	Entellus	1997
16	SIGNAL BUTTE	SCS	1987	SCS		A-N West	1998
17	SPOOK HILL	SCS	1980	McLaughlin Kmetty	88-68	Lowry	1985
18	SUNNYCOVE	SCS	1976	FCD	1987	FCD	
19	SUNSET	SCS	1976	FCD	1987	FCD	
20	VINEYARD	SCS	1968	James Montgomery	88-37	Baker (Task 2)	1998
21	WHITE TANKS #3	SCS	1954	AGK		Dames & Moore	1998
22	WHITE TANKS #4	SCS	1954	AGK		Hoskin (Task 1)	1998

1.8.5.2. Ownership and Responsibilities for Dams and FRS's

The District owns, operates, and maintains all of the Corps of Engineers and NRCS constructed structures. A portion of the Powerline Floodway and four FRS's are located in Pinal County, but protect portions of Maricopa County. The District is also responsible for the safety of the dams and FRSs as currently performed under elements of the District's Dam Safety Program. The twenty-two dams and FRS's are under the jurisdiction of the Arizona Department of Water Resources. Collectively these structures provide a large measure of flood control protection to the people and property of Maricopa County. Individually, each of these structures provides important protection to localized areas. Each of these structures benefit one or more watershed and are listed in their respective watersheds in Chapter 4.

1.9. Summary

Flooding, along with its adverse effects, has been a part of Maricopa County history as indicated in Table 1-2 and by the construction of the regional structures. Records of the flooding and problems have been kept for well over 100 years, which helps the District plan for the future. The District was organized over 40 years ago to address these flooding problems. Much progress has been made to address the issues identified in the 1963 and subsequent reports. However, much work remains to be done as Maricopa County continues to be one of the fastest growing counties in the United States.

This Chapter provides an overview of the needed coordination and planning and the regional efforts underway since the inception of the District. A broad listing of large-scale floods presents an indication of some of the flooding problems the District must respond to in addition to the more problematic localized flooding problems. More localized flood mitigation problems and solutions are covered in Chapter 4.

The remainder of this Comprehensive Plan will explore the characteristics that cause and/or contribute to flooding hazards in the County (Chapter 2). This Plan will also explain the programs the currently used by the District to mitigate flooding hazards (Chapter 3). Chapter 4 describes by region and watershed areas where flooding continues to be a concern, where significant problems still remain, and what will be done to address them over the next five years. Finally, the Plan will look at what is on the horizon in terms of action items and additional programs; needed policy changes; funding sources; and implementation (Chapter 5).

Endnotes

[1] Jim Patton, Sun Valley, Nov 2, 1966. "County Flood Control Plan Based on Historic Deluge of '91.

[2] Information from this Table has been taken from the following: various Corp of Engineer reports, Los Angeles Branch, flood damage reports made for the Phoenix Metro Area after Damaging floods;

1983 Source: The United States Department of the Interior Expedited Reconnaissance Study: Section 905b (WRDA 86) Analysis: Tres Rios, Arizona.1997 and Floods of October 1983 in Southeastern Arizona, United States Departments of the Interior, Geological Survey Water-Resources Investigations Report 85-4225-C
1993 Source: Maricopa County Emergency Management Reports 1990-1995

1997 Source: FCDMC Annual Hydrologic Data Report Volume II Surface Water Data: Water Year 1997
2001 Source: Storm report: Summer/Autumn Storms of 2000. FCDMC. Waters, Preferment & Gardner.2/1/01

[3] This information on the original Theodore Roosevelt Dam and the other five Salt River Project Dams and Reservoirs comes from a Bureau of Reclamation Publication entitled "Salt River Project, 1962".

[4] Information for this paragraph was taken from Section 7 Study for Modified Roosevelt Dam, Arizona, U.S. Army Corps of Engineers, Los Angeles District, March 1996.

[5] Information for New Waddell Dam is taken from the Agua Fria River Study New Waddell Dam to Gila River Confluence, Arizona, U.S. Army Corps of Engineers, Los Angeles District, July1995

[6] U.S. Geological Survey Water- Supply Paper 1850-C, Floods of November 1965 to January 1966 in the Gila River Basin, Arizona and New Mexico, and Adjacent Basins in Arizona, pp.75.

[7] This figure from a telephone conversation with San Carlos Project Office, Bureau of Indian Affairs, U.S. Department of Interior.

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CHAPTER 2. CHARACTERISTICS

2.1. Overview

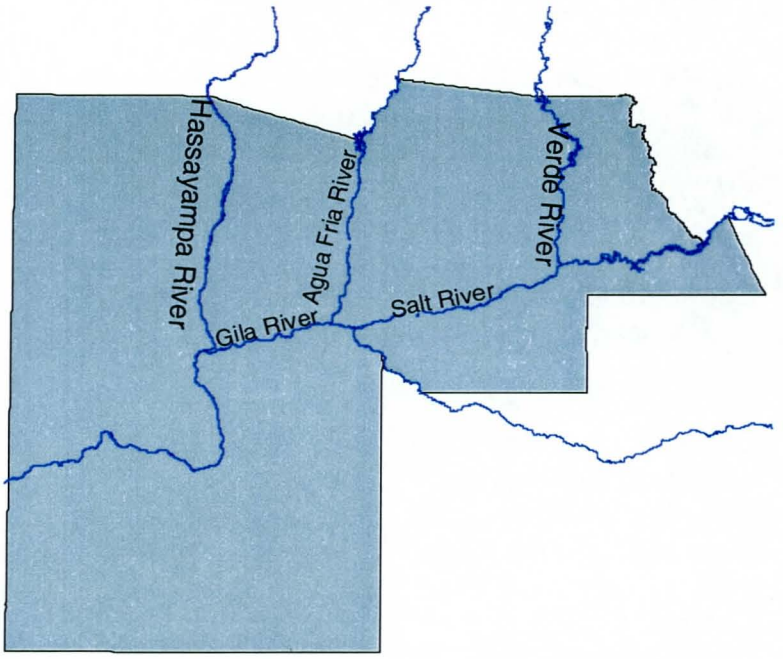
"The ***environment*** in which we currently exist within Maricopa County is influenced by the increase in projected population – Population growth in Maricopa County is pushing people to build in higher flood risk areas such as agricultural lands, deserts, washes, and in areas beyond those that are protected by existing dams. This increases the risks to life and property, and the demand for flood control. The combination of physical characteristics plus a large and continuing growth in population has made Maricopa County susceptible to flooding and/or erosion and sediment damages. Further the current environment reflects that County residents are requesting wildlife habitats, recreational facilities, and aesthetically pleasing open areas and are reluctant to accept concrete flood control structures resulting in the design and installation of more costly and complex multi-use facilities."[1]

To adequately understand the problems and opportunities of a region one must understand the physical conditions, and the environmental and socio-economic forces of that area. This chapter separates these characteristics for Maricopa County into two broad categories entitled physical and socioeconomic characteristics. Physical characteristics include topography, soils, climate, hydrology, geomorphology, vegetation, and riparian habitat. The physical characteristics describe pre-development conditions of the region. Human interaction with these conditions can contribute to flooding problems. Socioeconomic factors are those that identify the human variables that influence the physical space. This category includes population figures, land ownership and development trends.

2.2. Physical Characteristics

2.2.1. Size and Topography

Maricopa County is located in south central Arizona within the Sonoran Desert. The county is approximately 103 miles long (north to south) and 130 miles wide (east to west) at its most extreme locations. It has a land area of 9,226 square miles of which 1,441 square miles (15.6 percent) are incorporated and 7,785 square miles (84.4 percent) are unincorporated. Maricopa County is larger in area than seven states and the District of Columbia and rates as the 14th largest county in land area in the United States.[2]



Map 2-1 Major River Systems in Maricopa County

The County is bisected by the Salt River, which flows from northeast to southwest. It joins the Gila River near

the center of the County, continuing in a southwesterly direction to the County line (See Map 2-1). This extensive river system provided life-sustaining water to the desert. The series of dams built on this river system now provides this water in storage so it continues to provide for the large population growth in Maricopa County.

Elevations range from a high of 7,657 feet on Brown's Peak in the northeastern portion of the county, to a low of 436 feet above sea level near the southwestern boundary. This variance in elevation allows for several different plant communities. At the lower elevations, desert scrub, punctuated with saguaro cactus, is the predominate species. The higher elevations contain woodlands and forests. Riparian communities flourish along the rivers, streams and washes.[3]

2.2.2. Soils

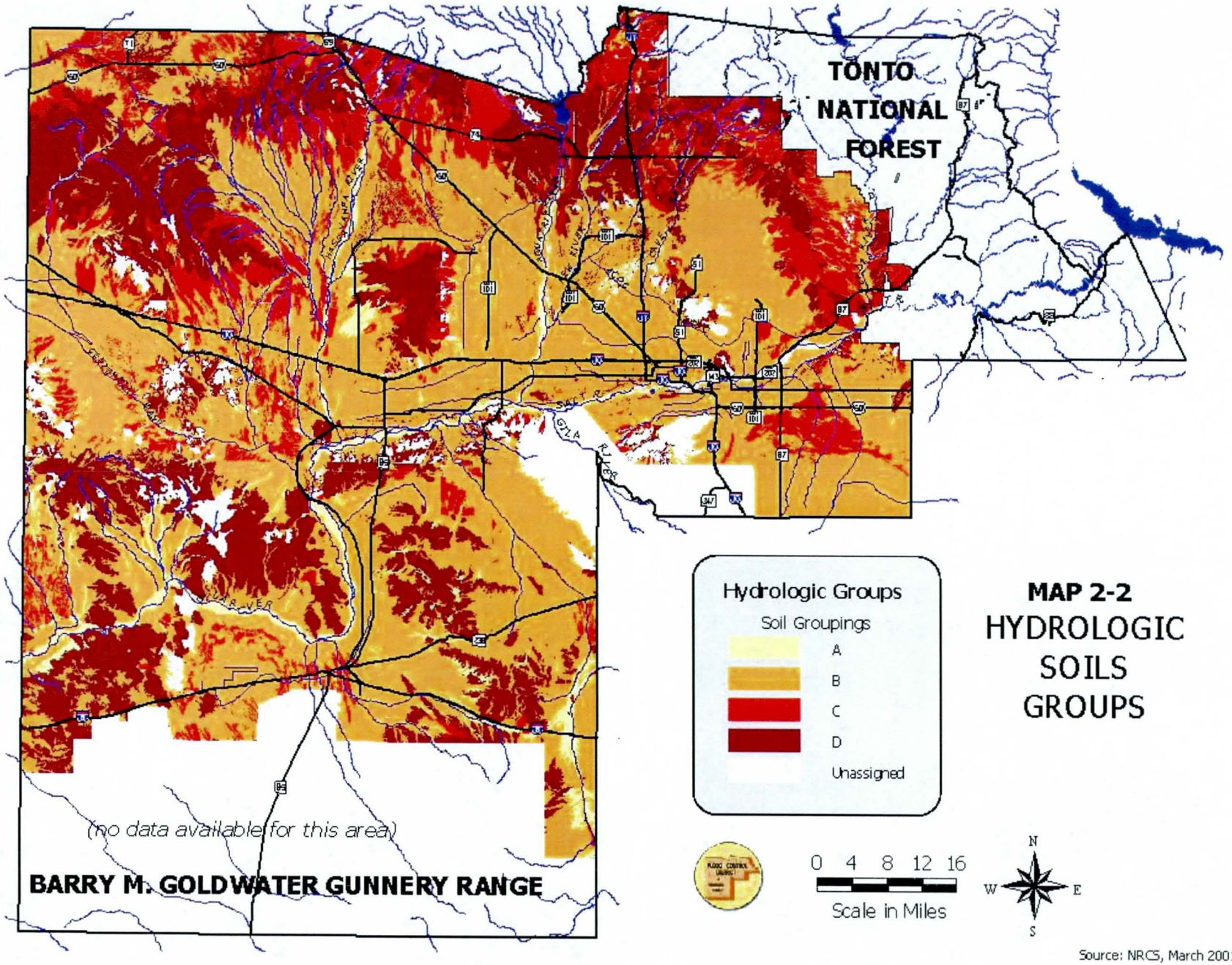
Soil quality is the capacity of a specific kind of soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support habitation. There are two aspects of the definition - dynamic soil quality and inherent soil quality.

> **Dynamic soil quality** - that aspect of soil quality relating to the change of soil physical properties as a result of soil use and management.
>
> **Inherent soil quality** - that aspect of soil quality relating to the natural composition and properties of soils.

Maricopa County has nearly 60 different soil types that have been surveyed and mapped to show the geographic distribution of dynamic and inherent soil qualities, some of which contribute to erosion and sedimentation problems. These potential hazards are of particular importance to the District.

Soils can be grouped according to their water runoff potential in Hydrologic Soil Groups that are used in equations that estimate runoff from rainfall. A Hydrologic Soil Group is a group of soils having similar runoff potential under similar storm and vegetative cover conditions. The physical properties of soil that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are the following: depth to a seasonally high water table, intake rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The influence of ground cover is treated independently.

The soils in the United States are placed into four Hydrologic Soil Groups; A, B, C, and D, three dual classes, A/D, B/D, and C/D; and an unclassified group as defined by the NRCS. Dual classes were not recognized by the NRCS in Maricopa County. In the definition of the classes, infiltration rate is the rate that water enters the soil at the surface and is controlled by the surface conditions. Transmission rate is the rate at which water moves in the soil and is controlled by soil physical properties. The unclassified grouping consists primarily of rock out cropping and soils with inadequate information available to be classified in one of the other four groups.[4]



MAP 2-2
HYDROLOGIC SOILS GROUPS

Source: NRCS, March 2001

- Hydrologic Soil Groups A and B have low and moderate runoff potential respectively. Soils in these two groupings range from sands and/or gravels to sandy loams and clay loams.

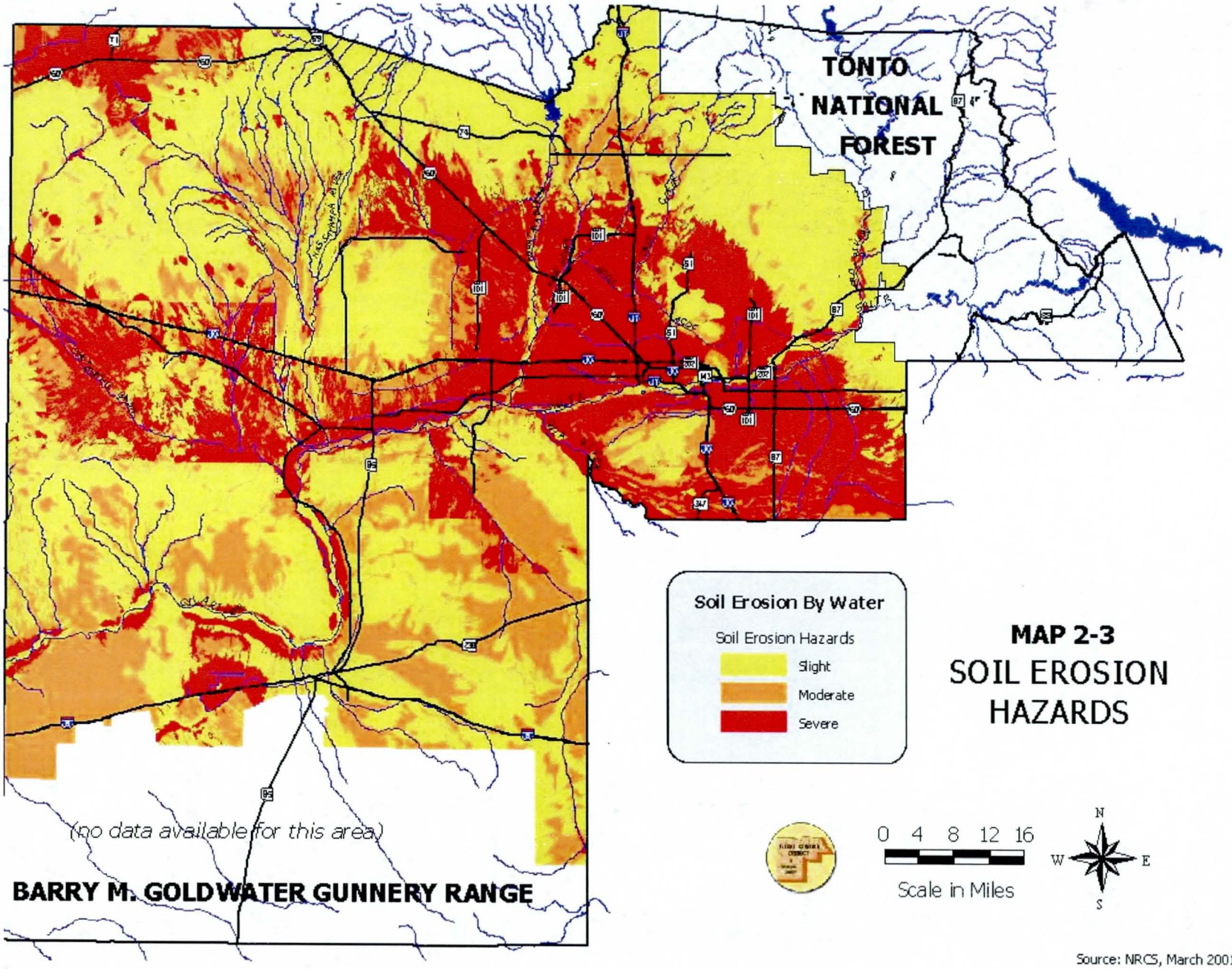
- Hydrologic Soil Groups C and D have a high runoff potential. These soils are primarily silt and clays or have an impervious under layer, such as bedrock that impedes the downward movement of water.

Approximately 35 percent of the total acreage in Maricopa County, excluding the Tonto National Forest and the Barry M. Goldwater Gunnery Range, fall into Hydrologic Group C or D (See Map 2-2). Most of the soils found in Groups C or D are in the mountains and low hills of the County. Most of these areas are sparsely populated and the threat of direct flood damages is relatively minor. However, runoff from these areas can impact lower lying, more densely populated tracts depending upon rainfall patterns.

There are areas in the County that fall into Groups A or B that have been or could be developed for intensive uses. These areas have the potential for increased runoff especially in the time frame after clearing but before development takes place. Without vegetative cover this land becomes very susceptible to erosion and sediment damages.

Erosion is a two-step process. The first of these is detachment, the breaking away of particles at the surface of the soil. The rate of detachment depends upon the type of soil, the steepness and length of slope, amount and type of land cover, and external forces such as duration and amount of runoff. Detachment, by itself, can be a major source of property damage, especially in areas where established drainage patterns have been disturbed. High velocity flows in these drainages can eat away at channel banks. Structures within these erosion areas may be damaged or destroyed unless some type of bank stabilization is installed. The second step in the erosion process is transportation, which results in the actual loss of soil material. The product of this transportation is called sediment. Sediment has been classified as a major contributor to water quality problems nation wide. Sediment, deposited by floodwaters within homes and businesses, will normally contribute as much to total damages as from the high water itself.

The NRCS, through their Digital Soil Survey program, has developed a Soil Erosion by Water Map for Maricopa County (See Map 2-3). The map shows the general relationship of potential soil detachment and movement by water, divided into slight, moderate and severe erosion hazard classes for the County with the exception of the Tonto National Forest, the Barry M. Goldwater Gunnery Range, and the Tohono O'Odham Indian Nation. Approximately 6,770 square miles of the 9,226 in the County were classified by the NRCS. A severe erosion hazard has been identified for approximately 1,800 square miles of land, or nearly 27 percent, and nearly 2,000 square miles, or 29 percent, has a moderate erosion hazard of the total 6,770. The remaining 2,970 or 54 percent is classified as having a slight erosion hazard. This is a generalized map suitable for making broad assumptions concerning the severity of potential erosion and sedimentation problems in the County. It does not eliminate the need for onsite sampling, testing and detailed study of specific sites.



MAP 2-3
SOIL EROSION HAZARDS

Source: NRCS, March 2001

Over 56 percent of the soils in the County are susceptible to detachment and/or transportation of soil particles under the right conditions. The location of future development can have a major influence on how severe damages from the erosion process might be in the future.

2.2.3. Climate

Maricopa County lies within a dry, subtropical desert climate zone. Average relative humidity and annual rainfall are low. Temperatures are normally high in the summer. Records kept at Phoenix Sky Harbor Airport show that, on the average over 80 days per year, the maximum temperatures exceed 100 degrees. Table 2-1 gives a breakdown of temperature ranges by month as studied over a 50-year period. This table was taken from the Western Regional Climate Center web site.

Table 2-1

Period of Record General Climate Summary for Phoenix from 1948 to 1998 - Temperature (°F)

	Monthly Averages			Monthly Extremes			
	Maximum	Minimum	Mean	Highest Mean	Year	Lowest Mean	Year
January	66.6	42.8	54.7	62.2	86	44.7	49
February	71.1	46.0	58.5	65.6	91	51.9	55
March	76.0	50.2	63.1	70.1	89	55.8	52
April	84.8	57.4	71.1	79.6	89	63.3	67
May	93.3	65.4	79.4	86.3	97	71.8	53
June	102.9	74.1	88.5	93.6	94	80.8	65
July	105.2	80.5	92.9	96.1	80	87.5	55
August	103.6	79.3	91.4	96.1	94	87.4	55
September	99.3	73.3	86.3	90.9	79	81.9	50
October	89.3	62.2	75.8	81.6	88	70.0	49
November	76.1	49.6	62.8	69.0	95	56.6	57
December	67.7	43.1	55.4	62.5	80	49.7	67
Annual	86.3	60.3	73.3	76.3	81	70.2	64
Winter	68.4	44.0	56.2	61.8	81	49.8	49
Spring	84.7	57.7	71.2	77.5	89	66.6	65
Summer	103.9	78.0	90.9	94.8	94	86.5	55
Fall	88.2	61.7	75.0	77.9	77	70.4	57

There are two separate precipitation seasons. The first occurs from November to March, when the region is subjected to occasional frontal storms from the Pacific Ocean. Winter precipitation is greatest when the mid-latitude storm track is unusually far south so storms enter Arizona directly from the west or southwest after picking up considerable moisture from the Pacific Ocean.

The second rainfall season occurs in July, August and most of September when the area experiences widespread thunderstorm activity associated with moist air moving into Maricopa County from the south and southeast. These thunderstorms are extremely variable in intensity and location, and some of the heaviest amounts of precipitation in a short period occur during these months. Table 2-2 gives a breakdown of precipitation by month for the greater Phoenix Area. This table was also taken from the Western Regional Climate Center web site.

Table 2-2
Period of Record General Climate Summary for Phoenix from 1948 to 1998 - Precipitation (in.)

	Mean	High	Year	Low	Year
January	0.9	4.3	93	0.0	67
February	0.8	3.1	98	0.0	60
March	1.0	3.1	83	0.0	55
April	0.3	2.3	52	0.0	50
May	0.1	0.9	76	0.0	50
June	0.1	1.2	65	0.0	51
July	0.8	4.9	84	0.0	63
August	1.1	5.3	51	0.0	75
September	0.7	2.9	66	0.0	48
October	0.7	4.3	72	0.0	50
November	0.6	3.1	93	0.0	48
December	0.9	4.1	67	0.0	56
Annual	8.0	15.1	93	2.9	53
Winter	2.6	9.7	93	0.2	64
Spring	1.4	4.1	52	0.0	56
Summer	2.0	8.0	55	0.1	75
Fall	2.0	5.5	93	0.0	53

2.2.4. Hydrology

The five major river systems flowing through Maricopa County drain an area of approximately 57,000 square miles, including areas of New Mexico and Mexico. This drainage area is approximately six times as large as Maricopa County. Storms as far away as Mexico can influence the probability of floodwaters causing damage somewhere within the County. Many of the most damaging floods have occurred when winter storms have extended well outside of the Maricopa County area.

Intense summer storms on a localized basis have the potential to cause flooding in Maricopa County on a much more frequent basis than the winter storms. How often flood damages result from these localized storms depends on the size of storm, where measurable damages would start, and whether the effects of the storm occurs in developed areas of the county. The point where measurable damages begin varies depending upon the type, location, and elevation of the property in question. However, experience with evaluating flood damages has shown that measurable damages can be determined for at least the ten-percent chance storm in most instances.[5]

Rainfall records have been kept for the Phoenix area on a consistent basis for over 100 years. These records have been analyzed and the data used to make predictions concerning return periods for short duration precipitation. These predictions were used in developing the following forecasts concerning rainfall in Maricopa County. At Sky Harbor Airport the 24-hour duration rainfall that would occur in a 100-year event[6] would be 4.04 inches; a 50-year event would generate 3.57 inches; and a 10-year event 2.53 inches.[7] These values vary throughout Maricopa County and by the size of the area impacted by the storm.

The District currently has over 260 precipitation measuring gages located in Maricopa County and surrounding counties. The first of these gages was installed in 1981. This system is still growing as increased definition is needed. Data from each of these gages is available from the District web site located at http://www.fcd.maricopa.gov/.

Summary data from these gages has been studied to determine how frequently rainfall, with the potential to cause measurable damages, has occurred in Maricopa County. The water years of 1992 through 1997 were used as being a fairly typical representation of historical rainfall patterns for the county. Rainfall events of 10-year frequency (10 percent) or greater were tabulated for each of the precipitation gages for this six year period. Table 2-3 gives the number of storms for the 10 percent or greater frequency in tabular form.

Table 2-3 Number of Rainfall Events of Greater than the Ten Percent Frequency, by year for Maricopa County

Year	10% or >	50% or >	100% or >
1992	21	1	0
1993	19	2	3
1994	13	0	0
1995	11	3	2
1996	2	0	0
1997	20	10	7
Totals	86*	16	12

* Ten of these readings approached the 50-year frequency rainfall.

In a six year period, the ten percent chance rainfall was equaled or exceeded somewhere in Maricopa County 114 times. This does not mean that damageable floods occurred 114 times during this period. It does mean that the potential existed 114 times, or an average of 19 times per year studied, for floodwater damages to take place if the right conditions should prevail. These "right conditions" become more and more prevalent as people continue to move to Maricopa County in ever increasing numbers.

2.2.5. Geology

Maricopa County lies within the Basin and Range province of the Southwest, which includes the lower third of Arizona. This province includes the Sonoran, Mojave and Great Basin Deserts. The Maricopa County portion of the province is located within the Sonoran Desert and can be characterized by wide valleys and mountain ranges. The mountain systems surrounding the valleys are generally comprised of metamorphic and igneous rocks. However, in the northern and western portions, volcanics are more dominant, while basalts are more common in the West. [8]

The majority of the populated areas of Maricopa County are located along the quaternary alluvial deposits of the river basins. The Salt and Gila River basins consist of recent alluvium (Holocene to late Pleistocene), while the Hassayampa River basin consists of older sedimentary materials (middle Pleistocene to late Pliocene). This fine-grained alluvial material produces the wide, flat open spaces that typify the desert. [9]

Water table depth, location of aquifers, and subsidence issues due to ground water mining can affect or contribute to flooding in some areas. The Arizona Department of Water Resources (ADWR) is responsible for groundwater issues.

2.2.6. Geomorphology

Geomorphology can be defined as the study of landforms and the processes that shape them. In the desert, both natural and artificial processes can shape landforms, as well as create relatively sudden (in geologic time) changes. Whether unexpected or predictable, these geologic changes can affect the drainage patterns of an area. Because the majority of the urbanized population live in the valleys where the results of processes such as sedimentation and erosion culminate, they are more likely to become susceptible to flooding. As the county continues to grow, pressure to develop hillsides could potentially lead to more complicated flooding problems.

Desert landforms are an exemplary display of erosion forces and depositional processes that are characteristic of the desert. In the Sonoran Desert water plays a large role in these erosion processes. Arroyos and alluvial fans, two specific types of landforms occurring in Maricopa County, can both influence and be influenced by floodwaters.

Arroyo (wash) is a term applied in the arid and semi-arid southwestern United States to a small flat-floored channel or gully usually with steep or vertical banks that form under certain conditions. As arroyos develop, sediment generated upstream is conveyed and deposited downstream, ultimately reducing flood storage capacity of the channel. Urban development along arroyos has resulted in straightening of the channel and the release of relatively clean water to the system which increases flood velocities and the rate of erosion. Other land uses, such as agricultural activity and mining, can also have deleterious effects on arroyos further complicating erosion and flooding problems.[10]

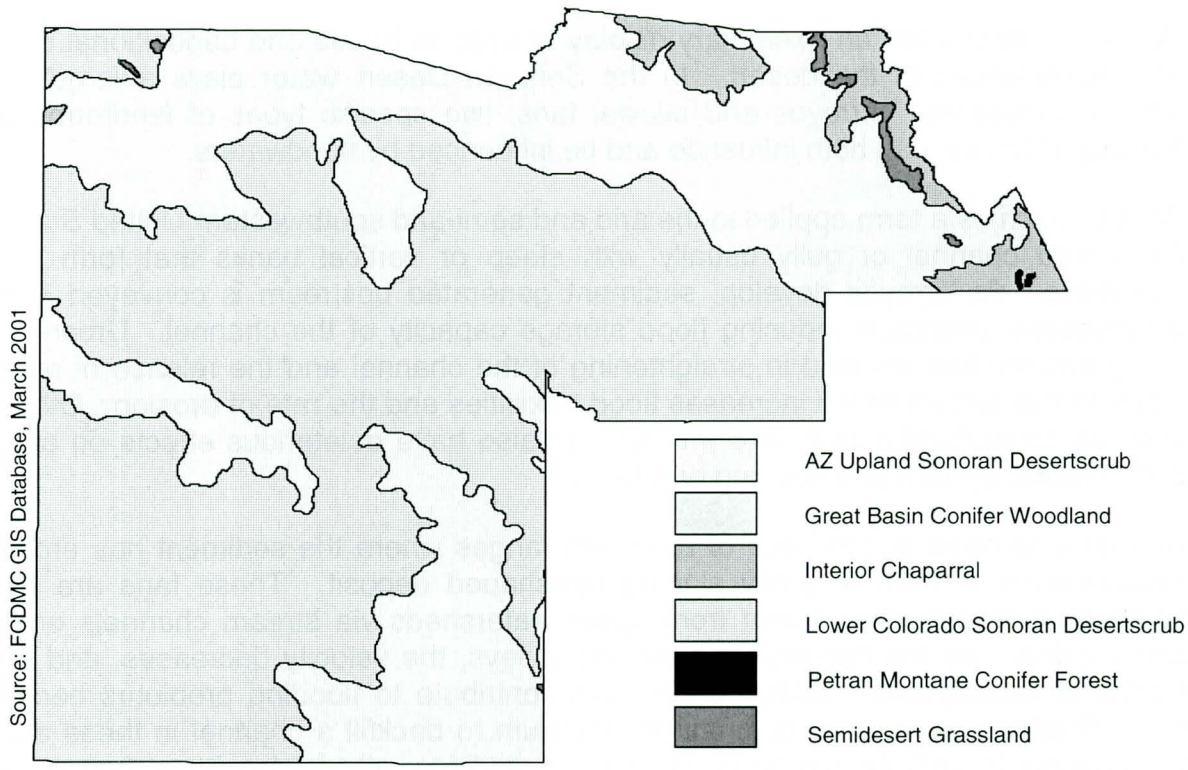
Alluvial fans occur at the base of mountain ranges where the sediment has eroded from the mountainside to form a gently sloping fan-shaped deposit. These fans are formed when floodwaters transport sediment from upper watersheds via stream channels onto the valley floors below. As the floodwaters near the valleys, the velocity decreases, and the sediment begins to be deposited. Alluvial fans can contribute to flooding problems because of their unpredictable nature. It is common for alluvium to backfill a channel in these areas causing the channel to shift its course (avulsion). In addition, alluvial fan flows frequently shift their position horizontally, a phenomenon known as lateral migration. The nature of this type of shift on an alluvial fan is very unpredictable and, as such, it is very difficult to forecast the course of flooding along an alluvial fan.

In a report entitled "Alluvial Fan Hazards in the United States" The Federal Emergency Management Agency (FEMA, 1989) lists the following as hazards that may occur on alluvial fans: high velocity flows; erosion/scour; deposition of sediment and debris; debris flows/impact forces; mudflows; inundation; and flash flooding.

Streams have a natural tendency to shift, or migrate, as the channel evolves. In the Southwest, this migration may occur either vertically or horizontally. Lateral migration or bank erosion occurs when the main channel shifts its course, either for natural or human induced reasons. Vertical channel migration is usually associated with aggradation or deposition, both of which affect the stability of the stream. Alterations in the channel, whether horizontal or vertical, can cause severe changes in the capacity of the channel to carry floodwaters and can affect peak flows and velocities.

2.2.7. Vegetation

The vegetative communities of Maricopa County can be divided into six major units. These units are Arizona Upland Subdivision of Sonoran Desertscrub, Lower Colorado Valley Subdivision of Sonoran Desertscrub, Interior Chaparral, Semidesert Grasslands, Great Basin Conifer Woodland, and Petran Montane Conifer Forest (See Map 2-4). The majority of the county falls within the Lower Colorado Valley Sonoran Desertscrub community (57%) or the Arizona Upland Sonoran Desertscrub community (38%). The remaining units comprise less than 5% of the total habitat. For the purposes of this discussion, only the two dominant communities will be described.



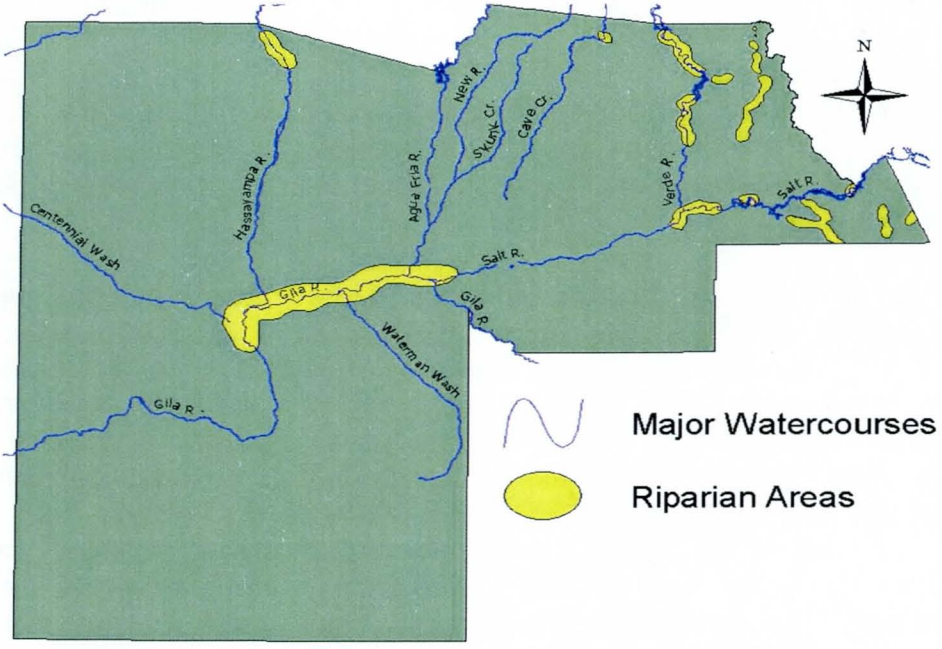
Map 2-4 Maricopa County Vegetative Communities

Arizona Upland Subdivision of Sonoran Desertscrub occurs primarily on the slopes and hills of the mountain ranges in the County. Due to the bimodal pattern of rainfall and subtropical climate, the Arizona Upland Subdivision community houses the most diverse desert vegetation.[11] This community is often very architecturally complex and may consist of a tall layer of trees such as Yellow (or Foothill) Palo Verde, Mesquite and Ironwood, a layer of shrubs and mid-height cacti such as Cholla and Jojoba, and a layer of low-level vegetation such as Barrel Cacti.[12]

In contrast, the Lower Colorado Valley Desertscrub community, which occurs primarily on the flat desert valleys, is much less varied. This is in part due to the substantially lower amount of rainfall it receives during the year. Plants commonly found in this community are Creosote Bush, Bursage, Yellow Palo Verde, Ocotillo, and Brittlebrush.

2.2.8. Riparian Habitat

Riparian areas are ecotones, or transition zones, between watercourses and the surrounding lands. Riparian habitat is associated with such a transition zone. In Maricopa County the majority of the watercourses are ephemeral; yet, due to the presence of intermittent seasonal, run-off, or groundwater riparian vegetation exists along many of the rivers. Riparian vegetation varies depending upon both groundwater and surface water levels. Perennial streams, especially along the Salt and Gila Rivers, often exhibit the cottonwood and willow association that was once typical along these rivers. Mesquite bosques are also found in these areas. Small pockets of cottonwood-willow association also occur in other areas that have a perennial or intermittent water source. Map 2-5 shows general riparian areas in the County.



Map 2-5 Maricopa County –Riparian Areas

Xeroriparian habitats are the most common type of riparian vegetation found in the County. This type of vegetation is commonly found along ephemeral streams where there is seldom any surface water. Many of the plant species within xeroriparian habitat are the same species as the ones that occur in the upland communities, however, the plant density and size are greater along ephemeral streams. Plants in this habitat may include Ironwood, Palo Verde and Mesquite.

Riparian habitat serves several natural flood control functions. Vegetation along watercourses acts as natural erosion control. Tree roots and vegetation help to stabilize soil and decrease erosion impacts near streams. This tends to decrease the probability that a stream will erode or that the channel will widen. Vegetation can also trap and stabilize sediment from floodwaters, and can store and slowly release floodwaters. In addition, riparian vegetation improves the water quality by trapping sediment and biodegredation. Due to the increased density and diversity of plants, as well as the diversity of topographical features, such as channel banks, riparian habitat provides food, breeding cover, and shelter for many wildlife

species. More than 80 percent of all wildlife in Arizona is dependent upon riparian areas. Another important function of riparian vegetation is that the vegetation in the floodplain tends to decrease the flow velocities, thereby attenuating the flows and alleviating some potential downstream flooding.[13]

In the past, riparian habitat has been considered a problem and the solution has been to eradicate it. Water loving plants, termed phreatophytes, were thought to consume water necessary for human purposes. They are also considered a flood threat because plants in the floodplain can divert water flows and adversely impacts the carrying capacity of the river. Research, however, has shown that riparian vegetation is necessary because it maintains the normal functions of the floodplain. Riparian vegetation is also effective at trapping and storing floodwaters, ultimately increasing groundwater depths through groundwater recharge.

2.2.9. Landscape Character

Landscape character refers to the overall visual and cultural impression of an area. It derives from the distinguishing visual characteristics of landforms, vegetation, rock formations, water forms, and cultural features that make up each area and give it an identifiable character and unique sense of place.

Maricopa County is characterized by a wide variety of landscape settings, each with its own individual character. These settings include a variety of natural, pastoral, suburban, urban and industrial attributes. The natural and traditional pastoral landscapes of the wide valley regions offer unobstructed large-scale panoramas of the Sonoran Desert. The uplands and rolling foothills (Bajadas) that surround the valley areas offer a variety of visually interesting and striking topographic and vegetative forms that create a feature landscape composition.[14] The surrounding steep and craggy mountain ranges that rise dramatically from the floor of the valleys serve as primary landscape focal points that capture the viewer's attention. The desert rivers, streams, and washes that transect the wide valley floors, together with the riparian vegetation, form small scale linear canopied landscapes that provide welcome visual contrast and relief. The suburban, urban and industrial landscapes offer a variety of historic, traditional and contemporary architectural forms and open spaces that define the cultural and historical context of the communities and places of the County.

The MAG Desert Spaces Plan,[15] in general, has identified the mountain ranges and major river lands of the County as having the highest value for open space preservation. The natural and cultural settings most vulnerable to loss of their natural character due to increasing urban growth and development within Maricopa County are the riparian settings of the rivers, streams and washes, the Bajadas, and the natural Desert Scrub, pastoral farmlands and the rural urban character of the small towns and communities located within the valleys. Non-structural flood control methods (regulatory) of providing flood protection offer the greatest potential for preservation of natural landscape character. Soft structural methods (earthen facilities) that include appropriate aesthetic features can also help to preserve or restore natural landscape character, and offer excellent opportunities for protection and enhancement of local community character. Hard structural methods (concrete lined structures) of providing flood protection provide more limited opportunities for helping to preserve natural Sonoran Desert landscapes and protection of local community character.

Landscape character can be systematically classified and mapped at different scales.[16] Landscape Character Types and Subtypes were identified and delineated for the entire state of Arizona by the USDA Forest Service.[17] The character types and subtypes represent regional and sub-regional areas of land having similar distinguishing characteristics of landform, vegetation, water features and rock formations. Two of these Character Types are represented in Maricopa County. They include: 1) the Sonoran Desert Character Type (89%) and 2) the Tonto Character Type (11%). The delineation of the Subtypes within Maricopa County by the USDA Forest Service is incomplete, presumably, due to the fact that most of the County is situated outside of the boundaries of the National Forests. The Character Types and Subtypes provide a frame of reference for further refinement and identification of existing landscape character at an appropriate scale for regional and project level planning of flood control facilities. Currently, no such refinement of landscape character mapping is available for the overall County.

Flood control facilities, including, dams, dikes, basins and channels, have the potential to beneficially or negatively affect the scenic character and aesthetic values of adjacent communities, pastoral and natural landscapes within Maricopa County. The identification and mapping of existing landscape character can provide a basis for the development of landscape themes and aesthetic features for flood Control facilities that will help preserve and protect natural Sonoran Desert landscapes and local community character.

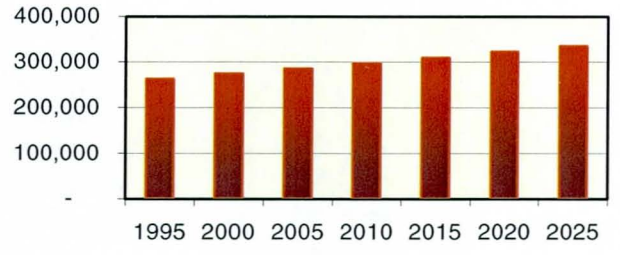
2.3. Socioeconomic Characteristics

2.3.1. Population

The population of the United States in 1995 stood at 262,754,000 and continues to grow. This total is expected to increase to 335,048,000 by the year 2025.[18] This is an increase of about 27.5 percent over the 30-year period or nearly one percent per year (see Figure 2-1).[19]

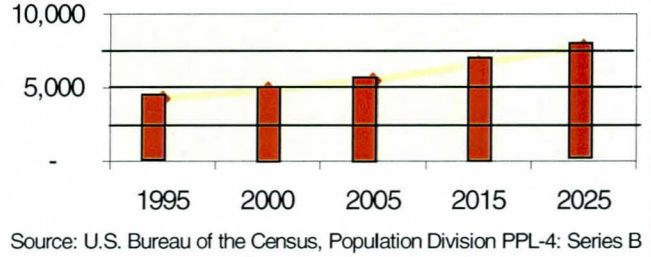
Arizona had a population of 4,218,000 people in 1995 (see Figure 2-2).[20] The State ranked as the 23rd most populous when compared to all 50 states and the District of Columbia. However, Arizona is projected to be the 13th most populous state by 2025, with approximately 7,729,000. This is a gain of 3,511,000 people over the 30-year period. This gain is just over 83 percent or approximately 2.77 percent per year. Arizona has been one of the fastest growing states ranking sixth in net gain between 1995 and 2000.

Figure 2-1 Population Growth in the United States 1995 - 2025
[Thousands. Resident population]



Source: U.S. Bureau of the Census, Population Division, PPL-47

Figure 2-2 Population Growth in Arizona 1995 - 2025
[Thousands, Resident Population]



Source: U.S. Bureau of the Census, Population Division PPL-4: Series B

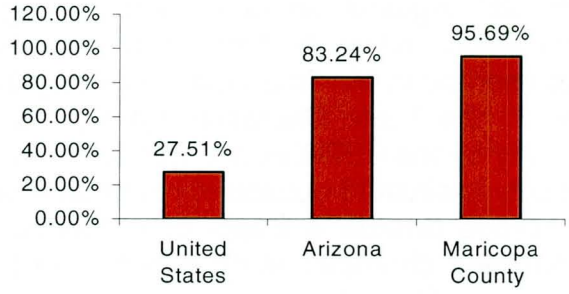
The increase in projected population in Arizona is over three times what is projected for the United States as a whole over the 30-year period. Much of the increase in Arizona can be attributed to Maricopa County, which is projected to increase from 2,528,700 people in 1995 to 4,948,400 people in 2025, an increase of over 2.4 million people (see Figure 2-3).[21] This addition of 2,419,700 people over the 30-year period equates to nearly a 96 percent increase or approximately a 3.2 percent growth rate on an annual basis (See Figure 2.4).

The significance of this growth rate is that Maricopa County will have a net average increase in population of 80,656 people each year over the 30-year period. Maricopa County ranked first of all the counties in the United States in total gain in population between 1996 and 1997. This total gain was 82,789 people, which was over 20,000 more than Los Angeles County, the number two county of the ten biggest numerical gainers for that year (see Table 2-4).[22] Maricopa County will be growing at approximately the same amount of people every year for the next 30 years as it was in 1996 when it ranked first in the Country in numerical growth.

There will be implications for the District if this rate of growth continues to take place in Maricopa County. The population data is reported in this Chapter so that a series of assumptions can be made to identify where future flooding, erosion, and sedimentation problems may impact people.

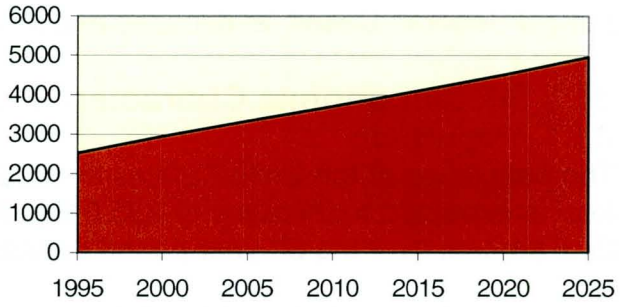
Continued rapid growth could put more people in harms way from flooding hazards. The District uses the assumptions detailed in Section 2.3.5. of this Chapter to assess where and when these people will locate in order to prioritize future projects, studies, and program activities. Chapters 4 and 5 of this Plan will address solutions (underway and proposed) to

Figure 2-3 Maricopa County, State of Arizona and The United States Projected Population Change 1995 to 2025



United States data source: U.S. Census Bureau
Arizona data source: Arizona Department of Economic Security
Maricopa County data source: Maricopa County Association of Governments
and the Arizona Department of Economic Security

Figure 2-4 Maricopa County Growth 1995 - 2025
[Thousands, Resident Population]



Source: MAG for the years 1995-2000, DES for 2025

Table 2-4
Ten Biggest Numerical Gainers in Population 1996 to 1997

Rank	County	State	No. Increase
1	Maricopa	Arizona	82,789
2	Los Angeles	California	61,623
3	Clark	Nevada	59,549
4	Orange	California	54,733
5	San Diego	California	45,447
6	Harris	Texas	43,296
7	Riverside	California	33,113
8	Broward	Florida	30,216
9	Dallas	Texas	28,918
10	Collin	Texas	27,991

Source: Census Bureau, 1997 County Population Projections,http://www.census.gov/Press-Release/cb98-41.html

mitigate or eliminate current known problems, approaches for identifying remaining flood hazard problems, and prioritization of watersheds for future projects.

2.3.2. Land Ownership and Land Use

The breakdown for land ownership for Arizona from the Arizona State Land Department is shown on Figure 2-5.[23] Approximately 70 percent of the land area of the State is under some level of federal control. In comparison, 60 percent of land in Maricopa County is federally controlled leaving 40 percent either privately or state controlled. Map 2-6 shows the location and breakdown of these land ownership groupings for the County. Approximately 625 square miles of the County's 9,226 square miles have been developed for residential or commercial use as of 1995. Map 2-7 gives a breakdown of land use in Maricopa County through 1995.

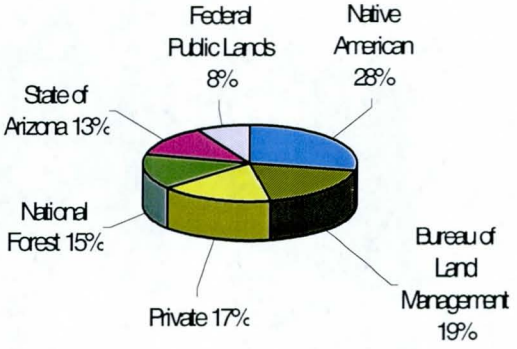


Figure 2-5 Land Ownership in Arizona per the Arizona State Land Department

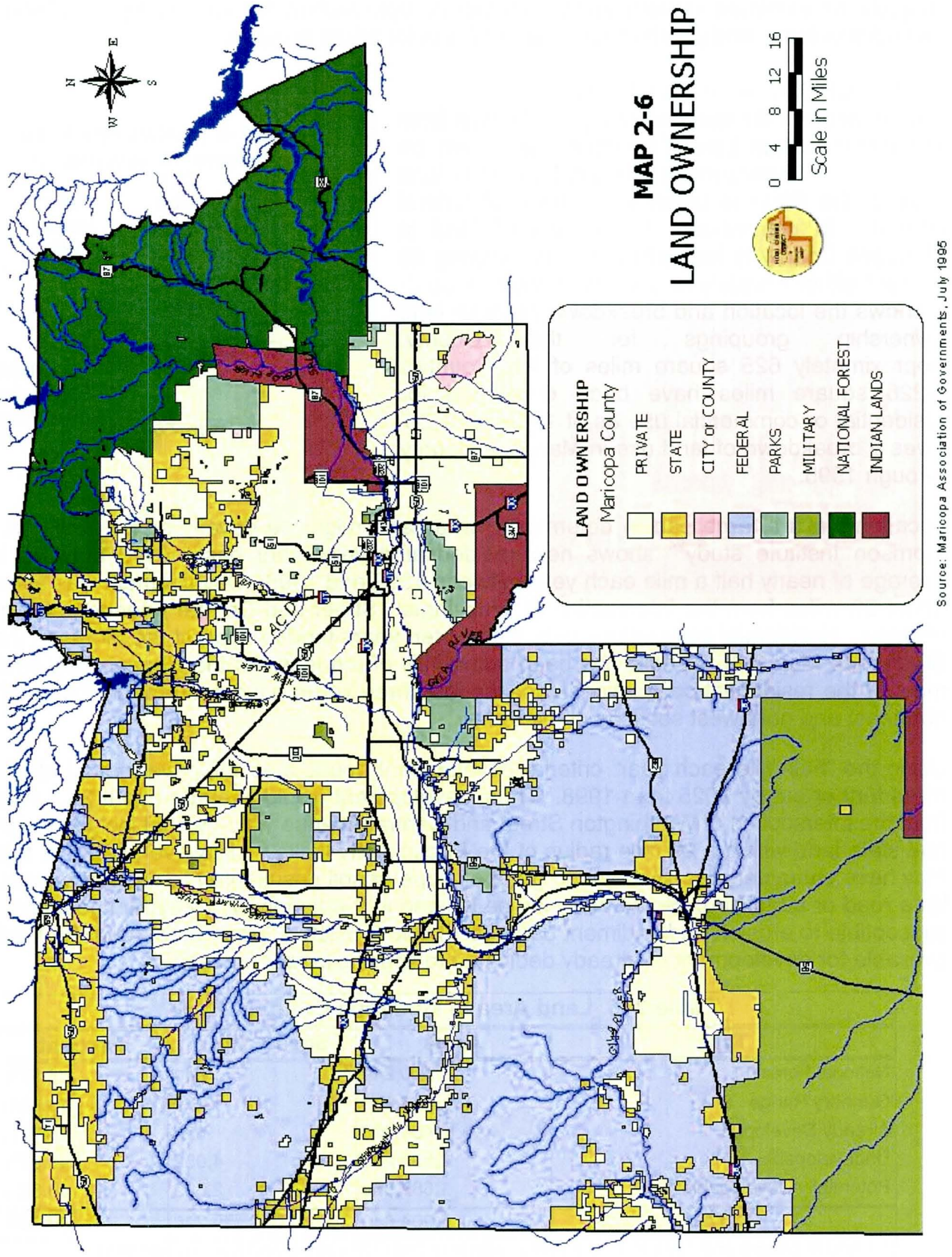
Location plays a large part in determining what land might be developed by 2025. A 1998 Morrison Institute study[24] shows new residential development has moved outward by an average of nearly half a mile each year between 1993 and 1998. Development was averaging about 20 miles from the intersection of Washington Street and Central Avenue in downtown Phoenix. Residential completions over the last ten years tend to support the Morrison Institute Study (see Map 2-8). There has been some infill of areas within the Phoenix City limits but most of the residential completions over the last three years have occurred in the southeast, northeast and northwest sections of the Valley.

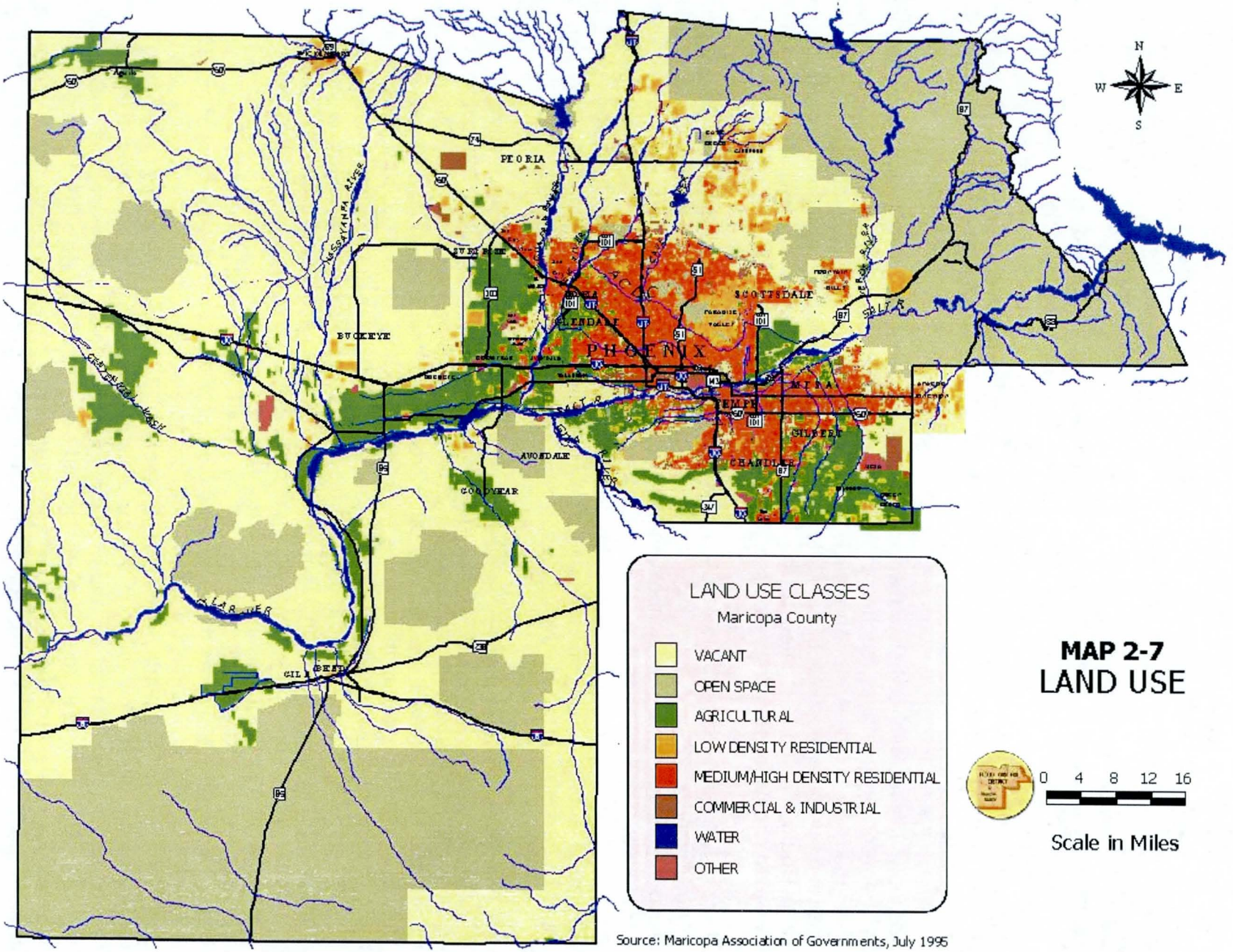
Using the "half-mile each year" criteria, development boundaries will have moved about 13.5 miles further out by 2025 from 1998. Thus, development would average about 33.5 miles out from the intersection of Washington Street and Central Avenue which would include the private and state land within a 20-mile radius of the Phoenix city limits.[25] However, some of this land may have characteristics such as too great of slope or soil unsuitability to support a foundation for a road or a building. Some of it may be located in the floodway, 100-year floodplain, or be susceptible to erosion and sediment damage. Table 2-5 lists a broad breakdown for land area available for development or already dedicated to specific long-term uses.

Table 2- 5 Land Area In Maricopa County - 2000

Type	Acres	Square Miles	Percent
National Forest	410,240	641	6.95%
Gunnery Range	818,560	1,279	13.86%
Already Developed	400,000	625	6.77%
Undevelopable	2,593,280	4,052	43.92%
Potentially Developable *	1,682,560	2,629	28.50%
TOTAL	5,904,640	9,226	100.00%

* Land in private and state trust ownership with less than 15% slope and not in a floodway.


MAP 2-6
LAND OWNERSHIP
0 4 8 12 16
Scale in Miles
LAND OWNERSHIP
Maricopa County
PRIVATE
STATE
CITY or COUNTY
FEDERAL
PARKS
MILITARY
NATIONAL FOREST
INDIAN LANDS
Source: Maricopa Association of Governments, July 1995



MAP 2-7
LAND USE

Source: Maricopa Association of Governments, July 1995

Zoning Regulations and Environmentally Sensitive Lands Ordinances (ESLO's) are now in place in many municipalities for prohibiting development of the land with severe limitations of any of the hazards identified above. In the past, however, a number of areas with one or more of these limitations have been developed.

2.3.3. Potential Developable Land

Future development is predicted to be most heavily concentrated in the west and north sections of the Metropolitan Area. This appears likely for two reasons. First, the southeast and the east sections of the County have development master plans almost developed to the boundaries of the Gila River, Salt River Pima-Maricopa and Fort McDowell Mohave-Apache Native American Communities. Thus, most of the remaining potential developable land lies to the north and west.

Secondly, the recently completed western section of Loop 101 has created a transportation link between the northern reaches of Interstate 17 and the western portion of Interstate 10 within the Metropolitan Area. This link is seen as an important stimulus for development in the west and northwest sections of the Metropolitan Area. The future plans for the continuation of State Route 303 Loop located to the west and north of Loop 101 will also increase the likelihood of development in these areas.

There is 1,625 square miles (1,040,000 acres) of developable land area within a 20-mile radius of the Phoenix city limits, which includes State Trust Lands. The State manages trust land to maximize the benefit to state schools, making these lands leaseable or for sale to developers. To date just over 8,100 acres or 12.65 square miles of State Trust Land have been sold, some of this for open space preservation. This 1,625 square miles is reduced to exclude previously developed land, geologic constraints, federally held lands, and preserve areas to leave about 1,240 square miles of land in the urbanized area available for development.

The Maricopa Association of Governments (MAG) has assembled a development database with information on active, planned and proposed development projects in Maricopa County as of July 1, 2001. These potential development areas are shown on Map 2-9. The total area in all of these developments is about 359,000 acres, more than enough land to take care of the projected population needs through the year 2025. Of this total, 131,000 acres are actively being developed, 87,000 acres are planned, and 141,000 acres are proposed. Over half of the 359,000 acres is in the western and northern sections where most of the future development is projected to take place. Section 2.3.5. of this Chapter presents assumptions and data in order to estimate acres needed for development through 2025. Development will also occur on non-master planned areas or infill.

Approximately 236,000 acres throughout the County will likely be developed over the 30 years from 1995 to 2025. There is about 1.7 million acres of potentially developable land in the County for this to take place. This Chapter looks at the areas where this development most likely will take place, how much of the presently developable land is subject to flood and/or erosion and sediment damages, and what the potential is for future development being located in areas susceptible to flood and/or erosion and sediment problems. This information is used to determine where flood control projects and regulatory programs will be needed to minimize or eliminate flood and erosion hazard public safety problems.

MAP 2 - 8

RESIDENTIAL COMPLETIONS

APRIL 1990 TO JUNE 1999

1 dot = 1 house

New Residential Completions

- Apr. 1990 - Dec. 1993
- Jan. 1994 - Dec. 1996
- Jan. 1997 - June 1999
- Watershed Boundaries

Residential Completions per year, 1990 - 1999:

1990	9,324*
1991	12,515
1992	17,049
1993	19,752
1994	25,426
1995	26,873
1996	31,990
1997	29,174
1998	32,672
1999	18,182**

*** 1990 data covers April to December.**

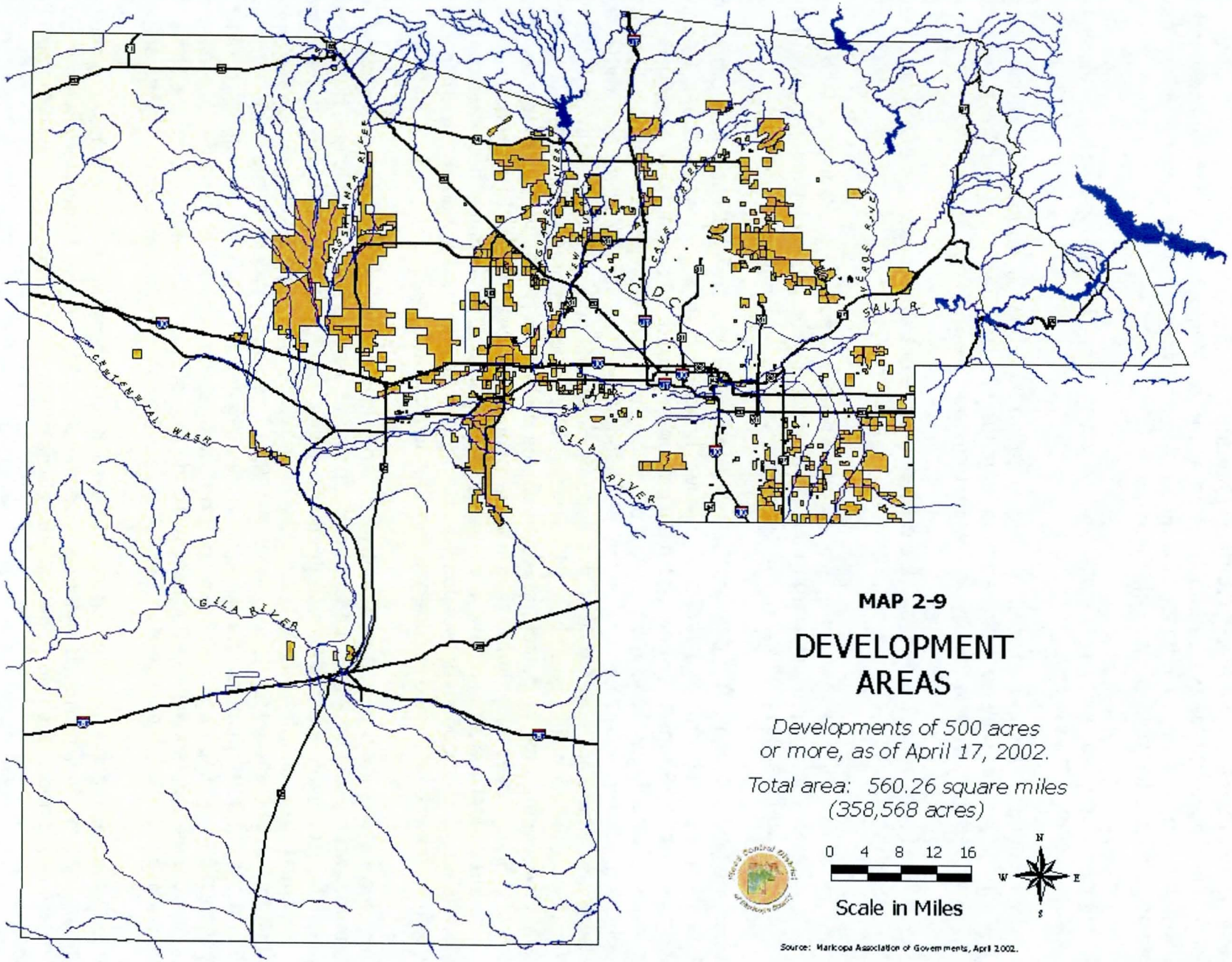
**** 1999 data covers January to June.**

Total new residencies, Apr. 1990 - June 1999: 222,957

0 1 2 3 4 5 6 7 8 9 10 11 12

Scale in Miles

SOURCE: MARICOPA ASSOCIATION OF GOVERNMENTS, MAY 2000.



MAP 2-9

DEVELOPMENT AREAS

Developments of 500 acres or more, as of April 17, 2002.

Total area: 560.26 square miles (358,568 acres)

0 4 8 12 16

Scale in Miles

N W E S

Source: Maricopa Association of Governments, April 2002.

2.3.4. Development in the Floodplain and Floodway

Delineations have not always been completed ahead of development, which has resulted in buildings being constructed in floodplains and/or floodways. Prior to 1978 floodplain mapping was not available for most areas of the County.

Definitions[26] for base flood, floodplain, and floodway from the Floodplain Regulations for Maricopa County are as follows:

- Floodplain - the area susceptible to inundation by a base flood including areas where drainage is or may be restricted by man-made structures which have been or may be covered partially or wholly by floodwater from the 100-year flood.

- Base flood - a flood that has a one percent chance of being equaled or exceeded in any given year.

- Floodway - the channel of a river or other watercourse and the adjacent land areas necessary in order to discharge the 100-year flood without cumulatively increasing the water surface elevation more than one foot.

There are approximately 8,700 linear miles per the 100,000 scale USGS Hydrography of stream courses with drainage areas of greater than one square mile in Maricopa County. Approximately 1,780 miles or only about 21 percent of the total have detailed floodplain and floodway delineations completed. Approximately 65 percent of the County's present population and about 49 percent of the projected population for 2025 will live within the watersheds where just over half of the floodplains and floodways are already delineated. Population projections indicate about 51 percent of the projected growth will take place in the watersheds where only 17 percent of watercourses have been delineated. If a projected rate of 1,000 linear miles of stream course were studied per year, most watersheds will have delineated floodplains and floodways within seven years for all of the identified watercourses. Prioritization of watercourse delineations will be needed to stay ahead of development to avoid structures being constructed in currently undesignated hazard areas.

The delineated floodways and floodplains, and floodplains defined using approximate methods, were placed on 1999 aerial photographs and used to count homes and businesses within the 100-year floodplain throughout the entire County (includes areas in municipal boundaries). This counting has indicated that over 22,000 homes or businesses currently exist within the one hundred-year floodplain as of 1999. This same procedure has identified about 430 of the 22,000 structures as being in a defined floodway. These structures could be susceptible to varying degrees of damage from water borne sediments. In addition, many of the structures, located within 1,000 feet of floodways, could be threatened by the erosion of stream banks caused by high water flows. Figure 2-6 gives an example of one of these areas.

Potential flooding and erosion problems also exist in the approximate 356,000 acres of master planned communities projected as future development areas. These areas were overlaid onto the delineated floodways and 100-year floodplains in Maricopa County (See Map 2-10). This procedure would place about 9,600 acres in the floodway and an additional 22,700 acres

within the currently designated 100-year floodplain. It is possible that future structures could be built in the floodway and in the 100-year floodplain without adequate safeguards in place.

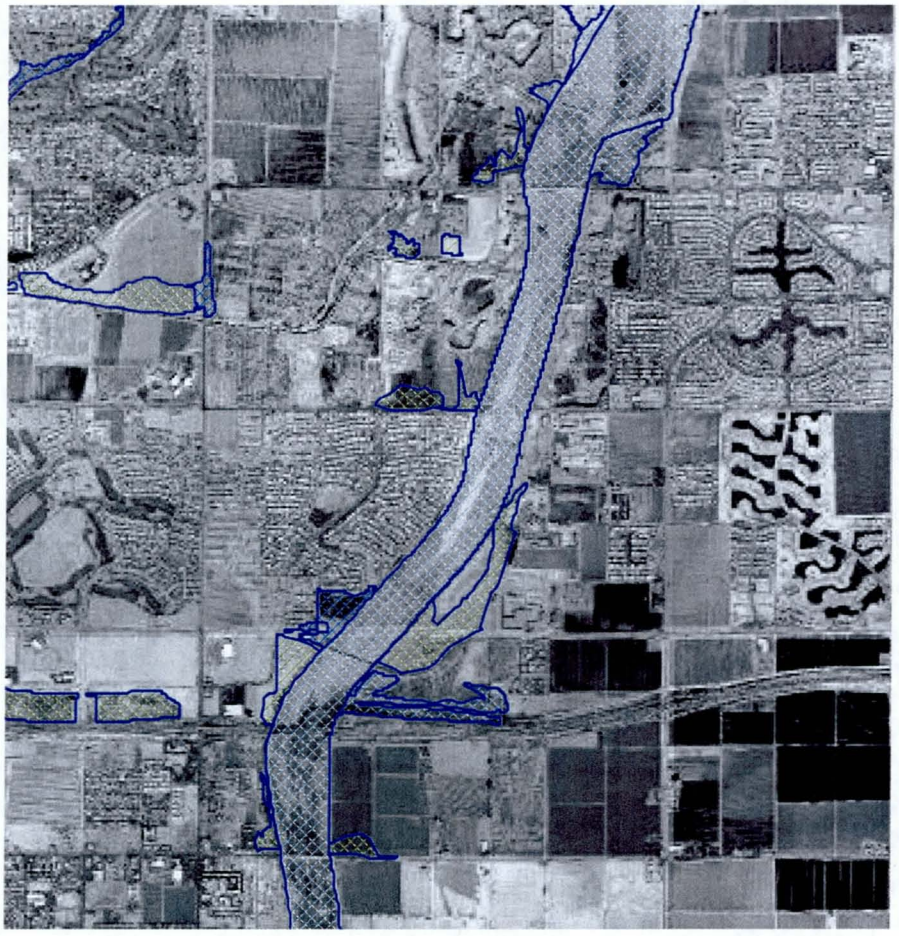
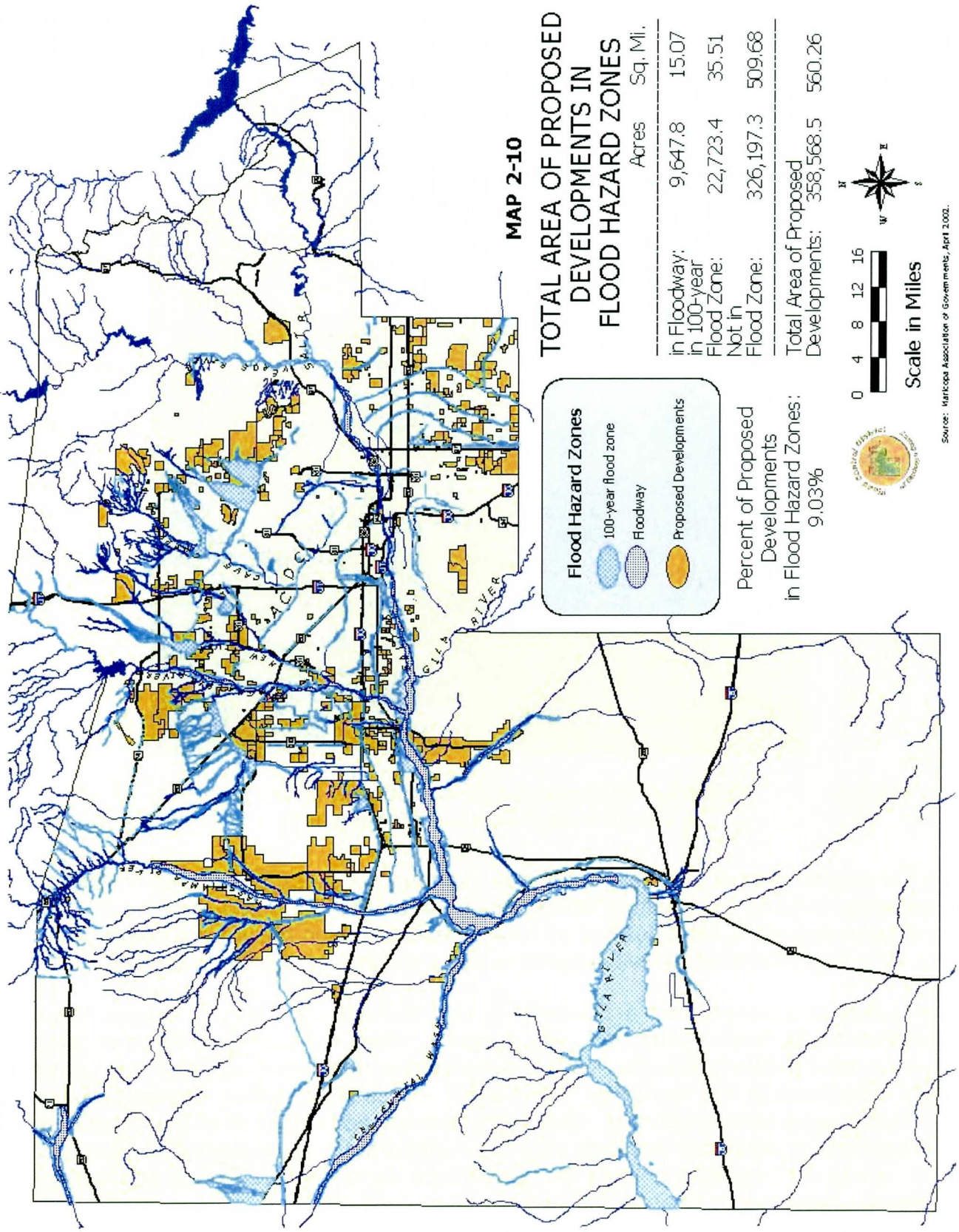
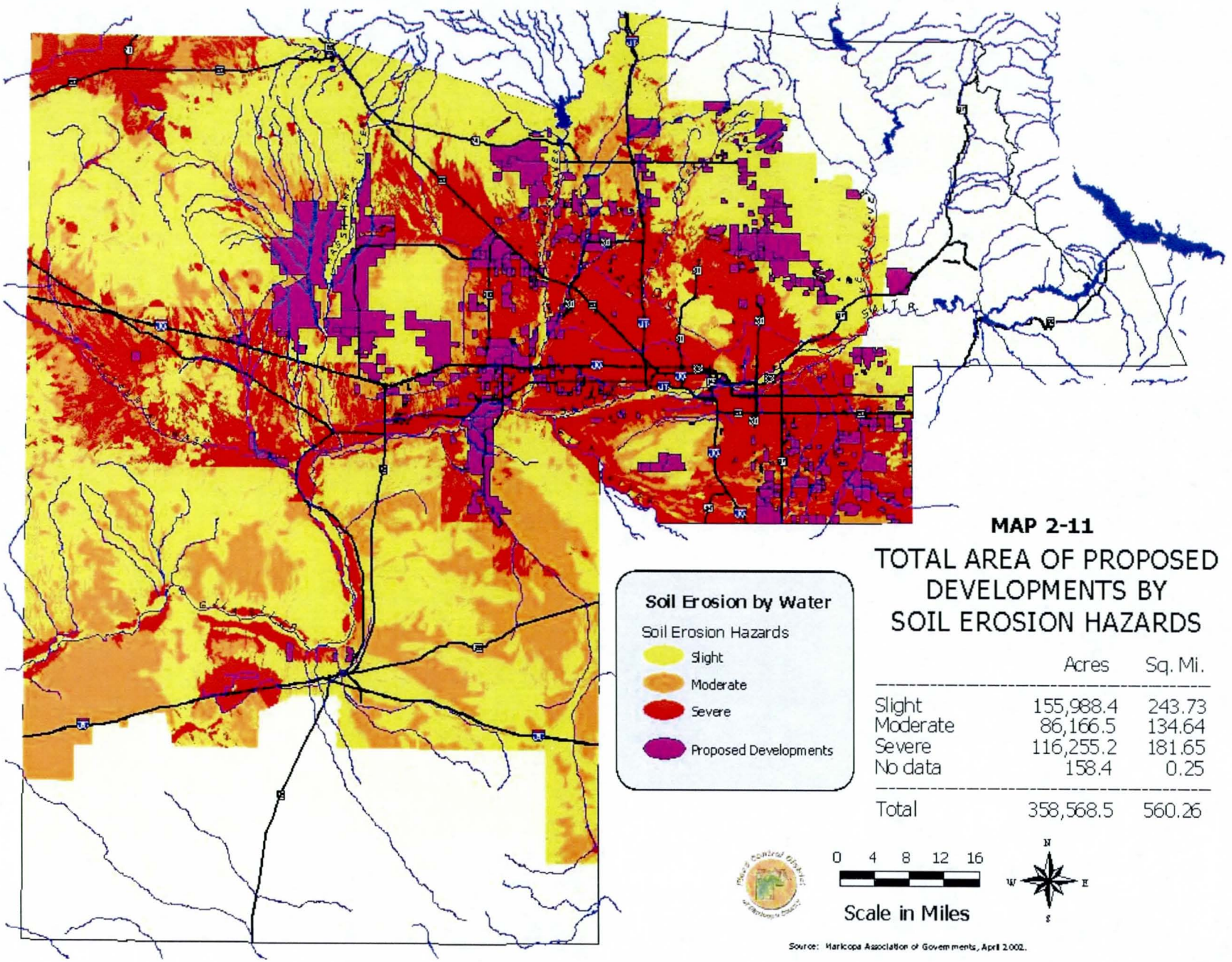


Figure 2 - 6 Example of a Maricopa County Aerial Photo with Delineated Floodplain (femazones)

Potential erosion hazard areas are even more pronounced. Map 2-11 shows the soil erosion hazard areas overlain on the future development areas. Nearly 116,300 acres or 32 percent of the development areas are classified as having severe erosion hazard potential from flowing water. The same issue as above applies to severe erosion hazard area delineations.

Constructing structures within a floodway is now prohibited under the current Floodplain Regulations for Maricopa County (adopted August 4, 1986, and subsequently amended). The 430 structures identified within the floodways would have been constructed prior to completing studies documenting the floodway. Therefore, construction within currently designated floodways is not a serious concern. Until floodplains are defined for all of the watercourses in Maricopa County, additional buildings could be constructed in undelineated floodprone areas and in areas that could eventually be determined as a floodway once delineations are completed. Table 4-2 in Chapter 4 shows, by watershed, the watercourse lengths for which floodplain delineations have not yet been completed.


MAP 2-10
TOTAL AREA OF PROPOSED DEVELOPMENTS IN FLOOD HAZARD ZONES
Acres Sq. Mi.
in Floodway: 9,647.8 15.07
in 100-year Flood Zone: 22,723.4 35.51
Not in Flood Zone: 326,197.3 509.68
Total Area of Proposed Developments: 358,568.5 560.26
Flood Hazard Zones
100-year flood zone
Floodway
Proposed Developments
Percent of Proposed Developments in Flood Hazard Zones: 9.03%
0 4 8 12 16
Scale in Miles
Source: Maricopa Association of Governments, April 2002.
GILA RIVER
SALT RIVER



MAP 2-11

TOTAL AREA OF PROPOSED DEVELOPMENTS BY SOIL EROSION HAZARDS

	Acres	Sq. Mi.
Slight	155,988.4	243.73
Moderate	86,166.5	134.64
Severe	116,255.2	181.65
No data	158.4	0.25
Total	358,568.5	560.26

Source: Maricopa Association of Governments, April 2002.

Completion of the A-Zone delineation, using approximate methods, will provide necessary flood hazard information to give notice to landowners so that precautions can be taken. Additional studies may be required in these areas to more precisely determine floodwater elevations and floodplain or floodway boundaries. Until floodplains are defined for all of the watercourses in Maricopa County additional structures could be constructed in undelineated flood prone areas and areas that could be determined to be floodway once delineations are completed.

2.3.5. Future Development Analysis

The District must anticipate where future development will be, so assumptions are made based on data presented in the previous sections. Some key numbers from this data used to make these assumptions are shown in Table 2-6.[27] These averages are used to determine development trends and amount of land needed for future growth which will then be used for analyses of watersheds for flooding risks. Although the individual watersheds of the County will develop with different densities and land use patterns based on geographical and regulatory constraints, these averages serve as a guide when analyzing each watershed for risk. The following assumptions based on the data from Table 2-6 and other information referenced in this Chapter are used for determining priority of each watershed for future study:

Assumptions

1. The projected population for Maricopa County, using MAG data that was based on the 1995 Census, in 2025 is 4,948,400. [4,948,400 (2025) – 2,528,700 (1995) = 2,419,700 additional people]

2. The U.S. Census Bureau shows an average of 2.59 persons per household in Maricopa County in 1990.[28] (2,419,700 ÷ 2.59 = 934,247 new households ÷30 = 31,141 average per year)

Table 2- 6
Housing Units Authorized for Installation in Maricopa County – 1999

Type	Number	% of Total
Single Family	35,430	75
Multi-Family	9,225	20
Mobile Home	2,447	5
TOTAL	**47,406***	**100**

* Averages approximately 3,950 per month.

3. The Morrison Institute for Public Policy has calculated a table showing that average lot size for new homes in the metropolitan Phoenix Region in the 1990's was 6,677 square feet.[29] Additional area will be taken up by streets and roads - a ratio of lot sizes by block to street widths and lengths per block produced a figure of 22.43 percent per lot (1,498 square feet) of urban development being attributed to transportation corridors.[30] Each single-family unit will therefore use an average of 8,175 square feet or 5.3 units per acre.

4. A small number of apartment complexes were selected at random from the east, central and western parts of the Phoenix Metro Area and then looked up on the County Assessor's records for square footage for Maricopa County.[31] The average number for this small random sample came out to be 990 square feet per housing unit, plus 405 square feet for 2.5 parking spaces per unit at 162 square feet for each parking stall (for the purposes of this study dimensions of 9 feet wide by 18 feet long are used),[32] plus 350 square feet of open space per unit deemed reasonable for each housing unit in a complex. The 22.43 percent per unit for transportation corridors must be added (390 square feet per unit). The average multi-family unit uses approximately 2,135 square feet per unit. This is approximately 20.4

units per acre. Most complexes are two-story which reduces the amount of land area covered. Dividing the 990 square feet in half would adjust for the second story. The total land covered for an apartment unit would be 1,640.

5. A typical lot in a mobile home park averages about 2,100 square feet. The 22.43 percent per lot for streets and roads must be added (471 square feet) for a total of 2,571 square feet per unit or 16.9 units per acre.

6. An average estimate of commercial and industrial development is about 21.65 percent of residential development or 1,426 square feet per household.

7. Public Safety (fire, police) facilities will require approximately 1,120 square feet per household.

8. On the average, there are 60 children of nursery school age per 1000 persons, 175 children of elementary school age per 1000 persons, and 75 students each of junior high and high school age per 1000 persons. The average nursery school uses about 0.138 acres, an elementary school uses approximately 14 acres, a junior high uses about 26 acres, and a high school about 40 acres.

9. An estimated 10.5 acres per 1,000 persons is needed for libraries, community facilities, recreation, and open space.[33] This is 1,138 square feet per household. Detailed calculations to arrive at the numbers for assumptions 7, 8, and 9 for Table 2-6 are in Appendix D.

In Table 2-7 below the area per household is multiplied by the estimated number of units for residential development to arrive at total land area needed for future development. Each non-residential use area per household is multiplied by the total number of housing units (934,247) to arrive at the total land area needed for those categories.

Table 2-7 Additional Land to be Developed 1995 - 2025

Type of Development	Area per Household * (square feet)	Average % of Development	Estimated No. of Units	Total Land Area Needed for Future Development		
				square feet	acres	sq. miles
Single Family	8,175	75%	700,685	5,728,099,875	131,499	205.47
Multi-Family	1,640**	20%	186,850	306,434,000	7,035	10.99
Mobile Home	2,571	5%	46,712	120,096,552	2,757	4.31
Subtotal	**N/A**	**100%**	**934,247**	**6,154,630,427**	**141,291**	**220.77**
Commercial / Industrial	1,426	21.65%	N/A	1,332,236,222	30,590	47.80
Public Safety Facilities	1,120	0.79%	N/A	1,045,440,000	24,000	37.50
Schools	723	0.51%	N/A	675,180,000	15,500	24.22
Open Space	1,138	0.81%	N/A	1,062,864,000	24,400	38.13
Subtotal	Subtotal 4,407	N/A	N/A	**10,270,350,649**	**235,781**	**368.42**

* Total includes areas for parking and open space as detailed in assumptions.
** This number is adjusted down to account for two story buildings (see assumption 4).

Maricopa County will need to develop an additional 141,300 acres for residential uses by 2025 to accommodate the population increases that are projected. Total land needed for development by 2025 is projected at about 236,000 acres or 368 square miles. Where and how this additional acreage is developed will have a major impact on the operation of the District for years to come.

Each watershed is expected to increase in population. The population projections by watershed are shown in Chapter 4 of this Report. MAG population projections for 2025 put more people in some watersheds than available developable land area can accommodate at current land use densities and trends. Population may spill over to neighboring watersheds, shifting the burdens and risks. In some areas the increased population will lead to build-out, putting pressure on regulators to allow floodplains, erosion hazard zones, and hillsides to be developed. This option may put greater numbers of people in high-risks areas for flood hazards. Requests for higher densities may be another option to pursue instead to accommodate this increased population growth in the areas indicated.

2.4. Summary

The combination of physical characteristics plus a large and continuing growth in population has placed Maricopa County residents in areas susceptible to flooding and/or erosion and sediment damages. The physical characteristics information presented at the start of this Chapter demonstrate the complexity of the vast area under the District's jurisdiction. In conjunction with differing physical characteristics across the County, population will be expanding in both existing urbanized areas and more remote unincorporated areas. The District faces challenges in providing the solutions for floodplain management for these diverse needs.

Assumptions indicate a need for approximately 236,000 acres to be developed to provide for the needs of the projected growth in the County. The data shows that about 356,000 acres are master planned, which will be adequate to cover future needs. The land that is undevelopable (15 percent and higher slopes, floodway/floodplain) needs to be subtracted from the total, lowering the 236,000 acres available in these master planned areas. However, all future development will not take place within a master planned area. This makes the District's job challenging when anticipating which areas will need to have flood related issues studied. It becomes essential to work with the development community at the front end of the process to provide for proper drainage and mitigation of flooding problems. The District through its studies, should provide assistance to the development community to help guide development away from high risk areas.

As more floodplain delineations are completed by the District it is likely that additional structures will be identified in the floodplain. It is crucial to get ahead of development with delineations to prevent this from occurring in the future. Numerous District programs have been initiated over the past 40 years to address alternative solutions to flood hazard elimination. These programs are identified and described in Chapter 3. Chapters 4 and 5 will further define problem areas by watersheds and how the District programs have been and will be used to eliminate or reduce these problems.

Endnotes

[1] Flood Control District of Maricopa County Draft Strategic Plan 2002.

[2] Information in this paragraph came from the Maricopa County web site. http://www.maricopa.gov

[3] Information in the preceding two paragraphs is taken from the Maricopa County Comprehensive Plan 2020 Eye to the Future, adopted October 20, 1997.

[4] General Soil Map with Soil Interpretations for Land Use Planning, Maricopa County, United States Department of Agriculture, Soil Conservation Service, March 1973.

[5] Assumption is based on evaluating and reviewing PL83-566 Small Watershed Projects for the Soil Conservation Service (Natural Resources Conservation Service) over a 30-year period.

[6] A one hundred year rainfall has a one percent chance of being equaled or exceeded in any given year. A fifty-year storm has a two percent chance and a ten year rainfall a ten percent chance of being equaled or exceeded in any given year.

[7] Figures taken from NOAA Technical Memorandum NWS WR-177, Climate of Phoenix, Arizona, December 1986 (Revised) p. 92.

[8] Reynolds, 1988 in Maricopa County, 1995.

[9] Ibid.

[10] Vogt, Brandon J., *The Arroyo Problem in the Southwestern United States.*

[11] Brown, David E., Ed. 1994. Biotic Communities: Southwestern United States and Northwestern Mexico. Salt Lake City: University of Utah Press.

[12] Ibid.

[13] Arizona Department of Water Resources (ADWR). 1994. *Arizona Riparian Protection Program Legislative Report.*

[14] 1963, Forest Landscape Description and Inventories – A Basis for Land Planning and Design, R. Burton Litton, PSWR&ES, USDA FS, USDA Forest Service Research Paper PSW-49.

[15] 1995, Desert Spaces, An Open Space Plan for the Maricopa Association of Governments, Design Workshop, Inc.

[16] 1995, Landscape Aesthetics, A Handbook for Scenery Management, USDA FS, Agriculture Handbook 701.

[17] Undated, Landscape Character Types of the National Forests in Arizona and New Mexico, USDA FS, Southwest Region.

[18] U.S. Bureau of the Census. http://www.census.gov.

[19] Ibid.

[20] Ibid.

[21] Figures taken from Maricopa Association of Governments. Calculation for 2025 was done by projecting the same percentage increase over the period of 2020 to 2025 as Maricopa County was to Arizona and the United States over the period 1995 to 2020.

[22] U.S. Bureau of the Census, 1997 County Population Projections (www.census.gov/Press-Release/cb98-41.html).

[23] Information from the Arizona State Land Department. Native American lands have their own governing bodies. However, The Bureau of Indian Affairs, U.S. Department of Interior, has certain responsibilities for Native American lands.

[24] Morrison Institute for Public Policy. September 2000. Hits and Misses: Fast Growth in Metropolitan Phoenix.

[25] Less than 12 miles to the east, west and south but much greater than 12 miles to the north.

[26] All three definitions are taken from Floodplain Regulations for Maricopa County, Flood Control District of Maricopa County, 11/01/2000.

[27] Data for this paragraph comes from the Arizona Real Estate Center, L. William Seidman Research Institute, College of Business, Arizona State University.

[28] Maricopa County Quick Facts from the U.S. Census Bureau.

[29] Morrison Institute for Public Policy, Arizona State University.

[30] Original percentage for streets to lot sizes taken from a study entitled "Economic and Social Costs of Urban Sprawl Versus a Proper Urban Density in Spokane County," Washington, October 1975.

[31] Metroscan for Windows 2.64.

[32] These dimensions were determined by measuring a typical parking space in the Flood Control District parking lot, which is based on standards from the City of Phoenix Zoning Ordinance.

[33] Kaiser/Godschalk/Chapin, Jr. (1995). Urban Land Use Planning. Fourth Edition. University of Illinois Press, Chicago. Assumptions 6 through 9 interpolated from this text book.

CHAPTER 3. DISTRICT ORGANIZATION & PROGRAMS

3.1. District Organization

3.1.1. Overview

The District's general organizational structure was set by State statute and has developed into today's framework over time to provide services to meet the public need as related to flood control. An annual strategic planning, programming, and budgeting process driven by the Management Team further defines how these services will be provided. This same process combines the mandates, public needs, and services to be provided to shape the budget for the coming years.

The District spent the early years establishing programs and staffing to meet the needs for designing and constructing flood control structures that were identified in the 1963 Report. By the late 1990's approximately 80 projects had been completed, including the 21 structures the District took over, which were completed in cooperation with other agencies. Having completed a majority of the projects identified in the 1963 report, the opportunity was present to identify more non-structural solutions to eliminate or reduce flooding problems in Maricopa County. The District began to focus more on programs, such as floodplain management and drainage ordinances, to keep people and structures out of areas that were prone to flooding rather than providing solutions once a problem developed.

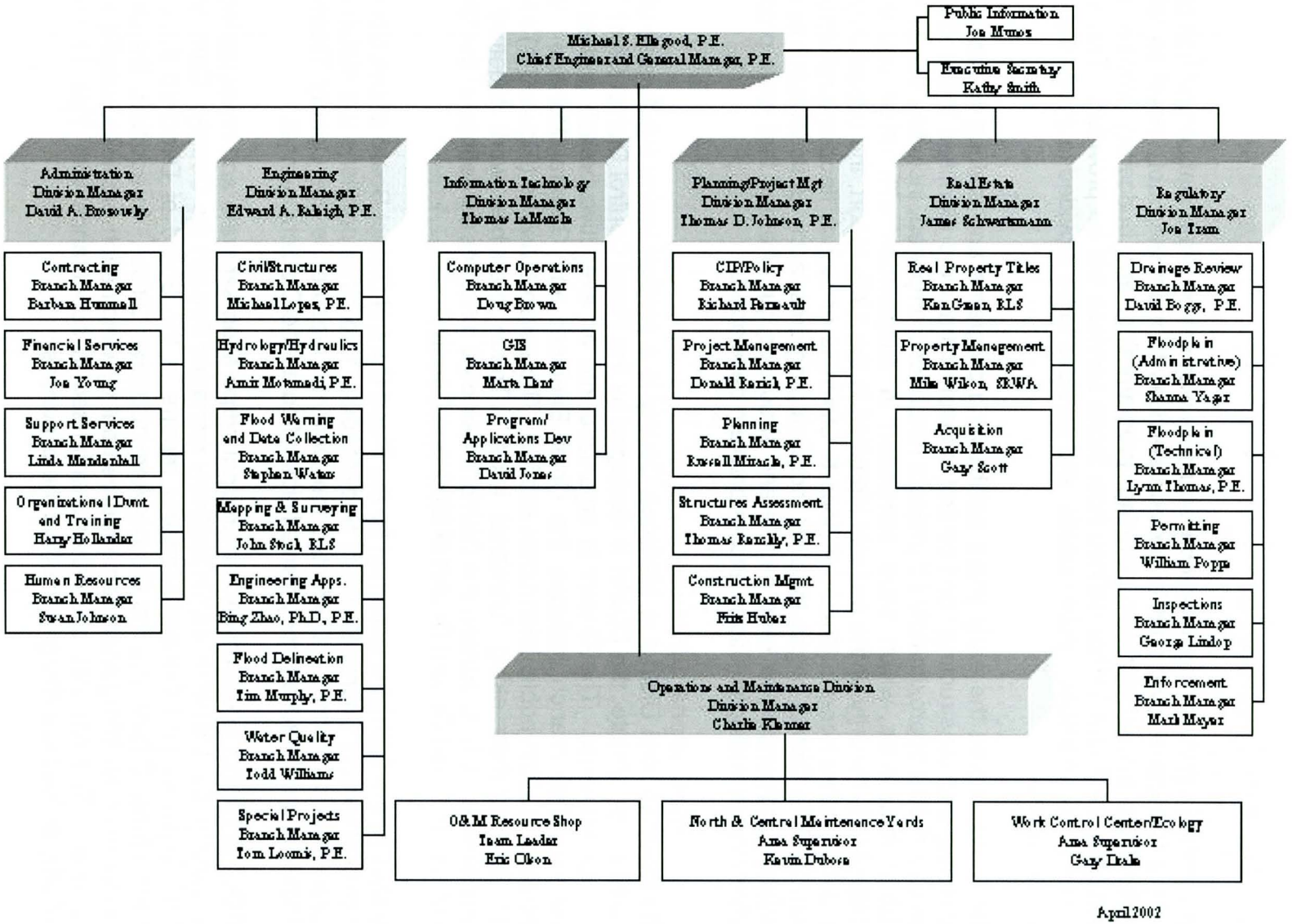
3.1.2. Organizational Structure

The Flood Control District of Maricopa County is a political taxing subdivision of the State of Arizona. By statute, the District is managed by the Flood Control District Chief Engineer and General Manager. The District is organized into an executive branch and seven divisions. The executive branch includes the Chief Engineer and General Manager, the executive secretary and the public information section. The seven divisions (Figure 3-1) are sub-divided into 33 branches along functional lines. These branches work together in a matrix management style to support the District's four core functions as defined in the "2002 Strategic Plan for the Flood Control District of Maricopa County."

By statute, the District is governed by the Flood Control District Board of Directors who are the elected Maricopa County Board of Supervisors. Two other positions are statutorily identified: treasurer and attorney. Currently, the District Treasurer is the County Treasurer and the attorney is a contract attorney formally identified as the District Counsel.

While the District is effectively a municipal corporation separate and on equal legal footing as the County, the District is administratively managed through the County. Currently the District Chief Engineer and General Manager reports to the Board of Directors through the Chief Public Works Officer and the County Administrative Officer. In addition, the District and the County have an intergovernmental agreement by which each provides specific services to/for the other. The services are either reimbursed in accordance with Title 11 and/or Title 48 authority or fees are charged to offset the expenses.

Figure 3-1 Flood Control District Org Chart



3.1.3. Strategic Planning Process

To address changes to the strategic environment, the District utilizes a strategic planning, programming and budget process which links the assessment provided by the Comprehensive Plan to the Capital Improvement Program and operating budget. The ***purpose*** of the District's 2002 Strategic Plan is to identify the basis for the District and future actions necessary to maintain the District's capability to provide mandated responsibilities. The ***goal*** is to provide a collective vision of the short, near and long-term direction of the District.

The mandated responsibilities are achieved through the various programs provided by the District. The Strategic Plan groups the District's functions into specified and implied tasks.

3.1.3.1. Specified Tasks

Specified tasks are those specifically identified in the statutes as functions that the District must do and represent core functions. These core functions fall into the following four main programs:

- **Flood Hazard Remediation** provides flood protection using structural and non-structural mitigation of flood hazards so that the public can live with minimal risk of loss of life or property damage due to flooding. This program includes: design, construction, operation, maintenance, land acquisition, management of flood control infrastructure, and environmental activities. It is managed and staffed by the Planning and Project Management and the Operations and Maintenance Divisions with support from the Lands, Engineering, and Information Technology Divisions.

- **Flood Hazard Regulation** provides guidance for floodplain and drainage compliance; direction; and enforcement for the public so that they can use their property safely and in compliance with applicable state and federal laws. This program includes: floodplain, drainage, storm water quality, and sand and gravel mining administration. It is managed and staffed by the Regulatory Division with technical support from the Engineering Division. The Water Quality Branch of the Engineering Division manages and monitors stormwater quality.

- **Flood Hazard Education** provides information collection and dissemination of flood hazard information, technical data, and flood safety guidance to public agencies and the public so that they are aware of and can respond to flood hazards. This program includes: public outreach, project public involvement, flood hazard preparedness, and warning and hydrometeorology information. It is managed and staffed by the Public Information Office Division with input from Planning and Project Management, Regulatory, and Engineering Divisions. Flood Hazard preparedness and warning is managed by the Flood Warning Data Collection Branch of the Engineering Division.

- **Flood Hazard Identification** provides flood and erosion hazard information and documentation to the public so that they can be knowledgeable about the dangers of erosion and flooding, the areas in which they occur, and the future remediation measures. This program includes: development of drainage master plans, watercourse master plans, floodplain delineations, landscape aesthetics/recreation multi-use, integration of projects into the natural environment, and strategic and comprehensive plans. It is managed and

staffed by the Floodplain Delineation Branch of the Engineering Division and the Planning Branch of the Planning and Project Management Division.

3.1.3.2. Implied Tasks

Implied tasks are those not core to the Flood Control District mandates but are necessary to be able to conduct the business of the District. The 2002 Strategic Plan groups these tasks into the following three programs:

- **Employee Program** develops the required staff with the appropriate training and skills to support the fundamental obligations of the District recognizing that qualified, experienced, customer oriented staff provide our shareholders the best service. This program includes human resources management and information technology support. It is managed and staffed by the Human Resources Branch of the Administrative Division and the Information Technology Division.

- **Customer Service Program** provides service to our client municipalities and the general public so that they can take advantage of employee knowledge so that they can live with acceptable risk of loss of life or property due to flooding. This program includes responses to individual, and group, public and private party requests. The Office of the Chief Engineer manages this program with support from all Flood Control District Divisions and staff.

- **Financial Management Program** provides financial services including program budget, financial resources and financial management of revenues and expenditures to support the organization to achieve success of the District's programs. This program includes financial services including budget, procurement, financial resources management, risk management and property management. It is managed and staffed by the Financial Services Branch of the Administration Division, and the Property Management Branch of the Land Division with support by the CIP/Policy Branch of the Planning and Project Management Division.

3.2. Financial Information

ARS §48-3603.A states that "A county flood control district organized under this article is a political taxing subdivision of this state and has all the powers, privileges and immunities granted generally to municipal corporations by the constitution and laws of this state including immunity of its property and bonds from taxation." Based on this authority, the Board of Directors approved a secondary property tax, which serves as the main funding for the District capital improvement and operational functions.

3.2.1. Revenue Sources

3.2.1.1. Property Tax

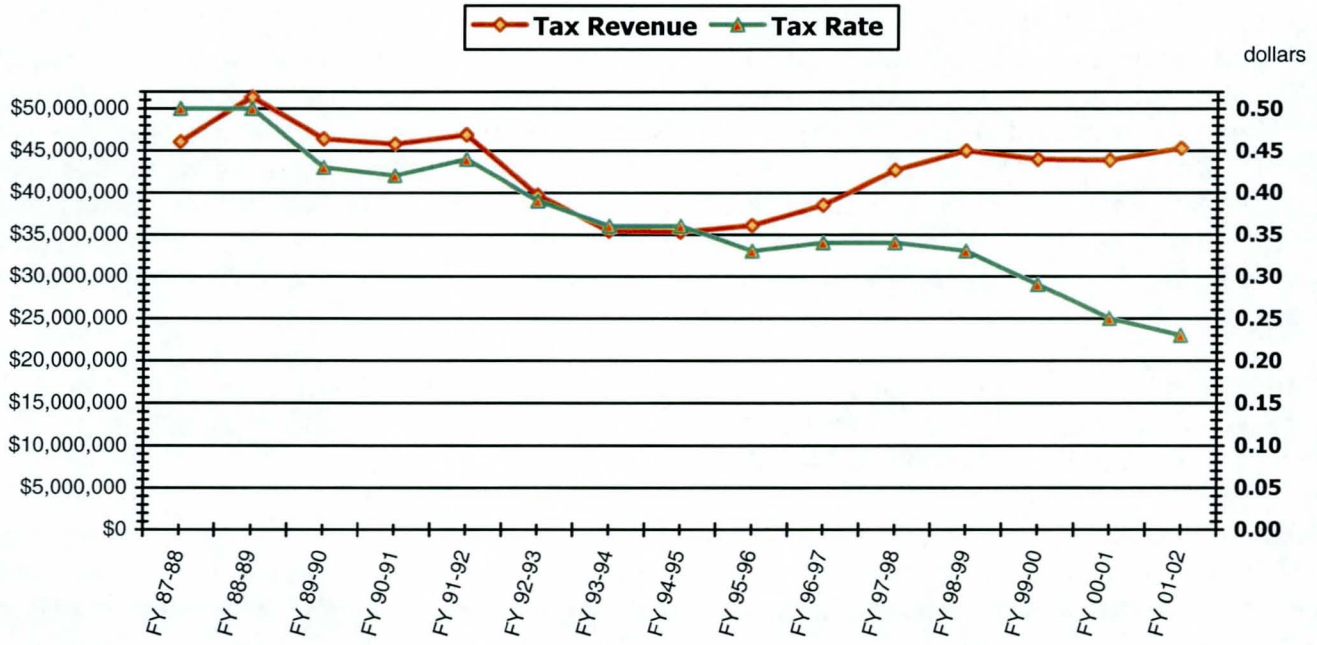
The majority of the District's revenue is derived from the secondary property tax for flood control placed on each parcel in Maricopa County. The County Board of Supervisors sets the rate of this tax and the assessed real property valuation to which the tax is applied on an annual basis. The tax rate was 50 cents for every $100 of valuation approximately ten years ago (see Table 3-1). This rate has been steadily declining and was set at 23.2 cents per $100 valuation for Fiscal Year 2001-2002.

Tax revenues have held fairly constant over the past ten years because of the large amount of construction taking place and the increase in real property valuations for previously built structures. However, District tax revenues have been steadily declining in real terms when inflation is taken into account (see Figure 3-2). It is anticipated that the District's property tax revenues over the coming five years will be capped at a maximum of about $45 million on an annual basis and will continue to result in continued reduction of the property tax rate.

Table 3-1
Flood Control Tax Rates and Revenue by Fiscal Year[1]

Fiscal Year	Tax Rate	Tax Revenue	
01/02	0.2319	$45,300,000	Est.
00/01	0.2534	43,874,335	
99/00	0.2858	43,992,461	
98/99	0.3270	44,995,000	
97/98	0.3425	42,697,000	
96/97	0.3413	38,501,000	
95/96	0.3332	36,085,500	
94/95	0.3632	35,300,000	
93/94	0.3632	35,400,000	
92/93	0.3901	39,715,000	
91/92	0.4447	46,879,000	
90/91	0.4235	45,797,000	
89/90	0.4303	46,408,000	
88/89	0.5000	51,345,000	
87/88	0.5000	46,059,000	

Figure 3-2 Property Tax Revenue and Rate Comparative Chart



3.2.1.2. Licenses and Permits

A second source of revenue is from fees that developers and individuals are required to pay to obtain building, drainage, floodplain, and zoning clearance permits within Maricopa County. Building permit applications are reviewed by the Floodplain Technical Branch if a structure is located within a delineated 100-year floodplain and reviewed by the Development Review Branch if the building is located outside of a 100-year floodplain. This revenue stream is closely tied to the number of building permits issued each year in Maricopa County. During Fiscal Year July 1, 2000 through June 30, 2001, this income source totaled $1.5 million.

3.2.1.3. Intergovernmental Participation

A third revenue source is cost sharing with other entities for project development and construction. Most of the early structural projects were constructed through cost sharing arrangements with the U.S. Army Corps of Engineers or the U.S. Department of Agriculture, Soil Conservation Service. The federal agency normally paid for project construction and the District furnished the land on which the structure would be built. The District took over operation and maintenance responsibilities once the project was completed. Federal cost sharing monies have been steadily decreasing in the last ten years as federal budgets have been reduced. Most recent cost sharing has been with local municipalities such as cities and other county agencies, with some monies coming from various state agencies.

Revenue generated from intergovernmental agreements was $17.0 million for Fiscal Year 2000-2001. Budgeted participation revenue for Fiscal Year 2001-2002 is $20.8 million.

Almost $556 million has been spent on flood control structures in Maricopa County since the District's inception. Approximately $333 million, or nearly 60 percent of this total, has come from federal sources.[2] This Federal/District partnership has produced structures worth nearly $650 million at 2000 prices.[3] There are approximately $196 million of structures at 2000 prices that were primarily built by the District and partners.[4]

3.2.1.4. Miscellaneous

Another source of revenue for the District is the sale of real property or lease of rights-of-way. The District owns approximately 22,000 acres in fee simple title and holds perpetual easements on an additional 38,000 acres. Revenue from easements and rights-of-way was approximately $564,000 for Fiscal Year 1999-2000. Revenue from land sales during this same time frame was $2.1 million. Land sales for Fiscal Year 2000-2001 was $2.59 million and is estimated to be $9.8 million for Fiscal Year 2001-2002. This figure can vary widely from year to year depending on the size and location of land available and the strength of the real estate market at any given time.

Additional sources of revenue for the District with the FY 2001-2002 estimates include the following: payments in lieu of taxes ($200,000), interest on fund balance ($878,500), building rentals ($155,000), and grants ($748,000 - Aguila).

3.2.2. Budget

The District's budget is separated into two main categories: Operating and Capital Improvement Program. There are subcategories under each of these. The revenue derived

from the property tax and the other sources is used for the CIP and operations expenditures. The District's Total Budget for Fiscal Year 2002 is approximately $80 million. About $58 million of this is dedicated to the Capital Improvement Program, and $22 million to Operations. The District maintains an end of year fund balance of approximately $11.5 million.

The estimated revenue from the four main sources for the proposed FY 2002 Budget are as follows: Property Tax = $45,500,000; Land Sales = $9,829,397; Intergovernmental = $20,800,000; Other = $3,329,527. The following Figures break down the revenues and expenditures by percent for the District.

Figure 3-3
FY 2002 District Revenues

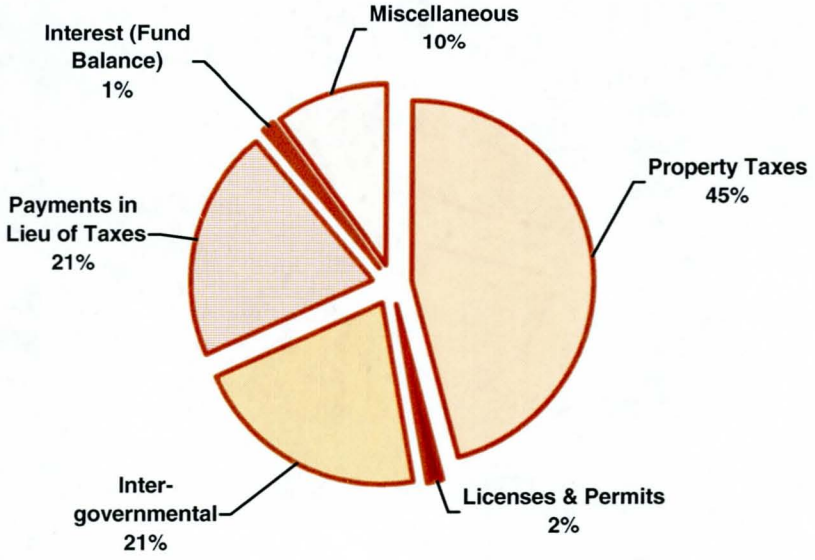
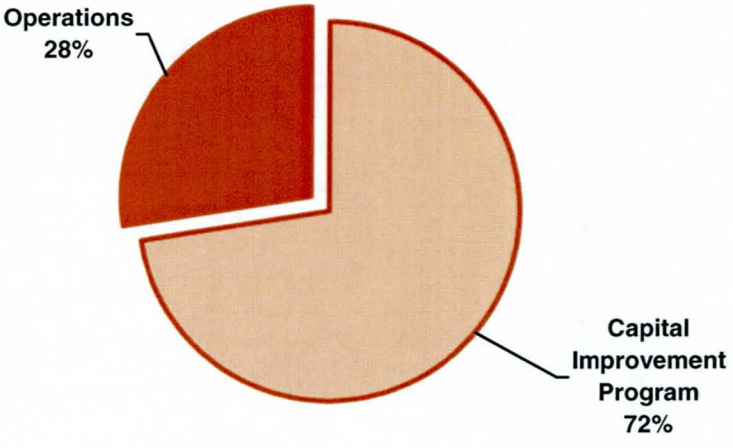


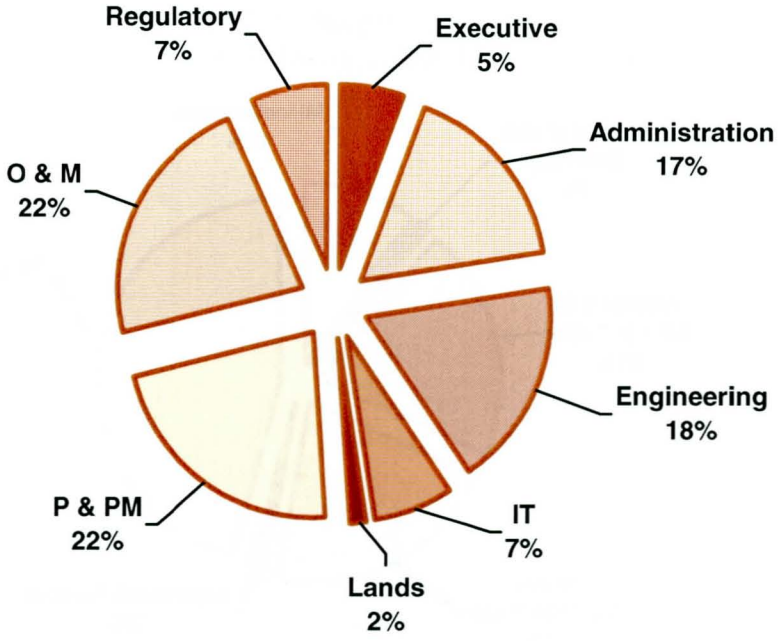
Figure 3-4
FY 2002 Budgeted Expenses



3.2.2.1. Expenditures – Operating and Capital Improvement Program

Operating Expenditures are shown by percent for each of the District's Divisions in Figure 3-5. The CIP, for FY 01/02- 05/06, has $275.5 million identified for capital improvements for the five-year period. An estimated $50 million will most likely be obtained from partners on various projects to cover the difference between expected revenue and capital projects to 2006.

Figure 3-5
Operating Expenditures
FY 2002 – Full District



3.2.2.2. Comparison With Other Districts

The Table below shows a quick overview of other arid region Flood Control Districts in comparison to Maricopa County. All but Clark County, Nevada utilize a property tax for funding. The District's population/land area to funding is relatively proportional to Clark County.

Table 3-2 Budget Comparison with Other Counties

	Population	Land Area (square miles)	Budget ($ million)			Primary Revenue Sources
			CIP	Operating Costs	Total Revenue	
Riverside, CA	1.6 million	2,700	64.7	24.2	88.9	property tax
Orange, CA	2.9 million	798	27.0	60.0	87.0*	property tax
Clark, NV	1.3 million	7,927	34.9	30.1	65.0	sales tax (0.25 cent)
Maricopa, AZ	3.1 million	9,226	45.0	23.0	68.0	property tax

* Separate Budget for Santa Ana River mainstem project ($25 million); not included in Orange Co. total.

Sources: Riverside County Flood Control District, County of Orange, Clark County Regional Flood Control District, Flood Control District of Maricopa County.

3.3. Flood Control District Programs

The District's flood control programs have continued to evolve over the years. A number of reasons can be cited for the development of new and varied programs. First, no one program would solve the flooding problems in Maricopa County. Proactive programs that prevent new development in flood prone areas and eliminate the need for future reactive programs made sense for certain locations. Reactive programs were very efficient in mitigating flooding problems in areas where development had previously taken place. Secondly, external influences have played a large role in the evolution of District programs. Environmental safeguards have lengthened installation time and increased the cost of structural measures. Water quality safeguards and wetland preservation have placed additional emphasis on non-structural measures that make use of and conserve these environmental values. Additionally, the reduction in or lack of federal programs available made it necessary for the District to create additional options.

New programs have been developed to respond to the changing landscape and need for new and innovative uses of the original programs. The following sections describe the major services available from the District in support of the four core functions as defined in the 2002 Strategic Plan.

3.3.1. Flood Hazard Remediation Program

3.3.1.1. Structural Measures

ARS §48-3603.C.1. authorizes the District to "..... construct, operate and maintain flood control works and storm drainage facilities within or without the district for the benefit of the district." Structural measures can reduce floodwater damages by controlling the floodwater and associated erosion and sedimentation. Structural measures include dams and reservoirs, floodwater retarding structures, channels, levees and dikes, floodways, floodwater diversion channels, basins, grade control structures, and stream bank stabilization. Structural measures to control or reduce flooding, erosion and sedimentation have been the primary program utilized by the District.

The 1963 Comprehensive Plan evaluated 41 projects of which all were structural in nature. Thirty of the 41 were recommended for constructed as soon as funding was available. All or portions of 20 of these projects have been constructed. A large majority of these projects were constructed through a Federal/District partnership. The Federal partner was responsible for facilities construction in most cases, with the District providing the necessary land rights. The District also took over operation and maintenance responsibilities for these projects. Most of the projects constructed under this partnership were started and constructed in the 30 years after the District was organized. Since then, federal project monies have become extremely scarce reducing the opportunity for these types of projects.

Other measures that would qualify as structural include raising foundations of buildings, blocking off low-level entrances and windows, strengthening existing walls and foundations and installing protective walls. These measures help minimize flood losses. They do not attempt to control floodwater or erosion and sedimentation. These measures are reviewed by the District's Regulatory Division.

In the last ten years, there has been a decided shift in the structural measures program of the District. First, the overall emphasis on structural measures has been augmented by other solutions made available through the other programs at the District. Secondly, the program is no longer predominantly funded through federal cost sharing. However, many of these projects have cost sharing arrangements with cities and towns or with other county and state agencies.

3.3.1.2. Capital Improvement Program

ARS §48-3616 requires preparation of a five-year capital improvement program that "..... shall separately identify capital improvements for engineering, rights-of-way and land acquisition, and construction with such supporting explanations, cost estimates and completion schedules as the board may require."

The Capital Improvement Program (CIP) links the planning and budget activities of the District. It can support past policy decisions by establishing priorities between existing and competing projects but can also measure and evaluate the merits of new proposals. Typically, a CIP describes each capital project proposed for development over the forthcoming five-year period by listing the year that it is to be started, the cost per year, and, when applicable, the proposed method of cost-sharing. Based on the details of each project, the District develops annual cost schedules for capital expenditures. The CIP presents both the cost and funding for all the project requirements for flood control purposes as tempered by current and future financial capability.

The five-year CIP for the District identifies spending for all anticipated capital projects to implement flood control and storm water management projects identified through the planning process. The CIP addresses both modification and replacement of existing infrastructure, development of new facilities, and studies to accommodate present and future growth. The CIP also enables the District and its stakeholders to identify needed capital projects and coordinate financing and construction timing. To increase effectiveness, the CIP consists of two crucial segments; an administrative process to identify and prioritize future capital projects ("Prioritization Procedures") and the fiscal plan to provide for the funding of those projects.

The Prioritization Procedures serve as the mechanism for ranking potential new CIP projects. Potential CIP projects are identified either by local cities, towns and other agencies, or through other District programs. The potential projects are evaluated on an annual basis for inclusion in the latter years of the CIP.

The prioritization procedure is accomplished in two major steps. First, all newly proposed projects are evaluated according to predetermined and weighted criteria by a committee of senior District staff members. The selected projects that require additional information are included in a District managed and prioritized pre-design study program. Requesting agencies may complete prioritized pre-design studies using consultants or in-house resources, provided the information produced meets the minimum requirements of District-sponsored studies. The purpose of the pre-design study program is to develop more detailed information on potential CIP projects. This includes design and construction costs, land acquisition requirements, required permits, mitigation and multiple-use potential. During the pre-design study, a

Memorandum of Understanding (MOU) is developed to define how the District staff, other agencies, or private partners will proceed with the project.

The second step includes the budgeting and scheduling of projects for inclusion in the District's Five-Year CIP. For projects requiring an Intergovernmental Agreement (IGA), the information developed in the pre-design study and MOU will serve as the basis for negotiations. When Area Drainage Master Plans are completed, a number of future pre-design studies and CIP project requests are identified. Input regarding the priorities for projects identified within these plans, will continue to be provided to local cities, towns and other agencies. Project IGA's will usually be signed prior to the District's commencement of the design activities. When a CIP project has progressed to the stage where the engineering design, plans and construction specifications are being prepared, its place in the Five-Year CIP program is generally maintained. The stability and timeliness of CIP project implementation are important to the timing of interrelated projects.

3.3.1.3. Structures Assessment Program

The District owns, operates, and maintains 22 dams and FRS's and is mandated by state and federal law to comply with dam safety regulations. The District created the Structures Assessment Program to assess and evaluate these structures and related features due to the increasing urbanization and to assure continued compliance with current regulations, standards and guidelines. The Structures Assessment Program is intended to address the above issues as well as to enhance and improve the District's ongoing Dam Safety Program.

The District established the Structures Management Branch of the Planning and Project Management Division to oversee the Structures Assessment Program and be responsible for both upgrading and ongoing implementation of the District's dam safety program. Primary elements of the District's dam safety program are annual and event related dam safety inspections; emergency action plan development and upgrades; field surveys; management of proposed uses by others at dam and FRS's; and interagency coordination of dam safety issues. As part of the Structures Assessment Program the District assesses its other flood control facilities (levees, floodways, and basins) in a similar manner as the dam and FRS assessments.

With increased urbanization, the need for the flood protection function provided by these structures has increased. Each dam and FRS will need to be evaluated on an individual basis to assess current and future function, risk and liability. Urbanization; aging infrastructure; multiple use opportunities; and changes in design flood methodology and rule changes (June 2000) by the Arizona Department of Water Resources (ADWR) on dam safety requirements have necessitated the Structures Assessment Program.

The Structures Assessment Program has three phases. Phase I Assessments primarily involve collection and review of records, field inspections of dams, subsidence surveys, risk assessments and the development of planning level recommendations for future actions to be considered for each dam or group of dams. Structural and non-structural solutions are being evaluated with emphasis on project partnering and multi-use opportunities for District facilities.

Phase I Assessments have been completed for one dam and six FRS's and assessments for one additional dam and six FRS's are in progress.

Phase II work will involve development of detailed alternatives and pre-design work, which will result in structural and non-structural solutions to address issues related to urbanization and dam safety. It is currently anticipated this work will be performed under consultant contracts upon completion of Phase I Assessments. Phase II tasks currently includes geotechnical field investigations, analysis, and development of site-specific corrective actions as needed to address potential dam safety issues. Additional tasks include implementation of the site-specific dam safety corrective measures as needed.

Phase III will address the long-term dam safety issues, project implementation to address these issues, flood protection, and urbanization. Phase III will also include structural solutions such as dam and FRS rehabilitation and large regional basins and/or flood conveyance features to replace dams and FRS's. Non-structural solutions such as land acquisition will also be implemented as appropriate. The District will continue to seek federal funding assistance in order to implement Phase II and Phase III of the program.

Multi-use opportunities are generally compatible with the function of the dams and FRS's since significant flood impoundments are infrequent. Examples of these other uses include hiking, camping, boating, fish and wildlife conservation, and groundwater recharge. These other uses can increase the risk and liability around the dams and reservoirs in addition to that added by the changes in land use downstream and will need to be addressed in the planning process.

3.3.1.4. Operation and Maintenance

In addition to the dams and FRS's, the District oversees many miles of underground infrastructure and improved channels. This infrastructure must be managed to its optimum potential in order to eliminate or greatly reduce the amount of floodwater damage for which it is designed. The Operations and Maintenance Division (O & M) is responsible for ensuring that each flood control structure functions as designed and that all dams comply with the licensing standards set by the Arizona Department of Water Resources (ADWR) as outlined in Arizona Revised Statutes.

It is the goal of the O & M Division to protect the lives and property of the citizens of Maricopa County by reducing the risks associated with stormwater runoff by maintaining all flood control facilities to the highest functional standards. Maintenance activities for District structures include mitigating the effects of erosion and sedimentation; vegetation and vector control; maintenance of channels, floodways and outflow devices; and storm damage repair. O & M staff must also maintain excess property obtained from severances and/or buy-out programs and respond to citizen complaints regarding trash removal, insects, odors, dust, gates, and other nuisances.

The Division provides both emergency response and storm monitoring services during a flood emergency or storm event. When an emergency exists, crews are dispatched to monitor the functions of the structures and operate outflow devices to control the release of storm water. Maintenance crews also transport and operate heavy equipment used to protect the public

during emergencies and to perform temporary repairs to structures. The significant objectives adopted by the Division include the following:

- Conduct annual inspections of each structure with the sponsoring agency and when applicable with ADWR.
- Perform quarterly dam operational inspections to guarantee the proper operation of outlets and spillways.
- Maintain structure features to design standards. Keep floodways free and clear of silt, debris and obstructive vegetation. Maintain protective linings of banks and dikes for the long-term functional life of the structure.
- Monitor all significant impoundments.
- Participate in the District's Dam Safety Program.
- Develop comprehensive weed abatement and rodent and vector treatment service that correspond with the Division's maintenance activity.

3.3.1.5. Property Management

Acquisition of real property by the District is authorized by State statute including A.R.S. §48.3603.C.1, §48-3603.C.2 and others. All acquisitions to acquire land as part of projects being done by the District are undertaken by adoption of resolutions by the Board of Directors. Other Board resolutions have authorized the District to lease properties, declare land in excess of District needs, and to sell excess land at public auction at fair market value (FCD 81-05, 86-21, 87-12, 88-5, 90-01, 92-07 et. al.). Currently, the District owns approximately 22,000 acres in fee simple and holds perpetual easements on an additional 38,000 acres.

The Property Management Branch of the Lands Division was initiated when the District was formed in 1959. Funding for this Branch is through a combination of property rental/leasing, property sale and the District property tax revenue. This Branch is responsible for leasing, selling and managing District real property to generate income and is also charged with maintaining the value of this property until all or a portion of the property is needed for a project. Additionally, the Branch is responsible for maintaining remnant property where size and/or physical boundaries preclude the sale of the property due to zoning restrictions. Excess lands comprise a small but valuable fraction of District ownership.

An objective of the Property Management Branch is to aggressively manage all District property to its maximum benefit. This is accomplished through the disposal of excess property by sale or exchange for appraised value. Also, District staff leases and authorizes easements to effectively manage District property. The Branch maintains an effective and efficient license and easement program by documenting procedures, creating standardized documents, and establishing fair market values for property. Management of District rental property is conducted to optimize interim return and maintain value. This is accomplished by leasing at appraised value, regular inspections, suitability for use determinations, advertising and background investigations for tenants.

3.3.1.6. Acquisition and Relocation

The Acquisition Branch acquires the land rights that are needed to construct, operate and maintain District projects. These acquisitions are accomplished by fee purchase, easements, rights of entry, and leases. Acquisitions are initiated by the District's project managers who, after project confirmation, supply the Lands Division with delineation maps outlining the property area needed for each particular project. Acquisition staff order title reports to verify ownership and clarity of title. If needed, environmental surveys or site assessments are also ordered. Appraisals are ordered on each property affected early on in the process to give the acquisition negotiator and the property owner a current value of the property.

In some cases, when a mutually agreed to acquisition price cannot be reached by both parties, it is necessary for the District to utilize its condemnation authority, and acquire property by eminent domain. The District is given immediate possession of the property for project use through court action, while litigation takes place to determine fair and equitable value for the property acquired. This requires the District to deposit what is perceived to be fair value until such time that a judge or jury can determine the final acquisition cost.

Another function of the acquisition process is relocating real property owners, or real property owner' tenants from property acquired by the District. The District performs these relocations in compliance with the "Uniform Act amended in 1987 by the Surface Transportation and Uniform Relocation Assistance Act of 1987, Title IV" (Public Law 100-17) regulations. This includes assistance in finding comparable real property or housing, as well as assistance with moving personal belongings from the acquired dwelling to the relocation dwelling.

An advanced land acquisition policy is in place to acquire property recognized to be needed for future projects. These advanced acquisitions will create a project inventory that will allow projects to be pulled from the shelf and quickly implemented, should the need arise. Advanced acquisition allows the District to acquire property at current values rather than wait and to acquire property at higher prices due to the rapidly appreciating market.

3.3.1.7. Environmental Activities

District structures receive stormwater runoff that has varying levels of water quality from over 9,200 square miles of watersheds within Maricopa County. Conveyance and discharge of this stormwater runoff from District structures may result in potential environmental impacts. The goal of the District's environmental process is to ensure that the construction, operation, and maintenance of flood control structures comply with Federal and State regulatory environmental requirements to prohibit problems from occurring.

The District's environmental process is directed at achieving several important and interrelated objectives. They are the following:

- Ensure that existing structures and capital improvement projects comply with Federal and State water quality programs in order to satisfy environmental requirements. These programs include permit requirements of the Clean Water Act relating to the discharge of dredge or fill material within waterways, control of the discharge of pollutants in waterways, and protection of wetlands, native desert and riparian ecosystems,

threatened and endangered species, protected plants and wildlife, and cultural resources.

- Reduce potential environmental hazards associated with hazardous materials that may exist on District property.
- Develop a process to design and implement structural and non-structural controls to improve stormwater quality.
- Establish and implement a County policy regarding the use of District property by municipalities and private organizations to recharge groundwater and conserve water resources.

Compliance with regulatory environmental permit programs requires coordination with numerous federal and State agencies, and the regulatory programs that they administer. These agencies and programs that relate to FCD environmental functions include the following:

AGENCY	REGULATORY PROGRAM
National Environmental Protection Agency	Clean Water Act (water quality standards)
Arizona Department of Environmental Quality	Clean Water Act (water quality standards)
National Environmental Protection Agency	Clean Air Act (Asbestos NESHAP)
Maricopa County Environmental Services	Dust Control Program (Rule 310 MCESD)
U.S. Fish and Wildlife Service	Endangered Species Act / Migratory Bird Treaty Act
U.S. Army Corps of Engineers	Clean Water Act (protection of navigable waters and wetlands)
State Historic Preservation Office	National Historic Preservation Act (protection of significant archaeological and historic resources), State Historic Preservation Act, Arizona Antiquities Act
Arizona Department of Game and Fish	Endangered Species Act
Arizona Department of Water Resources	Protection of groundwater resources
Arizona Department of Agriculture	Native Plant Law

3.3.2. Flood Hazard Regulation Program

3.3.2.1. Floodplain Administration

ARS §48-3609 authorizes the District to delineate floodplains and regulate use. The Floodplain Management Branch of the Regulatory Division is responsible for the identification and regulation of flood hazard areas and flood prone properties. This activity, in addition to others, qualifies the County for insurance premium reduction credits and provides guidance for the development of flood prone properties. Reduction of the risk to life and property is also achieved through compliance inspections in conjunction with approved permits.

Congress passed the National Flood Insurance Act in 1968, which created the National Flood Insurance Program (NFIP). The 1968 Act required the publishing of flood insurance studies within five years for every community with a special flood hazard. These studies identify the special flood hazard areas and establish flood risk zones within the community. The USACE began a massive nationwide surveying and mapping effort of major watercourses and other selected areas. During the first years of the NFIP operation it became evident that the time

required to complete the detailed flood insurance studies would delay implementation in many communities. The Housing and Urban Development Act of 1969 expanded participation by authorizing an Emergency Program under which insurance coverage could be provided during the period prior to the completion of a community's flood insurance study.

Maricopa County entered into the Emergency Program in 1970 and proposed flood damage prevention requirements to regulate development in 1971. Flood Prone Area Maps, generated by the United States Geological Survey (USGS), were used for floodplain management during this time. The USACE delineated portions of major watercourses such as the Salt, Gila, Agua Fria and New Rivers and Skunk and Cave Creeks after the District entered into the Emergency Program but prior to entering the regular NFIP program in 1979. The Federal Emergency Management Agency (FEMA) during this same period hired a private contractor to delineate additional reaches of the major watercourses and some of the major tributaries.

The 1973 Flood Disaster Protection Act made comprehensive revisions to the 1970 National Flood Insurance Program and required all participating communities to adopt and enforce floodplain regulations. The purpose was to supplement structural flood control projects with cost-effective, non-structural regulation of floodplain uses and development. In 1973, the State of Arizona passed legislation that empowered cities, towns, and counties to adopt floodplain regulations and established the Department of Water Resources as the Coordinator of the National Flood Insurance Program in Arizona.

In 1975, Maricopa County adopted its first floodplain regulations administered and funded through the office of the County Manager. The District acted as technical support during the years that followed until 1982 when the Board of Supervisors transferred full floodplain management responsibility to the District.

Flood Hazard Boundary Maps, which delineated the boundaries of the community's special flood hazard areas, were prepared by FEMA in July 1979 using available data and both approximate and detailed engineering studies. These identified the areas within a community subject to inundation by the 100-year flood. The Flood Hazard Boundary Map was intended to assist communities in managing floodplain development, and identifying areas where development was within a floodplain.

In 1984, the State flood control statutes were revised to require each County to organize a flood control district. These districts were mandated to identify and delineate floodplains and adopt and enforce floodplain regulations throughout the county unless municipalities specifically resolved to perform their own floodplain management. Maricopa County adopted the State revisions, which resulted in the responsibilities of floodplain management being transferred from the County to the District.

In 1990, the County volunteered to participate in the National Flood Insurance /Community Rating System (NFIP/CRS) Program. This is a program in which the County agrees to be rated by the federal government on its effectiveness in performing floodplain management. Citizens, within rated communities, may be eligible for flood insurance premium credit based on the community's rating. Several local communities receive discount ratings based partly on

District activities performed on a regional or inter-jurisdictional basis. The District also performs floodplain management activities for 13 incorporated communities in the County.

The NFIP/CRS is a means of comparing the Districts' floodplain management services with others nationwide. This activity provides a valuable benchmark to measure internal progress. This rating activity also provides an incentive to the District because flood insurance policy holders receive a reduction on their insurance premiums based on the performance of the District's floodplain management. Under the CRS activity, premium rates are adjusted when a community meets three goals: (1) reduce flood losses; (2) facilitate accurate insurance rating; and (3) promote the awareness of flood insurance.[5] The CRS recognizes ten classes and credits are awarded for 18 activities. The first class has the most credit points and receives the largest premium discounts. The District currently has class 5 status and is a Category **C** community (10 or more repetitive losses).

In 1991, the District rated a five percent (5%) discount on flood insurance rates within the unincorporated County. In 1993, this improved to a fifteen percent (15%) discount rating. In 2001, the ranking improved to a 25 percent discount rating. Maricopa County is rated in the top one percent in the nation. In 1994, Maricopa County was rated second highest in the nation. Other local communities participating in the CRS Program can receive credit based partly upon certain District activities within their corporate limits. This allows policyholders within those communities to also receive premium discounts.

The Flood Insurance Studies are updated in areas where new flood control structures have reduced flood risks and altered previously identified flood hazard areas. Also, research is conducted in areas of imminent or ongoing development where flooding has occurred but risks have not been determined. Flood Insurance Studies are also done for areas where previous studies have become outdated, inaccurate due to new development, new technical information, changes in federal or state laws, and/or changes in rules or guidelines.

3.3.2.2. Drainage Administration

Drainage Administration is one of the regulatory activities that the District provides as a flood and stormwater management service for the benefit of the residents of Maricopa County in order to reduce the potential for future losses resulting from changes due to stormwater runoff. Regulating new land development and enforcing drainage requirements reduces the cost of both future flood losses and the cost of required remedial flood control measures.

The Drainage Administration Branch administers the Drainage Regulations for Maricopa County, which were adopted by the County Board of Supervisors in 1988. The Regulations include a fee schedule for the processing of drainage permits and plan review. Adoption of these Regulations resulted in more efficient administration of the activity. Previously drainage compliance was covered in Subdivision Regulations, Zoning Ordinance or State Statutes. On December 14, 1994, a revision of the Drainage Regulation with a revised drainage and floodplain review fee schedule to reflect actual costs of the permitting/plan review effort was adopted, which clarified and strengthened the Regulation.

In 1994, a restructuring of the District resulted in the regulatory functions (inspections, enforcement, floodplain management and drainage administration) being combined into the Regulatory Division. This combining of functions has resulted in improved customer service, increased proficiency in the area of development review and interagency coordination, and improvements in the drainage/floodplain inspection and enforcement efforts. Four primary services are provided by this Branch.

1) Development Plan Review – The primary service provided by the development plan review is to enforce compliance with the Drainage Regulation. The intent is that stormwater is conveyed in a manner that does not adversely impact property, including adjacent properties and property within the development.
2) Drainage Permitting – The permitting service tracks development such that all development gets reviewed.
3) Drainage Inspection – The inspection service involves field inspections to verify that construction is proceeding in accordance with the approved plans.
4) Investigation and Correction of Drainage Violations – The drainage violation service investigates reported or observed violations of the provisions of the Drainage Regulation. These violations are processed to the extent necessary to correct the violation. Typically, this requires formal notification to the violator. Civil court action has been required in some instances. The end result of these services is a safer environment for the citizens of the County and a reduction of losses due to flooding.

Drainage Administration also results in benefits to the District by reducing costs for future flood control facilities, reducing flood damage and maintenance to District facilities, reducing flood and drainage complaint response costs and enabling the District to coordinate land development with Area Drainage Master Plans (ADMP) on a regional basis. The services of this activity are available within the unincorporated areas of Maricopa County and the Town of Cave Creek.

3.3.2.3. Stormwater Quality Management

The District implemented a regional stormwater management process to assist Maricopa County municipalities in complying with National Pollutant Discharge Elimination System (NPDES) stormwater permitting requirements. The District will apply for a NPDES permit on behalf of Maricopa County by March 10, 2003. By heading up the program on behalf of Maricopa County, the District can assume a leadership role on stormwater management issues since runoff ultimately ends up in District structures from municipalities or the unincorporated County.

The District's early involvement in the Phase I stormwater program was because establishing a regional network of stormwater monitoring stations was a cost-effective cooperative solution to stormwater management issues. Additionally, the District became involved in stormwater management issues due to runoff from various municipalities within the urbanized areas potentially entering District structures prior to entering the Salt or Gila River systems. As such, there is some liability associated with being a stormwater management agency. Active

involvement in the stakeholder process can allow the District to establish regional guidelines and regulations that are appropriate for the arid southwest.

Services associated with this activity include: stormwater quality monitoring for Phase I municipalities (Phoenix, Mesa, Scottsdale, Glendale and ADOT), Phase II permitting on behalf of Maricopa County and the District, and a regional source of information on stormwater management issues for other municipalities within and outside Maricopa County. Current stormwater monitoring services include monitoring at 23 different stormwater sampling stations throughout Maricopa County. Currently, the District has a 50/50 cost share agreement with Phoenix, Mesa, Scottsdale and Glendale. The agreement with ADOT requires the District to fund 100% of the stormwater monitoring effort for 5 years.

The second component to the stormwater program at the District involves applying for a NPDES stormwater permit on behalf of Maricopa County by March 10, 2003. Although, the District is not currently listed as a targeted permitee under the Phase II stormwater program, Environmental Protection Agency (EPA) and Arizona Department of Environmental Quality (ADEQ) have the option of enlisting flood control dtistricts as future permittees. By heading up the program under Maricopa County's permit, the District could be covered under this permit potentially helping to reduce the District's liability. The permit will have 3 permit cycles of 5 years at a time. During the first permit cycle, the County will have to implement a stormwater management plan to address water quality issues to the Maximum Extent Practicable (MEP) through the utilization of Best Management Practices (BMP's). It is expected the entire stormwater management program will be in place after the first five-year period. The Phase II program requires the implementation of six minimum BMP's including: 1) public education, 2) public involvement, 3) illicit discharge detection and elimination, 4) pre-construction activities, 5) post-construction activities and 6) good housekeeping at municipal operations. The District will be responsible for all six of these components in house, as will all of the other county departments. This effort will involve a great deal of interdepartmental interaction.

The third component to the water quality program involves being a regional leader on stormwater management issues. The District takes an active role in rulemaking at both the state and federal levels by regularly commenting on new legislation or regulations that will affect operations. The District is an active stakeholder working with ADEQ, EPA, the USACE and other entities. The District actively works with the National Association of Flood and Stormwater Management Agencies (NAFSMA) on lobbying efforts in Washington or within regional regulatory Districts (i.e. Region IX EPA). Due to this increased participation on the regulatory scene, the District can be seen as a resource to other municipalities within or without Maricopa County. Resources include District staff to answer stormwater questions, a stormwater webpage, and the Volume III – Erosion Control Manual with a series of BMPS for construction site activity.

3.3.2.4. Sand and Gravel Administration

ARS §48-3603 and §48-3609 direct each County Flood Control District to adopt and enforce floodplain regulations consistent with criteria adopted by the Director of ADWR. Chapter 44 of the Code of Federal Register, Chapter 1 (pertaining to the National Flood Insurance Program), defines development as a man-made change to improved or unimproved real estate including

but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials. Prior to commencing any development within a 100-year delineated floodplain that is within the jurisdiction of the Flood Control District (see Floodplain Regulations for Maricopa County), a Floodplain Use Permit shall be obtained.

The Floodplain Branch is responsible for issuing a floodplain use permit which shall be granted once the applicant shows that the excavations will not have a cumulative adverse impact nor be of such depth, width, length, or location as to present a hazard to life or property or to the watercourse in which they are located.

Mining extraction in areas located outside of the 100-year delineated floodplain does not require a floodplain use permit however, a minimum 200 feet wide setback should be provided to prevent flows from causing lateral migration during flooding events. These activities are not prohibited provided that plans are submitted to the Floodplain Administrator for review and comment prior to commencement.

The plan of development submitted for a floodplain use permit must include a plan of reclamation to leave the land when the approved use is terminated in such a condition as to maintain stability of the 100-year delineated floodplain or to an improved condition to enhance a higher use of the land.

The District's regulations, guidelines and watercourse master planning studies for sand and gravel mining activity acknowledges the economic value of aggregate mining, as well as protecting other values and activities in the floodplain. Extraction operations should be conducted in such a manner as to cause no obstruction to the natural flow of the waterways, to cause no damage to adjacent structures or properties, to maintain the continuity of flows and sediments, and to preserve the natural and beneficial function of the watercourse.

3.3.3. Flood Hazard Education Program

3.3.3.1. Public Involvement

Public Involvement and related activities were initiated as a District function in 1985. Until this time, the District had no specific policy for receiving or soliciting public comment concerning flood control projects or activities. In November of that year, the Flood Control Advisory Board approved the hiring of a Public Involvement Coordinator (PIC) to coordinate public involvement and information activities and to oversee the work of three public relations firms hired to conduct public involvement activities for several key projects.

Prior to the development of a Public Involvement Program, public involvement responsibilities were often performed by technical staff (Project Managers and Engineers). Transferring these tasks and responsibilities to someone trained in the public relations field improved consistency of implementation and the effectiveness of public involvement programs. Project Managers were able to focus their efforts on the tasks of overseeing the work of contractors and consultants and keeping the project on schedule and on budget.

Public Involvement and Public Information are conducted similarly, however, the key difference is in the direction that information travels. Public Information activities involve providing the public with information and education about District projects, regulations, studies, changes, and new challenges and opportunities. The District achieves this through brochures, handouts, videos, websites, direct mailers, advertising, community and school presentations, public meetings, open houses, and media relations. Public Involvement activities consist of setting up public input meetings, gathering feedback and input from the public, and incorporating that information into District projects and studies.

The required specific knowledge about projects that staff needs to inform the public is obtained through close daily coordination with the project managers and other branches. The District has been able to realize considerable cost savings and better communication and coordination with project managers by having public relations expertise in-house.

For many years, the public was not as involved as they are today in the District's flood control studies or projects. Shifts in social values, technology, heightened neighborhood activism and awareness, and increased expectations of tax-supported services have made the District projects more visible and accessible for the public. The District strives to improve the level of involvement by the public in the decision-making process through pro-active public information, education, and involvement activities. These positive results have greatly increased the District's chances for accomplishing its mission of flood protection.

3.3.3.2. Flood Warning and Data Collection

The flooding of the late 1970's and early 1980's made it clear that local authorities, including the District, lacked sufficient hydrometeorologic data to make decisions concerning evacuations and flood fighting efforts. Information was not available for watershed conditions, status of structures, and the quantity of storm runoff being conveyed to the natural streams and rivers affecting the County. Maricopa County is just over 9,200 square miles, yet it is affected by runoff from a drainage area greater than 50,000 square miles. In addition, the catastrophic failure of both the Grand Teton Dam in Wyoming and the Big Thompson flood in Colorado in 1976 brought a heightened awareness of the increased need for hydrologic data especially in light of the 22 structures the District owns and operates.

The Board of Directors, realizing the importance of real-time hydro-meteorologic data, authorized District staff to initiate a flood hazard information/mitigation system that could provide early warning of flooding. This warning system could allow time for cities and the County to initiate appropriate responses to save lives and reduce damages within endangered areas. The early warning system was developed according to a National Weather Service protocol called Automated Local Evaluation in Real Time (ALERT).

3.3.4. Flood Hazard Identification Program

3.3.4.1. Planning

Non-structural solutions required a land use planning emphasis to provide a regional, uniform, and coordinated approach to watershed management. This approach works to minimize the public cost of protecting citizens from flooding that results from private and public

development's cumulative effects on drainage characteristics. This regional approach has a high degree of importance throughout the planning process.

The first step towards an independent planning function began with the initiation of Area Drainage Master Studies (ADMS) in 1983 as a means to regulate development and have plans for the development community to implement similar to a road system. In 1989, Planning was first identified as a separate and distinct District program.
In support of the District's mission, the primary goal of the Planning Program is to reduce flood risks for the people of Maricopa County. The objective of this goal is to plan and facilitate implementation of flood control projects in the shortest time possible and at the lowest total cost, while balancing both social and environmental considerations. A second important goal of the Planning Program is to identify potential flood control and stormwater management problems prior to the onset of new development. The objective of this goal, through sound planning, is to avoid or minimize the future need for publicly funded structural flood control projects.

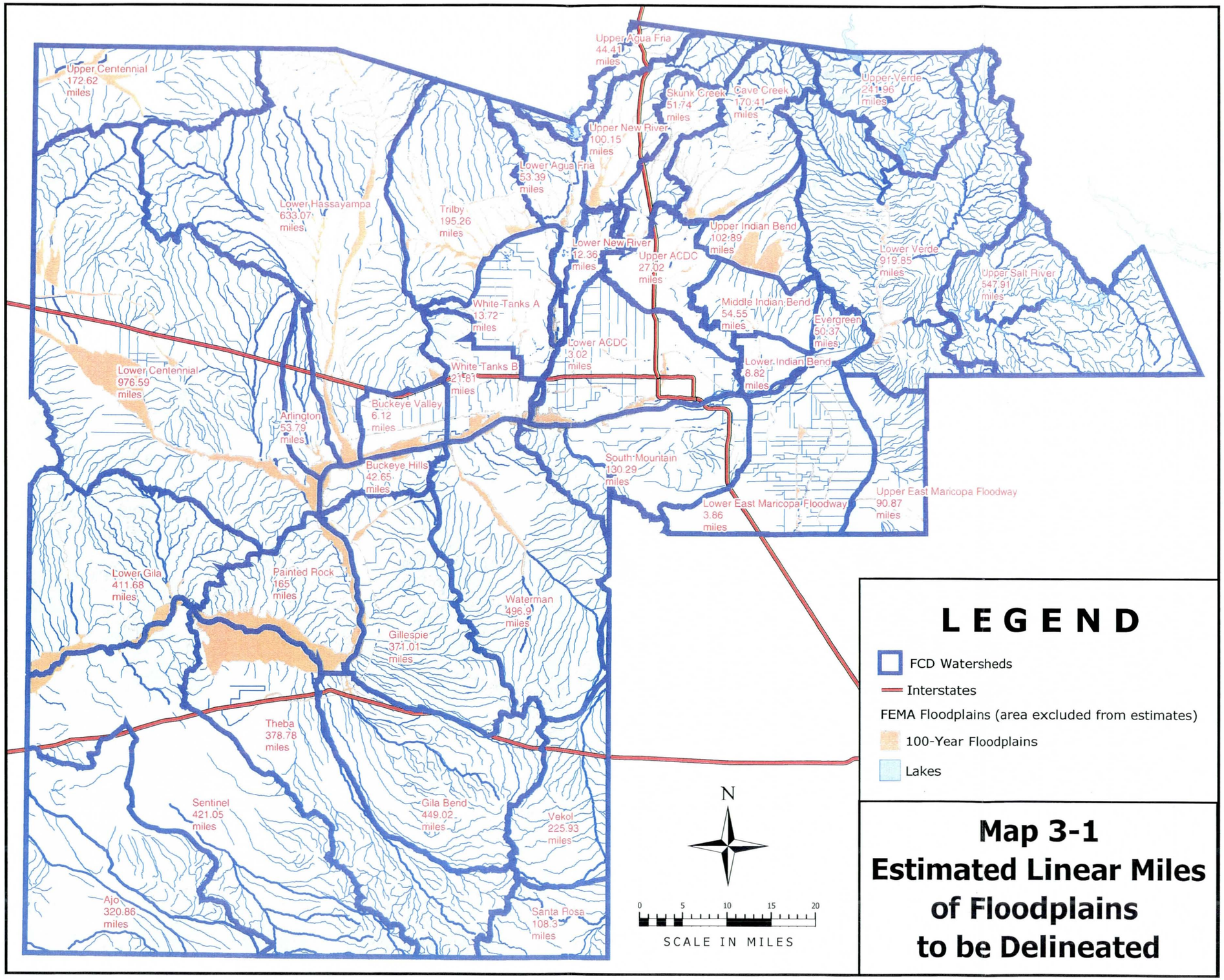
The Planning Branch prepares comprehensive regional studies and analyses; identifies locations and property at risk from potential flooding; and identifies regional flood control facilities that will be required in growth areas. Following an analysis of existing and future flooding problems, alternative solutions are developed to determine the most cost effective and publicly acceptable project. Recommended projects are then prioritized for inclusion in the District's CIP. Non-structural alternatives are also evaluated and recommended.

The District's planning activities are integrated with the regulatory and floodplain delineation activities. Information developed by the Planning Branch is utilized for completing floodplain delineations and regulating new developments. Conversely, the Planning Branch utilizes information developed in the regulatory and floodplain delineation activities. Activities in the Planning Program include: Area Drainage Master Studies (ADMSs) and Master Plans (ADMPs); Watercourse Master Plans (WCMPs); site specific master plans; project pre-design studies; and the coordination of interagency cooperative projects and agreements.

3.3.4.2. Floodplain Delineation

The District, recognizing the importance of pro-active floodplain management and the potential for problems resulting from continuing new development within the County, initiated a floodplain delineation program in 1986. This service was established to add detail to the remainder of the original Flood Prone Area Maps and to delineate those watercourses yet to be studied. The District has been studying about 130 linear miles of floodplains per year with approximately 1,800 linear miles completed as of 2001 and about 7,000 linear miles remaining to be done.

Map 3-1 shows the watersheds designated by stream symbology on USGS quadrangle and existing floodplain maps that will help assess and prioritize the remaining work. It should be noted that these watercourses are also depicted on the current Flood Insurance Rate Maps (FIRMs) for Maricopa County, which reflect the regional streams needing delineation to preserve the conveyance of runoff from the mountains to the confluence with the existing mapped floodplains.



Map 3-1
Estimated Linear Miles of Floodplains to be Delineated

The Floodplain Delineation Branch is currently identifying floodplains using both detailed and approximate methods. Detailed delineations are done in areas that are already developed or will soon be developed. Approximate delineations are done in order to get ahead of potential development, and are suitable in areas that currently have little development. This effort allows for sound floodplain management so that future development will not impede, divert or retard the conveyance of floodwaters to the detriment of others as well as reducing the flood damage potential to the development.

Ongoing A Zones and detailed delineations as of February 2000 totaled 384 linear miles for a cost of $2.5 million. The proposed delineations from this February report were 700 linear miles for an estimated cost of $1.5 million. The Floodplain Delineation Branch February 2001 report update indicated 3,184 linear miles of delineations to be ongoing, with 1,200 linear miles being proposed at $2.7 million and 500 additional linear miles being completed in the current ADMP studies in process. The Delineation Branch February 2002 report update indicates that for FY 2002-03, 213 additional linear miles of delineations are planned for an estimated cost of $1.35 million. There will be additional delineations completed in FY 2002-03 as part of the four ADMP's that are underway. On the average each year, approximately 1,000 linear miles of floodplain delineation will be completed over the next 6-7 years.

In 1994, FEMA established the Mapping Needs Assessment Process in order to identify and prioritize needs for community map updates in accordance with Section 575 of the National Flood Insurance Reform Act of 1994. Information regarding mapping needs is collected by FEMA in the Mapping Needs Update Support System (MNUSS) database. District staff is currently preparing a listing of mapping needs for a number of watercourses to submit to FEMA for assistance.

3.3.4.3. Area Drainage Master Studies/Plans

Area Drainage Master Studies (ADMS) were originally conceived in 1983 to provide technical information to define and quantify flood hazards. Authority for these studies is found in the Floodplain and Drainage Regulations for Maricopa County. The enormity of the ADMS program required that the county be divided into smaller study areas. The ADMS study areas were identified by first establishing the watershed boundaries, and then subdividing these to arrive at study areas that could reasonably be completed. There are forty-eight ADMS areas established from the watershed boundaries, ranging in size from 15 to 580 square miles. The areas with known flooding and with existing and expected development are given priority.

The purpose of the ADMS's is to identify existing flood-prone areas as well as projections of future conditions. The information obtained is then used to identify areas, which require flood mitigation, and to guide future development. To identify flood hazards a series of tools such as computer rainfall-runoff models; topographic mapping; soils data developed by the NRCS; and land use data developed by the Maricopa Association of Governments are used.

The purpose of the ADMP's is to develop plans to mitigate the flood hazards identified in the preceding ADMS. The major components of the ADMP's include public involvement, biological and archeological assessments, landscape character assessment, inventory of known hazardous waste sites, engineering analysis and cost estimates for alternative flood protection

facilities, evaluation of multi-use potential, and detailed engineering analysis of the recommended project features. The District's objective is to integrate these components to develop a solution that is cost effective, provides a high level of flood protection, and avoids impacting natural and cultural resources to the maximum extent practicable.

The planning program has been accelerated to get ahead of development. A goal of the District is to complete ADMP's for the entire developable portion of the County by 2010 subject to available funds. The various studies completed and underway are listed in Chapter 4 by watershed. Additionally, Map 5-1 shows the location and status of the current ADMS/ADMP's and Watercourse Master Plans.

3.3.4.4. Watercourse Master Plans (WCMPs)

ARS §48-3609.01 authorizes the District to perform Watercourse Master Plans. These are similar to the ADMS/ADMP program but focused on watercourses not watersheds. The primary goal of the WCMP is to provide information and develop solutions that protect existing and future residents from possible damages associated with floods up to and including the 100-year event. In addition, minimization of future expenditures of public funds for flood control and emergency management is also of paramount importance.

The intent of the WCMP concept is to bring together the public, the business community, and the concerned agencies for the purpose of identifying flood hazards and solutions to mitigate them. These plans incorporate identified unique characteristics that should be preserved, plan for ongoing uses - both commercial and recreational, which are often neglected in traditional floodplain management. Too often, neglect of these issues results in structural approaches to solve problems that traditional flood control methods have created.

WCMP's develop and identify alternative plans for providing flood control. Traditional structural flood control alternatives are compared to non-structural flood control alternatives. Selected solutions are based upon system hydrology, hydraulics, lateral migration potentials, and sediment trends. An objective of the District is to provide opportunities for multiple uses including recreation, groundwater recharge, riparian habitat preservation or restoration, and other related enhancements that would be implemented by others providing they are consistent with the District's flood control mission. The non-structural flood control alternatives are in addition to traditional floodplain management tools. The District's objective is to partner with the sand and gravel industry and other property owners to develop plans and implementation strategies that are mutually beneficial.

3.3.4.5. Landscape Aesthetics and Recreation Multiple-Use Opportunities

The planning and design of flood control facilities as *places for people* is a key issue and challenge facing the Flood Control District of Maricopa County. The rapid growth of urban development in recent years has been accompanied by increased public demand for the District to build more public value and benefits into its flood protection facilities. Increasingly, local citizens and community leaders are looking to the Flood Control District to plan and design flood protection facilities in ways that will preserve natural desert open space, enhance local community image, and provide opportunities for desert greenbelts and new parklands for year round recreation.

Landmark projects such as Indian Bend Wash, Tempe Town Lake and a host of others that include Freestone Park, Kiwanis Park, Old Cross Cut Canal, and Falcon Dunes Golf Course, amply demonstrate how flood control facilities can create aesthetic value, contribute a unique sense of identity and place to local communities, and provide a wide variety of open space opportunities and benefits for local citizens throughout the year. The examples offered by these projects are changing public understanding and expectations regarding the potential of flood control facilities to provide open space benefits.

Growing public concern for preserving the visual beauty of the urban, rural and natural settings in Maricopa County prompted the Board of Directors of the District to adopt an Aesthetic Treatment and Landscaping Policy in 1992. This Policy provides general guidance and direction for the integration of landscape aesthetic features and recreation multi-use opportunities in the planning, design, construction and operation of flood control facilities by the District. The Policy applies to the design of new structures and to existing structures that do not include aesthetic features. Key points of the Policy are the following:

- Promotes the preservation of Sonoran Desert natural landscapes and protection of local community character
- Authorizes expenditure of District funds for inclusion of landscaping and aesthetic features, and acquisition of right-of-way to provide for such features.
- Promotes full integration of aesthetic features, and multi-use opportunities in all phases of planning and design of District flood control facilities.
- Requires use of Aesthetic Advisory Committees, comprised of public interest groups, stakeholders and landscape aesthetics professionals, to provide project review and oversight.
- Requires the development of landscape themes for FCD structures that will help preserve natural landscape character and/or complement and enhance local community character.

The implementation of the District's Landscaping and Aesthetic Treatment Policy has been a major program thrust for the past several years. Additional initiatives for this program are addressed in Chapter 5.

3.3.4.6. Integrating Projects into the Natural and Urban Environment

The District has made a commitment that new flood control projects not only protect people and property from flooding threats, but also provide additional benefits. These benefits can include increased protection for natural habitat, new recreational facilities and open space, and aesthetically pleasing designs that contribute to the revitalization of urban areas. Although Maricopa County is located in a largely desert environment, much of the County is subdivided by canals, rivers, creeks and washes, and these linear attributes are a significant feature of the physical character of the area. Dams, retention basins, channels and outfalls can also be found throughout the County, and can have a major beneficial or negative impact on adjacent neighborhoods and natural areas depending on the design and management of these facilities.

The Federal Safe Harbor Policy was created in 1999 to relieve the burden of the Environmental Species Act (ESA) on landowners when listed species are found on the land. Safe Harbor Agreements through the "Enhancement of Survival Permit" provides assurances that future land activities will not be subject to EAS Section 9 takings. The District is participating in the Safe Harbor Program at Tres Rios, which will allow for maintenance after construction and the USACE adaptive management period (5 years).

3.4. Summary

The District's mission of protecting the public from flood hazards has remained constant since inception, but the organization has evolved to meet new challenges and the changing desires of the population. The organizational structure has been fine-tuned to respond to the core function that are mandated by state and federal laws. In addition, the organization has responded to the overall goals of County government to provide efficient and effective services to the public.

The District desires to provide cost effective programs and projects to the public. The financial information presented in this chapter shows revenue has dipped and fluctuated slightly. However, due to the increase in population and continued growth in new housing starts, the District has maintained a steady income over the last decade. Partnerships and multi-use projects will help the District to continue providing cost effective projects.

Maricopa County is a vast area with a mix of issues. The complexity and variety of geologic conditions in conjunction with rapid population growth has resulted in the development of a series of flood management programs. The County's population increased from 663,510 in 1960 to 2,954,150 in 2000, an increase of 345 percent. With growth spreading outward as indicated in Chapter 2, no one program can provide the solutions to the entire District's flood hazard problems. In addition to the expanse of programs now provided by the District to meet the challenges of the diverse environment as well as the desires of the public, the District is starting other initiatives. The future direction of the District is addressed in Chapter 5, as well as descriptions of some of the newer initiatives.

Endnotes

[1] *Taken from the Flood Control District of Maricopa County Five-Year Capital Improvement Program, FY 2001-02 to 05-06, October 15, 2001. p. 19.*

[2] *Figures taken from District financial analysis dated 6/7/02.*

[3] *Ibid.*

[4] *Updated to 2000 values by Mike Alexander, 06/27/00.*

[5] *FEMA. Community Rating System. (2000). http://www.fema.gov/nfip/crs.htm. (September 14, 2000).*

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CHAPTER 4. FLOOD CONTROL PROGRAM REPORT

4.1. Overview

The previous chapters provided an insight into the physical and man-made conditions in Maricopa County. Chapter 3 presented organization, funding, and programs that have made it possible for the District to provide solutions to flooding problems. This information and data are used in the assessment of flood control problems for the District and to guide decision making for future direction. As required by the Arizona Revised Statutes, an initial survey of the flood control problems was done in the1963 Report, discussed in Chapter 1. A series of reports and Capital Improvement Programs have followed the 1963 Report to address the recommended solutions in accordance with the guidance from ARS. In general those reporting requirements from ARS are as follows:

Arizona Revised Statute Requirements (§ 48-3616)

- Prepare a report describing existing flood control facilities in the area (see chapters 1 and 4),
- Recommendations as to cooperation between the District and the owner(s) of existing facilities, recommendations and a preliminary plan for the construction or other acquisition of facilities to carry out the purpose of the District,
- A description of the property proposed to be acquired or damaged in performing the work,
- A program for carrying out the regulatory functions (see chapter 3),
- A map showing the District boundaries and location of the work proposed to be done and property taken or damaged,
- An estimate of the cost of the proposed work, and
- Such other things as the Board of Directors may request.

This report shall be prepared at least every five years beginning in 1985 discussing past efforts of the District in eliminating or minimizing flood control problems and stating the planned future work of the District to eliminate or minimize remaining flood control problems.

In the 42 years the District has been in existence significant changes and growth have taken place in Maricopa County. In Chapter 1, Table 1-1 lists approximately 35 structural projects and several maintenance projects identified for flood management in Maricopa County as determined at the time of the District's 1963 Program Report. The population of Maricopa County was approximately 800,000 in 1963 and approximately 120 square miles of land were covered with urban development. The 2000 U. S. Census indicates the population of Maricopa County is 2,954,150, and growth has expanded to over 625 square miles of the 9,226 square miles of land in the County. This rapid growth has necessitated additional projects and studies to be identified and completed.

4.2. Present Status of all Projects Since 1963

A summary of the 1963 and 1991 Comprehensive Flood Control Program Reports are discussed In Chapter 1. An update to the 1963 list of projects is depicted in Table 4-1, indicating whether projects were completed and when. Capital Improvement Programs have

been prepared by the District for the last 30 plus years, prioritizing additional projects beyond those identified in the 1963 Report for the purpose of minimizing flooding problems. Some projects have been identified over the years but were never done. This is due to funding constraints, changed site conditions, and/or other reasons. Map 4-1 shows the general location of the previously completed structures up to January 2000. Table 4-2 indicates the number of past and proposed structural projects for each watershed. Table 4-3 lists the projects from the FY2001/02 to FY 2005/06 CIP for the District, and Map 4-2 shows the location of each project.

Table 4-1 Structural Project Update from 1963 to Present

Group No. 1 - Projects Recommended for Immediate Construction

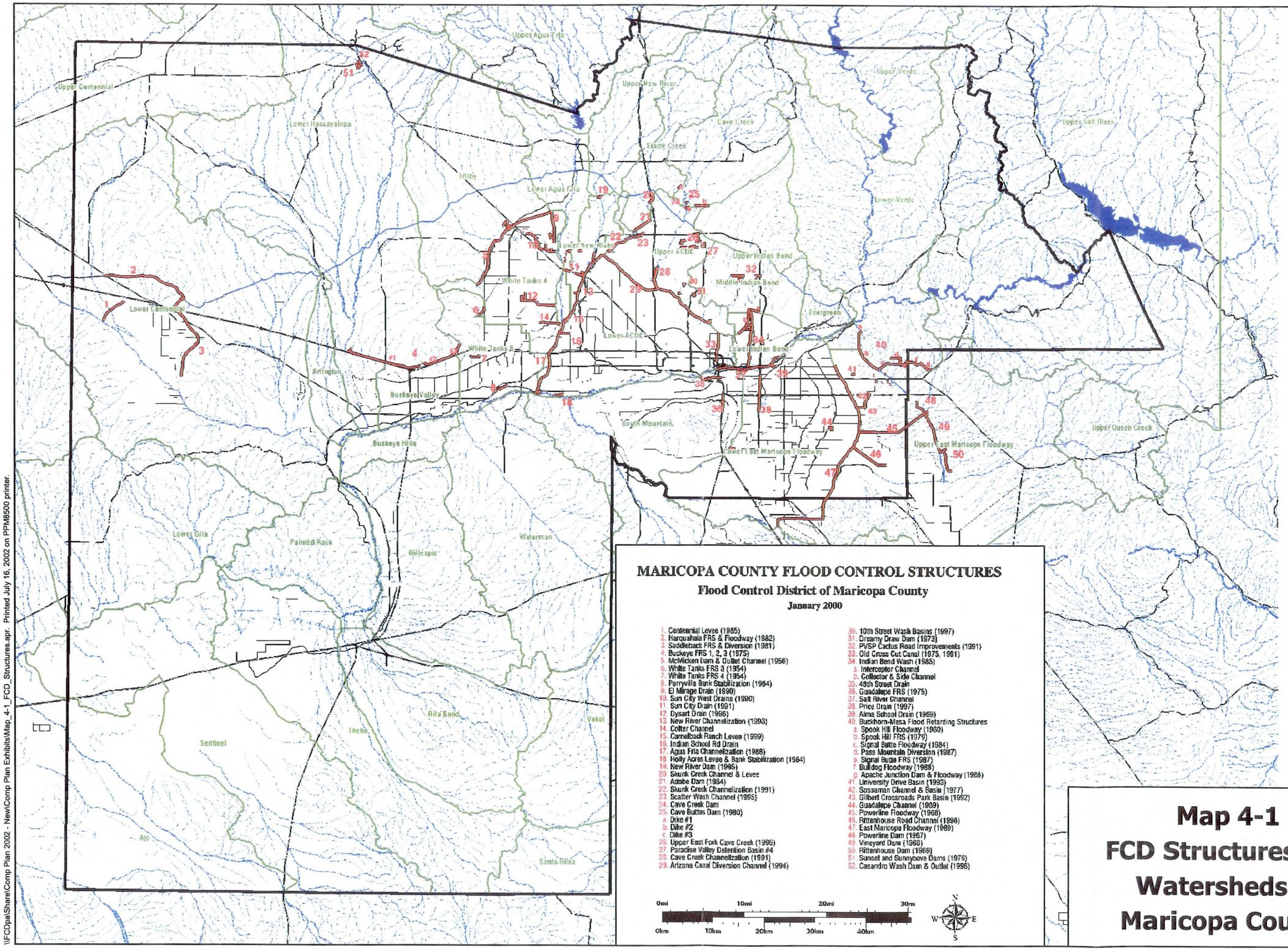
Drainage Area	Location	Job Description	Status
1	Gillespie Dam to 107th Ave.	Channel Clearing	Begun 1980, held up in 1994 due to litigation
27	Lower Indian Bend	Floodway Channel	completed 1980, maintained by Scottsdale
19-23	Agua Fria, New River, & Skunk Creek	Channelization, levees & bank stabilization	completed 1989-1990
22	Arizona Canal Diversion Channel (ACDC) - Cudia City Wash to Skunk Creek	Earthen & Concrete Channel	completed 1992
25	Dreamy Draw	Earth Dam	completed 1973
22	North Mt.-Arizona Canal, 20th St. to 23rd Ave	Construct Channel	begun 1990, completed from 48th Street to Cave Creek in 1992
22	New River northwest of Glendale	Earth Dam	completed 1985
22	Adobe Dam	Earth Dam	completed 1982
22	Lower Cave Creek Dam Site	Earth Dam	completed 1980
22	Union Hills Diversion	Lined Channel	I-17 to Skunk Creek started in FY 1992-1993
22	Maryvale-Glendale Drain	Line Channel	partially done - Sunset Basin
22	Glendale-Peoria Drain	Lined Channel	Completed 1990
7	Casandro Wash	Earth Dam	complete 1996
7	Sunset & Sunny Cove Washes	Earth Dams	completed 1976
32	Buckborn-Mesa	Levees & Channels	completed 1988 except Weekes Wash FRS
12	Bender & Sand Tanks Washes, Gila Bend	Levees	No Action

Table 4-1 Structural Project Update from 1963 to Present (con't)

Recommended Projects Group II - Subject to Availability of Funds			
32	Apache Junction-Gilbert	Levees & Channels	Powerline FRS & Floodway completed 1967 - East Maricopa Floodway completed 1989
32	Mesa-Chandler-Gilbert	Channel	replaced by Price Road Drain
32	Williams-Chandler	Levees & Channels	Vineyard FRS completed 1968 - Rittenhouse FRS completed 1969
9	Buckeye-Palo Verde	Levees & Channels	FRS #1 completed 1974 - FRS #2 and FRS #3 completed 1975
22	W. Phoenix-Maryvale	Channel	Replaced with the Maryvale Stadium (basin)
22	North Phoenix Mt.	Channel	part of ACDC dedicated in 1993
Recommended Projects Group III - Subject to Availability of Funds			
7	Sols Wash	Channel Alignment & Protection	no action
7	Powder House Wash	Earth Dam	No action
7	Cave Creek Town	Earth Levee	no action
31	Maxwell Dam (Flood Control)	Earth Dam	modifications to existing dams, renamed Roosevelt Modified Dam, completed 1995, Orme Dam never built
24	Cave Creek Dam (Old)	Levee	eliminated, Cave Buttes Dam constructed
33	Queen Creek	Channel	completed 1989 - part of the EMF
Group IV - Projects Deferred as not feasible at this time			
7	Flying "E" Wash Wickenburg	Earth Dam	No action
26	Guadalupe Watershed	Levees & Channels	FRS completed April 1975
26	South Mountain, 40th St. to 75th Ave.	Levees & Channels	43rd Ave to 75th Ave in the design process
28	Indian Bend Wash above Arizona Canal to Indian Bend Road	Channels	completed April 1979
33	Santan Watershed	Levees & Channels	no action; currently Queen Creek HMP
4	Harquahala Valley	Levees & Channels	completed
6	Box Canyon	Earth Dam	no action
7	Sols Wash (Matthie Dam)	Earth Dam	Wickenburg ADMS FY 1990/1991
8	Upper New River	Earth Dam & Channel	completed in February 1985
4	Tonopah and Winters Valley	Levees and Channels	no action
4	Eagle Tail Mountain	Levees and Channels	no action

Table 4-1 Structural Project Update from 1963 to Present (con't)

Additional Projects since 1963 Report			
REGION	PROJECT	DESCRIPTION	STATUS
southeast	Alma School Drain		completed 1969
	Sossaman Channel and Basin		completed 1977
	Guadalupe Channel		completed 1989
	Gilbert Crossroads Park Basin		completed 1992
	University Drive Basin		completed 1993
	Price Drain		completed 1997
	Rittenhouse Road Channel		completed 1998
	Salt River Channel		
	Holly Acres Levee and Bank Stabilization		completed 1984
	Agua Fria Channelization		completed 1988
	Old Cross Cut Canal		completed 1991
	New River Channelization		completed 1993
	Arizona Canal Diversion Channel (ACDC)		completed 1994
	Camelback Ranch Levee		completed 1999
	Indian School Road Drain		
	48th Street Drain		
	Ivanhoe and Erie Storm Drains		completed 2001
northeast	Sun City Drain		completed 1991
	Skunk Creek Channel and Levee		
	Adobe Dam		completed 1984
	Paradise Valley Detention Basin #4		
	PVSP Cactus Road Improvements		completed 1991
	Cave Creek Channelization		completed 1991
	Skunk Creek Channelization		completed 1991
	Scatter Wash Channel		completed 1995
	Upper East Fork Cave Creek		completed 1996
	10th Street Wash Basins		completed 1997
northwest	Centennial Levee		completed 1985
	Saddleback FRS and Diversion		completed 1981
	Casandro Wash Dam and Outlet		completed 1996
	El Mirage Drain		completed 1990
	Sun City West Drains		completed 1990
	Dysart Drain		completed 1996
	Colter Channel		
	Bullard Wash		completed 2001
southwest	NO PROJECTS FOR THIS AREA		



MARICOPA COUNTY FLOOD CONTROL STRUCTURES

Flood Control District of Maricopa County

January 2000

1. Centennial Levee (1985)
2. Harquahala FRS & Floodway (1982)
3. Saddleback FRS & Diversion (1981)
4. Buckeye FRS 1, 2, 3 (1975)
5. McMicken Dam & Outlet Channel (1956)
6. White Tanks FRS 3 (1954)
7. White Tanks FRS 4 (1954)
8. Perryville Bank Stabilization (1984)
9. El Mirage Drain (1990)
10. Sun City West Drains (1980)
11. Sun City Drain (1991)
12. Dysart Drain (1986)
13. New River Channelization (1993)
14. Colter Channel
15. Camelback Ranch Levee (1999)
16. Indian School Rd Drain
17. Agua Fria Channelization (1988)
18. Holly Acres Levee & Bank Stabilization (1984)
19. New River Dam (1985)
20. Skunk Creek Channel & Levee
21. Adobe Dam (1984)
22. Skunk Creek Channelization (1991)
23. Scatter Wash Channel (1995)
24. Cave Creek Dam
25. Cave Buttes Dam (1980)
    a. Dike #1
    b. Dike #2
    c. Dike #3
26. Upper East Fork Cave Creek (1996)
27. Paradise Valley Detention Basin #4
28. Cave Creek Channelization (1991)
29. Arizona Canal Diversion Channel (1994)
30. 10th Street Wash Basins (1997)
31. Dreamy Draw Dam (1973)
32. PVSP Cactus Road Improvements (1991)
33. Old Cross Cut Canal (1975, 1991)
34. Indian Bend Wash (1985)
    a. Interceptor Channel
    b. Collector & Side Channel
35. 48th Street Drain
36. Guadalupe FRS (1975)
37. Salt River Channel
38. Price Drain (1997)
39. Alma School Drain (1969)
40. Buckhorn-Mesa Flood Retarding Structures
    a. Spook Hill Floodway (1980)
    b. Spook Hill FRS (1979)
    c. Signal Butte Floodway (1984)
    d. Pass Mountain Diversion (1987)
    e. Signal Butte FRS (1987)
    f. Bulldog Floodway (1988)
    g. Apache Junction Dam & Floodway (1988)
41. University Drive Basin (1993)
42. Sossaman Channel & Basin (1977)
43. Gilbert Crossroads Park Basin (1992)
44. Guadalupe Channel (1969)
45. Powerline Floodway (1968)
46. Rittenhouse Road Channel (1998)
47. East Maricopa Floodway (1989)
48. Powerline Dam (1957)
49. Vineyard Dam (1968)
50. Rittenhouse Dam (1969)
51. Sunset and Sunnycove Dams (1976)
52. Casandro Wash Dam & Outlet (1956)

0mi 10mi 20mi 30mi

0km 10km 20km 30km 40km

N W E S

Map 4-1
FCD Structures and Watersheds in Maricopa County

\\FCDpa\Share\Comp Plan 2002 - New\Comp Plan Exhibits\Map_4-1_FCD_Structures.apr. Printed July 16, 2002 on PPM8500 printer.

Table 4-2 Summary of Capital Improvement Projects by Watershed

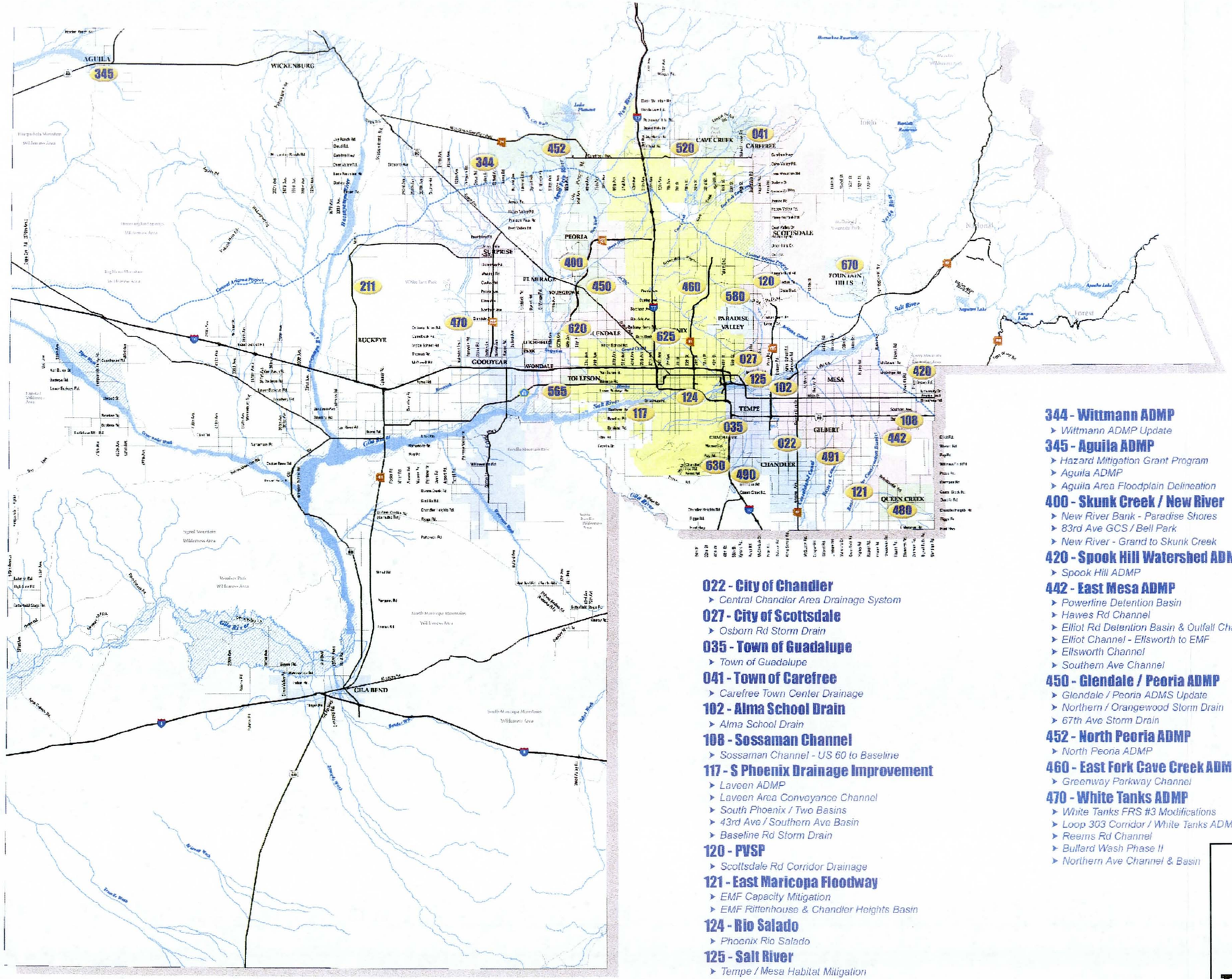
Region	Watershed	Projects
Southeast	Lower ACDC	8 past structural projects constructed, 9 planned in CIP FY01/02 - 05/06
	Lower East Maricopa Floodway ***	I past structural project constructed, 10 planned in CIP FY01/02 - 05/06
	South Mountain	2 past structural projects constructed, 6 planned in CIP FY01/02 - 05/06
	Upper East Maricopa Floodway **	12 past structural projects constructed, 9 planned in CIP FY01/02 - 05/06
	Upper Queen Creek *	Watershed outside of County boundary
Northeast	Cave Creek ***	2 past structural projects constructed, 1 planned in CIP FY01/02 - 05/06
	Evergreen	
	Lower Indian Bend	0 past structural projects constructed, 2 planned in CIP FY01/02 - 05/06
	Lower New River	2 past structural projects constructed, 3 planned in CIP FY01/02 - 05/06
	Lower Verde	7 past structural projects constructed, 2 planned in CIP FY01/02 - 05/06
	Middle Indian Bend	2 past structural projects constructed, 2 planned in CIP FY01/02 - 05/06
	Skunk Creek	2 past structural projects constructed
	Upper ACDC	6 past structural projects constructed, 1 planned in CIP FY01/02 - 05/06
	Upper Agua Fria **	
	Upper Indian Bend	
	Upper New River ***	
	Upper Verde **	
	Upper Salt River **	
Northwest	Arlington	
	Buckeye Hills	
	Buckeye Valley	1 past structural project constructed
	Lower Agua Fria	
	Lower Centennial ***	3 past structural projects constructed
	Lower Hassayampa ***	2 past structural projects constructed
	Trilby (Wittmann) ***	1 past structural projects constructed
	Upper Centennial ***	0 past structural projects constructed, 2 planned in CIP FY01/02 - 05/06
	White Tank A	5 past structural projects constructed
	White Tank B	3 past structural projects constructed, 1 planned in CIP FY01/02 - 05/06
	Upper Hassayampa *	Watershed outside of County boundary
Southwest	Ajo ***	
	Gila Bend	
	Gillespie	
	Lower Gila ***	
	Painted Rock	
	Santa Rosa ***	
	Sentinel ***	
	Theba ***	
	Vekol ***	
	Waterman ***	

* Watershed completely outside of Maricopa County boundary. (2)
** 90% of Watershed outside of Maricopa County boundary. (3)
*** A portion of the Watershed outside of Maricopa County boundary. (12)

Table 4-3 Five Year CIP FY 01/02 to FY 05/06

Summary					Five-Year CIP x $1,000						
City	Dist.	Reg	Act#	Description	FY 01/02	FY 02/03	FY 03/04	FY 04/05	FY 05/06	5-Yr Total	
				Tax Rate:	**0.2319**						
Multiple	All		C001	FCD Operations	154	0	0	0	0	**154**	
Chandler	1	SE	C022	Central Chandler Area Drainage System	1,673	805	1,635	1,269	0	**5,382**	
Scottsdale	2	NE	C027	City of Scottsdale	542	0	0	0	0	**542**	
Guadalupe	5	SE	C035	Town of Guadalupe	1,621	2,700	0	375	0	**4,696**	
Carefree	2	NE	C041	Town of Carefree	275	0	0	0	0	**275**	
Multiple	All		C050	Dam Safety Project	1,308	1,250	1,100	1,100	6,100	**10,858**	*
Multiple	All		C051	Candidate Assessment Reports	100	100	100	100	100	**500**	
Mesa/SRP	1	SE	C102	Alma School Drain	100	0	0	0	0	**100**	
Mesa	2	SE	C108	Sossaman Channel	82	0	0	0	0	**82**	
Phoenix, UMC	5	SE	C117	South Phoenix Drainage Improvement	10,985	7,800	150	2,500	2,500	**23,935**	*
Scottsdale	2	NE	C120	PVSP	150	150	1,000	2,100	0	**3,400**	
Gilbert/Mesa/UMC	1	SE	C121	East Maricopa Floodway	3,197	3,461	4,000	6,000	6,000	**22,658**	*
Phoenix	5	SE	C124	Phoenix Rio Salado	8,386	0	0	0	0	**8,386**	
Tempe/Mesa	2	NE	C125	Tempe/Mesa Habitat Mitigation	250	0	1,000	0	0	**1,250**	*
Buckeye/UMC	4	NW	C211	Buckeye/Sun Valley ADMP	600	1,200	0	0	0	**1,800**	
Surprise/UMC	4	NW	C344	Wittmann ADMP Update	600	1,200	0	0	0	**1,800**	
Aguila	4	NW	C345	Aguila ADMP	1,212	0	0	0	0	**1,212**	
Multiple	4	NE	C400	Skunk Creek/New River	450	1,550	2,300	0	0	**4,300**	
Mesa/UMC	2	NE	C420	Spook Hill ADMP	414	0	0	800	5,000	**6,214**	*
Mesa/UMC	1,2	SE	C442	East Mesa ADMP	8,081	9,135	5,555	5,000	1,500	**29,271**	*
Multiple	4	SE	C450	Glendale/Peoria ADMP	239	0	0	0	1,385	**1,624**	
Peoria/UMC	4	NW	C452	North Peoria ADMP	205	0	0	0	0	**205**	
Phoenix	3	NE	C460	East Fork Cave Creek ADMP	1,000	0	0	0	0	**1,000**	
Multiple	4	NW	C470	White Tanks ADMP	3,504	6,480	15,400	13,600	10,600	**49,584**	*
Queen Creek	1	SE	C480	Queen Creek ADMP	960	1,050	300	2,000	2,700	**7,010**	*
Chandler	1	SE	C490	Gilbert/Chandler ADMP	74	0	0	0	0	**74**	
Multiple	1,2	SE	C491	Higley ADMP	2,178	415	250	4,000	5,000	**11,843**	*
Phoenix/UMC	3,4	NE	C520	Adobe Dam ADMP	1,100	500	0	0	0	**1,600**	
Multiple	5	SE	C565	Durango ADMP	2,293	4,700	8,200	6,900	4,000	**26,093**	*
Paradise Valley	2	NE	C580	ACDC ADMP	0	0	0	0	0	**0**	
Phoenix/Glendale	4,5	SE	C620	Maryvale ADMP	995	8,099	6,000	6,000	6,000	**27,094**	*
Phoenix	3	SE	C625	Metro ADMP	0	3,500	3,500	0	0	**7,000**	
Phoenix	1	SE	C630	Foothills ADMP	41	0	0	0	0	**41**	
Fountain Hills	2	NE	C670	Fountain Hills ADMP	0	0	0	0	700	**700**	
				Estimated External Expense	**$52,769**	**$54,095**	**$50,490**	**$51,744**	**$51,585**	**$260,683**	
				CIP Project Contingency	$2,551	$2,455	$2,510	$2,256	$2,415		
				Force	$2,626						
				Projects Total	**$57,946**	**$56,550**	**$53,000**	**$54,000**	**$54,000**		

*Projects not completed during the five year CIP



022 - City of Chandler
- Central Chandler Area Drainage System

027 - City of Scottsdale
- Osborn Rd Storm Drain

035 - Town of Guadalupe
- Town of Guadalupe

041 - Town of Carefree
- Carefree Town Center Drainage

102 - Alma School Drain
- Alma School Drain

108 - Sossaman Channel
- Sossaman Channel - US 60 to Baseline

117 - S Phoenix Drainage Improvement
- Laveen ADMP
- Laveen Area Conveyance Channel
- South Phoenix / Two Basins
- 43rd Ave / Southern Ave Basin
- Baseline Rd Storm Drain

120 - PVSP
- Scottsdale Rd Corridor Drainage

121 - East Maricopa Floodway
- EMF Capacity Mitigation
- EMF Rittenhouse & Chandler Heights Basin

124 - Rio Salado
- Phoenix Rio Salado

125 - Salt River
- Tempe / Mesa Habitat Mitigation

211 - Buckeye / Sun Valley ADMP
- Buckeye / Sun Valley ADMP

344 - Wittmann ADMP
- Wittmann ADMP Update

345 - Aguila ADMP
- Hazard Mitigation Grant Program
- Aguila ADMP
- Aguila Area Floodplain Delineation

400 - Skunk Creek / New River
- New River Bank - Paradise Shores
- 83rd Ave GCS / Bell Park
- New River - Grand to Skunk Creek

420 - Spook Hill Watershed ADMP
- Spook Hill ADMP

442 - East Mesa ADMP
- Powerline Detention Basin
- Hawes Rd Channel
- Elliot Rd Detention Basin & Outfall Channel
- Elliot Channel - Ellsworth to EMF
- Ellsworth Channel
- Southern Ave Channel

450 - Glendale / Peoria ADMP
- Glendale / Peoria ADMS Update
- Northern / Orangewood Storm Drain
- 67th Ave Storm Drain

452 - North Peoria ADMP
- North Peoria ADMP

460 - East Fork Cave Creek ADMP
- Greenway Parkway Channel

470 - White Tanks ADMP
- White Tanks FRS #3 Modifications
- Loop 303 Corridor / White Tanks ADMP Update
- Reems Rd Channel
- Bullard Wash Phase II
- Northern Ave Channel & Basin

480 - Queen Creek ADMP
- Queen Creek Channelization
- Sonokai Wash Channelization

490 - Gilbert / Chandler ADMP
- San Tan Collector Channel Phase III

491 - Higley ADMP
- Higley ADMP
- Warner / Greenfield Park Basin
- RWCD Tailwater Analysis

520 - Adobe Dam ADMP
- Adobe Dam / Desert Hills ADMP

565 - Durango ADMP
- Durango ADMP
- Durango Regional Outfall Channel
- Durango Regional Conveyance Channel

580 - ACDC ADMP
- Doubletree Ranch Rd System

620 - Maryvale ADMP
- Bethany Home Outfall Channel

625 - Metro ADMP
- 24th Ave / Camelback Basin

630 - Foothills ADMP
- SE Phoenix Regional Drainage

670 - Fountain Hills ADMP
- Ashbrook / Balboa Wash Imp.

Flood Control District of Maricopa County

Planning and Project Management Division

N

Map 4-2

Five-Year Capital Improvement Program

\\FCDpalShare\Comp Plan 2002 - New\Comp Plan Exhibits\Map_4-2_Capital_Improvements.apr. Printed July 15, 2002 on PPM8500 printer.

4.3. Analyzing the Remaining Problems by Watersheds

In Chapter 3, the ADMS/ADMP programs were detailed noting that the District was divided into watersheds for study purposes. There are 37 watersheds now identified within the boundaries of Maricopa County and two outside the County boundary (39 total), but within the District's jurisdiction, that are analyzed in this Plan (see Map 4-3). A number of the 37 watersheds are partially outside the County boundary. This Plan concentrates on the land area that is within Maricopa County. These watershed boundaries were generally determined by major drainage areas and are usually named for watercourses or other significant features within the watershed boundary. In this Report the watersheds are divided into four regions for ease of mapping and discussion. These are not political boundaries but geographic. The regions are labeled as follows:

- Southeast Region
- Northeast Region
- Northwest Region
- Southwest Region

A broad summary of each Region is presented in this chapter with specific lists, by each watershed, for the District's completed and planned projects. As noted in Chapter 2, Maricopa County is made up of rugged mountains, hills and flat valleys with a variety of soils and vegetation types. Development trends and patterns are also varied across the County. These vast differences across the County make it necessary to study watersheds individually, in lieu of analyzing the District in whole, in order to determine what the appropriate solutions are for flood management in those areas. In addition, these watersheds are at varying stages of urbanization, which requires different levels of activity on the District's part.

Table 4-4 lists the watersheds and a summary of information such as area, expected population growth, linear miles of delineations, County road closure statistics, remaining land to be developed, structures in the floodplain and erosion hazard zones, and floodplain and drainage permits issued. This information is used for determining the level of risk for areas. Level of risk is critical for determining where studies and projects will be done each year.

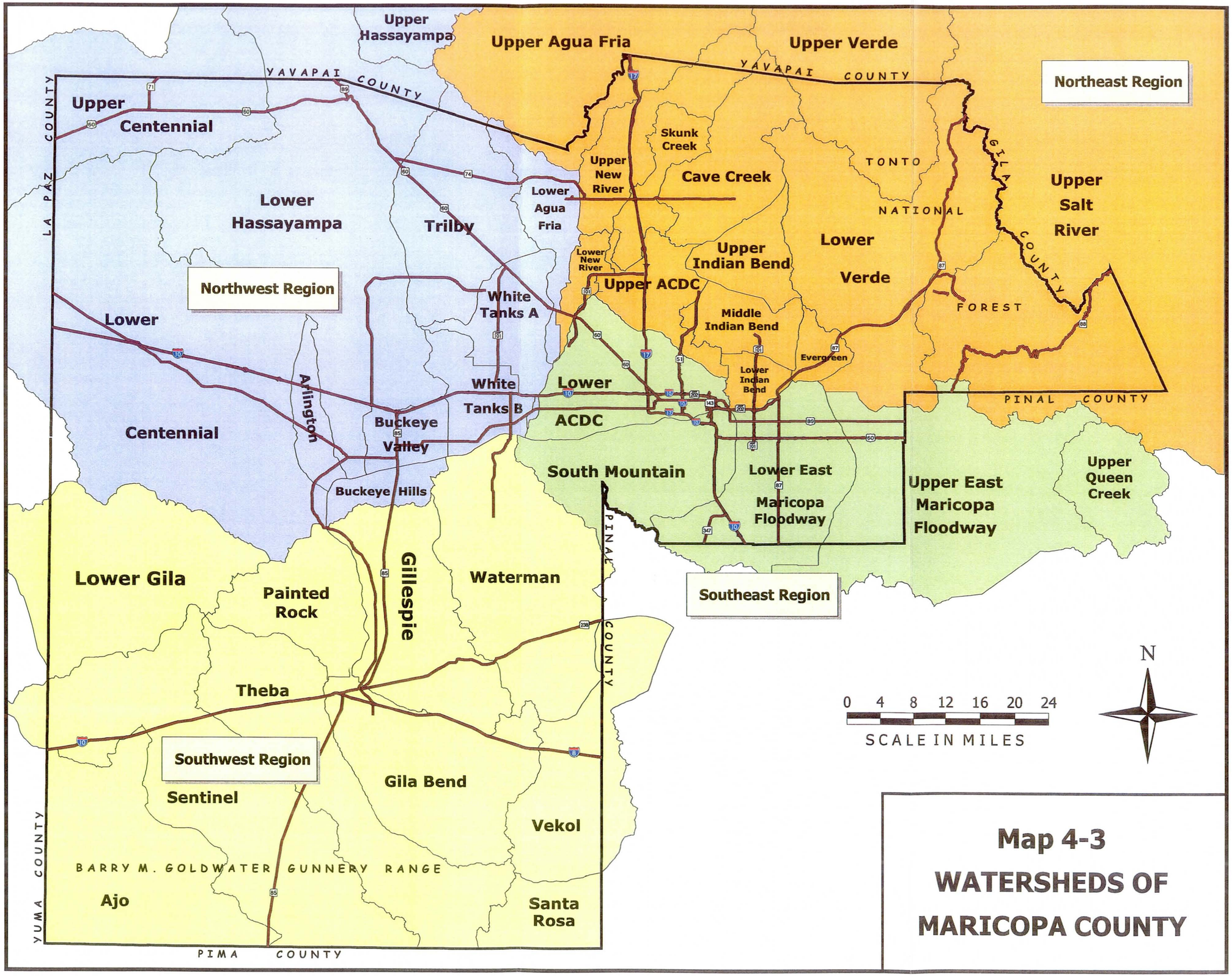
For Table 4-4, the population growth information was obtained from Maricopa Association of Governments (MAG). MAG updates these numbers annually using data from the Department of Economic Security (DES), U.S. Census, and other information. These are the numbers generally used by agencies within the County when population information is needed. Linear miles of delineations were calculated by District staff and are explained in footnotes on Table 4-4. The County road closure information was obtained from Maricopa County Department of Transportation's (MCDOT) road closure database. Calculations for the data for remaining land to be developed and number of structures in the floodway/floodplain were developed by the techniques noted in Chapter 2. Floodplain permits issued are based on the information from the District's database for these permits. The numbers for drainage clearance permits are a reflection of total building permits issued in the watersheds by the County and municipalities.

There are several levels of review needed to fully address the issues across the County and identify appropriate projects. A preliminary prioritization assess the criteria presented above. A more detailed risk assessment includes soil types, slopes, type of future development, projects underway, and the District's flood management responsibilities within each watershed.

The early years of District operation concentrated on capital improvement projects to protect the existing urbanized area from flooding hazards. Since, the District has diversified its approaches. The summary by region in this Plan lists the capital improvement projects; non-structural projects; studies; structural assessment and retrofit projects; and landscape aesthetics and recreational multi-use projects for each watershed.

In addition, the District performs ongoing operations and maintenance (O & M) of projects throughout the County. Natural channel clearing and maintenance of excess land also must be addressed in the maintenance program. The Districts budget for O & M is approximately 6.1 percent of the overall budget. Maintenance requirements must also be addressed when future projects are being considered for each watershed.

There are four maps for each Region that depicts the following: Developable Lands, Soil Erosion, and Floodplains; Land Use; Land Ownership and Projected Populations; and Residential Completions.



Map 4-3
WATERSHEDS OF MARICOPA COUNTY

Table 4-4 Watershed Summary by Region with Critical Elements Information

Watershed	Area (square miles) inside County Boundary	Population (1995)	Projected Population (2025)	Population Change (1995-2025)	100,000 scale USGS Hydrography (linear miles)	Approximate & Detailed Delineations (linear miles)[1]	Delineations remaining to be done (linear miles)[2]	County Road Closures (1996-2000)	Potential Developable Land (square miles)[3]	Structures in the Floodway	Structures in the Floodplain	Structures in a Moderate or Severe Erosion Hazard Zone	Flodplain Use Permits Issued (1990 - 1999)	Drainage Clearance Permits Issued (1990 - 1999)
Southeast Region														
Upper Queen Creek *	[143]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Upper East Maricopa Floodway **	132	96,565	299,706	203,141	118.0	27.0	91.0	196	68.00	0	70	70	16	16,600
South Mountain	245	226,051	409,043	182,992	167.0	36.0	131.0	29	46.90	1	453	449	12	17,000
Lower ACDC	235	772,467	1,134,100	361,633	83.0	80.0	3.0	26	77.31	58	6,370	6,235	50	20,000
Lower East Maricopa Floodway ***	265	556,096	986,188	430,092	72.0	68.0	4.0	31	87.00	0	3,959	3,761	39	57,600
TOTAL	877	1,651,179	2,829,037	1,177,858	440.0	211.0	229.0	282	279.21	59	10,852	10,515	117	111,200
Northeast Region														
Cave Creek ***	194	16,669	105,000	88,331	280.3	109.9	170.4	37	63.00	52	2,173	370	402	9,392
Evergreen	40	1,969	14,377	12,408	60.0	9.6	50.4	0	2.15	0	0	10	0	1,195
Lower Indian Bend	43	94,551	103,704	9,153	27.0	18.2	8.8	3	0.50	1	692	1	5	694
Lower New River	42	61,321	143,475	82,154	28.0	15.7	12.3	35	16.93	2	40	42	N/A	14,038
Lower Verde	560	23,556	111,277	87,721	996.5	76.6	919.9	24	55.20	3	11	1	8	6,950
Middle Indian Bend	95	184,042	236,070	52,028	54.6	16.5	38.0	0	11.17	2	330	279	2	16,307
Skunk Creek	89	11,814	79,628	67,814	105.3	53.6	51.7	46	41.10	85	155	148	93	3,123
Upper ACDC	120	341,822	462,706	120,884	89.8	62.8	27.0	0	25.00	51	1,661	1,595	18	20,722
Upper Agua Fria **	62	11	1,771	1,760	66.4	22.0	44.4	0	7.23	0	0	0	N/A	2
Upper Indian Bend	99	13,165	185,240	172,075	144.7	41.8	102.9	0	63.99	0	4,818	1,000	72	12,525
Upper New River ***	143	2,984	76,017	73,033	160.8	60.7	100.2	15	68.58	3	40	19	17	360
Upper Verde **	168	N/A	N/A	N/A	242.0	0.0	242.0	0	0.20	0	0	0	0	0
Upper Salt River **	358	N/A	N/A	N/A	547.9	0.0	547.9	0	0.00	0	0	0	0	0
TOTAL	2,012	751,904	1,519,265	767,361	2,803.2	487.4	2,315.7	160	355.05	199	9,920	3,465	617	85,308
Northwest Region														
Arlington	66	606	5,011	4,405	66.9	13.0	53.9	21	59.40	9	4	13	6	162
Buckeye Hills	58	78	5,640	5,562	52.3	10.0	42.3	0	3.78	0	0	0	1	9
Buckeye Valley	70	8,440	39,983	31,543	43.0	37.0	6.0	32	57.91	0	37	37	7	497
Lower Agua Fria	106	20,882	68,698	47,816	118.4	65.0	53.4	18	47.70	1	13	13	2	3,561
Lower Centennial ***	990	1,589	16,993	15,404	1,073.0	97.0	976.0	103	347.03	4	42	35	17	130
Lower Hassayampa ***	800	9,691	32,457	22,766	927.5	294.5	633.0	79	390.82	122	252	246	18	677
Trilby (Wittmann) ***	290	3,474	27,623	24,149	372.6	177.0	195.6	77	210.36	4	28	31	60	530
Upper Centennial ***	231	257	9,017	8,760	194.3	22.0	172.3	20	172.20	11	131	141	24	106
White Tank A	132	60,138	206,924	146,786	86.7	72.9	13.8	138	92.25	0	270	270	26	16,751
White Tank B	110	14,192	123,353	109,161	88.1	66.3	21.8	78	76.81	4	17	21	25	271
Upper Hassayampa *	[600]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TOTAL	2,851	119,347	535,699	416,352	3,022.8	854.7	2,168.1	566	1,458.26	155	794	807	186	22,694
Southwest Region														
Ajo ***	418	4	59	55	320.9	0.0	320.9	0	5.14	0	0	0	0	0
Gila Bend	350	1,095	1,752	657	468.0	19.0	449.0	12	24.93	12	116	14	0	40
Gillespie	322	379	10,220	9,841	409.0	38.0	371.0	11	84.70	0	0	0	0	29
Lower Gila ***	380	195	2,000	1,805	440.7	29.0	411.7	11	62.90	0	4	3	1	4
Painted Rock	188	91	663	572	205.9	40.8	165.1	3	16.20	0	0	0	0	0
Santa Rosa ***	107	N/A	N/A	N/A	108.3	0.0	108.3	0	0.00	0	0	0	0	0
Sentinel ***	627	134	1,426	1,292	446.0	25.0	421.0	0	55.23	0	3	3	0	2
Theba ***	433	608	2,220	1,612	429.0	50.0	379.0	10	125.65	0	28	12	0	3
Vekol ***	190	12	1,149	1,137	225.9	0.0	225.9	0	25.06	0	0	0	0	2
Waterman ***	462	2,982	41,302	38,320	521.5	24.0	497.5	45	144.17	0	1	1	15	1,100
TOTAL	3,476	5,500	60,791	55,291	3,575.1	225.8	3,349.3	92	543.98	12	152	33	16	1,180
COUNTY TOTAL	**9,217**	**2,527,930**	**4,944,792**	**2,416,862**	**9,841.0**	**1,778.8**	**8,062.0**	**1,100**	**2,637.05**	**425**	**21,718**	**14,820**	**936**	**220,382**

* Watershed completely outside of Maricopa County boundary.	2
** 90% of Watershed outside of Maricopa County Boundary.	3
*** A portion of the Watershed outside of Maricopa County Boundary.	12

[1] Linear miles of floodplain already delineated. Based on 100-year floodplains and floodways. 100,000 scale USGS hydrography used as well as "lineal miles" digitized by hand.

[2] Estimate of linear miles yet to be delineated within each watershed. Developed by subtracting 100,000 scale USGS hydrography from delineated floodplains and tabulating the remainder for each watershed.

[3] Estimate of land area remaining to be developed within a watershed. Estimated by subtracting areas with 15% or more slope (based on USGS digital elevation model data) and also subtracting areas already developed(based on 1995 MAG landuse data) from state trust land and private land (based on ALRIS's land coverage). Also subtracted from the totals was areas within FEMA 100-year floodways, the Tonto National Forest, & Gunnery Range.

4.3.1. Southeast Region

4.3.1.1. Description

The Southeast Region includes the five watersheds in the southeast portion of Maricopa County, which are the Lower ACDC, Lower East Maricopa Floodway, South Mountain, Upper East Maricopa Floodway, and Upper Queen Creek. The watersheds are shown on Map 4-3. These watersheds contain 877 square miles or about 10 percent of the County. The Upper Queen Creek Watershed and the majority of the Upper East Maricopa Floodway are outside of the County boundary. A portion of the Lower East Maricopa Floodway is outside the County. Four of the watersheds are on the south side of the Salt River. The Gila River runs through the South Mountain Watershed. Queen Creek and Sanokai Washes run through the Upper East Maricopa Floodway. The Western and Highline Canals run through the South Mountain Watershed. The Kyrene, Consolidated, Eastern, and Roosevelt Conservation District Canals run through the Lower East Maricopa Floodway. The ACDC Canal serves as the northeast boundary for the Lower ACDC Watershed. The Arizona, Grand, and Roosevelt Irrigation District Canals also run through the Lower ACDC Watershed. The Highland and Western Canals are in the South Mountain Watershed. Powerline, Vineyard, and Rittenhouse Dams are in this Region.

Approximately 65 percent of the land is developed or undevelopable. The urbanized area is served by an extensive arterial grid street system and numerous freeways crossing the area.

Portions of the Gila River and Salt River Pima-Maricopa Indian Communities are in this region. All or parts of the municipal boundaries of Avondale, Apache Junction, Chandler, Gilbert, Glendale, Guadalupe, Mesa, Peoria, Phoenix, Tempe, Tolleson, and Queen Creek fall within this region. Of these municipal areas the District performs Floodplain Management for Chandler, Guadalupe, Mesa, Tolleson, and Queen Creek.

4.3.1.2. Physical Characteristics

The area in general is flat with only the South Mountains with slopes over 15 percent. The majority of the land area in the five watersheds falls into the Hydrologic Soil Groups B and C. South Mountain Park, which is situated in the center of the South Mountain Watershed, is unclassified (consisting primarily of rock out cropping). Map 4-4 shows areas of soil erodability by water and the flood hazards for this Region. The numerous watercourses and canals in this area pose potential flooding hazards that are being mitigated. Run-off from the urban development throughout the region and the irrigated farmland in the Lower East Maricopa Floodway, Lower ACDC, and South Mountain Watersheds may cause water quality problems. The majority of the land in the South Mountain Watershed, which includes the South Mountain Park, still retains its natural desert vegetation. Landscaped yards make up a majority of the area. River restoration along the Salt and Gila Rivers is being planned with clean-up projects in the Rivers underway. This should restore riparian areas along these corridors.

4.3.1.3. Land Status

Land ownership patterns in the Maricopa County portion of the Southeast Region are decidedly different from the County as a whole. Private ownership accounts for 73 percent of the total land in this Region versus 30 percent for the total County. Native American lands

account for over 17 percent of ownership versus just under five percent for the County as a whole. State, federal, military, and national forest ownership are all under one percent of the total, which is well under the total for the entire County. Map 4-5 shows the land use patterns over this Region.

The existing land use pattern for the Southeast Region is also vastly different from the total County averages. Residential and commercial development is much more pronounced while the percentage of vacant land is approximately half as much. There is also a much higher percentage of land still classified as agricultural when compared to the overall County figures. Breakdowns of percentage of each land use for the individual watersheds can be found in Appendix B.

Approximately 597 square miles of the 877 square miles of the total area have already been developed or are considered undevelopable. This leaves about 280 square miles of land to still be developed. Using the assumptions from Chapter 2, it is anticipated that about 180 square miles of the 280 will be needed to accommodate the expected growth to 2025.

4.3.1.4. Socioeconomic Characteristics

The Southeast Region (Maricopa County portion only) had a population of 1,651,179 in 1995. Nearly two-thirds (65 percent) of the total residents of Maricopa County lived in this Region as of 1995, but this total will drop from 65 percent to 57 percent by 2025 as other regions gain in population. The projected population for the Region is expected to be 2,829,037 by 2025 or an increase of 1,177,858 over the 30-year time frame. The additional 1.18 million people is an increase of approximately 71 percent over the 30 years or about 39,000 people per year. This 2.37 percent growth rate on an annual basis lags behind the state average of 2.77 percent and well behind the overall Maricopa County rate of 3.2 percent per year. The Lower ACDC and Lower East Maricopa Floodway Watersheds are expected to have the largest population gains over this 30-year period.

4.3.1.5. District Activities Completed

4.3.1.5.a. Structural

Structures that have been constructed in the Southeast Region are the following (more detail is in Appendix B under each watershed write-up):

Upper Queen Creek
- No District Structures

Lower ACDC
- Holly Acres Levee & Bank Stabilization (1984)
- Agua Fria Channelization (1988)
- Old Cross Cut Canal (1975, 1991)
- New River Channelization (1993)
- Arizona Canal Diversion Channel (1994)
- Camelback Ranch Levee (1999)
- Indian School Road Drain
- Northern/Orangewood Storm Drain (2001)

Upper East Maricopa Floodway
- Powerline Dam (1967)
- Powerline Floodway (1968)
- Vineyard Dam (1968)
- Rittenhouse Dam (1969)
- Alma School Drain (1969)
- Sossaman Channel & Basin (1977 & 1998)
- Guadalupe Channel (1989)
- East Maricopa Floodway (1989)
- Gilbert Crossroads Park Basin (1992) (Lower EMF)
- University Drive Basin (1993)
- Price Drain (1997) (Lower EMF)
- Rittenhouse Road Channel (1998)

Lower East Maricopa Floodway
Salt River Channel

South Mountain
Guadalupe FRS (1975)
48th Street Drain

4.3.1.5.b. Non-Structural

211 linear miles of watercourse delineations have been completed in the five watersheds out of an estimated 440.0 linear miles from the 100,000 scale USGS Hydrography. The South Mountain Watershed has 131 lineal miles of these detailed delineations. About 111,200 drainage permits and 117 floodplain use permits were issued from April 1990 to June 1999.

4.3.1.5.c. Studies

The following studies have been completed or are in process for the Southeast Region:

ADMS/ADMP

- Maryvale ADMS (1997) and the Durango ADMP (2002) were conducted for the Lower ACDC Watershed.
- Mesa/Gilbert/Chandler ADMS (1987-88, 1993-94), Lower East Maricopa Floodway Study (1980's), Southeast Mesa ADMP (1996), Higley ADMP (1999-00), and EMF Capacity Mitigation Study (2000) for the Lower East Maricopa Floodway Watershed.
- Hohokam (1980's), Foothills ADMS (1980's), Laveen ADMS (1990, 1994), South Phoenix/Laveen ADMP (1997), Laveen ADMP (2001) for the South Mountain Watershed.
- East Maricopa County ADMS (1986-87), Queen Creek ADMS (1991), and East Mesa ADMP (1998) for the Upper East Maricopa Floodway Watershed.
- No studies have been done by the District for the Upper Queen Creek Watershed.
- Queen Creek/Sanokai Wash Hydraulic Master Plan (2000) for the Lower East and Upper East Maricopa Floodways Watersheds.
- A study was done by the Corp of Engineers and City of Phoenix for the Tres Rios area that the District was invited to participate in.

Floodplain Delineation Studies	Year	River Miles
• Queen Creek Topo/FIS	1986	22
• Salt River Topo/FIS	1986	11
• Gilbert-Chandler Topo/FIS	1987	45
• Southern Pacific Railroad/Queen Creek	1989	8
• Laveen (ADMS)	1989	21
• Cross Roads Park LOMR	1990	-
• Salt-Gila Master Study	1991	80
• Tolleson Area Study (SPRR, Roosevelt Canal)	1995	-

Floodplain Delineation Studies (con't)	Year	River Miles
• Queen Creek (near the Town)	1995	-
• EMF – all 6 reaches, 3 discharges (non-FEMA)	1997	-
• Sanokai Wash (not submitted to FEMA)	1997	-
• Laveen	1999	-
• Phoenix Rio Salado (Salt River above 19th Ave)	1999	-
• Eastern Canal North FDS	2000	7
• Consolidated Canal	2000	7
• Highline/Western Canal FDS	2002	10

4.3.1.6. Hazard and Problem Assessment

The Southeast Region is more heavily populated than the other three regions. Population projections show the largest 30-year increase in total numbers of people among the four regions. The population is expected to increase by an additional 1.2 million over the 30-year period. There are about 280 square miles of land area still available for development to hold this population. However, 229 linear miles of delineations out of 440 still remain to be done so that these new residents will not develop in flood and erosion hazard areas.

There are 59 structures in the floodway and 10,852 structures in the floodplain. The majority (10,515 buildings) are also in a moderate or severe erosion hazard zone. In addition, there were 86 County road closures from 1996-2000, which were roughly equally split between South Mountain, Lower ACDC, and the Lower East Maricopa Floodway. No Maricopa County road closures were reported in the Upper East Maricopa Floodway Watershed. Reported flooding problems for each watershed are in Appendix B. This Region also contains the County's only area where buildings with repetitive flood insurance damage claims paid by the U.S. government (repetitive loss) are located. There are currently 34 residences in the repetitive loss area.

Problems that need to be addressed per the District's programs in the Southeast Region Watersheds (that are inside the County's boundary) include the following:

- ADMP's need to be completed for those areas not yet studied and those studies completed need to be reviewed.
- A number of stormwater drainage and channel projects need to be completed for this Region. Several of them have been identified in recent ADMP's and are listed in the next section.
- Some of the dams and flood retarding structures were built approximately 30 years ago. Remedies identified by the Structures Assessment Branch will need to be implemented.
- The 229 linear miles of watercourses need to be prioritized for delineation.
- A buy-out program needs to be considered for the properties with buildings that have been constructed in delineated floodways, with priority given to residential homes in the highest hazard category.

- A more detailed look at the approximate 10,800 buildings that have been constructed in delineated floodplains and severe erosion hazard areas needs to be done.

Each of the above issues needs to be evaluated and prioritized through the various District programs. The District is responsible for floodplain Management for the majority of this area and, as the lead agency, has done a number of studies to identify the hazards and solutions for these watersheds. The next section identifies the flood control projects in the FY 01/02 - 05/06 CIP to mitigate these flooding hazards for the watersheds in the Southeast Region.

4.3.1.7. Future Activities Identified

4.3.1.7.a. Capital Improvement Program

The CIP for Fiscal Years 2001/2002 to 2005/2006 (see Table 4-3 for project cost and year) indicates that the following projects are in process or are planned for the Southeast Region:

Upper East Maricopa Floodway Watershed

- *108 Sossaman Channel* – The previous channel section did not have sufficient capacity to convey the 100-year peak discharge. This project completed the Sossaman drainage system. The landscaping element of this project has been designed and will be installed by Summer of 2002.

- *442 East Mesa ADMP*
  - *Hawes Road Channel* – The project will consist of channel and culvert improvements from Apache Trail to Emelita Avenue (north of Southern Avenue) to help resolve drainage problems along Hawes Road within the City of Mesa.
  - *Elliot Channel (Ellsworth to East Maricopa Floodway (EMF))* – This project includes a study to evaluate potential for combining flows from the proposed Elliot Road Channel and Basin with drainage facilities for the proposed San Tan Freeway.
  - *Elliot Road Detention Basin and Outfall Channel* – The basins collect runoff from the Crismon Channel, Siphon Draw Wash, and general area sheet flow and are intended to become multi-use facilities. The outfall channel conveys discharge from the basins ultimately to the EMF.
  - *Ellsworth Channel* – This project includes construction of a flood control channel to mitigate existing and future flooding along Ellsworth Road. Flooding occurs frequently at 5 dip crossings on the existing roadway.
  - *Powerline Detention Basin* – This project involves construction of a detention basin adjacent to the Powerline Floodway near Meridian and the Warner Road alignment. The basin will reduce peak flows in the existing Powerline Floodway and intercept surface runoff from Pinal County.
  - *Southern Avenue Channel* – An existing channel, which is deteriorating, does not have adequate capacity to convey the 100-year flow and was completed in 2002. The channel will be replaced with a box culvert and storm drain system as an integral part of the drainage system in this area.
- *480 Queen Creek ADMP*
  - *Queen Creek Channelization* – Based on the Flood Insurance Study on Queen Creek Wash there are areas of significant breakouts particularly along the north bank of this

reach. This project will increase the hydraulic capacity of the wash to contain the 100-year flows.

- *Sanokai Wash Channelization* – Channelization of portions of the wash will be done to improve the hydraulic conveyance capacity and reduce floodplain limits.

Lower East Maricopa Floodway Watershed

- *022 Central Chandler Drainage System* – The City of Chandler has requested the District cooperate and cost share in the modification and enhancement of its existing storm water facilities to provide a 100-year level of protection and a regional outfall for the system. Five improvements have been identified that would help the City accomplish its goal of alleviating flooding problems in Chandler's central area.

  Phase 1 – Ivanhoe and Erie Storm Drains (complete)
  Phase 2 – Arrowhead Pump Station and Force Main (design is complete and project is under construction)
  Phase 3 – Galveston Basin and Erie Drains (design is scheduled for FY 01-03)
  Phase 4 – Denver Basin Pump Station
  Phase 5 – Hartford Force Main and Pecos Road Drain

- *102 Alma School Drain* – The District, the City of Mesa, SRP, and the Arizona Department of Transportation (ADOT)) entered into IGA 371-67-F on November 16, 1967 for the Alma School Drain, from the Tempe Canal to the Salt River located in Section 17, T1N, R5E. Future plans for the Alma School Drain include lining the invert of the un-lined reach of the channel and reconstructing the lined reach of the channel.

- *121 East Maricopa Floodway (EMF)*
  - *Capacity Mitigation Plan* – This plan includes in-line and/or off-line detention basins with channel improvements between Broadway Road and Main Street to increase the capacity of the Floodway to convey the 100-year flows originating within the East Mesa watershed. The channel improvements, scheduled to be completed during FY 2002-03, will include increasing the bank height by raising the maintenance roads on both sides of the channel between Rittenhouse Road and Warner Road.

  - *EMF Rittenhouse & Chandler Heights Basins* - The East Maricopa Floodway (EMF) Mitigation Study identified several drainage and flooding problems along the EMF. The capacity of the EMF is about 8,000 cfs. The existing condition 100-year is about 16,000 cfs. The study proposes mitigating the problem by constructing off-line retention basins. The results will be the design and construction of 1) the Chandler Heights Basin that will mitigate flows from the Sanokai Wash, Queen Creek Wash, and the EMF; 2) the Rittenhouse Basin that will mitigate flows from the Rittenhouse Channel and the EMF.

- *490 Gilbert/Chandler ADMP*
  - *San Tan Collector Channel Phase III* – This is the final phase of a three phase project to provide 100-year level protection for contributing areas of Chandler, Tempe, and Gilbert as well as provide a drainage outfall for the ADOT San Tan Freeway system. Phase III of the project consists of approximately 2.5 miles of concrete lined channel and box culvert.

- *491 Higley ADMP*
  - Roosevelt Water Conservation District (RWCD) Tailwater Analysis – This project is a study to evaluate the conveyance capacity of the existing RWCD Tailwater Ditch located adjacent to the Eastern Canal.
  - *Warner/Greenfield Park Basin* – This basin will accommodate passage of flows along the east side of the SRP Eastern Canal to the Crossroads Park Basin.
  - *Queen Creek Road Drainage Basin* – The Higley ADMP indicate that the most feasible solution to stormwater ponding along the eastern bank of the SRP Consolidated Canal is to construct detention basins, channels and outfall facilities to collect and safely convey storm water to the Gila River which will reduce or eliminate the potential flood hazard and flood damages. This Storm Drainage Basin is the first element considered for implementation of regional flood control infrastructure for this area.

South Mountain Watershed

- *035 Town of Guadalupe* – This project will provide a storm drain collection system and four retention basins located along the Highline Canal that will capture and convey the 10-year storm event within the Town and east of Avenida Del Yaqui. Three of the basins will also serve as parks in the Town. This will alleviate flooding for a number of homes in the area.
- *117 South Phoenix Drainage Improvements*
  - *43rd Avenue / Southern Avenue Basin* – This basin is an integral component of the Laveen Area Conveyance Channel (LACC) project and will be a multi-use facility located at the upstream end of the LACC.
  - *Laveen Area Conveyance Channel* – This project includes the design and construction of a 6.5-mile long conveyance channel capable of conveying a 100-year flood event in the vicinity of the existing Maricopa Drain from 43rd Avenue to the Salt River.
  - *South Phoenix / Two Basins* – The basins will provide protection from a 100-year event for residents in South Phoenix, farmland, and a proposed high school and elementary school.
  - *Baseline Road Storm Drain* – This is a storm drain system and basins that will provide flood protection to residents and school facilities.
- *630 Foothills ADMP*
  - *Southeast Phoenix Regional Drainage System* – The project consist of a large retention basin that will provide a 100-year outfall for a 4.5 square mile watershed. The basin will be used as a multi-use City park.

Lower ACDC Watershed

- *124 Phoenix Rio Salado Project* – Involves the environmental restoration of approximately five miles of the Salt River within the City of Phoenix from the I-10 Bridge to 19th Avenue. The project will provide riparian habitat restoration and include channel stabilization, riverbank protection, water quality improvements, aesthetic improvements and recreational opportunities. The low flow channel will stabilize the river gradient, safely convey frequent flood flows and reduce the frequency of inundation of channel vegetation from flood events.

- *450 Glendale/Peoria ADMP Update*
  - *67th Avenue Storm Drain* – 10-year frequency protection for a three square mile area lying within the Cities of Glendale and Peoria. The project will consist of storm drain pipes and catch basins and will be constructed in rights-of-way provided by Glendale. The outfalls for the project were constructed by the District along Cactus Road and Olive Avenue and are presently owned and operated by Peoria.

- *565 Durango ADMP*
  - *Durango Regional Outfall Project* – The project consists of a primary outlet channel, three basins and two auxiliary channels. These auxiliary channels, located on 91st and 99th Avenues will intercept and divert storm water runoff which now floods Van Buren Street. The basins will be sited along the principal channel to reduce the storm water peak flows in the channel.

- *620 Maryvale ADMP*
  - *Bethany Home Road Outfall Channel* – Includes a linear basin and channel along the north side of the Grand Canal extending westerly from 64th Avenue to New River. The project will have a 100-year storm capacity removing about 745 structures from the 100-year floodplain. The channel will receive storm water from portions of Peoria, Glendale, Phoenix and unincorporated Maricopa County. Phase 1 of the project has been completed by ADOT with District participation. Phase 2 of the project will include a channel from the Agua Fria Freeway alignment to 73rd Avenue and an earthen, linear, on-line detention basin from 67th Avenue to 73rd Avenue. The ADMP also recommends ten year capacity storm drains, located within Bethany Home Road and Camelback Road, extending from 59th Avenue to the Outfall Channel.

- *625 Metro ADMP*
  - *24th Avenue / Camelback Basin* – This project is proposed to reduce flooding for the area.

4.3.1.7.b. Recommended Projects from On-going ADMPs

Additional projects that were recommended through the Area Drainage Master Plans but not yet included in the CIP are the following:

Durango ADMP

- *Durango Regional Conveyance Channel* – Begins just south of Van Buren Street near 67th Avenue. It runs in a southerly direction to just below Lower Buckeye Road, where it turns west and eventually empties into the Agua Fria River. The length of the channel system is approximately 10 miles. There are also three basins, one near Van Buren Street and 67th Avenue, one near Buckeye Road and 75th Avenue, and one near Lower Buckeye Road and 91st Avenue. Total cost of this project is estimated at $55,000,000.

- The 43rd Avenue Channel is approximately 2.25 miles long. It begins with a detention basin just north of Buckeye Road and drains south to the Salt River. A 1,200-foot lateral channel flows into the north end of the detention basin. Total cost of this project is estimated at $16,000,000.

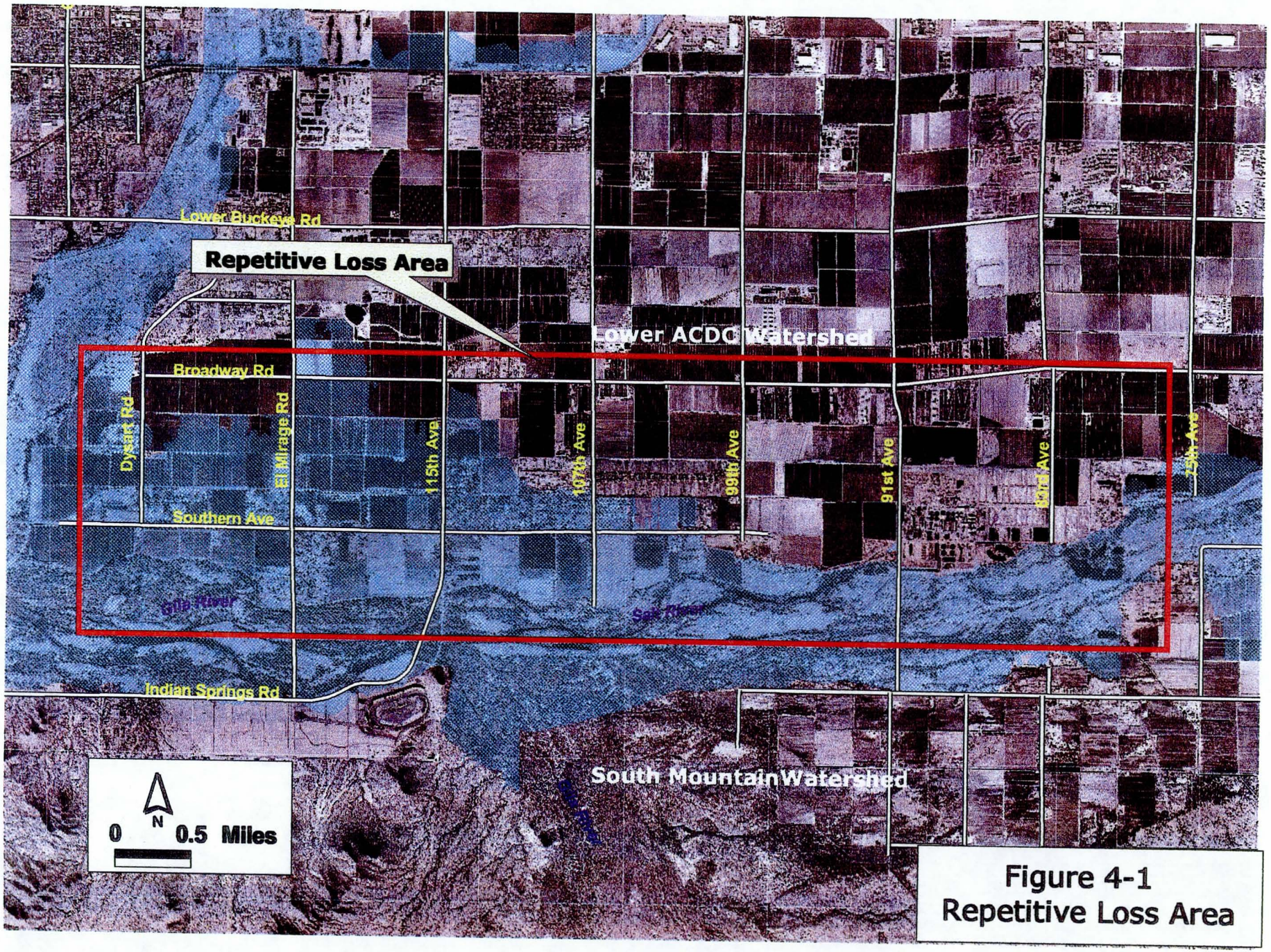


Figure 4-1
Repetitive Loss Area

- The Tres Rios Basins Project is planned for the southwestern portion of the Watershed. The Tres Rios Project calls for four detention basins, two adjacent to the Salt River and two adjacent to the Gila River. The basins would be located between 107th Avenue and Dysart Road. This project will remove 21 structures from the floodplain, which is approximately 62 percent of the structures in a repetitive loss area (see Figure 4-1). A levee is being constructed as part of a USACE/City of Phoenix project.

4.3.1.7.c. Structures Assessment / Dam Safety Program

Currently all of the dams and FRS's under the District's jurisdiction are being assessed as part of the three-phase Structural Assessment Program. There is one FRS and three dams in this Region.

4.3.1.7.d. Landscape Aesthetics and Recreational Multi-Use Projects

The implementation of the District's Landscaping and Aesthetic Treatment Policy has been a major District activity for the past several years. Implementation of this Policy includes tasks in the scope of work for WCMP's and ADMP's that provide for landscape character and visual assessment; multi-use opportunities assessment; plant community and biological resource assessment; historic character assessment; and cultural resource assessment. Implementation of this Policy also includes independent structures assessment for retrofit reports. The following is a list of the initiatives that have been undertaken, are in progress, or are planned to be undertaken in the near future in support of the Landscape Aesthetics and Multi-Use Opportunities Program for the Southeast Region:

- Landscape Character Elements applied in the following studies or projects:
  - Agua Fria WCMP
  - West Valley Rivers Project (New River and Lower Agua Fria)
  - Durango ADMP
  - Higley ADMP
  - Queen Creek-Sanoki Wash ADMP
  - Bethany Home Road Outfall Channel
  - Laveen Area Conveyance Channel
  - Elliot Detention Basins and Outfall Channel
  - 4-5 Basins Project
  - Sossoman Channel Landscape Project
  - Chandler Heights / EMF Mitigation Site
  - 43rd Avenue Detention Basin
  - Tempe Town Lake
  - Old Cross Cut Cannel Project
- Assessment of opportunities to retrofit existing flood control facilities to provide landscaping and aesthetic treatments and recreational multi-use opportunities Phase 3 – East Valley Structures is scheduled for completion in 2002.
- Coordination with Maricopa County Trails Commission in the possible utilization of existing and future planned District flood control facilities and floodplain areas as components of the Maricopa County Regional Trail System. Design Concept Reports completed for the following:

- Agua Fria River (1999)
- East Maricopa Floodway (2000)

- An analysis of recreation multi-use opportunities in conjunction with the District's Structures Assessment Program is ongoing.
- Native vegetation salvage as part of project implementation for 4-5 Basins Project is complete and has been initiated for the Spook Hill Detention Basin Project.

4.3.1.7.e. Other Non-Structural

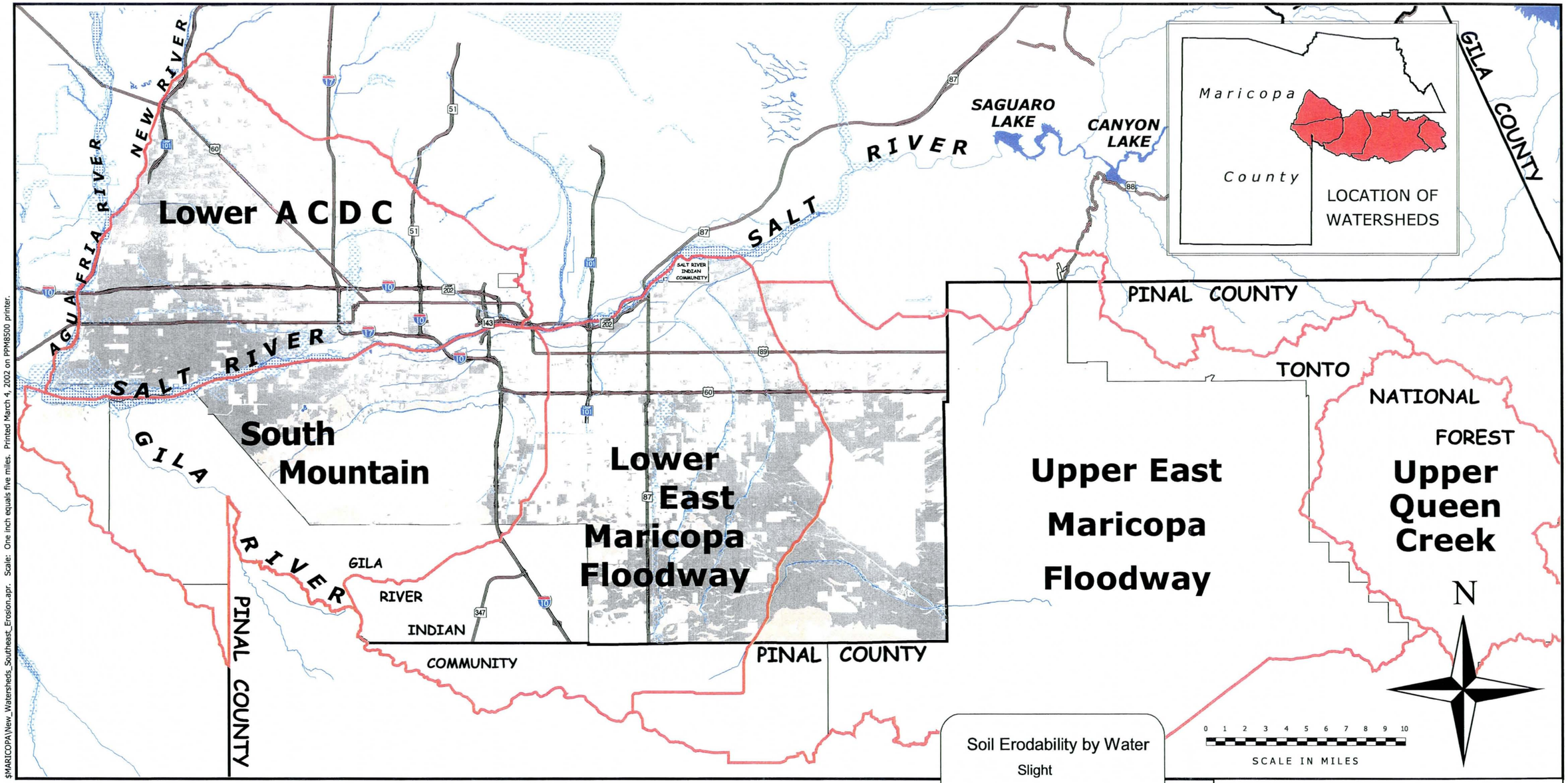
In addition, the District will utilize existing floodplain and drainage regulations to minimize and prevent damages from flooding problems. Also, the Floodplain Delineation Branch has plans to delineate an additional 74 linear miles outside of the ADMP's and other studies being prepared. Operation and maintenance of existing structures will be ongoing to preserve the life of facilities and prevent flooding from occurring due to maintenance issues.

4.3.1.8. Summary

Considerable effort by the District over the years has resulted in mitigation of many of the flood hazards in the Southeast Region, which is the most populated area. The Salt River, major washes, and irrigation canal systems still pose some hazards and the District does floodplain management for five of the twelve municipalities and unincorporated areas of this Region. The District will continue to have involvement in studies and projects throughout this area. Table 4-5 gives a summary of the critical element data discussed earlier in this section.

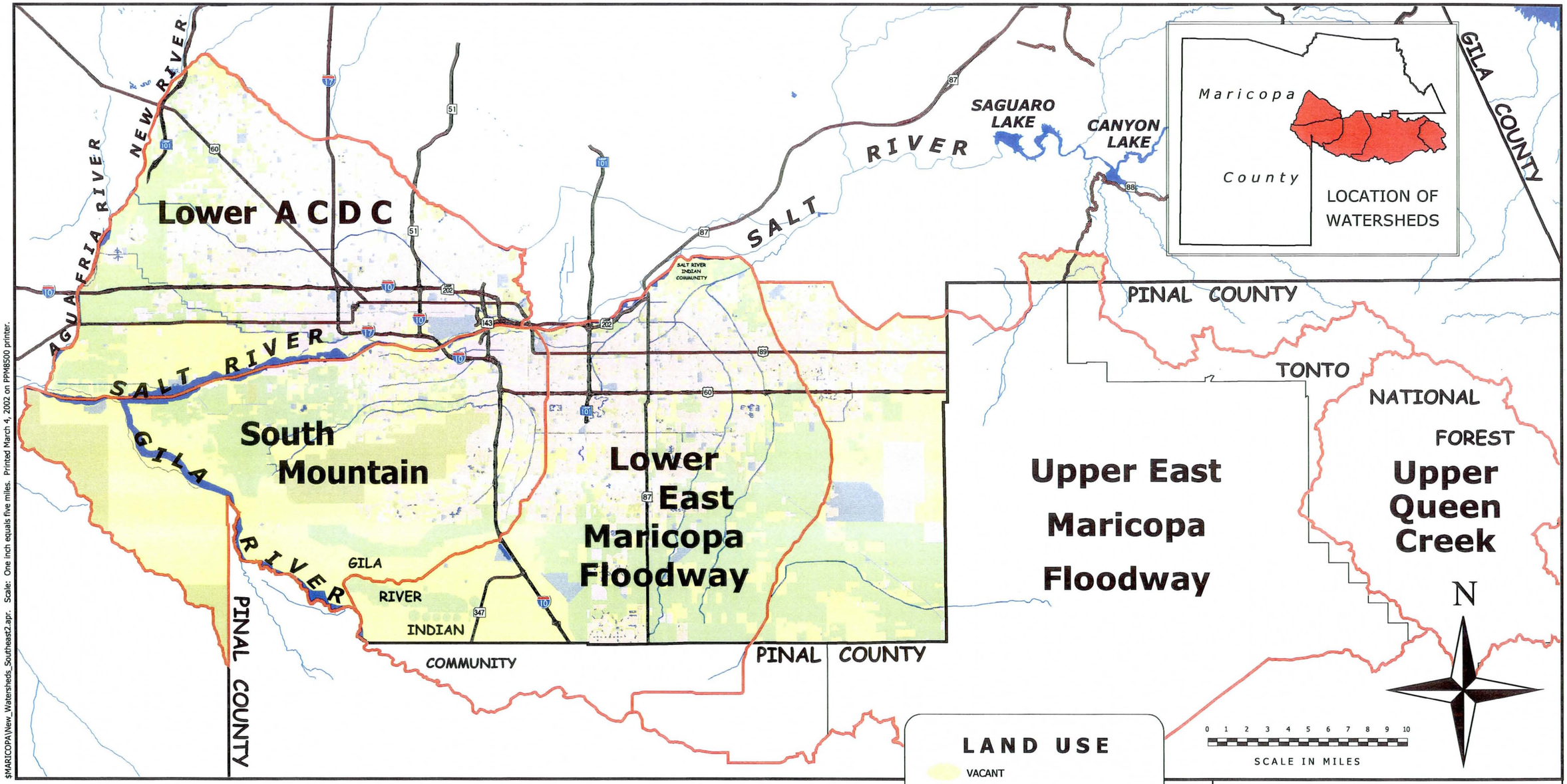
Table 4-5 Southeast Region – Summary of Critical Elements

Critical Elements	Watershed					
	Upper Queen Creek	Upper EMF	South Mountain	Lower ACDC	Lower EMF	**TOTALS**
Area inside County Boundary (square miles)	[143]	132	245	235	265	877
Population (1995)	N/A	96,565	226,051	772,467	556,096	1,651,179
Projected Population (2025)	N/A	299,706	409,043	1,134,100	986,188	2,829,037
Population Change (1995 - 2025)	N/A	203,141	182,992	361,633	430,092	1,177,858
100,000 scale USGS Hydrography (linear miles)	N/A	118	167	83	72	440
Approximate & Detailed Delineations (linear miles)	N/A	27	36	80	68	211
Delineations Remaining to be done (linear miles)	N/A	91	131	3	4	229
County Road Closures (1999 - 2000)	N/A	196	29	26	31	282
Potentially Develobable Land (square miles)	N/A	68	47	78	87	280
Structures in the Floodway	N/A	0	1	58	0	59
Structures in the Floodplain	N/A	70	453	6,370	3,959	10,852
Structures in a Moderate or Severe Erosion Hazard Zone	N/A	70	449	6,235	3,761	10,515
Floodplain Use Permits Issued (April 1990 - June 1999)	N/A	16	12	50	39	117
Drainage Clearance Permits Issued (April 1990 - June 1999)	N/A	16,600	17,000	20,000	57,600	111,200



$MARICOPA\New_Watersheds_Southeast_Erosion.apr. Scale: One inch equals five miles. Printed March 4, 2002 on PPM8500 printer.

Map 4-4
Southeast Region
Developable Lands, Soil Erosion, and Floodplains



$MARICOPA\New_Watersheds_Southeast2.apr. Scale: One inch equals five miles. Printed March 4, 2002 on PPM8500 printer.

Map 4-5

Southeast Region

Land Use

Lower A C D C

South Mountain

Lower East Maricopa Floodway

Upper East Maricopa Floodway

Upper Queen Creek

AGUA FRIA RIVER

NEW RIVER

SALT RIVER

GILA RIVER

GILA RIVER INDIAN COMMUNITY

SALT RIVER INDIAN COMMUNITY

SAGUARO LAKE

CANYON LAKE

GILA COUNTY

PINAL COUNTY

TONTO NATIONAL FOREST

Maricopa County

LOCATION OF WATERSHEDS

N

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

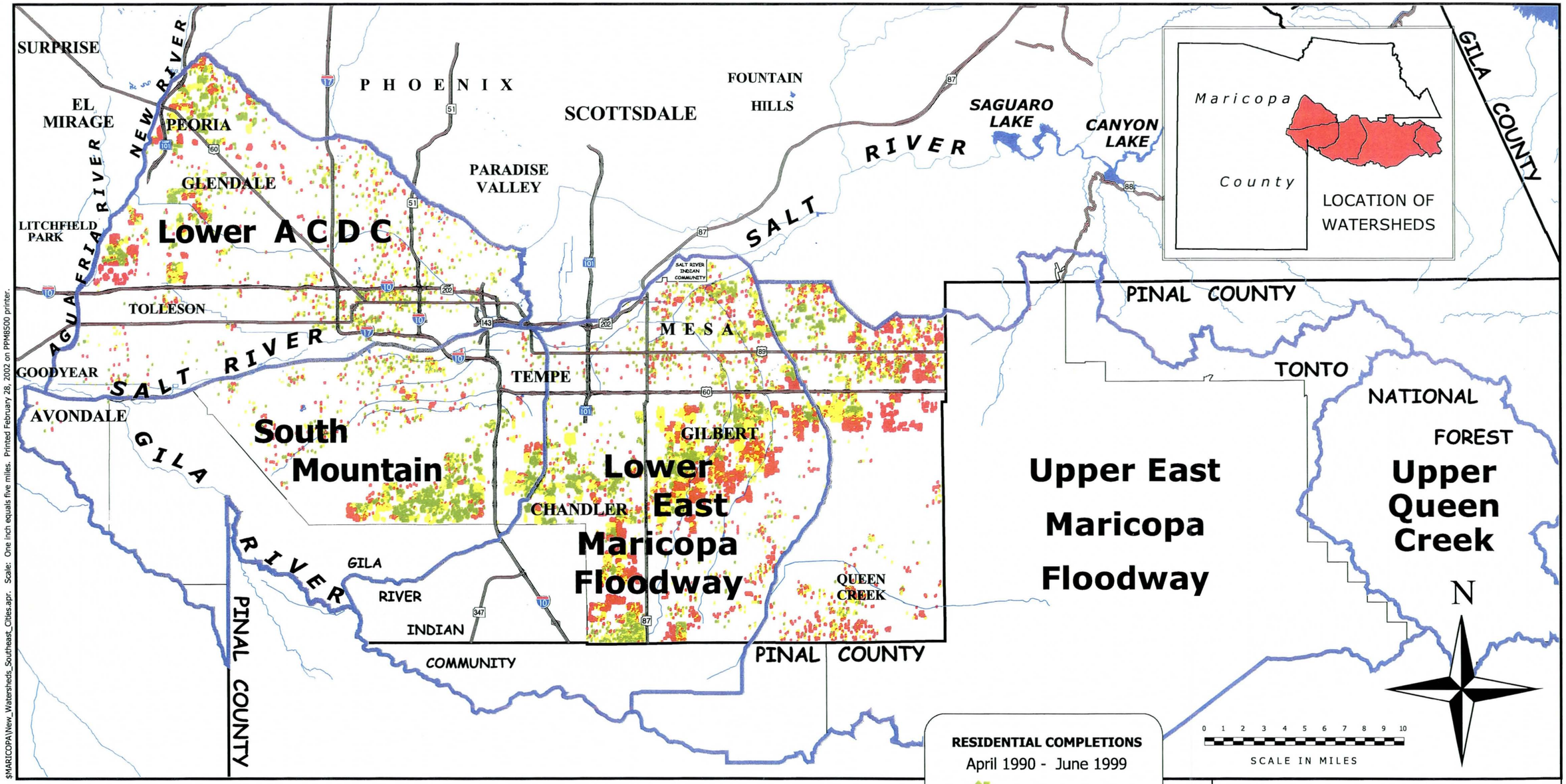
LAND OWNERSHIP

- PRIVATE
- INDIAN
- PARKS
- NATIONAL FOREST
- FEDERAL
- STATE
- MILITARY
- COUNTY
- OTHER

2020 Population Projections
One dot (·) = 100 people

Map 4-6
Southeast Region
Land Ownership and Population Projections

$MARICOPA\New_Watersheds_Southeast_Landownership.apr. Scale: One inch equals five miles. Printed March 4, 2002 on PPM8500 printer.



$MARICOPA\New_Watersheds_Southeast_Cities.apr. Scale: One inch equals five miles. Printed February 28, 2002 on PPM8500 printer.

Map 4-7

Southeast Region

Residential Completions

4.3.2. Northeast Region

4.3.2.1. Description

The Northeast Region includes the 13 watersheds in the northeast portion of Maricopa County. They are Cave Creek, Evergreen, Lower Indian Bend, Lower New River, Lower Verde, Middle Indian Bend, Skunk Creek, Upper ACDC, Upper Agua Fria, Upper Indian Bend, Upper New River, Upper Verde, and Upper Salt River. Map 4-3 shows the location of these watersheds. The watershed areas within Maricopa County in this Region contain 2,012 square miles, or about 22 percent of the total area in the County. The Upper Salt River Watershed is primarily located in Gila County but extends into Pinal and Navajo Counties with the Maricopa County portion primarily within the Tonto National Forest. The Upper Verde Watershed extends into Yavapai and Coconino Counties. The Upper New River and the Upper Agua Fria Watersheds all extend well into Yavapai County. The Cave Creek and Lower Verde Watersheds extend slightly into Yavapai and Pinal Counties respectively. The Northeast Region is bounded on the east by Gila County, on the west by the Agua Fria River, on the north by Yavapai County, and on the south by Pinal County and the watersheds of the Southeast Region.

The Salt, Verde, and New Rivers run through this Region. Lake Pleasant is in the lower portion of the Upper Agua Fria Watershed. Saguaro Lake, Canyon Lake, Apache Lake, Bartlett Reservoir, and Horseshoe Reservoir are in the Upper Verde and Upper Salt River Watersheds. There are five major washes in the area: Cave Creek, Skunk Creek, Indian Bend Wash, Camp Creek, and Sycamore Creek. There are a number of other washes such as Scatter Wash in this Region. In addition, the Central Arizona Project Canal crosses diagonally through the region from the lower portion of the Skunk Creek Watershed through the Evergreen Watershed on its route through Pinal County to the southeast. The Grand Canal is on the lower edge of the Upper New River and Lower Indian Bend Watersheds. The ACDC Canal and Salt-Gila Aqueduct are also in this Region. Granite Reef, Cave Butte, Cave Creek, Adobe Dam, New River, Dreamy Draw, and Apache Dam are all within this Region.

Several regional and interstate transportation corridors, which also serve the population in the southern portion of this region, cross through the area – Interstate-17, State Route Loop 101, and State Routes 51 and 87.

The Salt River Pima-Maricopa and Fort McDowell Mohave-Apache Indian Communities are in this region. All or parts of the municipal boundaries of Apache Junction, Carefree, Cave Creek, Fountain Hills, Glendale, Mesa, Paradise Valley, Peoria, Phoenix, Scottsdale, and Tempe are located within this Region. The District does Floodplain Management for the Towns of Carefree and Cave Creek, and the City of Mesa.

4.3.2.2. Geology / Hydrology

The Region in general is mountainous with slopes over 15 percent for more than fifty percent of the area. The majority of the land area in these watersheds within Maricopa County falls into the Hydrologic Soil Group B. The Central portion of the Region consists of Hydrologic Soil Groups C and D. The Eastern half of the Region is National Forest Area. Map 4-8 shows areas of soil erodability by water and the flood hazards for this Region. The numerous watercourses and canals in this area pose potential flooding hazards. Run-off from mountains

creates serious threats for the region especially during the monsoon when flash floods occur. The majority of the land in the Region still retains its natural desert vegetation. The Salt River serves as a recreation area and has riparian areas along its' corridor as do many of the other area watercourses.

4.3.2.3. Land Status

Land ownership patterns in the Maricopa County portion of the Northeast Region follow County percentages fairly closely in some areas. For instance, private ownership is 26 percent of the total land versus 30 percent for the County as a whole. Native American lands account for 6 percent of the Region versus just under 5 percent for the County. An extreme is national forest which accounts for 51 percent of the Region versus 11 percent for Maricopa County.

The land use patterns vary in certain aspects from Maricopa County. Open space accounts for nearly 57 percent of the Region versus about 33 percent for the County. This is primarily due to the large acreage of the national forest that is found within the Region. Additional open space areas of significance outside of the Forest Service boundary are Lake Pleasant and BLM land holdings. On the other hand, vacant land is about half as much as the County average and agriculture is approximately one-fifth of the County average. Map 4-9 displays the land use patterns.

Approximately 1,657 square miles of the 2,012 square miles of the total area have already been developed or are considered undevelopable. This leaves about 355 square miles of land to still be developed. Using the assumptions from Chapter 2, it is anticipated that about 117 square miles of the 355 will be needed to accommodate the expected growth to 2025.

4.3.2.4. Socioeconomic Characteristics

The Northeast Region (Maricopa County portion only) had a population of 751,904 in 1995. This was approximately 30 percent of the total population of the County at that time. The Northeast Region is the second most populated of the four Regions. The projected population for the Region in 2025 is 1,519,265 or an increase of 767,361 people over the 30-year time frame or about 25,580 per year. This 3.4 percent growth rate on an annual basis is greater than the Maricopa County rate of 3.2 percent per year. The Upper ACDC and Upper Indian Bend Watersheds are expected to see the largest increases.

4.3.2.5. District Activities Completed

4.3.2.5.a. Structural

Structures that have been constructed in the Northeast Region are the following:

Cave Creek Watershed
- Cave Creek Dam
- Cave Butte Dam (1980)
- Includes Dykes #1, #2, #3

Lower New River Watershed
- New River Dam (1985)
- Sun City Drain (1991)

Upper ACDC Watershed
- Dreamy Draw Dam (1973)
- Cave Creek Channelization (1991)
- Skunk Creek Channelization (1991)
- Scatter Wash Channel (1995)
- Upper East Fork Cave Creek (1996)
- 10th Street Wash Basins (1997)

Lower Verde Watershed
Buckhorn-Mesa FRS's
a) Spook Hill FRS (1979)
b) Spook Hill Floodway (1980)
c) Signal Butte Floodway (1984)
d) Pass Mountain Diversion (1987)
e) Signal Butte FRS (1987)
f) Bulldog Floodway (1988)
g) Apache Junction Dam & Floodway (1988)

Middle Indian Bend Watershed
Paradise Valley Detention Basin #4
PVSP Cactus Rd Improvements (1991)

Skunk Creek Watershed
Skunk Creek Channel and Levee
Adobe Dam (1984)

4.3.2.5.b. Non-Structural

Approximately 487 linear miles of watercourse delineations have been completed in the Northeast Region out of 2,316 linear miles estimated from the100,000 scale USGS Hydrography. Delineations have been done in all of the watersheds, with the most in the Lower Verde Watershed. About 85,300 drainage permits and 617 floodplain use permits were issued from 1990 to 1999.

4.3.2.5.c. Studies

The following studies have been done or are in process for the various watersheds in this Region:

ADMS/ADMP

- Apache Wash Drainage/Storm Drain Master Plan (1990), Cave Creek/Carefree ADMS (1993), Upper Cave Creek/Apache Wash Watercourse Master Plan (2001), and the Town of Carefree ADMP (2002) for the Cave Creek Watershed.
- ACDC ADMS (1986, 1993), Glendale/Peoria ADMP (1987, 2001) for the Lower New River Watershed.
- Spook Hill ADMP (1987, 2002) for the Lower Verde Watershed.
- Scottsdale/Paradise Valley ADMS (1980's) for the Middle Indian Bend Watershed.
- Adobe Dam (1980's, 2002) and Skunk Creek Watercourse Master Plan (2001) for the Skunk Creek Watershed.
- Upper East Fork Cave Creek ADMS (1986-87) and ACDC ADMS (1986, 1992) covering 69 percent of the Watershed for the Upper ACDC Watershed.
- Desert Greenbelt (1980's) and Fountain Hills (1996-97) for the Evergreen Watershed.
- Pinnacle Peak ADMS (1980's) for the Upper Indian Bend Watershed.
- New River ADMS (1995) for the Upper New River Watershed.

Floodplain Delineation Studies	Year	River Miles
• Buchanan Wash Topo/FIS	1986	1
• Cave Creek FEMA Topo/FIS	1988	15
• Cemetery Wash FEMA Topo/FIS	1988	2

Floodplain Delineation Studies (con't)	Year	River Miles
• Galloway Wash FEMA Topo/FIS	1988	3
• Cave Creek/Carefree FIS	1988	35
• Cave Creek – ACDC to Cave Buttes	1988	13
• Cline & Roger Creek, Morgan City	1989	25
• New River/Skunk Creek FIS	1989	6
• Apache Wash FIS	1989	25
• Skunk Creek FIS	1989	15
• East Fork of Cave Creek	1989	-
• Deadman Wash	1991	14
• New River (Grand Ave to Bell Rd – spf only)	1991	3
• Fountain Hills	1992	35
• New River (Grand to Bell – 10 & 100 yr spf)	1993	3
• Indian Bend Wash	1993	-
• Rio Verde - North (several washes)	1993	-
• Rio Verde - South (several washes)	1993	-
• Echo Canyon Wash	1994	-
• Skunk Creek (above the CAP)	1995	-
• Cave Creek (above Carefree Highway)	1995	-
• Granite Reef Wash	1995	-
• Cave Creek (below Carefree Highway0	1995	-
• Tatum Wash Sediment Study (non-FEMA)	1995	-
• Skunk Tank Wash (tributary to Skunk Creek)	1996	-
• Desert Hills	1996	-
• Skyline Wash (alluvial fan, washes above Buckeye FRS # 3)	1996	-
• 10th Street Wash	1996	-
• Sweat Canyon Wash and Doe Peak	1997	-
• Rio Verde South Extension (several washes)	1997	-
• Skunk Creek Channel Improvements (51st Ave to 75th Ave)	1998	4
• Skunk Creek Tributaries	1998	-
• Rock Springs Creek FDS	1998	3
• Sonoran Wash (FLO-2D)	1999	-
• Camelback Ranch Levee North	1999	-
• Rawhide Wash FDS	2000	12
• Rio Verde North Extension FIS	2001	71
• Wash B	2001	3.5
• New River Bridge LOMR	2001	3.5

Floodplain Delineation Studies (con't)	Year	River Miles
• Andora Hills/Galloway	2001	7
• Gavilan Peak FDS	2001	15
• Upper Agua Fria Watershed Zone A	2001	49
• Skunk Creek FDS (CAP to I-17)	2002	5
• North Scottsdale FDS	2003	22

4.3.2.6. Hazard and Problem Assessment

The Northeast Region is presently not as populated as the Southeast Region. However, the rate of growth for the Northeast Region is over 30 percent or greater per year than the Southeast Region. The population is expected to increase 767,361 over the 30-year period. There are 355 square miles of area still available for development to hold this population. Areas that could be developed are not as extensive in this Region as private land is less than the County average.

Approximately 2,316 linear miles of delineations out of 2,803 still remain to be done so that these new residents will not develop in flood and erosion hazard areas. The low population and high percentage of government held land have potentially caused studies and delineation work to be directed to more urbanized areas. This has resulted in 198 structures in the floodway and 9,228 structures in the floodplain. Approximately 3,400 of these structures are also in a moderate or severe erosion hazard zone. In addition, there were 157 County road closures from 1996-2000 that were concentrated in the Cave Creek, Lower New River, Lower Verde, Skunk Creek, and Upper New River Watersheds. Reported flooding problems for each watershed are in Appendix B.

Problems that need to be addressed per the District's programs in the Northeast Region Watersheds (that are inside the County's boundary) include the following:

- ADMP's need to be completed for those areas not yet studied and those studies completed need to be reviewed.
- About 83 percent of the watercourses are not yet delineated. Evaluation of the remaining 2,316 linear miles of watercourses needs to be done to determine additional delineations.
- The 12 dams and flood retarding structures were built from 1973 to 1988. Some are reaching the end of their design lives. Remedies identified by the Structures Assessment Branch will need to be implemented.
- A buy-out program needs to be considered for the 198 property owners with buildings that were constructed in delineated floodways, with priority given to residential homes in the highest hazard category. A number of them have been identified in recent ADMP's and are listed in the next section.
- A more detailed look at the approximate 9,200 buildings at risk that were constructed in the delineated floodplain and severe erosion hazard areas needs to be done.

Each of the above issues needs to be evaluated and prioritized through the various different District programs. The District is responsible for the Floodplain Management for the majority of this area and, as the lead agency, has done a number of studies to identify the hazards and solutions for these watersheds. The next section identifies the flood control projects in the FY 01/02 to 05/06 CIP to mitigate these flooding hazards for the watersheds in the Southeast Region.

4.3.2.7. Future Activities Identified

4.3.2.7.a. Capital Improvement Program

The CIP for Fiscal Years 2001/2002 to 2005/2006 (see Table 4-4 for cost and year) indicates that the following projects are in process or are planned for the Northeast Region:

Lower Indian Bend Watershed

- 027 City of Scottsdale:
  Osborn Road Storm Drain – The project is proposed to consist of approximately 2.5 miles of storm drain with 10-year level of protection for contributing areas and will reduce the required pipe sizes for the downstream storm drain. (completed 2002)

- *125 Salt River: Tempe/Mesa Habitat Mitigation* – This project includes a study of the vegetation maintenance alternatives to maintain conveyance capacity of the Salt River Channel upstream of the existing Tempe Town Lake.

Middle Indian Bend Watershed

- *120 Scottsdale Road Corridor Drainage* – The first phase of this project is to identify the drainage problems and develop cost-effective solutions for a storm water collection system for the Scottsdale Road Corridor from Thunderbird and Mountain View Roads. The benefit area contains approximately 300 residences and 70 commercial structures.

- *580 ACDC ADMP: Doubletree Ranch Road System* – This storm drain project will provide solutions for the flooding problems that exist within a mostly built out residential area in the Town of Paradise Valley. The project consists of a 10-year storm drain system in Doubletree Ranch Road, with storm drain laterals extending along intersecting and adjacent streets.

Upper ACDC Watershed

- *460 East Fork Cave Creek ADMP: Greenway Parkway Channel* – This project is part of a series of projects to collect and convey storm water and to significantly reduce the 100-year floodplain on the Upper East Fork of Cave Creek. These modifications will allow for the removal of over 400 homes and numerous commercial establishments along Bell Road from the current FEMA delineated floodplain. (completed 2002)

Lower New River

- 400 Skunk Creek / New River
  - *New River Bank – Paradise Shores* – This project is to provide bank stabilization and armoring along the west bank of the New River. This is the only portion of the west bank unprotected between Bell Road and the New River confluence with Skunk Creek.

- *83rd Avenue GCS / Bell Park* – This is one of several projects to improve the conveyance capacity and provide bank protection along the New River. The constructed improvements would be a grade control structure and channelization near the 83rd Avenue crossing. The City of Glendale will be constructing a bridged crossing at 83rd Avenue and New River. (under construction)
- *New River: Grand to Skunk Creek* – This project would include channelization and bank protection along the reach of the New River from the State Route Loop 101 and Skunk Creek confluence south to Grand Avenue.

Cave Creek Watershed

- *041 Town of Carefree: Carefree Town Center Drainage* – Flooding in this area has resulted in damages to existing commercial buildings. Improvements to the existing drainage facilities are required. (completed 2002)
- *520 Adobe Dam / Desert Hills ADMP*

Lower Verde Watershed

- *420 Spook Hill ADMP* – This ADMP updates and expands the existing ADMS conducted in 1987. The study will quantify the extent of flooding problems, incorporate existing drainage structures into the model, and develop alternative solutions to flooding problems for this watershed. An objective is to develop a plan to control runoff to prevent flood damage.

4.3.2.7.b. Recommended Projects from On-going ADMPs

No projects are identified for this Report.

4.3.2.7.c. Structures Assessment / Dam Safety Program

Currently all of the dams and FRS's under the District's jurisdiction are being assessed as part of the three-phase Structural Assessment Program. There are two FRS's and six dams in this Region.

4.3.2.7.d. Landscape Aesthetics and Recreational Multi-Use Projects

The implementation of the District's Landscaping and Aesthetic Treatment Policy has been a major District activity for the past several years. Implementation of this Policy includes tasks in the scope of work for WCMP's and ADMP's that provide for landscape character and visual assessment; multi-use opportunities assessment; plant community and biological resource assessment; historic character assessment; and cultural resource assessment. Implementation of this Policy also includes independent structures assessment for retrofit reports. The following is a list of the initiatives that have been undertaken, are in progress, or are planned to be undertaken in the near future in support of the Landscape Aesthetics and Multi-Use Opportunities Program for the Northeast Region:

- Landscape Character Elements applied in the following studies or projects:
  - Tatum Wash Basin
  - West Valley Rivers Project (New River and Lower Agua Fria)

- Assessment of opportunities to retrofit existing flood control facilities to provide landscaping and aesthetic treatments and recreational multi-use opportunities Phase 2 – North Valley Structures completed in 2000.
- Coordination with Maricopa County Trails Commission in the possible utilization of existing and future planned District flood control facilities and floodplain areas as components of the Maricopa County Regional Trail System.
- An analysis of recreation multi-use opportunities in conjunction with the District's Structures Assessment Program is ongoing.
- Integration of landscape aesthetics and open space opportunities in the management of District lands and existing facilities include the following activities:
  - An IGA with Maricopa County Parks and Recreation Department for the use and management of the Adobe Dam Reservoir area for recreation and open space purposes. (completed)
  - An IGA with the City of Phoenix for preparation of a recreation master plan and management of the Cave Creek Reservoir area for recreation and open space purposes. (initiated)

4.3.2.7.e. Other Non-Structural

In addition, the District will utilize existing floodplain and drainage regulations to minimize and prevent damages from flooding problems.

The Floodplain Delineation Branch has plans to delineate an additional 189 linear miles outside of the ADMP's and other studies being prepared. Operation and maintenance of existing structures will be ongoing to preserve the life of facilities and prevent flooding from occurring due to maintenance issues.

4.3.2.8. Summary

Considerable effort by the District over the years has resulted in mitigation of many of the flood hazards in the Northeast Region, which is the second most populated area in the County. The Salt and Verde Rivers, major washes, and run-off from the forest still pose some hazards. The District does floodplain management for three of the eleven municipalities and unincorporated areas of this Region. The unincorporated area is much greater in this Region than the Southeast Region. The District will continue to have long-term involvement in studies and projects throughout this area. Table 4-6 gives a summary of the critical element data discussed earlier in this section.

Table 4-6 Northeast Region - Summary of Critical Elements

Critical Elements	Watershed													
	Cave Creek	Ever-green	Lower Indian Bend	Lower New River	Lower Verde	Middle Indian Bend	Skunk Creek	Upper ACDC	Upper Agua Fria	Upper Indian Bend	Upper New River	Upper Verde	Upper Salt River	TOTAL
Area inside County Boundary (square	194	40	43	42	560	95	89	120	62	99	143	168	358	2,013
Population (1995)	16,669	1,969	94,551	61,321	23,556	184,042	11,814	341,822	11	13,165	2,984	N/A	N/A	751,904
Projected Population (2025)	105,000	14,377	103,704	143,475	111,277	236,070	79,628	462,706	1,771	185,240	76,017	N/A	N/A	1,519,265
Population Change (1995 - 2025)	88,331	12,408	9,153	82,154	87,721	52,028	67,814	120,884	1,760	172,075	73,033	N/A	N/A	767,361
100,000 scale USGS Hydrography (linear	280	60	27	28	997	55	105	90	66	145	161	242	548	2,803
Approximate & Detailed Delineations	110	10	18	16	77	17	54	63	22	42	61	0	0	487
Delineations Remaining to be done	170	50	9	12	920	38	52	27	44	103	100	242	548	2,316
County Road Closures (1999 - 2000)	37	0	3	35	24	0	46	0	0	0	15	0	0	160
Potentially Develobable Land (square miles)	63	2	1	17	55	11	41	25	7	64	69	0	0	355
Structures in the Floodway	52	0	1	2	3	2	85	51	0	0	3	0	0	199
Structures in the Floodplain	2,173	0	692	40	11	330	155	1,661	0	4,818	40	0	0	9,920
Structures in a Moderate or Severe	370	10	1	42	1	279	148	1,595	0	1,000	19	0	0	3,465
Floodplain Use Permits Issued (April 1990 - June 1999)	402	0	5	N/A	8	2	93	18	N/A	72	17	0	0	617
Drainage Clearance Permits Issued (April 1990 - June 1999)	9,392	1,195	694	14,038	6,950	16,307	3,123	20,722	2	12,525	360	0	0	85,308

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DRAFT

YAVAPAI COUNTY

Upper Agua Fria

LAKE PLEASANT

Skunk Creek

Cave Creek

Upper New River

HORSESHOE RESERVOIR

YAVAPAI COUNTY

Upper Verde

BARTLETT RESERVOIR

GILA COUNTY

Upper Salt River

Lower Verde

TONTO

GILA COUNTY

THEODORE ROOSEVELT LAKE

NATIONAL FOREST

SAGUARO LAKE

CANYON LAKE

APACHE LAKE

Lower New River

Upper A C D C

Upper Indian Bend

Middle Indian Bend

Lower Indian Bend

SALT RIVER INDIAN COMMUNITY

Evergreen

FORT McDOWELL INDIAN COMMUNITY

SALT RIVER

SALT RIVER

PINAL COUNTY

Maricopa County

LOCATION OF WATERSHEDS

Soil Erodability by Water

- Slight
- Moderate
- Severe

Flood Hazards

- 100-year flood zone
- Floodway

N

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

Map 4-8
Northeast Region
Developable Lands, Soil Erosion, and Floodplains

$MARICOPA\New_Watersheds_Northeast_Erosion.apr. Scale: One inch equals five miles. Printed February 28, 2002 on PPM8500 printer.

YAVAPAI COUNTY

Upper Agua Fria

LAKE PLEASANT

Skunk Creek

Cave Creek

Upper New River

HORSESHOE RESERVOIR

YAVAPAI COUNTY

Upper Verde

BARTLETT RESERVOIR

GILA COUNTY

Upper Salt River

Lower Verde

Lower New River

Upper Indian Bend

Upper A C D C

Middle Indian Bend

Lower Indian Bend

FORT McDOWELL INDIAN COMMUNITY

TONTO NATIONAL FOREST

THEODORE ROOSEVELT LAKE

SAGUARO LAKE

CANYON LAKE

APACHE LAKE

SALT RIVER INDIAN COMMUNITY

Evergreen

SALT RIVER

NEW RIVER

CAVE CREEK

VERDE RIVER

GILA COUNTY

PINAL COUNTY

SALT RIVER

Maricopa County

LOCATION OF WATERSHEDS

LAND USE

- VACANT
- OPEN SPACE
- AGRICULTURAL
- LOW DENSITY RESIDENTIAL
- MEDIUM/HIGH DENSITY RESIDENTIAL
- COMMERCIAL & INDUSTRIAL
- WATER
- OTHER

N

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

Map 4-9

Northeast Region

Land Use

$MARICOPA\New_Watersheds_Northeast_Landuse.apr. Scale: One inch equals five miles. Printed February 28, 2002 on PPM8500 printer.

YAVAPAI COUNTY

Upper Agua Fria

LAKE PLEASANT

Skunk Creek

Cave Creek

Upper New River

Lower New River

Upper A C D C

Middle Indian Bend

Upper Indian Bend

Lower Indian Bend

HORSESHOE RESERVOIR

YAVAPAI COUNTY

Upper Verde

BARTLETT RESERVOIR

VERDE RIVER

Lower Verde

TONTO NATIONAL FOREST

GILA COUNTY

Upper Salt River

INDIAN COMMUNITY

FORT McDOWELL

SALT RIVER INDIAN COMMUNITY

Evergreen

SALT RIVER

SAGUARO LAKE

CANYON LAKE

APACHE LAKE

PINAL COUNTY

SALT RIVER

N

Maricopa County

LOCATION OF WATERSHEDS

LAND OWNERSHIP

- PRIVATE
- NATIONAL FOREST
- STATE
- FEDERAL
- INDIAN
- PARKS
- MILITARY
- COUNTY

2020 Population Projections
One dot (·) = 100 people

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

Map 4-10
Northeast Region
Land Ownership and Population Projections

$MARICOPA\New_Watersheds_Northeast_Landownership.apr. Scale: One inch equals five miles. Printed February 28, 2002 on PPM8500 printer.

YAVAPAI COUNTY

Upper Agua Fria

LAKE PLEASANT

Skunk Creek

Upper New River

Cave Creek

CAVE CREEK

CAREFREE

PEORIA

Lower New River

Upper ACDC

Upper Indian Bend

SCOTTSDALE

Middle Indian Bend

Lower Indian Bend

SURPRISE

EL MIRAGE

GLENDALE

LITCHFIELD PARK

PHOENIX

GOODYEAR

AVONDALE

SALT RIVER

TEMPE

MESA

HORSESHOE RESERVOIR

YAVAPAI COUNTY

Upper Verde

BARTLETT RESERVOIR

Lower Verde

SALT RIVER INDIAN COMMUNITY

FORT McDOWELL INDIAN COMMUNITY

FOUNTAIN HILLS

Evergreen

SALT RIVER

TONTO NATIONAL FOREST

GILA COUNTY

Upper Salt River

THEODORE ROOSEVELT LAKE

SAGUARO LAKE

CANYON LAKE

APACHE LAKE

PINAL COUNTY

Maricopa County

LOCATION OF WATERSHEDS

RESIDENTIAL COMPLETIONS

April 1990 - June 1999

Apr. 1990 - Dec. 1993

Jan. 1994 - Dec. 1996

Jan. 1997 - June 1999

N

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

Map 4-11

Northeast Region

Residential Completions

$MARICOPA\New_Watersheds_Northeast_Cities.apr. Scale: One inch equals five miles. Printed February 26, 2002 on PPM8500 printer.

4.3.3. Northwest Region

4.3.3.1. Description

The Northwest Region includes the 11 watersheds in the northwest portion of Maricopa County. These watersheds are Arlington, Buckeye Hills, Buckeye Valley, Lower Agua Fria, Lower Centennial, Lower Hassayampa, Trilby, White Tanks A, White Tanks B, Upper Centennial, and Upper Hassayampa. Map 4-3 shows the exact location of these watersheds. Several of these watersheds extend outside of Maricopa County. The County portion covers 2,850 square miles or about 31 percent of the total area in the County. Approximately 1,008 square miles are outside of Maricopa County. The Upper Hassayampa Watershed is outside of the District boundary, entirely located in Yavapai County. A small portion of the Lower Agua Fria Watershed extends north into Yavapai County. Approximately a third of the Lower Hassayampa and a tenth of the Trilby Watersheds are also in Yavapai County. The Upper Centennial Watershed is also in Yavapai and La Paz Counties in addition to the extreme northwest Maricopa County. The western portion of the Lower Centennial Watershed is located in eastern La Paz County. The County portion of the Northwest Region is bounded on the west by La Paz County, on the north by Yavapai County, approximately bounded on the south by the Gila River, and on the east by the Agua Fria River.

The Gila, Agua Fria and Hassayampa Rivers are in this Region. The Central Arizona Project Canal runs northeast through the middle of four of the watersheds. The Roosevelt Irrigation District, Buckeye, Arlington, and Beardsley Canals are located in this Region. Major washes in the Region are Sols, Centennial, Trilby, Morgan City, Jackrabbit, Tiger, and Luke. There are several dams and FRS's in this Region.

The Region is not as populated as the previous two discussed, but a major network of roads for regional and interstate travel crosses through all of the watersheds. These are Interstate-10, U. S. Route 60, State Routes 74 and 85, State Route Loops 101 and 303, Sun Valley Parkway, Old U.S. 80 and MC 85.

All or parts of the municipal boundaries of Avondale, Buckeye, El Mirage, Glendale, Goodyear, Litchfield Park, Peoria, Surprise, Youngtown, and Wickenburg are located within this Region. The District does Floodplain Management for Buckeye, El Mirage, Litchfield Park, Surprise, and Youngtown.

4.3.3.2. Physical Characteristics

The area in general is mountainous with large developable valleys between ranges. Slopes over 15 percent make up more than fifty percent of the area. The majority of the land area in these watersheds falls into the Hydrologic Soil Groups C and D. A portion of the Region consists of Hydrologic Group B. The Region has a number of large County parks and conservation areas. Map 4-12 shows areas of soil erodability by water and the flood hazards for this region. The numerous watercourses and canals in this area pose potential flooding hazards that are being evaluated in upcoming studies. Run-off from the urban development in the east portion of the Region and the irrigated farm land in the southern portion may cause water quality problems. The majority of the land west of the Hassayampa River, which includes a number of conservation and preservation areas, still retains its natural desert

vegetation. Landscaped yards make up a majority of the area in the east around the Agua Fria River. River restoration along the Gila and Agua Fria Rivers is being planned with recent studies underway. This may restore riparian areas along these corridors.

4.3.3.3. Land Status

Land ownership patterns in the Maricopa County portion of the Northwest Region vary widely from most overall County percentages. For instance, private ownership is nearly 40 percent of the total land versus about 30 percent for the County as a whole. Federal and state land ownership are also about 10 percentage points higher than the Maricopa County average. There are no Native American lands or national forest in the Northwest Region versus nearly five percent and 11 percent, respectively, for Maricopa County as a whole.

The land use patterns vary in certain aspects from the Maricopa County average. Vacant land accounts for nearly 78 percent of the Region versus about 51 percent for the County. Agricultural use is just over 10 percent as compared to the county average of 7 percent. On the other hand, open space is less than one quarter as much as the County average and residential use is approximately 40 percent of this average. Map 4-13 displays the breakdown of land uses in this Region.

Approximately 1,391 square miles of the 2,851 square miles of the total area have already been developed or are considered undevelopable. This leaves about 1,460 square miles of land still developable. Using the assumptions from Chapter 2, it is anticipated that about 65 square miles of the 1,460 will be needed to accommodate the expected growth to 2025.

4.3.3.4. Socioeconomic Characteristics

The Northwest Region (Maricopa County portion only) had a population of 119,347 in 1995. This was approximately five percent of the total population of Maricopa County at that point in time. The Northwest Region is the third most populated region of the four in Maricopa County. The projected population for the Region in 2025 is 535,699 or an increase of 416,352 over the 30-year time frame or about 13,880 per year. This 11.6 percent growth rate on an annual basis far exceeds the projected growth rate of 3.2 percent for Maricopa County. Development pressure is intense in portions of this Region.

4.3.3.5. District Activities Completed

4.3.3.5.a. Structural

Structures that have been constructed in the Northwest Region are the following:

Buckeye Valley Watershed
- Buckeye FRS 1, 2, & 3 (1975)

Lower Centennial Watershed
- Centennial Levee (1985)
- Harquahala FRS and Floodway (1982)
- Saddleback FRS and Diversion (1981)

Trilby Watershed
- McMicken Dam and Outlet Channel (1956)

White Tank A Watershed
- El Mirage Drain (1990)
- Sun City West Drains (1990)
- Dysart Drain (1996)
- Colter Channel
- Agua Fria Channelization (1988)
- RID Overchutte, Channel & Basins (1996)

Lower Hassayampa Watershed
Sunset and Sunnycove Dams (1976)
Casandro Wash Dam and Outlet (1996)

White Tank B Watershed
White Tanks FRS 3 (1954)
White Tanks FRS 4 (1954)
Perryville Bank Stabilization (1984)
Bullard Wash Channel Phase I (1998)

4.3.3.5.b. Non-Structural

Approximately 855 linear miles of detailed delineations have been completed in the Northwest Region out of a total of 3,022.8 linear miles estimated from the100,000 scale USGS Hydrography. Delineations have been done in all of the watersheds, with the most in the Lower Hassayampa Watershed. About 22,700 drainage permits and 186 floodplain use permits were issued from April 1990 to June 1999.

4.3.3.5.c. Studies

The following studies have been done or are in process by the District for this Region:

ADMS/ADMP

- Buckeye/Sun Valley ADMS (1989, 2002) for the Buckeye Valley Watershed.
- Glendale/Peoria ADMS/ADMP (1993, 2001) for the Lower Agua Fria Watershed.
- Wickenburg ADMS (1992) for the Lower Hassayampa Watershed.
- Wittmann ADMS/ADMP (1989, 2003) for the Trilby Watershed.
- White Tanks ADMS/ADMP (1989, 1992) and Loop 303 Corridor/White Tanks ADMP update (2002) for White Tanks A and B Watersheds.
- The Agua Fria Watercourse Master Plan (2002) for the Lower Agua Fria and White Tanks A Watersheds.

Floodplain Delineation Studies	Year	River Miles
• Agua Fria Topo FIS (Gila River to Waddel Dam)	1987	33
• Hassayampa	1988	53
• Centennial	1988	40
• Gila River FIS	1988	18
• Upper Grass/Centennial Washes	1988	27
• Wagner Wash FIS	1990	12
• Sun Valley Parkway – North	1990	22
• Jackrabbit Wash FIS	1990	22
• CAP Overchutes	1990	12
• Trilby Wash FIS	1990	7
• White Tanks Wash	1991	12
• Luke Wash	1991	12
• Buckeye/RID Canals/Railroad	1991	36
• Salt-Gila Master Study	1991	80
• Agua Fria Sediment Transport Study (HEC-6)	1991	-

Floodplain Delineation Studies (con't)	Year	River Miles
• Star Wash	1992	11
• Daggs Wash	1992	12
• Mill Wash	1992	12
• Iona Wash	1992	12
• Agua Fria River (Gila River to New Waddel Dam)	1995	-
• Padelford Wash	1999	14
• Tiger Wash Alluvial Fan	2000	-
• Wickenburg Zone A, Watershed G	2001	100
• White Tanks Alluvial Fan, Site 36	2001	15
• Luke Wash – Zone A FDS	2001	90
• Jackrabbit Watershed Zone A	2002	397
• Palo Verde Watershed Zone A	-	350

4.3.3.6. Hazard and Problem Assessment

The Northwest Region is presently not nearly as populated as either of the eastern regions in the County. However, the rate of growth for the Northwest Region is projected to be much greater than for either of the more populated eastern regions over the next 30 years. This percentage increase is primarily due to the smaller population base in this region in 1995. There is a potential population increase of an additional 416,352 over the 30-year period. There are 1,458.26 square miles of area still available for development to hold this population. Areas that are developing rapidly are those watersheds that border on the western edge of the Phoenix Metropolitan Area.

Approximately 2,168 linear miles of delineations out of 3,023 still remain to be done so that these new residents will not develop in flood and erosion hazard areas. There are 154 structures in the floodway and 795 structures in the floodplain. The majority (524 structures) are also in a moderate or severe erosion hazard zone. In addition, there were 566 County road closures from 1996-2000, which were concentrated in the White Tank A, Lower Centennial, Lower Hassayampa, and the White Tank B Watersheds. Major flooding occurred along the Centennial Wash in the winter of 2000 causing severe flood damage. Additional reported flooding problems for each watershed are in the individual write-ups in Appendix B.

Problems that need to be addressed per the District's programs in the Northwest Region Watersheds (that are inside the County's boundary) include the following:

- ADMP's need to be completed for those areas not yet studied and those studies completed need to be reviewed.
- A number of storm water drainage and channel projects need to be completed for this Region. A number of them have been identified in recent ADMP's and are listed in the next section.
- About 72 percent of the watercourses are not yet delineated. Evaluation of the remaining 2,168 linear miles of watercourses needs to be done to determine additional delineations to be done and priority.

- A buy-out program needs to be considered for the 154 property owners with buildings in delineated floodways, with priority given to residential homes in the highest hazard category.
- A more detailed look at the approximately 795 buildings at risk in delineated floodplains and severe erosion hazard areas needs to be done.
- Some of the dams and flood retarding structures were built approximately 30 years ago. McMicken Dam is being evaluation for fissures. Remedies identified by the Structures Assessment Branch will need to be implemented.
- A study of the various road crossings that have been closed due to flooding should be done.

Each of the above issues needs to be evaluated and prioritized through the various different District programs. The District is responsible for the Floodplain Management for the majority of this area and, as the lead agency, has done a number of studies to identify the hazards and solutions for these watersheds. The next section identifies the flood control projects in the FY01/02 to 05/06 CIP to mitigate these flooding hazards for the watersheds in the Northwest Region.

4.3.3.7. Current Future Activities Identified

4.3.3.7.a. Capital Improvement Program

The CIP for Fiscal Years 2001/2002 to 2005/2006 (see Table 4-4 for cost and year) indicates that the following projects are planned for the Northwest Region:

Lower Hassayampa Watershed

- *211 Buckeye/Sun Valley ADMP* – This study will include an area of over 200 square miles of watershed for the eastern contributing watershed for the Hassayampa River. The Buckeye portion of the study is historically an agrarian community with development starting to infiltrate. The Sun Valley portion is made up of mostly desert foothills with many small watercourses throughout the area. The study will be completed in two parts: a planning study that will lay the groundwork for further flood control activities; and a design and construction phase that will address flooding issues.
- *Aguila ADMP* – The contributing watershed to the Town of Aguila is approximately 231 square miles. This study will only look at a portion of the watershed that is surrounding the Town of

Trilby Watershed

- *344 Wittmann ADMP Update* – This Study is divided into drainage mapping, a structures study, hazards assessment, and a planning study. An area drainage master plan will be developed to determine guidelines for stormwater management and mitigation of flooding hazards within the 300 plus square miles of the Wittmann Watershed.

Upper Centennial Watershed

- *345 Aguila ADMP*
  - ➢ *Hazard Mitigation Grant Program* – This project is to purchase and relocate approximately 10 to 20 residences located in the floodplain in Aguila. On November 21,

2000 a severe rainstorm flooded the area, causing extensive damage to homes and placed lives in danger. The District conducted a study and decided to acquire the properties.

➢ *Aguila ADMP* – The study will be completed in two parts. The first phase is a planning study that will identify the drainage problems, develop the hydrology and hydraulics analysis, complete the floodplain delineations, and develop preliminary engineering alternatives to be recommended for consideration in the second phase of the study. The second phase will be conducted only if feasible engineering alternatives are identified in the first phase. The second phase includes refinements of the engineering alternatives, a detailed alternative analysis and preparation of the final recommended plan.

➢ *Aguila Area Floodplain Delineation* – This study was identified after homes that were located in a non-flood hazard area were flooded in a 100-year storm. Flooding occurred in areas that were shown to be outside of the existing floodplain limits on the FEMA Flood Insurance Rate Map (FIRM). Re-delineation of the floodplain limits for Upper Centennial and Grass Washes and the Aguila Farm Channel. New hydrology will need to be produced for this study.

Lower Agua Fria Watershed

- *452 North Peoria ADMP* – This Study laid the groundwork for flood control activities in the mostly un-urbanized area of North Peoria. The goal is to minimize the need for future CIP expenditures by developing a plan that incorporates Rules of Development for future projects. The study area is approximately 73 square miles with 52 miles of new delineations for floodplain and erosion hazards.

White Tank A and B Watersheds

- *470 White Tanks ADMP*
  - ➢ *White Tanks FRS # 3 Modifications* – This existing facility requires corrective action to bring the structure into compliance with dam safety standards and requirements. Alternatives to dam rehabilitation have recently been completed by the District which would allow for the removal of dams by replacing the FRS with a combination of other flood control features that can also provide multi-use opportunities.
  - ➢ *Bullard Wash Phase II* – This phase includes an earthen greenbelt channel along Bullard Wash from Lower Buckeye Road to McDowell Road. This channel will divert a portion of the peak storm flows from Bullard Wash through existing detention basins located north of I-10, and then outlet to the Agua Fria River. This project will reduce the floodplain and protect the Phoenix-Goodyear Airport and nearby development.
  - ➢ *Loop 303 Corridor / White Tanks ADMP Update* – This Study will lay the groundwork for further flood control activities. The study will analyze approximately 220 square miles of watershed from the McMicken Dam south to the Gila River, and from the White Tank Mountains east to the Agua Fria River.

Lower Hassayampa Watershed

- *343 Sols Wash Hassayampa Watercourse Master Plan* – Study

4.3.3.7.b. Recommended Projects from On-going ADMPs

Additional projects that were recommended through the Area Drainage Master Plans or other studies but not yet included in the CIP are the following:

- *Reems Road Channel* – The proposed project includes the construction of a channel along Reems Road to convey off-site drainage for the 100-year storm water event. The project would protect one arterial roadway, three collector roadways, the City of Surprise's wastewater treatment plant, and other utilities.

4.3.3.7.c. Structures Assessment / Dam Safety Program

Currently all of the dams and FRS's under the District's jurisdiction are being assessed as part of the three-phase Structural Assessment Program. There are seven FRS's and three dams in this Region.

4.3.3.7.d. Landscape Aesthetics and Recreational Multi-Use Projects

The implementation of the District's Landscaping and Aesthetic Treatment Policy has been a major District activity for the past several years. Implementation of this Policy includes tasks in the scope of work for WCMP's and ADMP's that provide for landscape character and visual assessment; multi-use opportunities assessment; plant community and biological resource assessment; historic character assessment; and cultural resource assessment. Implementation of this Policy also includes independent structures assessment for retrofit reports. The following is a list of the initiatives that have been undertaken, are in progress, or are planned to be undertaken in the near future in support of the Landscape Aesthetics and Multi-Use Opportunities Program for the Northwest Region:

- Landscape Character Elements applied in the following studies or projects:
  - Agua Fria WCMP
  - West Valley Rivers Project (New River and Lower Agua Fria)
  - White Tanks / Loop 303 ADMP
  - North Peoria ADMP
  - Glendale / Peoria ADMP
  - El Rio Vision Study
  - Falcon Dunes Golf Course
- Assessment of opportunities to retrofit existing flood control facilities to provide landscaping and aesthetic treatments and recreational multi-use opportunities Phase 1 – West Valley Structures completed in 2000.
- Coordination with Maricopa County Trails Commission in the possible utilization of existing and future planned District flood control facilities and floodplain areas as components of the Maricopa County Regional Trail System. Design Concept Report for McMicken Dam Corridor is scheduled for 2003.
- An analysis of recreation multi-use opportunities in conjunction with the District's Structures Assessment Program is ongoing.

- Integration of landscape aesthetics and open space opportunities in the management of District lands and existing facilities for SRP McMicken Dam Power Substation and Palmilla Apartment Complex in the City of Avondale.
- IGA's have been completed and approved by the cities of Avondale and Peoria and the District Board of Directors for Recreational Use of District Property for the cities' use and management of District property along the Agua Fria River and New River respectively. Multi-use trail projects are planned by the cities for these river corridors.

4.3.3.7.e. Other Non-Structural

In addition, the District will utilize existing floodplain and drainage regulations to minimize and prevent damages from flooding problems. The Floodplain Delineation Branch will delineate an additional 860 linear miles outside of the ADMP's being prepared. Operation and maintenance of existing structures will be ongoing to preserve the life of facilities and prevent flooding from occurring due to maintenance issues.

4.3.3.8. Summary

Considerable effort by the District over the years has resulted in mitigation of some of the flood hazards in the Northwest Region, which is the second most populated of the Regions. The Agua Fria, Gila, and Hassayampa Rivers, major washes, and run-off from the mountainous areas pose hazards that, in many areas, have not been studied yet. The District does floodplain management for five of the ten municipalities and unincorporated areas of this Region. The unincorporated area is much greater in this Region than the Southeast Region. The District will continue to have long-term involvement in studies and projects throughout this area. Table 4-7 gives a summary of the critical element data discussed earlier in this section.

Table 4-7 Northwest Region - Summary of Critical Elements

Critical Elements	Watershed											
	Arlington	Buckeye Hills	Buckeye Valley	Lower Agua Fria	Lower Cen-tennial	Lower Hassa-yampa	Trilby	Upper Cen-tennial	White Tank A	White Tank B	Upper Hassa-yampa	TOTAL
Area inside County Boundary (square miles)	65.8	58	70	106	990	800	290	231	132	110	[600]	2,851
Population (1995)	606	78	8,440	20,882	1,589	9,691	3,474	257	60,138	14,192	N/A	119,347
Projected Population (2025)	5,011	5,640	39,983	68,698	16,993	32,457	27,623	9,017	206,924	123,353	N/A	535,699
Population Change (1995 - 2025)	4,405	5,562	31,543	47,816	15,404	22,766	24,149	8,760	146,786	109,161	N/A	416,352
100,000 scale USGS Hydrography (linear miles)	67	52	43	118	1,073	928	373	194	87	88	N/A	3,023
Approximate & Detailed Delineations (linear miles)	13	10	37	65	97	295	177	22	73	66	N/A	855
Delineations Remaining to be done (linear miles)	54	42	6	53	976	633	196	172	14	22	N/A	2,168
County Road Closures (1999 - 2000)	21	0	32	18	103	79	77	20	138	78	N/A	566
Potentially Develobable Land (square miles)	59	4	58	48	347	391	210	172	92	77	N/A	1,458
Structures in the Floodway	9	0	0	1	4	122	4	11	0	4	N/A	155
Structures in the Floodplain	4	0	37	13	42	252	28	131	270	17	N/A	794
Structures in a Moderate or Severe Erosion Hazard Zone	13	0	37	13	35	246	31	141	270	21	N/A	807
Issued (April 1990 - June 1999)	6	1	7	2	17	18	60	24	26	25	N/A	186
Issued (April 1990 - June 1999)	162	9	497	3,561	130	677	530	106	16,751	271	N/A	22,694

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DRAFT

YAVAPAI COUNTY

LA PAZ COUNTY

YUMA COUNTY

Upper Hassayampa

Upper

Centennial

Lower Hassayampa

Lower

Centennial

Arlington

Buckeye Valley

Buckeye Hills

Trilby

Lower

Agua Fria

White Tanks A

White Tanks B

LAKE PLEASANT

LUKE A.F.B.

HASSAYAMPA RIVER

TRILBY WASH

CENTENNIAL WASH

GILA RIVER

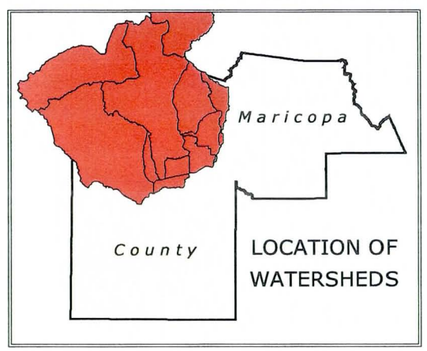
AGUA FRIA RIVER

Soil Erodability by Water

- Slight
- Moderate
- Severe

Flood Hazards

- 100-year flood zone
- Floodway
- Alluvial fan



LOCATION OF WATERSHEDS

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

N

Map 4-12
Northwest Region
Developable Lands, Soil Erosion, and Floodplains

$MARICOPA\New_Watersheds_Northwest_Landuse.apr. Scale: One inch equals six miles. Printed March 4, 2002 on PPM8500 printer.

Upper

Upper Hassayampa

YAVAPAI COUNTY

LA PAZ COUNTY

Centennial

Lower Hassayampa

Lower

Centennial

Arlington

HASSAYAMPA RIVER

TRILBY WASH

CENTENNIAL WASH

GILA RIVER

AGUA FRIA RIVER

LAKE PLEASANT

Lower Trilby

Agua Fria

White Tanks A

LUKE A.F.B.

White Tanks B

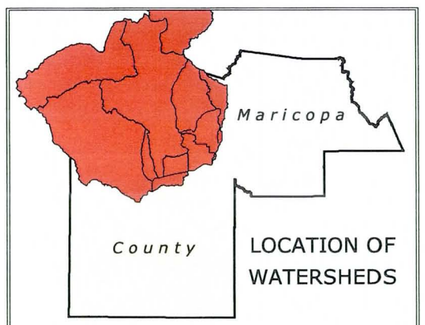
Buckeye Valley

Buckeye Hills

YUMA COUNTY

LAND USE

- VACANT
- OPEN SPACE
- AGRICULTURAL
- LOW DENSITY RESIDENTIAL
- MEDIUM/HIGH DENSITY RESIDENTIAL
- COMMERCIAL & INDUSTRIAL
- WATER
- OTHER



LOCATION OF WATERSHEDS

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

N

Map 4-13

Northwest Region

Land Use

$MARICOPA\New_Watersheds_Northwest_Landuse.apr. Scale: One inch equals six miles. Printed March 4, 2002 on PPM8500 printer.

Upper

YAVAPAI COUNTY

Upper Hassayampa

Centennial

LA PAZ COUNTY

Lower Hassayampa

LAKE PLEASANT

Lower

Trilby

Agua Fria

HASSAYAMPA RIVER

TRILBY WASH

AGUA FRIA RIVER

White Tanks A

LUKE A.F.B.

White Tanks B

Lower

Centennial

CENTENNIAL WASH

Arlington

Buckeye Valley

GILA RIVER

Buckeye Hills

YUMA COUNTY

N

LAND OWNERSHIP

- FEDERAL
- PRIVATE
- STATE
- PARKS
- MILITARY
- COUNTY

2020 Population Projections
One dot (·) = 100 people

Maricopa County

LOCATION OF WATERSHEDS

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

Map 4-14
Northwest Region
Land Ownership and Population Projections

$MARICOPA\New_Watersheds_Northwest_Landownership.apr. Scale: One inch equals six miles. Printed March 4, 2002 on PPM8500 printer.

Map 4-15

Northwest Region

Residential Completions

RESIDENTIAL COMPLETIONS

April 1990 - June 1999

- Apr. 1990 - Dec. 1993
- Jan. 1994 - Dec. 1996
- Jan. 1997 - June 1999

LOCATION OF WATERSHEDS

Maricopa County

SCALE IN MILES 0 1 2 3 4 5 6 7 8 9 10

N

YAVAPAI COUNTY

LA PAZ COUNTY

YUMA COUNTY

Upper Hassayampa

Upper

Centennial

Lower Hassayampa

Lower

Centennial

Buckeye Valley

Buckeye Hills

Trilby

Lower

Agua Fria

White Tanks A

White Tanks B

WICKENBURG

BUCKEYE

PEORIA

SURPRISE

EL MIRAGE

YOUNGTOWN

LUKE A.F.B.

LITCHFIELD PARK

GLENDALE

TOLLESON

AVONDALE

GOODYEAR

LAKE PLEASANT

HASSAYAMPA RIVER

TRILBY WASH

CENTENNIAL WASH

ARLINGTON

GILA RIVER

AGUA FRIA RIVER

$MARICOPA\New_Watersheds_Northwest_Landuse.apr. Scale: One inch eugals six miles. Printed March 4, 2002 on PPM8500 printer.

4.3.4. Southwest Region

4.3.4.1. Description

The Southwest Region includes the 10 watersheds in the southwestern portion of Maricopa County. These watersheds are Ajo, Gila Bend, Gillespie, Lower Gila, Painted Rock, Santa Rosa, Sentinel, Theba, Vekol, and Waterman. These watersheds are shown on Map 4-3. These watersheds contain 3,591 square miles of which 3,473 square miles of the total area is in the County. Approximately 118 square miles are outside of Maricopa County. All but three of the watersheds have areas that extend outside the District's boundary. Lower Gila and Sentinel both extend into eastern Yuma County. Waterman and Vekol Watersheds both extend into western Pinal County. The Ajo Watershed extends into both southeastern Yuma County and western Pima County. The Theba Watershed is partly in western Pima County and the Santa Rosa Watershed extends into Pima County and southwestern Pinal County.

The Southwest Region is bounded on the west by Yuma County, on the south by Pima County, and on the east by Pinal County. The northern boundary is roughly formed by the Gila River in the northeast and Centennial Wash in the northwest. The Gila River runs through a number of the watersheds. Major washes in the area include Tenmile, Waterman, Rainbow, Sandtank, Vekol, Midway, Copper, Loudermilk, and Sauceda. The Enterprise and Gila Bend Canals run through the Painted Rock, Gila Bend, and Theba watersheds. Interstate 8, State Route 85, and Old U. S. 80 bisect the region dividing it in quarters. Signal Mountain, Painted Rock, Woolsey Peak, the Sierra Estrella, North Maricopa Mountains, and South Maricopa Mountains wilderness areas are scattered through this region. The southern portion of the region is the Barry M. Goldwater Gunnery Range, which contains the Sand Tank and Sauceda Mountains.

The Gila Bend Indian Community and portions of the Gila River and Tohono O'Odham Indian Communities are in this region. All or parts of the municipal boundaries of Avondale, Goodyear and Gila Bend are in this Region. Unincorporated communities include Agua Caliente, Sentinel, Palo Verde, Arlington, and Rainbow Valley. The District does the Floodplain Management for the Town of Gila Bend.

4.3.4.2. Physical Characteristics

The area in general is mountainous with slopes over 15 percent for more than fifty percent of the area with valleys between ranges. The majority of the land area that was classified in these watersheds falls into Hydrologic Soil Group B . Hydrologic Soil Groups A, C and D are distributed through the Region. The Southern half of the Region, the Barry M. Goldwater Gunnery Range, was not classified on the USDA/NRCS Digital Soil Survey. Map 4-16 shows areas of soil erodability by water and the flood hazards for this Region. The numerous watercourses and several canals in this area pose potential flooding hazards. Run-off from the irrigated farmland scattered through several of the watersheds may cause water quality problems. The majority of the land in the Region still retains its natural desert vegetation. River restoration along the Gila River is being planned, which should help maintain or restore riparian areas along this corridor.

4.3.4.3. Land Status

Land ownership is mainly government held with federal at 41.5 percent of the area and military at 36.8 percent of the area. Both of these figures are well above the overall Maricopa County average. Private and state ownership are less than the County averages with 11.1 percent and 5.7 percent respectively as compared to 29 percent and 11.2 percent.

Native American lands are nearly on the County average with 4.4 percent of the total versus 4.6 percent for Maricopa County. There is no national forest in this Region, however, there are numerous conservation and preserve areas.

Land use patterns vary widely from Maricopa County averages in several categories. Open Space in this Region accounts for nearly 47 percent of the total versus 32.8 percent. Agriculture accounts for just three percent versus seven percent for the County. The most striking difference is in residential and commercial where less than a quarter of a percent of this land use occurs versus nearly seven percent for the County as a whole. Map 4-17 shows the land use patterns throughout the Region.

Approximately 2,932 square miles of the 3,476 square miles of the total area have already been developed or are considered undevelopable. This leaves about 544 square miles of land to still be developed. Using the assumptions from Chapter 2, it is anticipated that about 10 square miles of the 544 will be needed to accommodate the expected growth to 2025.

4.3.4.4. Socioeconomic Characteristics

The Southwest Region (Maricopa County portion only) had a population of 5,570 people in 1995. This was approximately one-quarter of one percent of the total population for Maricopa County in 1995. This Region is by far the least populated region in terms of numbers of people. Population is projected to reach 61,831 people by 2025. This increase of 56,261 people is a percentage increase of over 1,000 percent for the 30-year period or about 1,900 people per year. This 33.7 percent growth rate on an annual basis far exceeds the projected growth rate of 3.2 percent for Maricopa County.

4.3.4.5. District Activities Completed

4.3.4.5.a. Structural

No structural projects have been completed by the District in the Southwest Region.

4.3.4.5.b. Non-Structural

156.0 linear miles of watercourse delineations have been completed in the Southwest Region out of 2,273.5 linear miles estimated from the100,000 scale USGS Hydrography. Delineations have been done in seven of the ten watersheds, with the most in the Waterman Watershed. About 1,180 drainage permits and 16 floodplain use permits were issued from 1990 to 1999.

4.3.4.5.c. Studies

The following studies have been done or are in process by the District for this Region:

ADMS/ADMP

- Gila Bend ADMP (1980's, 2001) for the Gila Bend, Theba, and Painted Rock Watersheds.

- Rainbow Valley/Waterman Wash ADMS (1980's) for the Waterman Watershed.
- The El Rio Watercourse Master Plan will be beginning in 2002.

Floodplain Delineation Studies	Year	River Miles
• Lower Gila Topo/FIS	1986	30
• Waterman Wash FIS	1988	35
• Gila Bend Canal FIS	1990	23
• Rainbow Wash	1990	-
• Gila Bend	1991	15
• Little Rainbow Valley	1991	12
• Salt & Gila Rivers	1992	-
• Gila Bend FDS, LOMR for Unnamed Wash No. 1 & 2	1999	-

4.3.4.6. Hazard and Problem Assessment

The Southwest Region has considerable acres of land under federal control (Gunnery Range, BLM, Conservation Areas) with very few people living in the remaining area. However, there are 538.84 square miles of area still available for development to hold the projected population. The population is expected to increase 56,261 over the 30-year period. The percentage rate of growth over the next 30 years will far exceed that for the County as a whole. But, by 2025, total population in this Region will still be just one-ninth of the next least populated region. Areas where development is projected include Goodyear and Avondale, which are located in the far northeastern corner of the Region.

However, 3,349.3 linear miles of delineations out of 3,575.2 still remain to be done so that these new residents will not develop in flood and erosion hazard areas. There are 12 structures in the floodway and 148 structures in the delineated floodplains. Only 18 of these structures are also in a moderate or severe erosion hazard zone. In addition, there were 78 County road closures from 1996-2000, which were mostly in the Waterman Watershed. Reported flooding problems for each watershed are in Appendix B.

Problems that need to be addressed per the District's programs in the Southwest Region Watersheds (that are inside the County's boundary) include the following:

- ADMP's need to be completed for those areas not yet studied and those studies completed need to be reviewed.
- Evaluation of the remaining 2,118 linear miles of watercourses needs to be done to determine prioritization for additional delineation.
- A buy-out program needs to be considered for the property owners with buildings in delineated floodways, with priority given to residential homes in the highest hazard category.
- A more detailed look at the approximately 148 buildings at risk in delineated floodplains needs to be done.

Each of the above issues needs to be evaluated and prioritized through the various different District programs. The District is responsible for the Floodplain Management for the majority of this area and, as the lead agency, has done several studies to identify the hazards and solutions for these watersheds. The next section identifies the flood control projects in the FY 01/02 to 05/06 CIP to mitigate these flooding hazards for the watersheds in the Southwest Region.

4.3.4.7. Presently Identified Future Activities

4.3.4.7.a. Capital Improvement Program

The CIP for Fiscal Years 2001/2002 to 2005/2006 indicates that there are no projects planned for the Southwest Region.

4.3.4.7.b. Recommended Projects from On-Going ADMPs

There are no projects currently recommended in recently completed studies for this report.

However, the District will utilize existing floodplain and drainage regulations to minimize and prevent damages from flooding problems. The Floodplain Delineation Branch will delineate an additional 250 linear miles outside of the ADMP's being prepared. Operation and maintenance of existing structures will be ongoing to preserve the life of facilities and prevent flooding from occurring due to maintenance issues.

4.3.4.7.c. Structural Assessment / Dam Safety Program

There are currently no District structures in this Region.

4.3.4.7.d. Landscape Aesthetics and Recreational Multi-Use Projects

The implementation of the District's Landscaping and Aesthetic Treatment Policy has been a major District activity for the past several years. Implementation of this Policy includes tasks in the scope of work for WCMP's and ADMP's that provide for landscape character and visual assessment; multi-use opportunities assessment; plant community and biological resource assessment; historic character assessment; and cultural resource assessment. Implementation of this Policy also includes independent structures assessment for retrofit reports. The following is a list of the initiatives that have been undertaken, are in progress, or are planned to be undertaken in the near future in support of the Landscape Aesthetics and Multi-Use Opportunities Program for the Southwest Region:

- Landscape Character Elements applied in the following studies or projects:
  - El Rio Vision Study
  - Gila Bend ADMP
- Coordination with Maricopa County Trails Commission in the possible utilization of existing and future planned District flood control facilities and floodplain areas as components of the Maricopa County Regional Trail System.

4.3.4.7.e. Other Non-Structural

The Arlington School has been flooded numerous times and acquisition of the property is underway.

4.3.4.8. Summary

This area has a relatively low population and half the land is within the boundary of the Barry M. Goldwater Gunnery Range. Effort has been made by the District over the years, which has resulted in mitigation of some of the flood hazards in the Southwest Region. The Gila River, major washes, and run-off from the mountainous areas pose hazards in this Region. The District is responsible for floodplain management for the majority of the land area within this Region. The unincorporated area is much greater in this Region than any of the other Regions. The District will continue to have long-term involvement in studies and projects throughout this area. Table 4-8 gives a summary of the critical element data discussed earlier in this section.

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Table 4-8 Southwest Region - Summary of Critical Elements

Critical Elements	Watershed										
	Ajo	Gila Bend	Gillespie	Lower Gila	Painted Rock	Santa Rosa	Sentinel	Theba	Vekol	Waterman	TOTAL
Area inside County Boundary (square miles)	418	350	322	380	188	107	627	433	190	462	3,476
Population (1995)	4	1,095	379	195	91	N/A	134	608	12	2,982	5,500
Projected Population (2025)	59	1,752	10,220	2,000	663	N/A	1,426	2,220	1,149	41,302	60,791
Population Change (1995 - 2025)	55	657	9,841	1,805	572	N/A	1,292	1,612	1,137	38,320	55,291
100,000 scale USGS Hydrography (linear miles)	321	468	409	441	206	108	446	429	226	522	3,575
Approximate & Detailed Delineations (linear miles)	0	19	38	29	41	0	25	50	0	24	226
Delineations Remaining to be done (linear miles)	321	449	371	412	165	108	421	379	226	498	3,349
County Road Closures (1999 - 2000)	0	12	11	11	3	0	0	10	0	45	92
Potentially Develobable Land (square miles)	5	25	85	63	16	0	55	126	25	144	544
Structures in the Floodway	0	12	0	0	0	0	0	0	0	0	12
Structures in the Floodplain	0	116	0	4	0	0	3	28	0	1	152
Structures in a Moderate or Severe Erosion Hazard Zone	0	14	0	3	0	0	3	12	0	1	33
Floodplain Use Permits Issued (April 1990 - June 1999)	0	0	0	1	0	0	0	0	0	15	16
Drainage Clearance Permits Issued (April 1990 - June 1999)	0	40	29	4	0	0	2	3	2	1,100	1,180

$MARICOPA\New_Watersheds_Southwest_Erosion.apr. Scale: One inch equals six miles. Printed March 4, 2002 on PPM8500 printer.

CENTENNIAL WASH

GILA RIVER

GILA RIVER

WATERMAN WASH

GILA RIVER

YUMA COUNTY

Lower Gila

Painted Rock

Waterman

GILA RIVER INDIAN COMMUNITY

GILA RIVER

GILA BEND INDIAN COMMUNITY

Theba

Gillespie

AK CHIN INDIAN COMMUNITY

Sentinel

Gila Bend

Ajo

Vekol

PINAL COUNTY

BARRY M. GOLDWATER GUNNERY RANGE

YUMA COUNTY

Santa Rosa

TOHONO O'ODHAM INDIAN NATION

PIMA COUNTY

Maricopa County

LOCATION OF WATERSHEDS

N

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

Soil Erodability by Water

- Slight
- Moderate
- Severe

Flood Hazards

- 100-year flood zone
- Floodway
- Alluvial fan

Map 4-16
Southwest Region Developable Lands, Soil Erosion, and Floodplains

$MARICOPA\New_Watersheds_Southwest_Landuse.apr. Scale: One inch equals six miles. Printed March 4, 2002 on PPM8500 printer.

CENTENNIAL WASH

GILA RIVER

GILA RIVER

WATERMAN WASH

YUMA COUNTY

Lower Gila

Painted Rock

Waterman

GILA RIVER

GILA BEND INDIAN COMMUNITY

Theba

Gillespie

Sentinel

Gila Bend

Ajo

Vekol

BARRY M. GOLDWATER GUNNERY RANGE

YUMA COUNTY

Santa Rosa

TOHONO INDIAN

O'ODHAM NATION

PIMA COUNTY

PINAL COUNTY

GILA RIVER INDIAN COMMUNITY

AK CHIN INDIAN COMMUNITY

Maricopa County

LOCATION OF WATERSHEDS

N

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

LAND USE

- VACANT
- OPEN SPACE
- AGRICULTURAL
- LOW DENSITY RESIDENTIAL
- MEDIUM/HIGH DENSITY RESIDENTIAL
- COMMERCIAL & INDUSTRIAL
- WATER
- OTHER

Map 4-17

Southwest Region

Land Use

$MARICOPA\New_Watersheds_Southwest_Landownership.apr. Scale: One inch equals six miles. Printed March 4, 2002 on PPM8500 printer.

CENTENNIAL WASH

GILA RIVER

GILA RIVER

WATERMAN WASH

GILA RIVER

YUMA COUNTY

Lower Gila

Painted Rock

Waterman

GILA RIVER

GILA BEND INDIAN COMMUNITY

Theba

Gillespie

Sentinel

Gila Bend

Ajo

Vekol

BARRY M. GOLDWATER GUNNERY RANGE

Santa Rosa

TOHONO O'ODHAM INDIAN NATION

YUMA COUNTY

PINAL COUNTY

PIMA COUNTY

Maricopa County

LOCATION OF WATERSHEDS

N

GILA RIVER INDIAN COMMUNITY

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

LAND OWNERSHIP

- FEDERAL
- MILITARY
- STATE
- PRIVATE
- INDIAN
- PARKS

2020 Population Projections
One dot (·) = 100 people

Map 4-18
Southwest Region Land Ownership and Population Projections

CENTENNIAL WASH

GILA RIVER

PHOENIX

AVONDALE

GOODYEAR

GILA RIVER

WATERMAN WASH

YUMA COUNTY

Lower Gila

Painted Rock

Waterman

GILA RIVER

GILA BEND INDIAN COMMUNITY

Theba

Gillespie

GILA BEND

Sentinel

Gila Bend

Ajo

Vekol

BARRY M. GOLDWATER GUNNERY RANGE

YUMA COUNTY

PINAL COUNTY

Santa Rosa

TOHONO O'ODHAM INDIAN NATION

PIMA COUNTY

GILA RIVER INDIAN COMMUNITY

AK CHIN INDIAN COMMUNITY

Maricopa County

LOCATION OF WATERSHEDS

N

0 1 2 3 4 5 6 7 8 9 10

SCALE IN MILES

RESIDENTIAL COMPLETIONS

April 1990 - June 1999

Apr. 1990 - Dec. 1993

Jan. 1994 - Dec. 1996

Jan. 1997 - June 1999

Map 4-19

Southwest Region

Residential Completions

$MARICOPA\New_Watersheds_Southwest_Cities.apr. Scale: One inch equals six miles. Printed March 4, 2002 on PPM8500 printer.

4.4. Summary

Considerable measures have been taken to minimize or eliminate flood control hazards throughout the County. But with the rapid and continuing growth Maricopa County has experienced, in conjunction with funding limitations, there is considerable work left to be done. The best approach is to first assess risk through a prioritization process for each watershed and then establish a schedule to complete needed projects over time. This has been done for the most part through the CIP process. Approximately 40 additional projects have been done through the CIP program since the 1963 Report. Many of the urban area problems have been addressed. However, many areas of concern remain to be addressed in the heavily developed portions of the Metropolitan Area. Also, now the District, through the ADMP Program, has the opportunity to get ahead of development in identify flooding hazards, and to prevent similar situations from happening in the future. The upcoming ADMP studies will look at implementation of both the structural and non-structural solutions, as well as low-impact measures. The recently completed North Peoria Area Drainage Master Plan for the Lower Agua Fria Watershed demonstrates the use of non-structural principles using a "Rules of Development" approach. Future flood management for the District will employ a combination of these principles as well as structural solutions. Table 4-9 compares the Region totals for the critical elements.

Table 4-9 Summary of Critical Elements - Regions

Critical Elements	Region				
	Southeast	Northeast	Northwest	Southwest	Total
Area inside County Boundary (square miles)	877	2,013	2,851	3,476	9,217
Population (1995)	1,651,179	751,904	119,347	5,500	2,527,930
Projected Population (2025)	2,829,037	1,519,265	535,699	60,791	4,944,792
Population Change (1995 - 2025)	1,177,858	767,361	416,352	55,291	2,416,862
100,000 scale USGS Hydrography (linear miles)	440	2,803	3,023	3,575	9,841
Approximate & Detailed Delineations (linear miles)	211	487	855	226	1,779
Delineations Remaining to be done (linear miles)	229	2,316	2,168	3,349	8,062
County Road Closures (1999 - 2000)	282	160	566	92	1,100
Potentially Develobable Land (square miles)	280	355	1,458	544	2,637
Structures in the Floodway	59	199	155	12	425
Structures in the Floodplain	10,852	9,920	794	152	21,718
Structures in a Moderate or Severe Erosion Hazard Zone	10,515	3,465	807	33	14,820
Floodplain Use Permits Issued (April 1990 - June 1999)	117	617	186	16	936
Drainage Clearance Permits Issued (April 1990 - June 1999)	111,200	85,308	22,694	1,180	220,382

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CHAPTER 5. IMPLEMENTATION

5.1. Overview

Maricopa County is too vast to determine all of the flood hazard problems in a short time frame and the focus has been in the rapidly developing watersheds. Growth has expanded the Metropolitan Area and development is now occurring outside of the flood control dams and facilities constructed in the 1950's through the 1970's, which surround the Metropolitan Area. Approximately 1,400 square miles of land in the County are within municipal boundaries, leaving the District responsible for 7,785 of the 9,226 square miles within the County boundary.

As indicated in the previous chapters approximately 30 percent of the County is still available for development. Approximately 64 percent of the land within the County may never urbanize; such as the Tonto National Forest, Barry M. Goldwater Gunnery Range, and steep slopes; but still contributes to the flood hazards and must be addressed. Population is expected to increase by an additional 2.4 million people by 2025 expanding further out in the County, outside of the flood control dams that provide protection to the Metropolitan Area. It is likely that these people will locate in these outlying areas. Although attention will need to be directed to the new growth areas, there are still urbanized areas that have not been completely delineated. Many proposed projects and anticipated future projects, to be identified through the planning process, are yet to be completed. As noted in Chapter 4, there are numerous projects to be completed in the urbanized areas.

The District continues to initiate studies and construct projects to address the above issues, which were detailed in Chapter 4. In addition, the County continues to be an active participant in the NFIP through regulatory and floodplain management efforts. The District is also moving forward on several newer initiatives that are shifting from the study or strategy direction stage into implementation. These activities are not addressed in detail in Chapter 3 with the existing programs, as they are not fully implemented yet. An introduction to these efforts is provided in this Chapter.

5.2. NFIP Community Rating System

The District is required by State law to produce a report that describes existing facilities and programs for flood control mitigation as well as identify future flooding problems. In addition, a Floodplain Management Plan must be part of Maricopa County's application to the Insurance Services Office for the NFIP Community Rating System (CRS). This is required because Maricopa County is a Category **C** community (10 or more repetitive losses). Currently the County's rating is CRS Class 5. The District's involvement in the CRS program is on behalf of the County for the unincorporated County only. Municipalities must prepare their own comprehensive plans for CRS credits.

Credit for this program is provided for preparing, adopting, implementing, evaluating, and updating a comprehensive floodplain management plan (FPM). Up to 235 points are provided for a series of planning steps. Those steps are the following:

Subsection	Step	Max. Points
510. a.	Organize to prepare the plan	10
510. b.	Involve the public	48
510. c.	Coordinate with other agencies	18
510. d.	Assess the hazard	10
510. e.	Assess the problem	35
510. f.	Set goals	2
510. g.	Review possible activities	30
510. h.	Draft an action plan	60
510. i.	Adopt the plan	2
510. j.	Implement, evaluate, and revise	10
510. k.	Adopt a Habitat Conservation Plan (optional)	10

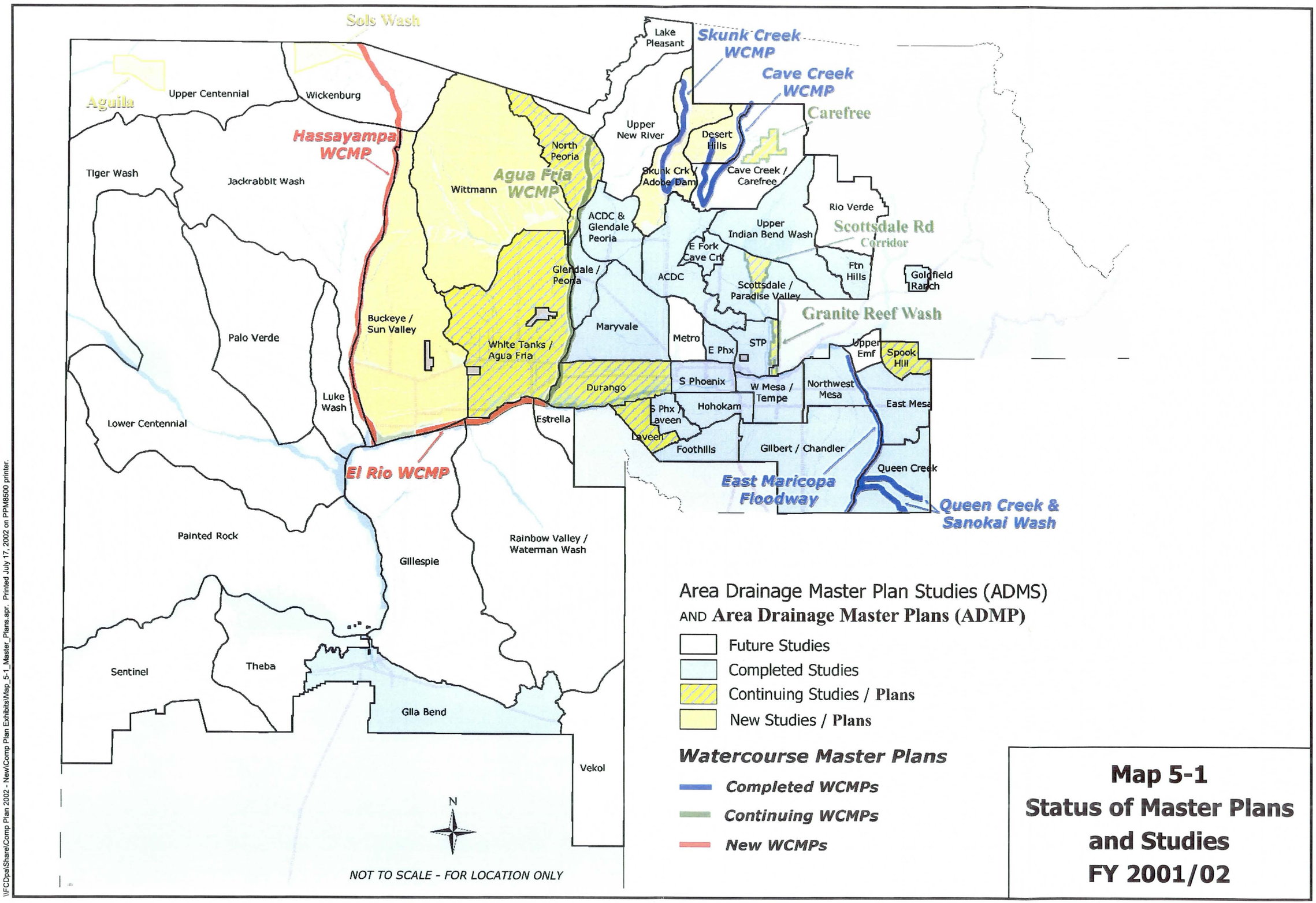
A number of the above items are addressed throughout this Comprehensive Plan. This Chapter of the Comprehensive Plan identifies the District's Floodplain Management Planning activity following the guidance set in the CRS Coordinator's Manual, Section 510.

5.3. Assessing the Hazards and Problems (CRS 510. d, e)

Because of Maricopa County's vast size, assessment of the remaining hazards and problems is done by watershed through the ADMS/ADMP program. An ADMP may cover one or more watersheds. Eight of these studies were begun in the last two years with five of these studies just being completed. Anticipated projects from these studies are identified in Chapter 4 and detailed in the District's current CIP. Map 5-1 shows the location of studies and the six areas where studies are starting up. District studies include environmental hazards identification, environmental characteristics evaluation, multi-use opportunities, public involvement, development and evaluation of alternatives. When practical, studies will contain a "Rules of Development" section which applies non-structural and low-impact solutions to development while incorporating trails and other multi-use opportunities. The North Peoria ADMP, completed in February 2002, contains this element.

In the 42 years the District has been in existence considerable progress has been made to study and resolve the flooding problems in Maricopa County. However, there is still much to be done. The specific lists by Region are identified in Chapter 4. A general list of issues countywide is as follows:

- 11 of the 37 watersheds within the District's boundary have not yet been studied.
- Of the remaining 26, approximately 12 of these studies are over ten years old.
- 6,950 of 8,730 linear miles of 100,000 scale USGS Hydrography remain to be done.
- An estimated 423 buildings have been constructed in the delineated floodways and 22,000 buildings constructed in delineated floodplains with 14,511 of these in moderate or severe erosion hazard zones (incorporated and unincorporated). Of the 22,000 buildings countywide about 60 percent are within municipal boundaries beyond District authority for remediation.
- The dams and flood retarding structures under the District's jurisdiction were built approximately 30 years ago. Remedies identified by the Structures Assessment Branch will need to be undertaken.



Area Drainage Master Plan Studies (ADMS)
AND **Area Drainage Master Plans (ADMP)**

- Future Studies
- Completed Studies
- Continuing Studies / **Plans**
- New Studies / **Plans**

Watercourse Master Plans

- ***Completed WCMPs***
- ***Continuing WCMPs***
- ***New WCMPs***

Map 5-1
Status of Master Plans and Studies FY 2001/02

\\FCDpalShare\Comp Plan 2002 - New\Comp Plan Exhibits\Map_5-1_Master_Plans.apr. Printed July 17, 2002 on PPM8500 printer.

- Development pressure on the order of 2,500 – 3,600 new residential starts are expected per month, and are spreading into areas not yet delineated or studied and areas outside of the existing flood control dams.
- Not all flood problems have been addressed in the existing urbanized areas.

Chapters 1 through 3 give a background on conditions that affect District activities and the programs that have been in progress to address the flood hazards and problems. Chapter 4 represents the District's report to meet ARS § 48-3616, which gives a summary of existing structural and non-structural projects to mitigate flooding problems and identifies future projects and problems by watershed. The sections of this Chapter present goals, activities, an and Action Plan to frame the process for implementation of this Plan. Implementation of the Plan will result in continued remediation of flood and erosion hazards.

5.4. Floodplain Management Goals (CRS 510. f)

In 1993 the Board of Supervisors adopted the *County-Wide Comprehensive Plan Goals, Policies and Standards.* Many of the goals and policies reflected a close relationship between the District's programs and Maricopa County's stated planning initiative. A series of planning documents with policies, goals and objectives have followed this initial effort. An additional tool the District uses to set a course for future direction and type of projects to be done is the annual Strategic Planning Process. This Strategic Plan is prepared by a Team made up of staff members from the District's Divisions. The Strategic Plan is adopted by the Board of Directors. The 2000-2001 strategic planning process for the District, Managing for Results, produced the following Floodplain Management Goals for FY 01-06:

1. The Flood Control District will conduct two studies per year for the next five years to identify flood prone areas, limit growth in those areas, and establish plans for the required drainage infrastructure.
2. The Flood Control District will study, each year for the next five years, two major areas of Maricopa County that are not yet under development, but are expected to be according to the Maricopa Association of Governments' projections.
3. Each year for the next five years, the Flood Control District will evaluate five existing flood control facilities' safety monitoring procedures, evaluate District-owned flood control facilities, and begin plans to mitigate, upgrade, or redesign these facilities to reduce the increased risk and liability associated with them, meet all regulatory requirements, and maintain or improve their flood control functions.
4. The Flood Control District will initiate at least one project each year for the next five years that uses innovative and resourceful operational and financial strategies.
5. The Flood Control District will evaluate five existing flood control facilities each year for the next five years to determine how they can be made more aesthetically pleasing or used as multi-use facilities.
6. The Flood Control District will plan and design future flood control projects to incorporate multi-use facilities where practical.

In addition, The Maricopa County Comprehensive Plan 2020 – Eye to the Future, adopted by the Board of Supervisors on October 20, 1997, identifies the following Goals, Objectives, and Policies that pertain to the District's programs and activities:

Land Use

Goal: Promote efficient land development that is compatible with adjacent land uses, is well integrated with the transportation system, and is sensitive to the natural environment.

Objective L10 Promote the balance of conservation and development.

Policy L10.1 *Encourage the preservation of environmentally sensitive areas through the transfer of development rights, density transfers, or other suitable techniques.*

Policy L10.2 *Encourage building envelopes and localized grading, to reduce blading and cut and fill, in environmentally sensitive areas.*

Policy L10.5 *Encourage development standards for hillsides and other environmentally sensitive lands that allow street standards and other infrastructure to respond in an innovative manner to topography and drainage.*

Objective L11 Promote an interconnected open space system.

Policy L11.1 *Support techniques for acquisition and maintenance of open space.*

Policy L11.2 *Preserve and respect private property rights in any future designation of open space areas.*

Policy L11.3 *Encourage the protection of ridgelines, foothills, significant mountainous areas, wildlife habitat, native vegetation, and riparian areas.*

Policy L11.4 *Discourage development within major 100-year floodplains.*

Environmental

Goal 1: Promote development that considers adverse environmental impacts on the natural and cultural environment, preserves highly valued open space, and remediates areas contaminated with hazardous materials.

Objective E5 Promote the protection and preservation of riparian areas within the framework of state and federal laws, regulations, and guidelines.

Policy E5.1 *Encourage site evaluation and classification of riparian-areas as required by the United States Army Corps of Engineers 404 permit program or by other state or federal laws, regulations, and/or guidelines.*

Policy E5.2 *Consider incentives and options for preservation.*

Objective E6 Encourage the reduction of pollutants in rivers and streams within the framework of state and federal laws, regulations, and guidelines.

Objective E7 Discourage new development in major 100-year floodplains.

Policy E7.1 *Ensure that local floodplain management regulations remain in conformance with state flood control statues and the National Flood Insurance Program (NFIP) rules and guidelines.*

Policy E7.2 *Review proposed floodplain uses and issue only appropriate permits and clearances.*

Policy E7.3 *Review existing 100-year floodplains as necessary against changed conditions and obtain revisions through Federal Emergency Management Agency (FEMA) where necessary.*

Policy E7.4 *Encourage flood identification studies in areas where development is imminent or ongoing to identify 100-year flood hazard areas.*

Policy E7.5 *Continue public education efforts pertaining to the judicious uses of flood-prone properties.*

The following are the goals, objectives, and policies for the Maricopa County Comprehensive Pan 2020 Open Space Element that was recently added to the County Plan:

Open Space

Goal: Maintain and, where necessary, encourage expanding the open space system for Maricopa County to address public access, connectivity, education, preservation, buffering, quantity, quality, and diversity for regionally significant open spaces.

Objective O2 **Establish regional open space connectivity and linkages for both recreation and wildlife purposes.**

Policy O2.1 *Coordinate trail linkages in new developments with Maricopa County Flood Control projects and other open space projects and/or resources.*

Policy O2.2 *Encourage development of trails along rivers, washes, and canals to link existing open space resources throughout the region.*

Policy O2.3 *Design all road crossings to minimize disturbance to the natural environment, and to accommodate identified trail crossings and other open space.*

Policy O2.5 *Encourage completion of the Sun Circle Trail (Figure 2) through integration into the Maricopa County Regional Trail plan.*

Policy O2.7 *Encourage integration and consideration of the proposed Maricopa County Regional Trail into future development.*

Policy O2.8 *Support partnerships with public and private entities whenever possible to establish open space corridors and linkages.*

Objective O4 **Protect and enhance environmentally sensitive areas, including mountains and steep slopes; rivers and washes; historic, cultural, and archeological resources; view corridors; sensitive desert; and significant wildlife habitat and ecosystems.**

Policy O4.7 *Discourage development in areas that are environmentally sensitive.*

5.5. Review of Possible Activities (CRS 510. g)

The District cannot fund programs, studies, and projects for the entire County all at once, nor is there a need to do so. The five-year ADMP and CIP Programs allow the District to plan ahead and spread these projects out over a reasonable time frame based on highest need. Prioritization of District activities for flooding problem mitigation starts at a very broad level through the Planning and Project Management (PPM) Division. A process has been established through a committee of District staff led by the PPM Division to evaluate all of the watersheds based on critical elements that assess area risk and are tied to the District's core programs and activities. This ranking of watersheds for risk assessment is a preliminary look at where the greater problems appear to exist and therefore where ADMS, ADMP, or WCMP's need to be done or updated. A summary of the critical element data used for risk assessment of each watershed is presented in Chapter 4 in Table 4-4.

With this preliminary risk assessment phase, there are two levels to consider when deciding on what order areas should be evaluated: 1) addressing existing urban areas and people currently at risk where solutions have not yet been completed and 2) getting ahead of development to prevent current and costly problems from occurring in urbanizing areas.

The process above needs to be refined even further to look at additional data that would affect risk. This data would include soil conditions, slope, type of future development expected (i.e.: infill, master planned communities, large lot), floodplain management responsibilities, and solutions already planned in the next five years. At the same time these assessments and prioritizations are in process, each watershed needs to be looked at in terms of individual District programs. While the PPM division in coordination with the other Divisions identifies future problems, each Division is also moving forward with activities under their programs. Examples of this would be as follows:

- ✗ A study may not be scheduled for several years for a watershed, however development is occurring. The Regulatory Branch would continue to provide floodplain management through its activities, which are detailed in Chapter 3. The District staff can anticipate issuing approximately 20,000 drainage clearance permits each year.
- ✗ Independent of a study being underway, the Delineations Branch will move forward on A Zones or detailed delineations for water courses where there are identified risks and floodplain management is needed. The Floodplain Delineation Branch has 1,375 miles of new delineations planned for the next 4 years (02-05).
- ✗ Flood Hazard Education is an ongoing process in conjunction with all other District programs and activities.
- ✗ Placement of flood warning and data collection devises continues to grow and are prioritized on risk assessment. This program contributes to the District's floodplain management efforts either as a recommended solution to a study, to prevent possible lost lives, or to prevent flood damages prior to future solutions being developed.

Prioritization will be affected by other projects that can reduce costs, timing, development pressure in an area, and a number of other factors. Chapter 3 emphasizes the multitude of

programs that have evolved over time at the District to allow floodplain management to take place on numerous levels. The process to schedule what projects will get done and when is a complex layer of program activity and prioritization as indicated above.

Chapter 4 identified past projects and upcoming activity for the FY 2001-2002 to 2005-2006 Capital Improvement Program. The District is responsible for unincorporated County, but works with partners on projects within municipal boundaries. Section 5.5. identifies action items for the District to achieve floodplain management for the areas under its jurisdiction. The action items are specific to addressing unincorporated county issues.

5.6. Action Plan (CRS 510. h)

5.6.1. Short-Term FY2001-2002 to FY2005-2006

The action plan items listed below specify those activities that the District expects to continue or initiate over the next years. This list is not inclusive of all District activity, but captures key elements.

5.6.1.1. Preventive

5.6.1.1.a. *Action*: The District is currently working with County Planning and Development on a cooperative effort to notify developers of ADMP's and floodplain regulations early on in the development process. The District is expecting the Board of Supervisors to also adopt the District's Area Plans.

Budget: Staff time (District budget)

Responsible Party: Planning Branch of Planning & Project Management Division

5.6.1.1.b. *Action*: Maricopa County has recently adopted an Open Space Element for the Comprehensive Plan 2020 – Eye to the Future. See 5.3. Floodplain Management Goals.

Budget: Staff time (County General Fund)

Responsible Party: Maricopa County Planning & Development

5.6.1.1.c. *Action*: The District's Floodplain Regulations were updated in 1999 and the fees were revised.

Budget: Staff time (District Budget)

Responsible Party: District Regulatory & Engineering Divisions

5.6.1.1.d. *Action*: The District staff is currently updating the "Drainage Design Manual for Maricopa County" and the "Uniform Drainage Policies and Standards for Maricopa County". The goal is to promote adoption of the Drainage Design Manual by all communities within Maricopa County. This will promote consistency in technical methodology and reduce future losses related to flooding.

Budget: Staff time (District Budget), IGA with the City of Phoenix

Responsible Party: Special Projects Branch of the Engineering Division

5.6.1.1.e. *Action*: The District will apply for and prepare a Stormwater Management Plan in accordance with the Phase II NPDES stormwater regulations on behalf of Maricopa County (including FCD interests). The Volume III – Erosion Control Manual will be rewritten to incorporate new Phase II stormwater concerns as part of the county's permit. As part of the Phase II process, the District intends to head up a regional public education campaign and promote one unified message to be established valley wide. The existing public education program that the District already has in place can be tapped into and expanded.

Budget: Staff time (District Budget, Maricopa County general fund – see FCD IGA 99-006)

Responsible Party: Water Quality Branch, Engineering Division

5.6.1.2. Property Protection

5.6.1.2.a. *Action*: The District staff is finalizing a Floodprone Properties Acquisition policy that better defines our existing programs for acquisition and relocation especially in situations where a few structures need to be removed from the floodway and floodplain. Floodproofing is included in this policy. This policy is described in Chapter 6.

Budget: Staff time (District budget)

Responsible Party: Planning Branch, Planning & Project Management Division

5.6.1.2.b. *Action*: The District staff will continue to require property owners to provide the federal elevation certification forms for building elevations for new construction to protect the public from flood damage.

Budget: Staff time (District budget)

Responsible Party: Regulatory Division

5.6.1.2.c. *Action*: The District will continue to participate in the CRS program and get credit for the various activities that assist property owners in receiving reduced insurance premiums.

Budget: Staff time (District budget)

Responsible Party: Regulatory and Planning & Project Management Divisions.

5.6.1.3. Natural Resource Protection

5.6.1.3.a. *Action*: Revision of the Volume III - Erosion Control Manual will address Phase II stormwater issues. The District is including delineation of erosion hazard zones in its current studies. [54+ erosion hazard zones were recently

delineated in the following studies: Skunk Creek Watercourse Master Plan (2001), Agua Fria Watercourse Master Plan (2002), North Peoria ADMP (2002)],

Budget: Staff time and outside consultants (CIP Budget)

Responsible Party: Planning Branch, Planning & Project Management Division, Engineering Division

5.6.1.3.b. *Action*: The District takes into account and incorporates wetlands protection and mitigation sites into the planning process when preparing new studies for watercourses.

Budget: Staff time, consultant contracts (District Budget, partnerships with other agencies)

Responsible Party: Planning & Project Management, Engineering, and Operations & Maintenance Divisions

5.6.1.4. Emergency Services

5.6.1.4.a. *Action*: The District will continue to provide the ALERT and other flood warning and response programs as needed based on flood hazard risks.

Budget: Staff time (District budget, project partners)

Responsible Party: Flood Warning Branch, Engineering Division

5.6.1.5. Structural Projects

5.6.1.5.a. *Action*: A series of levees, channels, storm drain diversions, retention basins, and FRS's have been built over the years in the County for flood protection, usually in already urbanized areas as a retrofit or prior to urbanization by federal agencies to protect farmland. There are currently 35 structural projects identified in the FY 2001-2002 to 2005-2006 CIP. The projects are listed in Chapter 4 by watershed and region.

Budget: Capital Improvement Program Budget (property tax)

Responsible Party: Planning & Project Management Division

5.6.1.5.b. *Action*: Phase I and II of a Structures Retrofit Program have been completed. There will be two more phases to this process. The intent of this program is to look at incorporating multi-use opportunities into existing structures, make them more aesthetically pleasing, and blend with the environment. The City of Peoria is in the process, under an IGA with the District, of developing a trail and park along existing District fee-held property. This project is along the New River and confluence of the New River with Skunk Creek. Much of the trail will be on the existing maintenance/access road along the river. The Cities of Avondale and Glendale are currently working with the District on similar projects. Avondale's project will be on the Agua Fria River and Glendale's on the New River.

Budget: Staff time, Consultant contracts (Operations & Capital Improvement Program Budget)

Responsible Party: Structures Management Branch, Planning & Project Management Division

5.6.1.5.c. *Action*: Analysis for low-impact structural alternatives are being incorporated into District ADMP studies.

Budget: Staff time, consultant contracts (Operations & Capital Improvement Budgets)

Responsible Party: Planning Branch. Planning & Project Management Division

5.6.1.6. Public Information

5.6.1.6.a. *Action*: Map information will continue to be made available in paper form, but increased emphasis will be to utilize Geographic Information Systems (GIS) to expand access to flood delineation/boundary maps to the public.

Budget: Staff time, consultant contracts (District budget)

Responsible Party: Regulatory Division, Engineering and GIS Branch, Information Technology Division

5.6.1.6.b. *Action*: Outreach projects – The District will increase its Public School Safety Presentation Program. (21,000+ elementary school children have participated in the Public School Safety Presentation in the last 3 years)

Budget: Staff time (District budget0

Responsible Party: Public Information Office

5.6.1.6.c. *Action*: Real estate disclosures – the District will adopt Resolutions as needed to alert property owners to areas that are being studied for flood and erosion hazard.

Budget: Staff time (District budget)

Responsible Party: Planning & Project Management Division

5.6.1.6.d. *Action*: The District maintains a library at the District's main facility that contains all past studies and reports. Much of this information can be accessed on-line from the District's webpage (www.fcd.maricopa.gov). The District staff also has pamphlets available on basic flood preparedness for distribution.

Budget: Staff time (District budget)

Responsible Party: Engineering Division and Public Information Office

5.6.1.6.e. *Action*: The District staff offers technical assistance to 13 of the 24 municipalities in Maricopa County as their Floodplain Management Agency, to residents seeking information, and to municipalities that do their own floodplain management at their request.

Budget: Staff time (District budget)

Responsible Party: Regulatory and Engineering Divisions

5.6.1.6.f. *Action*: General education will be provided year-round through increased visibility utilizing the District's web site, print media, electronic media, and staffed display booths at trade shows.

Budget: Staff time (District budget)

Responsible Party: Public Information Office

5.7. New Initiatives

As noted in Chapter 3, the District realizes the need to continuously evaluate the success of existing programs and activities, and revise as needed. Also, the District needs to consider new services that reflect the changes and needs within the County. As a result of current ongoing mitigation efforts, several newer initiatives have been identified to provide additional tools for the District to use for providing solutions to flood and erosion hazard mitigation. These activities are not addressed in detail with current programs, as they are not fully implemented yet. The following sections describe some of these initiatives in process that add to the set of tools for mitigating or eliminating flood and erosion hazards.

5.7.1. Erosion Hazard Ordinance

Under ARS § 48-3605 the Arizona Department of Water Resources has established criteria and standards for determining flood and erosion hazard areas. The District is including delineation of erosion hazard areas in recently completed ADMP's, and will continue to analyze these areas in future studies. In conjunction with identifying and mapping the erosion hazard areas, the District will be looking at its current regulations and need for additional policy or action items.

5.7.2. Floodprone Properties Acquisition or Floodproofing

The *Alternative Flood Control Works Program* (Resolution FCD 95-01) was developed to provide another mechanism through which the District could achieve its mission of protecting the public from hazards due to flooding. Through implementation of this Program, the District will allow limited funding for the use of voluntary, non-structural flood mitigation measures, such as property acquisition or floodproofing. This funding will provide assistance to residents of flood or erosion prone properties where large-scale structural or non-structural CIP projects are determined to be unfeasible.

The District, however, did not have a specific pool of money set aside annually to floodproof or acquire properties in flood or erosion prone areas to protect the public from flooding hazards.

There was clearly a need for a consistent, proactive program for addressing properties in these flood and erosion prone areas.

To reduce the occurrence of repetitive loss properties and to protect the public, the District desires to work with property owners to remove them from harm's way. To achieve these objectives, the District developed the proactive *Alternative Flood Control Works Program* to provide limited District funding for voluntary non-structural mitigation measures. A voluntary floodproofing or acquisition and relocation program with uniform guidelines and annual funding is being implemented to address properties in high-hazard flood or erosion prone areas. Acquired properties may serve a dual purpose as community open space in addition to providing a conveyance for floodwaters.

The goals of the *Alternative Flood Control Works Program* are the following:

- To reduce the risk of injury, death, and property damage due to flooding by providing flood or erosion hazard remediation in the form of acquisition or floodproofing.
- To establish a program and funding source to acquire or floodproof properties in flood or erosion prone areas including delineated floodways, erosion hazard zones, and local areas of repetitive flooding.
- To maximize the use of federally sponsored programs for flood or erosion remediation while avoiding conflicts with existing floodplain regulations.
- To identify all properties in flood or erosion prone areas in Maricopa County that pose a threat to personal and public safety, and to identify similar properties in all future District studies.
- To encourage local jurisdictions to consider alternative flood control programs, and to provide a mechanism through which they might remove or floodproof properties in flood or erosion prone areas.

This policy is intended as a voluntary program, with limited exceptions, that would increase the District's and its client communities' economic, technical and administrative flexibility while improving beneficial floodplain characteristics. The Program is not intended to facilitate urban renewal or Community Development Block Grant projects or to allow non-structural, stand-alone CIP projects to bypass the requirements of the *Procedure for Identifying and Prioritizing Potential 5-Year CIP Projects.*

5.7.3. Structure Rehabilitation

The District owns and operates 22 flood control dams, which provide highly beneficial flood protection for significant portions of Maricopa County. If the extensive flood protection function provided by these dams is to be maintained for the future, significant issues of aging infrastructure and increasing urbanization must be addressed. The District has already initiated programs, described in Chapter 3 to address dam safety issues. The District is addressing the more immediate issues of dam safety with the ongoing implementation of the three programs. The primary focus of these efforts is to assure that the dams as they exist are well maintained and kept in a safe and proper operating condition. Site-specific dam safety issues and potential dam safety issues are being identified, investigated and repaired or

corrected as needed. The issues described below are being addressed in the District Dam Safety Program, Operation and Maintenance Program and Structures Assessment Program.

- Addressing dam design standards today are significantly more stringent than the standards of 50-years ago or even 10-years ago.
- Maintaining flood control benefits for an increasingly urbanized environment that is rapidly encroaching on inundation areas from emergency spillway discharges and design flood pool levels in the reservoir areas.
- Addressing significant structural integrity issues from the cracking of the earth embankment that has occurred over time.
- Addressing subsidence fissures caused by settlement of the underlying soil zone due to groundwater pumping.
- Addressing where upstream development and other factors can change the ability of a dam to provide the level of flood protection for which it was designed.
- Addressing the impact of extreme flood events and the ability of the existing dams to safely pass such a flood.

5.7.4. Watercourse Master Plans – Riparian Conservation

The District staff has been actively participating in expanding the potential for river management and restoration to link the urban, urban/rural fringe with the rural rivers of the region. The District is working with the Corps of Engineers, Cities, sand and gravel operations and private non-profit corporations, to pursue within its authority, managing the river resources for restoration opportunities through the watercourse master plans. This effort includes development of tools that help to quantify the risk associated with the problems restoring vegetation poses to flood control measures and to establish maintenance guidelines that allow for better risk management.

5.7.5. Multi-Use and Recreation / Structures Retrofit

Growing public concern for preserving the visual beauty of the urban, rural and natural settings in Maricopa County prompted the District to recommend and the Board of Directors to adopt an Aesthetic Treatment and Landscaping Policy May 3, 1999 (Resolution 93-03). This policy provides general guidance and direction for the integration of landscape aesthetic features and recreation multi-use opportunities in all phases of planning, design, construction and operation of flood control facilities by the District. The policy applies to the design of new structures and to existing structures that do not include aesthetic features. Continuing efforts on the preparation of the Flood Control Structures Analysis to preserve natural desert open space, enhance local community image, and provide opportunities for desert greenbelts and new parklands coincidental with flood control measures.

The following is a list of the initiatives that have been undertaken, or are in progress, or are planned to be undertaken in the near future in support of the Landscape Aesthetics and Multi-Use Opportunities Program:

1. Development of Improved Planning Guides and Tools:
    a. Update Cost Ceiling tables in the District's Landscaping and Aesthetics Policy to provide increased capability to provide aesthetic features and adequate Right of Way for flood protection projects.
    Status: Completed in 2001

    b. Update the District's Landscaping and Aesthetics Policy to provide clarification and improved direction for integrating landscape aesthetics and recreation multi-uses in District projects.
    Status: In progress

    c. Development of regional landscape design guidelines for use in project planning and design.
    Status: In progress

    d. Prepare a Guideline for Consultants to use in preparing landscape aesthetics and recreation multi-use opportunities assessments for project planning and design.
    Status: In progress

    e. Prepare a regional landscape character assessment of the District to serve as a frame of reference for area and project planning and design.
    Status: In progress

2. Project Implementation Initiatives:
    a. Employ the use of professional landscape architects to serve as interdisciplinary team members in all phases of project planning and design:

    b. Employ the use of Citizens Aesthetic Advisory Committees routinely in project planning and design.

    c. Complete assessments of existing, historic, and future desired landscape character, scenic quality and visual sensitivity to help guide alternatives formulation, establishment of landscape themes and aesthetic design guidelines for project planning and design.

    d. Complete assessments of recreation open space opportunities including trails and parks to help guide development of alternatives that incorporate local and regional open space needs into flood control plans and designs, and promote expanded cost-share partnerships with local communities.

5.7.6. Additional Non-Structural Approaches to Flood Mitigation

The Interagency Floodplain Management Review Committee prepared a report in 1994, which evaluated the performance of existing floodplain management practices and offered guidelines for improved efficiency and effectiveness. Inspired by the Midwest Flood of 1993, which caused between $12 billion and $16 billion dollars in damages, the report contains several non-structural approaches to reduce the vulnerability to damages resulting from severe floods. These methods are less costly than most structural approaches and can potentially achieve

other objectives, such as preserve agricultural and natural resources, and increase recreational opportunities, and protect wildlife habitats.

Buyout Programs – The Midwest Flood of 1993 prompted the federal government to acquire about 10,000 buildings located within flood-prone areas. Federally funded buyout programs such as this not only reduce the potential for flood damages, but can also improve the quality of life for many homeowners who reside in homes particularly prone to severe flood damages due to poor quality and improper location. The public perception toward buyout programs has often been mixed, but the Midwest Flood of 1993 has reminded many of the potential dangers associated with floodplain occupancy. There are several principal sources of funding for buyouts. These include the Community Development Block Grants by the Department of Housing and Urban Development (CDBG), Section 404 Hazard Mitigation Grants from the Federal Emergency Management Agency, Economic Development Administration Grants (EDA), the Section 1362 Flood Damaged Property Purchase Program, and Small Business Administration loans. Establishing federal interagency and state-chaired task forces can help expedite these buyout programs.

Insurance Programs – A number of federally funded insurance programs provide at least partial coverage for floods resulting in structural damages to property and crop losses.

Environmental Enhancement – Although many floodplains are not a safe bet for man-made dwellings, they are often an important physical and biological system. Floodplains with significant habitat values and resource impacts necessitate a union between floodplain management and ecosystem planning. Reducing the vulnerability to flood damages and maintaining a healthy ecosystem are important national goals that can be achieved through adequate funding for land acquisition programs, expanding the range of cost-share partners, and interagency cooperation between local, state and federal entities. Federal fee title and land easement acquisitions can be an important initial step in an intergovernmental effort toward environmental enhancement of floodplains.

Education and Outreach Efforts – Flood hazard awareness should be the first step in pre-disaster planning, especially if individuals are going to participate in pre-disaster, response, recovery, and mitigation efforts. Local efforts in zoning and planning shared with all levels of the public in order can provide a heightened understanding of floodplain management options. A strong outreach program can equip the public with better knowledge concerning the economic, environmental and social benefits of many of the methods already discussed. Floodplain mapping can also be an informative tool in preventing flood damages, as NFIP provides the public with the Flood Insurance Rate Map. However, many of these maps are out of date and in need of substantial revisions. Utilizing current technology to improve floodplain mapping is another step in informing the public about potential flood hazards in their area. The conversion of FIRMs to a digital format can also result in more accurate maps, reduce costs associated with ongoing maintenance requirements, and streamline disaster planning efforts.

5.8. Plan Organization

This Plan was prepared by a professional planner (AICP – American Institute of Certified Planners) with the assistance of a committee composed of staff from several of the branches

that implement the Plan. The list of team members is noted on the inside cover sheet. This Team met weekly for two years to gather and process data, determine level of detail needed, and develop the Comprehensive Plan. The Plan has then gone through an extensive internal review by District Division and Branch Managers and other key staff who are responsible for the implementation of the District's flood management programs.

5.9. Implementation (CRS 510. j)

Implementation of all activities identified in this Plan is underway. The District staff will further evaluate both the plan and the level of reduction in flood related problems through records and public feedback. The evaluation of both program success and determining flood hazards is a continual process throughout the year. The District staff will also look at its programs and revise them as needed to meet the demands and changes of the needs in the County for flood hazard remediation.

The objectives of this Plan identified in the Introduction of this Executive Summary are to be implemented as noted below.

- Public information and education as it relates to this Plan will be achieved by making the full "Comprehensive Plan 2002 – Flood Control Program Report" available to the public.
- The District will comply with ARS through preparation and adoption of the Plan and follow through in implementation of the flood protection projects identified in the Plan.
- The District will comply with the NFIP Community Rating System Program through adoption of the Plan and continued implementation of the structural and non-structural measures identified for each watershed.
- The presentation in the Plan of characteristics that shape the County and affect flooding combined with the brief summaries of problem and hazard identification by region will aid staff in identifying project and program activity necessary to provide flood hazard mitigation by watershed.
- Additionally, the above information will aide staff in determine the longer-term level of fiscal need to provide complete flood protection to County residents.

5.10. Summary

This Plan has described existing flood control projects and structures and identified future opportunities for flood hazard mitigation. This first part of this report gives a broad overview of the challenges and constraints the District faces in floodplain management. More detail followed in Chapters 4 and 5 to present problems and address them. The bottom line is there is considerable work to still be completed. A reasonable comprehensive strategy has been presented herein to achieve public safety from flood hazards. The District's area of jurisdiction is vast but mitigation or elimination of flood hazards has continued to meet the needs of the County residents.

The numerous dry riverbeds, combined with the relatively infrequent rainfall events in the county contribute to the general attitude of complacency towards flooding events. Often, years or decades may pass before a particular area experiences flooding problems. This length of

time plus the transience of the population leads people to believe they are not at risk. As development continues to expand, the effects of flooding will become more evident.

With over two-thirds of the County still in need of assessment and planning for future floodplain management the District and the public face challenging years ahead. A partnership with the residents of the County through education and other programs is essential for a successful Plan. Citizens have had more opportunity to participate in the planning process over the last ten years, and through continued education by the District will be able to help implement the flood management programs. The simple steps of having access to a floodplain map or the District's library available on the internet to review a study can accomplish the task of keeping structures out of harms way. In order for the District staff to keep the floodplain management program effective, annual review and revision as needed of the Comprehensive Plan, as well as the Strategic and Business Plans, is crucial. This Plan will be updated annually in conjunction with the budget and CIP cycles (December to March) by the District's Planning Branch.

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ABBREVIATIONS

ACDC	Arizona Canal Diversion Channel
ADEQ	Arizona Department of Environmental Quality
ADMP	Area Drainage Master Plan
ADMS	Area Drainage Master Study
ADOT	Arizona Department of Transportation
ADWR	Arizona Department of Water Resources
ALERT	Automated Local Evaluation in Real Time
ARS	Arizona Revised Statutes
BMP	Best Management Practices
BOD	Board of Directors
CAP	Central Arizona Project
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CIP	Capital Improvement Program
CRS	Community Rating System
DES	Department of Economic Security
EPA	Environmental Protection Agency
FCAB	Flood Control Advisory Board
FCD	Flood Control District
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FRS	Flood Retarding Structure
IGA	Intergovernmental Agreement
MAG	Maricopa Association of Governments
MCDOT	Maricopa County Department of Transportation
MEP	Maximum Extent Practicable
MNUSS	Mapping Needs Update Support System
MOU	Memorandum of Understanding
NAFSMA	National Association of Flood and Stormwater Management Agencies
NFIP	National Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
O & M	Operations and Management
OSHA	Occupational Safety and Health Administration
PIC	Public Involvement Coordinators
SCC/NRCS	Soil Conservation Commission/Natural Resource Conservation Service
USACE	United States Army Corps of Engineers
USBOR	United States Bureau of Reclamation
USGS	United States Geological Service
WCMP	Watercourse Master Plan

GLOSSARY OF FLOOD CONTROL TERMS

Alluvial Fan
A geomorphologic feature characterized by a cone or fan-shaped deposit of boulders, gravel and fine sediments that have been eroded from mountain slopes, transported by flood flows and then deposited in the valley floors and which is subject to flash flooding, high velocity flows, debris flows, erosion, sediment movement and deposition and channel migration.

Aggradation
A progressive buildup or raising of the channel bed due to sediment deposition. Permanent or continuous aggradation is an indicator that a change in the stream's discharge and sediment characteristics is taking place.

Area Drainage Master Study (ADMS)
A study to develop hydrology for a watershed, to define watercourses, identify potential flood problem areas, drainage problems and recommend solutions and standards for sound floodplain and stormwater management. The ADMS will identify alternative solutions to a given flooding or drainage problem.

Area Drainage Master Plan (ADMP)
A plan which identifies the preferred alternatives of those identified in an ADMS. An ADMP provides minimum criteria and standards for flood control and drainage relating to land use and development.

Backfill
The placement of fill material within a specified depression, hole or excavation pit below the surrounding adjacent ground level, as a means of improving flood water conveyance, or to restore the land to the natural contours existing prior to excavation.

Base Flood Elevation
A base flood elevation (BFE) is the height of the base flood, usually in feet, in relation to the National Geodetic Vertical Datum of 1929, the North American Vertical Datum of 1988, or other datum referenced in the Flood Insurance Study report, or the depth of the base flood, usually in feet, above the ground surface.

Braided Stream
A stream whose flow is divided at normal stage by small islands.

Community Rating System
A program administered by the Federal Emergency Management Agency (FEMA) that recognizes and rewards communities working to reduce flood damages through a variety of approved floodplain management and flood awareness activities. Through the program, a community can reduce the flood insurance premiums that floodprone property owners pay.

Catch Basin
A chamber or well, usually built at the curb line of a street, for the admission of surface water to a storm sewer or sub-drain.

Channel (Conveyance)
Defined landforms that carry water. The deepest portion of a watercourse through which the majority of runoff is conveyed.

Channel Failure
Sudden collapse of a channel due to an unstable condition.

Culvert
A hydraulically short conduit that conveys surface water runoff through a roadway embankment or through some other type of flow obstruction.

Dam
An earthen, metal, masonry, or wooden wall or barrier across a flow of water, which is used to restrict or prevent the water from flowing.

Degradation
A deepening of a channel over time, or in a single storm event due to erosion processes.

Detention Basin
A basin or reservoir where water is stored for regulating a flood. It has outlets for releasing the flows during the floods

Development
A man-made change to property, such as buildings or other structures, mining, dredging, filling, grading, paving, excavation, or drilling operations.

Design Discharge
The nth-year storm for which it is expected that the structure or facility is designed to accommodate.

Discharge
The amount of water that passes a specific point on a watercourse over a given period of time. Rates of discharge are usually measured in cubic feet per second (cfs).

Diversion
A waterway used to divert water from its natural course.

Drainage Basin
A geographical area which contributes surface water runoff to a particular point. The terms "drainage basin," "tributary area," and "watershed" can be used interchangeably.

Drainage Clearance
The approval by the Maricopa County Drainage Administrator of a grading and drainage plan to develop a site. This plan may be a site plan or an engineered grading and drainage plan.

Dry Well
A deep hole, covered and designed to hold drainage water until it seeps into the ground.

Embankment
A man-made earth structure constructed for the purpose of impounding water.

Emergency Spillway
An outflow from a detention/retention facility that provides for the safe overflow of floodwaters for large storms that exceed the design capacity of the outlet or in the event of a malfunction. The emergency spillway prevents the water from overtopping the facility.

Encroachment
The result of placing a building, fence, berm or other structure in a floodplain in a manner that obstructs or increases the depth (or velocity) of flow on a watercourse.

Ephemeral Watercourse
A watercourse or portion of a watercourse that flows only in direct response to rainfall.

Erosion
The wearing away of land by the flow of water.

Erosion Hazard Zone
Land adjacent to a watercourse regulated by Maricopa County that is subject to flood-related erosion losses.

Federally-Mapped Floodplain
A floodprone area that has been mapped and accepted by FEMA as the result of a flood insurance study (FIS) for a watercourse and surrounding areas. Mapped floodplains are used for flood insurance needs and for other regulatory purposes.

FEMA (Federal Emergency Management Agency)
An independent federal agency established to respond to major emergencies that state and local agencies don't have the resources to handle. FEMA seeks to reduce the loss of life and protect property against all types of hazards through a comprehensive, risk-based emergency management program.

Flood/Flooding
A temporary condition caused by the accumulation of runoff from any source, which exceeds the capacity of a natural or man-made drainage system and results in inundation of normally dry land areas.

Flood Insurance Rate Map (FIRM)
Issued by FEMA, these maps show special hazard areas, including the 100-year floodplain. They also show flood insurance risk zones and other flood-related information applicable to a community.

Flood Insurance Study (FIS)
Hydrologic and Hydraulic studies that identify a flood hazard area, flood insurance risk zones and other flood data such as flood depths and velocities.

100-Year (or Base) Flood
A flood event that statistically has a 1 out of 100 (or one percent) chance of being equaled or exceeded on a specific watercourse in any given year. A flood event of this magnitude is often used to determine if flood insurance is either advisable or required on a property.

100-Year Storm
A rainfall event that has a one percent chance of occurring or being exceeded in any given year.

Flood Control
Various activities and regulations that help reduce or prevent damages caused by flooding. Typical flood control activities include: structural flood control works (such as bank stabilization, levees, and drainage channels), acquisition of floodprone land, flood insurance programs and studies, river and basin management plans, public education programs, and flood warning and emergency preparedness activities.

Flood Proofing
Any combination of changes to a structure or property using berms, flood walls, closures or sealants, which reduces or eliminates flood damage to buildings or property.

Floodplain
The area adjoining a watercourse that may be covered by floodwater during a flood. Storm runoff and flood events may cause alterations in the floodplain in certain areas.

Floodplain Management
A program that uses corrective and preventative measures to reduce flood and erosion damage and preserve natural habitat and wildlife resources in floodprone areas. Some of these measures include: adopting and administering floodplain regulations, resolving drainage complaints, protecting riparian habitat communities, and assuring effective maintenance and operation of flood control works.

Floodplain Regulations
Adopted policies, codes, ordinances, and regulations pertaining to the use and development of lands that lie within a regulatory floodplain.

Floodplain Use Permit
An official document which authorizes specific activities within a regulatory floodplain or erosion hazard area.

Floodway
The channel of a watercourse and portion of the adjacent floodplain that is needed to convey the base or 100-year flood event without increasing flood levels by more than one foot and without increasing velocities of flood water.

Floodway Fringe
The areas of a delineated floodplain adjacent to the Floodway where encroachment may be permitted.

Flowage Easement
Legal right to allow water to flow across someone's property

Grading
Disturbance of existing land contours

Grade Control Structure
A structure used across a stream channel placed bank to bank to control bed elevation, velocity, pressure, etc.

Habitat Mitigation
The compensation for the removal of natural vegetation during the construction of a flood control project by establishing new vegetation elsewhere.

Hydraulics
A field of study dealing with the flow pattern and rate of water movement based on the principles of fluid mechanics.

Hydraulic Structures
The facilities used to impound, accommodate, convey, or control the flow of water, such as dams, intakes, culverts, channels, and bridges.

Hydrology
A field of study concerned with the distribution and circulation of surface water, as well as water dynamics below the ground and in the atmosphere.

Lateral Stream Migration
Change in position of a channel by lateral erosion of one bank and simultaneous deposition on the opposite bank.

Levee
A man-made structure, usually an earthen embankment often reinforced with soil cement, that is designed to contain or divert the flow of water.

LOMA (Letter of Map Amendment)
An official amendment of a current Flood Insurance Rate Map (FIRM) accepted by FEMA for a property or a structure. The LOMA verifies that the structure or portions of the property have been removed from a designated-floodplain area.

LOMR (Letter of Map Revision)
An official revision of a current Flood Insurance Rate Map (FIRM) accepted by FEMA, which reflects changes in mapped areas for flood zones, floodplain areas, floodways and flood elevations.

Low Flow Channel
A channel within a larger channel which typically carries low and/or normal flows

Map Repository
An agency or entity designated to maintain official FEMA flood insurance rate maps for the community as well as LOMAs and LOMRs to those maps.

Multi-Use Facility
A detention or retention basin that provides additional benefits to its primary function of flood control. Such benefits include recreation, parking, visual buffers, or water harvesting.

National Flood Insurance Act of 1968
An Act passed by Congress that established the National Flood Insurance Program as a means of mitigating flood damages. The Act makes flood insurance available to communities that adopt and enforce measures to reduce flood losses. Prior to the Act, property owners in floodprone areas typically were not able to obtain this coverage through private insurance companies.

National Flood Insurance Program (NFIP)
A federal program that allows property owners to purchase insurance protection against losses due to flooding. In order to participate in this program, local communities must agree to implement and enforce measures that reduce future flood risks in special flood hazard areas.

Outlet Structure
A hydraulic structure placed at the outlet of a channel, spillway, pipe, etc., for the purpose of dissipating energy and providing a transition to the channel or pipe downstream.

Peak Flow
The maximum rate of flow through a watercourse for a given storm.

Perennial Flow
Watercourses, or a portion of a watercourse, that flow year round.

Probable Maximum Flood
The flood runoff that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Reach
A term used to describe a specific length of a stream or watercourse. For example, the term can be used to describe a section of a stream or watercourse between two bridges.

Regulatory Floodplain
A portion of the geologic floodplain that may be inundated by the base flood where the peak discharge is 100 cubic feet per second (cfs) or greater. Regulatory floodplains also include areas which are subject to sheet flooding, or areas on existing recorded subdivision plats mapped as being floodprone.

Retention Basin
A basin or reservoir where water is stored for regulating a flood. Unlike a detention basin, it does not have outlets for releasing the flows, the water must be disposed by draining into the soil, evaporation, or pumping systems.

Regulatory Flood Elevation
The elevation which is one foot above the base flood elevation for a watercourse. Where a floodway has been delineated, the base flood elevation is the higher of either the natural or encroached water surface elevation of the 100-year flow.

Riparian Habitat
Plant communities that occur in association with any spring, cienega, lake, watercourse, river, stream, creek, wash, arroyo, or other body of water. Riparian habitats can be supported by either surface or subsurface water sources.

Runoff
The portion of precipitation on land that ultimately reaches streams, especially water from rain or melted snow that flows over ground surface.

Setback
The minimum distance required between a man-made structure and a watercourse. This distance is measured from the top edge of the highest channel bank or the edge of the 100-year flood water surface elevation.

Sheet Flooding
A condition where stormwater runoff forms a sheet of water to a depth of six inches or more. Sheet flooding is often found in areas where there are no clearly defined channels.

Spillway
An outlet pipe or channel serving to discharge water from a dam, ditch, gutter, or basin.

Stormwater
Precipitation from rain or snow that accumulates in a natural or man-made watercourse or conveyance system.

Storm Drainage System
A drainage system for collecting runoff of stormwater on highways and removing it to appropriate outlets. The system includes inlets, catch basins, storm sewers, drains, reservoirs, pump stations, and detention basins.

Tailwater
The water surface elevation in the channel downstream of a hydraulic structure

Trashrack
A metal bar or grate located at the outlet structure of a detention or retention basin that is designed to prevent blockage of the structure by debris.

Variance
Legal permission to build a structure in a manner that would otherwise be prohibited by an ordinance.

Watercourse
Any minor or major lake, river, creek, stream, wash, arroyo, channel or other topographic feature on or over which waters flow at least periodically. Watercourse includes specifically designated areas in which substantial flood damage may occur.

Watercourse Master Plan
A hydraulic plan for a watercourse that examines the cumulative impacts of existing development and future encroachment in the floodplain and future development in the watershed on potential flood damages, and establishes technical criteria for subsequent development so as to minimize potential flood damages for all flood events up to and including the one hundred-year flood.

Watershed
An area from which water drains into a lake, stream or other body of water. A watershed is also often referred to as a basin, with the basin boundary defined by a high ridge or divide, and with a lake or river located at a lower point.

Waters of the U.S.
All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce.

Zone A (unnumbered)
Zone A is a Special Flood Hazard Area identified by FEMA that is subject to inundation from a 100-year flood event. Because detailed hydraulic analyses have not been performed, no base flood elevation or depths are shown. Mandatory flood insurance requirements apply.

Zone AE and A1-30
Special Flood Hazard Areas subject to inundation by the 100-year flood determined by a Flood Insurance Study (FIS). Base flood elevations are shown within these zones and mandatory flood insurance requirements apply. (Zone AE is used on newer maps in place of Zones A1-30.)

Zone AH
Special Flood Hazard Areas subject to inundation by 100-year shallow flooding (usually areas of ponding) with average depths between one and three feet. Base flood elevations derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance requirements apply.

Zone AO
Special Flood Hazard Areas subject to inundation by 100-year shallow flooding, usually resulting from sheet flow on sloping terrain, with average depths between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown within this zone. Mandatory flood insurance requirements apply.

Zone B, C and X
Areas that have been identified in a community flood insurance study as having moderate or minimal hazard from flooding. Buildings or other improvements in these zones could be flooded by severe, concentrated rainfall, in the absence of adequate drainage systems. Flood insurance is available in participating communities, but it is not required in these zones. (Zone X is used on newer maps in place of Zones B and C.)

Zone D
Unstudied areas where flood hazards are undetermined but where flooding is possible. No mandatory flood insurance requirements apply, but coverage is available in participating communities.

APPENDIX A

ARS & Resolutions

Arizona Revised Statutes – Flood Control

Chapter 21 FLOOD CONTROL DISTRICTS

Article 1 - County Flood Control Districts

Section

48-3601 - Definitions
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48-3601. Definitions

In this article, unless the context otherwise requires:

1. "Area of jurisdiction" means the incorporated and unincorporated areas of the county, including public lands, excluding those incorporated areas of cities or towns which have elected to assume floodplain management powers and duties pursuant to section 48-3610.

2. "Board" means the board of directors of a flood control district organized under this article.

3. "District" means a flood control district organized pursuant to this article.

4. "Flood" or "floodwaters" means a temporary rise in water level including groundwater or overflow of water onto lands not normally covered by water.

5. "Floodplain" means the areas adjoining the channel of a watercourse including areas where drainage is or may be restricted by man-made structures which have been or may be covered partially or wholly by floodwater from the one hundred-year flood.

6. "Floodplain regulations" means the codes, ordinances and other regulations adopted pursuant to this article relating to the use of land and construction within the floodway and floodplain areas.

7. "Floodway" means the channel of a river or other watercourse and the adjacent land areas necessary in order to discharge the one hundred-year flood without cumulatively increasing the water surface elevation more than one foot.

8. "One hundred-year flood" or "base flood" means a flood that has a one per cent chance of being equalled or exceeded in a one year period, based on the criteria established by the director of water resources.

9. "Person" means an individual or his agent, firm, partnership, association or corporation, or agent of the aforementioned groups, or this state or its agencies or political subdivisions.

10. "Regulatory flood elevation" means the elevation which is one foot above the base flood elevation for a watercourse for which the base flood elevation has been determined and shall be as determined by the criteria developed by the director of water resources for all other watercourses.

11. "Watercourse" means a lake, river, creek, stream, wash, arroyo, channel or other topographic feature on or over which waters flow at least periodically. Watercourse includes specifically designated areas in which substantial flood damage may occur.

48-3602. Organization of county flood control district

A. Each county shall organize a county flood control district to include and govern its area of jurisdiction.

B. The county board of supervisors shall be the board of directors of the district. The directors shall not receive compensation for their services as such but are entitled to reimbursement for their necessary expenses in attending district meetings and for necessary expenses incurred in traveling within and without this state if necessary to carry on the affairs of the district.

C. County flood control districts are in addition to any flood protection district organized pursuant to chapter 18, article 10 of this title, and the mere existence of a county flood control district does not of itself affect the existence or operation of any flood protection district organized pursuant to chapter 18, article 10 of this title.

48-3603. Powers, duties and immunities of district and board; exemption

A. A county flood control district organized under this article is a political taxing subdivision of this state and has all the powers, privileges and immunities granted generally to municipal corporations by the constitution and laws of this state including immunity of its property and bonds from taxation.

B. The board of directors shall exercise all powers and duties in the acquisition and operation of the properties of the district and in carrying out its regulatory functions under this article as are ordinarily exercised by the governing body of a municipal corporation.

C. A district organized under this article, acting through its board of directors, may:

1. Acquire by eminent domain, purchase, donation, dedication, exchange or other lawful means rights-of-way for and construct, operate and maintain flood control works and storm drainage facilities within or without the district for the benefit of the district.
2. Acquire by eminent domain, purchase, donation, dedication, exchange or other lawful means and dispose of by sale, exchange or other lawful means real and personal property within the boundaries of the district.
3. Contract and join with this state, the United States or any other flood control district or floodplain board, municipality, political subdivision, governmental agency, irrigation or agricultural improvement district, association, corporation or individual in acquiring, constructing, maintaining and operating flood control works, and regulating floodplains.
4. Enter into contracts of indemnity to indemnify this state, the United States or any other flood control district, municipality, political subdivision, governmental agency, irrigation or agricultural improvement district, association, corporation or individual against liability by virtue of injuries, losses or damages occurring through the use of their facilities, structures, streets, rights-of-way or properties in connection with the operation of a flood control district and the regulation of floodplains.
5. Acquire and maintain existing flood control and drainage facilities within the district for the benefit of the district if mutually agreeable to the owners of such facilities.
6. Acquire, convert and maintain surplus irrigation facilities as storm drainage facilities if mutually agreeable to owners of such facilities.
7. Construct, maintain and operate flood control and storm drainage facilities and regulate floodplains in the district by agreement with this state, counties, other municipal corporations, political subdivisions and other persons and reimburse such agencies or persons for the cost of the work.
8. On the dissolution of any other flood control district, assume the assets and obligations of the other district.
9. Enter into intergovernmental agreements with other public agencies pursuant to title 11, chapter 7, article 3 to carry out the objects and purposes of the district.
10. Apply for, obtain, expend and repay flood control loans pursuant to title 45, chapter 8, article 5.
11. Apply to the director of water resources for alternative flood control assistance for flood control projects pursuant to section 45-1471, except that the director shall not grant any such assistance for any project unless he has approved the project in advance of planning.
12. Sue and be sued, enter into contracts and generally do all things which may be necessary to construct, acquire and maintain facilities, operate the district and perform its regulatory functions and which are in the interests of the district.
13. Adopt such rules and bylaws for its orderly operation as it sees fit.
14. Appoint a chief engineer and general manager, who may be the county engineer.
15. Appoint a treasurer, who may be the county treasurer, an attorney, who may be the county attorney, and other employees it considers desirable and necessary to carry out the purposes of the district. Any other work required by the district may be performed by regular employees of the county on assignment by the board of supervisors, except that regular county employees shall not undertake construction projects with an estimated cost of five thousand dollars or more.
16. Allow variances from the terms or regulations adopted pursuant to this article to the extent permitted by section 48-3609, subsection B, paragraph 7 and if, owing to peculiar conditions, a strict interpretation would work an unnecessary hardship, if in granting the variance the general intent and purposes of this article and the regulations will be preserved.
17. Construct, operate and maintain artificial groundwater recharge facilities, and, if organized in a county having a population of more than five hundred thousand persons according to the most recent United States decennial census, underground storage and recovery facilities, if they have flood control benefits, and contract and join

with the United States, this state and other governmental units for the purpose of constructing, operating and maintaining multipurpose groundwater recharge, underground storage and recovery and flood control facilities, except that a district shall not expend district funds for any underground storage and recovery facility that does not have flood control benefits.

18. Acquire real property by purchase, donation, dedication, exchange or other lawful means, except by eminent domain, in areas suitable for groundwater recharge projects.
19. Cooperate and join with other entities that engage in underground water storage and recovery projects under title 45, chapter 3, including multi-county water conservation districts and other political subdivisions.

D. The board shall adopt and enforce floodplain regulations as provided in section 48-3609.

E. The board may adopt a fee schedule for review of applications for permits and variances from or interpretations of the floodplain regulations.

F. The affirmative vote of a majority of the board of directors is necessary to approve any measure. One member may adjourn any meeting at which a quorum is not present.

G. The board shall keep a proper written record of all of its proceedings, which shall be open to public inspection.

H. The accounts of the district are subject to annual and other audits as provided by law.

I. The provisions of section 9-403 do not apply to a flood control district organized under this article.

48-3604. Establishing zones in the district

A. The board may divide the area of jurisdiction into two or more zones, the boundaries of which shall be described in a resolution adopted at a hearing held pursuant to subsection C.

B. The board may alter the boundary lines of any previously established zone or zones pursuant to subsection C.

C. Before establishing zones or altering their boundary lines, the board shall fix a date for a hearing, which shall be not less than twenty-one days nor more than forty days from the date of the resolution. Any interested citizen may appear at the hearing and be heard on any matter relating to the reasonableness of establishing the zones. Notice of the hearing shall be published once a week for three consecutive weeks in a newspaper of general circulation in the area of jurisdiction and zone and shall be posted in not less than thirty public places in the zone. The posting and the first date of the publications shall be not less than three weeks before the date of the hearing.

D. The board shall meet at the time and place fixed for the hearing and may adjourn the hearing from time to time. At the hearing any interested owner of real property in the proposed zone may appear and be heard on any matter relating to the establishment of the zone and may allege that his real property in the proposed zone will not be benefited by the proposed improvements. If after the hearing it appears to the board that the establishment of the zone is necessary and desirable to carry out the objects and purposes of the district in the proposed zone and that all property in the zone will benefit by the establishment of the zone, the board shall establish the zone. If the board determines that any property in the proposed zone is not benefited, it shall delete the property from the zone. Thereupon the board shall adopt a resolution establishing the zone and shall file with the county recorder, the county assessor and the department of revenue a certified copy of the resolution and a map showing the zone and its boundaries. The board shall publish a copy of the resolution once a week for three consecutive weeks in a newspaper of general circulation in the area of jurisdiction and zone and shall post a copy of the resolution in not less than thirty public places in the zone.

E. A party aggrieved by action of the board in establishing a zone may bring an action in the superior court in the county in which the area of jurisdiction is located to set aside the action of the board. The action shall be heard in a trial de novo. The action must be instituted not more than thirty-five days after the last publication or date of posting, whichever is later, of the copy of the resolution establishing the zone.

48-3605. Assistance for floodplain delineations; duties of director

A. The director of water resources shall develop and adopt criteria for establishing the one hundred-year flood and delineating floodplains.

B. If a district is required to delineate a floodplain pursuant to section 48-3609 and the floodplain has not been delineated with sufficient accuracy to allow adoption of regulations pursuant to section 48-3609, the district may request the director for assistance in delineating the floodplain.

C. If sufficient monies have been appropriated, the director may either provide the engineering and technical services necessary to delineate the floodplains and floodway and determine water surface profile data associated with such delineations or disburse monies for such services to the requesting district.

D. If a district chooses to be reimbursed for costs incurred to have floodplains delineated after August 3, 1984, monies appropriated to the director shall be disbursed on order of the director after application by the district showing the necessity and purpose of the expenditures for which reimbursement is required.

E. The director may refuse to provide financial or technical assistance allowed by this section if, in the opinion of the director, such assistance is not necessary for the district to comply with section 48-3609.

48-3606. Assistance for topographic mapping

If sufficient monies have been appropriated, state monies or assistance allowed by this chapter may be provided to a district to aid in preparing topographic maps or to gather other elevation or channel cross-sectional data necessary, as determined by the director, for making hydraulic and hydrologic computations for determining floodplain and floodway limits.

48-3607. Director may contract for work

The director may contract with private persons, firms or other governmental agencies to carry out his duties under this article.

48-3608. Assistance in flood insurance program

A. The director is designated as the state coordinator of the national flood insurance program to assist local jurisdictions in complying with the requirements of such program and state law.

B. The director is designated as the state coordinator of the United States army corps of engineers floodplain management services program and shall coordinate floodplain information studies of federal, state and local agencies and make recommendations to such agencies.

48-3609. Floodplain delineation; regulation of use

A. Except as provided in section 48-3610, the board within its area of jurisdiction shall delineate or may by rule require developers of land to delineate for areas where development is ongoing or imminent, and thereafter as development becomes imminent, floodplains consistent with the criteria developed by the director of water resources.

B. Except as provided in section 48-3610, the board shall adopt and enforce regulations governing floodplains and floodplain management in its area of jurisdiction which shall include the following:

1. Regulations for all development of land, construction of residential, commercial or industrial structures or uses of any kind which may divert, retard or obstruct floodwater and threaten public health or safety or the general welfare.
2. Regulations which establish minimum flood protection elevations and flood damage prevention requirements for uses, structures and facilities which are vulnerable to flood damage. Regulations adopted under this section shall comply with state and local land use plans and ordinances, if any.
3. Regulations which provide for coordination by the district with all other interested and affected political subdivisions and state agencies.
4. Regulations that require any residential structure built in a floodplain to be constructed so as to place the lowest floor elevation of the structure at or above the regulatory flood elevation, that require commercial or industrial

structures to be flood proofed or elevated to or above the regulatory flood elevation and that prohibit any activity in a designated floodway, including fill, that would increase the water surface elevation during a base flood.

5. Regulations to allow a mobile home located in a floodplain on August 3, 1984 to be replaced by another mobile home if:
   (a) The mobile home to be replaced was not damaged by a flood to more than fifty per cent of its value before the flood.
   (b) The replacement mobile home is elevated so that the bottom of the structural frame or the lowest point of any attached appliances, whichever is lower, is at or above the regulatory flood elevation.
6. Regulations that require all new placement of mobile homes to be anchored to prevent flotation, collapse or movement.
7. Variance procedures to permit variances from the regulations that do not result in danger or damage to persons or property in floodplains in the area of jurisdiction. Variances may be granted only if special circumstances, such as size, shape, topography, location or surroundings of the property, would cause the strict application of the regulations to deprive the property of privileges enjoyed by similar property in the floodplain. A variance is subject to conditions to ensure that the variance does not constitute a grant of special privileges inconsistent with the limitations on similar property in the floodplain.

C. Waste disposal systems shall not be installed wholly or partially in a regulatory floodway.

D. Water supply, water treatment and sewage collection and disposal systems built in a regulatory floodplain shall be designed to prevent or minimize floodwater infiltrating the systems and to prevent or minimize floodwater contamination during the base flood.

E. Floodplain regulations enacted pursuant to this article may only be adopted after a public hearing at which parties in interest and other citizens have an opportunity to be heard. At least thirty days before the hearing, a notice of the time and place of the hearing shall be published in a newspaper of general circulation within the county or, if no newspaper of general circulation is regularly published, in a newspaper of general circulation nearest the area of jurisdiction. A notice of any hearing accompanied by a copy of each of the proposed regulations shall be furnished to the director at least thirty days before the date of the hearing. A copy of any regulation adopted by a district pursuant to this article shall within five days thereafter be filed with the director and with each political subdivision and municipal corporation in the area of jurisdiction.

F. All development of land, construction of residential, commercial or industrial structures or future development within delineated floodplain areas is prohibited unless floodplain regulations have been adopted pursuant to this article for such floodplain area and are in full force and effect.

G. Before adopting regulations the board may issue a special permit authorizing construction or development if the board finds that construction or development is not a danger to persons or property.

H. Unless expressly provided, this article and any regulations adopted pursuant to this article do not affect:

1. Existing legal uses of property or the right to continuation of such legal use. However, if a nonconforming use of land or a building or structure is discontinued for twelve months or destroyed to the extent of fifty per cent of its value, as determined by a competent appraiser, any further use shall comply with this article and regulations of the district.
2. Reasonable repair or alteration of property for the purposes for which the property was legally used on August 3, 1984 or on the date any regulations affecting such property take effect, except that any alteration, addition or repair to a nonconforming building or structure which would result in increasing its flood damage potential by fifty per cent or more shall be either flood proofed or elevated to or above the regulatory flood elevation.
3. Reasonable repair of structures constructed with the written authorization required by section 48-3613.
4. Facilities constructed or installed pursuant to a certificate of environmental compatibility issued pursuant to title 40, chapter 2, article 6.2.

I. Within one hundred twenty days after completion of construction of any flood control protective works which changes the rate of flow during the flood or the configuration of the floodplain upstream or downstream from

or adjacent to the project, the person or agency responsible for installation of the project shall provide to the governing bodies of all jurisdictions affected by the project a new delineation of all floodplains affected by the project. The new delineation shall be done according to the criteria adopted by the director of water resources.

J. On the granting of a variance, permit or waiver for the construction of a structure which is otherwise contrary to the adopted floodplain regulation of the area, the board shall provide written notice to the grantees of such variance, permit or waiver that, if the structure is a dwelling unit or business as defined by section 26-321, the land on which the structure is located is ineligible for exchange of state land pursuant to the flood relocation and land exchange program provided for by title 26, chapter 2, article 2. The board shall record a copy of the notice in the office of the county recorder in a manner so that it appears in the chain of title of the affected parcel of land.

K. A flood control district or appropriate public agency which has failed to adopt or enforce floodplain regulations required by this section shall not be eligible for disaster relief identified by section 35-192, subsection D, paragraphs 3 and 5. The director of water resources shall advise the director of the division of emergency management within the department of emergency and military affairs of such failure to comply.

48-3609.01. Watercourse master plans; definition

A. If a district organized pursuant to this chapter has completed a watercourse master plan which includes one or more watercourses, and if the plan has been adopted by the board or by any other jurisdiction in that river or drainage system, then the board and the governing body of each jurisdiction may adopt and shall enforce uniform rules for that river or drainage system within the jurisdiction using criteria that meet or exceed criteria adopted by the director of water resources pursuant to section 48-3605, subsection A.

B. During the preparation of a watercourse master plan, record owners of real property in and immediately contiguous to the watercourse or watercourses included in the planning shall be publicly notified by the board or its agents so that the owners may have input to the planning process. In addition, sand and gravel recommendation committees organized pursuant to section 11-830, subsection D, if any, shall be notified.

C. All watercourse master plans shall consider recharge techniques including gabions, swales, dry wells, sand tanks and small dams.

D. This section does not apply to any city or town which has adopted a resolution assuming floodplain management and regulation within its area of jurisdiction as provided in section 48-3610 prior to July 1, 1990.

E. A "watercourse master plan" means a hydraulic plan for a watercourse that examines the cumulative impacts of existing development and future encroachment in the floodplain and future development in the watershed on potential flood damages, and establishes technical criteria for subsequent development so as to minimize potential flood damages for all flood events up to and including the one hundred-year flood.

48-3610. Assumption of powers and duties by cities and towns; resolution; definitions

A. The powers and duties prescribed by section 48-3609 for floodplain management may be assumed by the governing body of an incorporated city or town within its area of jurisdiction if the incorporated city or town declares by resolution that it intends to assume the powers and duties, including the adoption of floodplain management regulations, pursuant to this article. An incorporated city or town currently engaged in floodplain management may continue to exercise the floodplain management powers and duties pursuant to this article in its area of jurisdiction by passing a resolution declaring its intent to do so before August 3, 1984.

B. If the assumption of powers and duties under this section occurs:

1. The city or town shall advise the district and any adjacent jurisdiction having responsibility for floodplain management in writing and provide a copy of any development plan of all applications for floodplain use permits or variances to develop land in a floodplain or floodway within one mile of the boundary between the city's or town's area of jurisdiction and the area of jurisdiction of the district. The city or town shall also advise the district and any adjacent jurisdiction having responsibility for floodplain management in writing and provide a copy of any development plan of any major development proposed within a floodplain or floodway

which could affect floodplains, floodways or watercourses outside the city's or town's area of jurisdiction. Written notice and a copy of the plan of development shall be sent to any adjacent jurisdiction no later than three working days after having been received by the city or town.

2. The district shall advise the city or town in writing and provide a copy of any development plan of any application for a floodplain use permit or variance to develop land in a floodplain or floodway within one mile of the boundary between the district's area of jurisdiction and that of the city or town. The district shall also advise the city or town in writing and provide a copy of any development plan of any major development proposed within a floodplain or floodway which could affect floodplains, floodways or watercourses within the city's or town's area of jurisdiction. Written notice and a copy of the plan of development shall be sent to any adjacent jurisdiction no later than three working days after having been received by the district.

C. Nothing in this section shall act to delay approval of a development plan by a city, town, county or district.

D. If the city or town assuming the floodplain management and regulation function declares by resolution that it no longer wishes the powers and duties, then the powers and duties shall be assumed by the district.

E. If the assumption of powers and duties occurs under this section, for purposes of applying this article to the city or town:

1. "Area of jurisdiction" means the lands within the municipal boundaries of the city or town.

2. "Board" means the governing body of a city or town.

48-3611. Citizens' flood control advisory board; qualification; functions

A. The board of supervisors may appoint a citizens' flood control advisory board consisting of seven members. Five members shall be resident taxpayers and qualified electors of the district, at least three of whom shall be residents of the cities in the district. At least one of the board members who are residents of cities shall be a resident of the largest city in the district. The city engineer of the largest city in the district and the chief engineer or manager of a major irrigation or agricultural improvement district, or their representatives, shall be ex officio members of the advisory board with all rights and privileges granted to other board members.

B. In appointing members of the advisory board the board of supervisors shall designate which appointive member shall serve for one year, which for two years, which for three years, which for four years and which for five years. Thereafter the term of each appointive member is five years except for a member appointed to an unexpired term.

C. The citizens' flood control advisory board may request information from the chief engineer and general manager and his staff, engineering personnel from cities in the district and any other person with a knowledge of flood control practices. They may recommend the employment of consultants for the purpose of obtaining technical information and recommendations regarding flood control and floodplain management practices.

D. The advisory board shall study the flood control, floodplain regulation, drainage and water conservation needs of the district, shall meet with and advise the board as requested by the board and may submit to the board reports and recommendations relating to such studies, but the recommendations are advisory only.

48-3612. Board of review

A. The board of supervisors may establish a board of review, which may be the advisory board or a committee of the advisory board to sit in review and make decisions as follows:

1. Interpret regulations adopted pursuant to this article if the meaning of a word, phrase or section is in doubt, if there is dispute between the appellant and district employees or if location of a floodway or floodplain is in doubt.
2. Allow variances from the terms or regulations adopted pursuant to this article to the extent permitted by section 48-3609, subsection B, paragraph 7 if, owing to peculiar conditions, a strict interpretation would work an unnecessary hardship and if in granting the variance the general intent and purposes of this article and the regulations will be preserved.

B. Appeals to the review board may be taken by any person who feels that there is error or doubt in the interpretation of the regulation or that due to unusual circumstances attaching to his property an unnecessary hardship is being inflicted on him. The appeal shall state whether it is a plea for an interpretation or a variance and the grounds for the appeal.

C. A person aggrieved in any manner by an action of the review board may within thirty days appeal to the district board.

48-3613. Authorization required for construction in watercourses; exceptions; enforcement

A. Except as provided in section 48-3625 and in this section, a person shall not construct any structure which will divert, retard or obstruct the flow of waters in any watercourse without securing written authorization from the board of the district in which the watercourse is located. Where the watercourse is a delineated floodplain, no structure shall be constructed in the floodplain without written authorization from the board of the district in which the floodplain is located.

B. Written authorization is not required nor shall the board prohibit:

1. The construction of bridges, culverts, dikes and other structures necessary for the construction of public highways, roads and streets intersecting or crossing a watercourse.
2. The construction of storage dams for watering livestock or wildlife and structures on banks of a watercourse to prevent erosion of or damage to adjoining land if the structure will not divert, retard or obstruct the natural channel of the watercourse or dams for the conservation of floodwaters as permitted by title 45, chapter 6.
3. Construction of tailing dams and waste disposal areas used in connection with mining and metallurgical operations. This paragraph does not exempt those sand and gravel operations which will divert, retard or obstruct the flow of waters in a watercourse from complying with and acquiring authorization from the board pursuant to regulations adopted by the board under this article.
4. Other construction if it is determined by the board that written authorization is unnecessary.
5. Any flood control district, county, city, town or other political subdivision from exercising powers granted to it under this article.
6. The construction of streams, waterways, lakes and other auxiliary facilities in conjunction with development of public parks and recreation facilities by a public agency or political subdivision.
7. The construction and erection of poles, towers, foundations, support structures, guy wires, and other facilities related to power transmission as constructed by any utility whether a public service corporation or a political subdivision.

C. Before any construction authorized by subsection B of this section may begin, the person must submit plans for the construction to the board for review and comment.

D. In addition to other penalties or remedies otherwise provided by law, this state, a political subdivision or a person who may be damaged or has been damaged as a result of the unauthorized diversion, retardation or obstruction of a watercourse has the right to commence, maintain and prosecute any appropriate action or pursue any remedy to enjoin, abate or otherwise prevent any person from violating or continuing to violate this section or regulations adopted pursuant to this article. If a person is found to be in violation of this section, the court shall require the violator to either comply with this section if authorized by the board or remove the obstruction and restore the watercourse to its original state. The court may also award such monetary damages as are appropriate to the injured parties resulting from the violation including reasonable costs and attorney fees.

48-3614. Declaration of public nuisance; abatement

Every new structure, building, fill, excavation or development located or maintained in a floodplain since August 8, 1973 in violation of this article or of floodplain regulations established by the board and without written authorization from the board is a public nuisance per se and may be abated, prevented or restrained by action of this state or any of its political subdivisions.

48-3615. Violation; classification

A. It is unlawful for a person to divert, retard or obstruct the flow of waters in a watercourse if it creates a hazard to life or property without securing the written authorization required by section 48-3613. Where the watercourse is a delineated floodplain, it is unlawful to excavate or build any structure affecting the flow of waters without securing written authorization required by section 48-3613.

B. A person who violates this section is guilty of a class 2 misdemeanor.

48-3616. Survey and report of flood control problems and facilities; comprehensive program; adoption by board; hearing

A. After a flood control district has been established in a county having a population of over three hundred thousand persons according to the latest federal decennial census, the board shall cause the chief engineer to make or have made by the flood control engineer or by qualified private engineers a survey of the flood control problems of the district and to prepare a report describing existing flood control facilities in the area, recommendations as to cooperation between the district and the owner or owners of existing facilities, recommendations and a preliminary plan for the construction or other acquisition of facilities to carry out the purpose of the district, a description of the property proposed to be acquired or damaged in performing the work, a program for carrying out the regulatory functions, a map showing the district boundaries and location of the work proposed to be done and property taken or damaged, an estimate of the cost of the proposed work and such other things as the board of directors may request. Before submission to the board of directors the report shall be submitted to the citizens' advisory board if one is established for its review and recommendations. The report shall be prepared at least every five years beginning in 1985 and shall indicate the past efforts of the district in eliminating or minimizing flood control problems and state the planned future work of the district to eliminate or minimize flood control problems.

B. The chief engineer and his staff shall then prepare a comprehensive program of flood hazard mitigation, taking into consideration the recommendations submitted in the report. When a comprehensive program satisfactory to the board is available, the board shall tentatively adopt and schedule a public hearing on the program and the performance of the proposed work. The comprehensive program shall be reviewed and modified as necessary to reflect the past and future planned flood control works of the district. Notice of the hearing shall be given by publication once a week for two consecutive weeks in a newspaper of general circulation in the area of jurisdiction, the first of which shall be at least ten days before the date fixed for the hearing.

C. The chief engineer and his staff shall prepare and submit to the board a five year capital improvement program in a form approved by the board. The program and annual extensions shall be submitted to the board at least three months before the final date for submission of the annual budget. The program shall separately identify capital improvements for engineering, rights-of-way and land acquisition and construction with such supporting explanations, cost estimates and completion schedules as the board may require. The program shall be annually reviewed for endorsement by the citizens' advisory board if one is established.

D. After a flood control district has been established in a county with a population of fewer than three hundred thousand persons, the chief engineer may conduct a survey of flood control problems, prepare a comprehensive program for flood control and a five year capital improvement program pursuant to this section. He shall at least make an assessment of flood control problems in the area of jurisdiction and make an annual report of his findings and recommendations for dealing with them to the board.

48-3617. Development of flood control plan by director of water resources

A. On the application of a district organized pursuant to this article, and subject to available appropriations, the director of water resources shall conduct a study and, if deemed justified by the director, develop a flood control plan to address any flood control problem in the area of jurisdiction of the district.

B. The director shall conduct such studies and develop such plans for counties having a population of fewer than one million persons. If personnel are available and if monies are specifically authorized by the legislature, the director may conduct such studies and develop such plans for counties having a population of one million or

more persons. The director shall perform his responsibilities under this section in such a manner as to spread the benefits of such assistance among all counties of this state.

C. In operating pursuant to this section, the director may utilize his own engineers and resources or may contract for outside consulting engineers and resources.

D. Any plan developed by the director pursuant to this section shall, to the extent practicable, resolve the particular flood control or regulation problem. The practicality of any solution to a flood control or regulation problem shall be determined jointly by the director and the flood control district based on cost effectiveness and design criteria developed by the director.

48-3618. Resolution calling for bond election; notice; manner of conducting election

A. After a county flood control district has been established pursuant to this article, the board may order that facilities be acquired, constructed, operated and maintained from available monies of the district. If sufficient monies are not available, the board may call an election of the electors of the district qualified to vote under article VII, section 13, Constitution of Arizona, to obtain approval for incurring bonded indebtedness of the district to obtain revenue to acquire by purchase, construction or otherwise all or any portion of such facilities.

B. After authority has been acquired for instituting a project within a zone or a joint project by two or more contiguous zones in a district established under this article, the board may order that the facilities approved in the project or joint project be acquired, constructed, operated and maintained from the monies held by the district treasurer for expenditure in the respective zone or zones. If sufficient monies are not available, the board may call an election of the electors of the zone, or of the zones for which a joint project has been authorized, who are qualified to vote under article VII, section 13, Constitution of Arizona, to obtain approval for incurring bonded indebtedness, to obtain revenue to acquire by purchase, construction or otherwise all or any portion of the facilities.

C. The board resolution shall set forth the purpose of the indebtedness, the amount of the indebtedness, the maximum number of years for which the indebtedness is to be incurred, the maximum rate of interest to be paid and the date of the election and shall list the voting places to be used at the election. The resolution constitutes a notice of the election and shall be published once each week for three consecutive weeks in a newspaper of general circulation in the area of jurisdiction, or if there is no such newspaper, then notice shall be posted in not less than three public places within the area of jurisdiction, the first of which publications shall be not less than twenty days before the date fixed for the election. Publication on the same day of each week is sufficient whether or not a daily newspaper is used for the publication.

D. Except as otherwise expressly provided, the election shall be called and held and the results canvassed in the manner provided by the laws of this state for holding elections on the issuance of bonds by counties for general county purposes. The board may for purposes of the election treat the entire district as a single precinct or may divide the district into such precincts and fix such polling places as it may see fit.

E. If a majority of the votes cast on the proposition is in favor of incurring the bonded indebtedness proposed, the bonds so authorized may be sold and issued by the board of directors either at one time or in blocks.

48-3619. Form, issuance and sale of bonds; limitation on bonded indebtedness; payment of bonds and interest

A. The bonds authorized pursuant to section 48-3618 shall be issued for the general purpose or purposes provided in the voted proposition, which may be the acquisition by purchase, construction or otherwise of any facilities designed to further the objects or purposes of the district or for improving and extending any such facilities, or any combination of such purposes, and may include the payment of all legal, engineering and fiscal expenses reasonably incurred in connection with the authorized purposes of the bonds and with the authorization and issuance of the bonds as well as expenses incurred in connection with the original organization of the district. The bonds shall be fully negotiable for all purposes and shall never be issued in an amount which:

1. Together with all other existing bonded indebtedness of the district then outstanding, exceeds in total principal amount five per cent of the assessed valuation of taxable property in the district as computed from the last assessment roll for county purposes completed before issuing the bonds.

2. Together with all other existing bonded indebtedness of a zone then outstanding for which the property of a zone is subject to tax under this article, exceeds in total principal amount five per cent of the assessed valuation of taxable real property in the zone as computed from the last assessment roll for county purposes completed before issuing the bonds.

B. The limitation on bonded indebtedness does not apply in those districts or zones which embrace portions of two or more irrigation districts which have water delivery contracts with the United States pursuant to federal reclamation laws.

C. The bonds are the general obligations of the district, zone or zones and the full faith, credit and resources of the district, zone or zones shall be pledged for their payment. The board shall certify to the board of supervisors to levy annually on all taxable real property in the district, zone or zones secondary property taxes fully sufficient without limitations as to rate or amount to pay principal of and interest on such bonds as principal and interest fall due.

D. The bonds shall mature at such time or times not more than forty years from their date, shall bear interest at such rate or rates set by the accepted bid which shall not exceed the maximum rate of interest stated in the resolution calling the election, shall be payable at such place or places within or without this state and generally shall be issued in such manner and with such details as may be provided in the resolution. The bonds may be made callable on any interest payment date at a premium not to exceed three per cent of their face amount. If the district has any source of revenues other than from the proceeds of taxes, all or such part of the revenues as the board of directors may deem advisable may, in the discretion of the board, be pledged to the payment of the bonds.

E. The board may provide in the resolution authorizing bonds that the bonds shall recite that they are issued under authority of this article. Such recital conclusively imports full compliance with this article and all bonds issued containing the recital are incontestable for any cause whatsoever after their delivery for value.

F. The board may provide for the publication of any resolution or other proceeding adopted by the board in a newspaper of general circulation in the area of jurisdiction. For a period of thirty days after the date of publication any person in interest may contest the legality of the resolution or proceedings of any bonds which may be authorized, or the provisions made for the security and payment of the bonds, and after such time no person has any cause of action to contest the regularity, formality, legality or source of payment for any cause whatsoever.

G. Subject to this section, the board shall declare by resolution its intention to sell such bonds and shall fix the date, hour and place of sale and shall give notice of the sale of the bonds by publication for at least ten days in a newspaper of general circulation in the area of jurisdiction and in any other newspaper as the board directs. The notice shall state that sealed bids only will be received by the board for the purchase of the bonds, and the bonds will be awarded to the highest responsible bidder at a price of not less than par and accrued interest, and that a good faith check equal to two per cent of the principal amount of bonds to be sold must accompany all sealed bids. The board may reject any and all bids. The bonds may be in denominations or multiples of one thousand dollars and shall be signed by such officers of the board as are designated by resolution adopted by the board. Any bonds bearing the signature of officers in office at the date of signing are valid and binding for all purposes, notwithstanding that before their delivery any such person whose signature appears on the bonds may no longer be an officer.

H. Bonds may be issued by the district after the issuance of all of the first bonds but must be issued pursuant to the making of a supplemental engineer's program and a hearing as prescribed in this section.

I. Bonds issued under authority of this article do not enjoy a priority over other bonds issued under this article by reason of time of authorization or issuance. Bonds issued under this article are not taxable by this state or by any county, city, town or other political subdivision of this state.

J. All bonds issued under this article are legal investments for all trust funds, including those under jurisdiction of this state, and for the funds of all insurance companies, banks and trust companies, for the investment of state monies and for all sinking funds under the control of this state and political subdivisions of this state.

48-3620. Certification and levy of taxes; limitation

A. The district shall annually, not less than fifteen days before the first day of the month in which the county board of supervisors is required by law to levy county taxes, certify to the board of supervisors:

1. The amount of taxes to be levied in each year on the taxable real property in the district as it considers necessary or appropriate to pay the expenses of administering the district and maintaining and operating the district's flood control system, to carry out its regulatory functions and to carry out any of the objects and purposes of this article of common benefit to the district. The maintenance and operation tax proceeds not used for current expenses of maintenance and operation may either be paid into a reserve to be accumulated for such purpose or may be used for extending, improving and constructing the flood control system including acquiring rights-of-way.
2. The amount of taxes to be levied in each year on all taxable real property in each zone or in any of the zones into which the district has been divided, according to the benefits derived or to be derived by the respective zones, to pay the cost and expenses of carrying out any of the objects or purposes of this article of special benefit to the respective zones, including acquiring, constructing, maintaining, operating, extending, repairing or otherwise improving any or all flood control works or improvements in the respective zones and including acquiring rights-of-way. No revenues derived from any of the several zones from the taxes levied under this section may be expended for acquiring, constructing, maintaining, operating, extending, repairing or otherwise improving any works or improvements located in any other zone, except under section 48-3620.01.
3. The amount of secondary property taxes necessary to be levied to pay the principal and interest falling due during the ensuing year on, or to provide a sinking fund for, any bonds issued pursuant to section 48-3619.

B. The taxes collected pursuant to this section shall be paid to the district treasurer and used solely for the purpose for which they were levied.

C. The board of supervisors at the time of levying general county taxes shall levy and cause to be collected in the manner prescribed by law for county taxes a property tax or taxes on the taxable real property in the district, zone or zones sufficient to provide the amounts set forth in subsection A of this section.

D. If the district fails to certify to the board of supervisors any of the amounts of taxes necessary to be levied as required by this section, the board of supervisors shall ascertain the amount which should have been certified and shall levy the tax sufficient to produce such amount.

E. If a district is located in a county having a population of less than six hundred thousand persons according to the most recent United States decennial census, beginning with the 1993 tax year, the aggregate taxes levied in any year under this article by the district for the purposes listed in subsection A, paragraph 1 of this section shall not exceed twenty per cent of the county primary property tax rate exclusive of the county equalization assistance for education rate or fifty cents per one hundred dollars of assessed valuation, whichever is greater. The aggregate taxes levied for any year under this article on property in a zone for the purposes listed in subsection A, paragraph 2 of this section in a district located in a county having a population of less than six hundred thousand persons according to the most recent United States decennial census, if added to the aggregate taxes, if any, levied for the purposes listed in subsection A, paragraph 1 of this section, shall not exceed twenty per cent of the county primary property tax rate exclusive of the county equalization assistance for education rate or fifty cents per one hundred dollars of assessed valuation, whichever is greater. The taxes levied under this article in a district located in a county having a population of less than six hundred thousand persons according to the most recent United States decennial census may exceed the limits prescribed by this subsection if approved by a majority of the qualified electors of the district voting in a regular general election held pursuant to title 16, chapter 2, article 2 or at a special election held pursuant to title 16, chapter 2, article 3. The ballot for the election shall specifically state the proposed rate and the fiscal year or years in which the excess tax levies are proposed to be assessed.

48-3620.01. Joint projects by zones

The board of directors may institute joint projects by two or more contiguous zones for acquiring, financing, constructing, maintaining, operating, extending, repairing or otherwise improving any flood control work or improvement located or to be located in one or more of such zones and of common benefit to the zones.

48-3620.02. Authority for zone projects

A. For the purpose of acquiring authority to proceed with any project of special benefit to a zone, as well as for the purpose of acquiring authority to proceed with any joint project by any two or more contiguous zones, as provided by section 48-3620.01, the board of directors shall adopt a resolution stating its intention to undertake the zone project or joint project, together with the engineering estimates of the project's cost to be borne by any participating zones, fixing a time and place for a public hearing on the resolution once a week for two consecutive weeks in a newspaper of general circulation in the affected zone or zones, the first of which publications shall be at least ten days before the date fixed for the hearing or, if there is no such newspaper, by posting the notice for two consecutive weeks before the hearing in three public places in each of the affected zones. The notice shall designate a public place in each of the zones where a copy of the map or maps of any joint project may be seen by an interested person.

B. At the time and place fixed for the hearing or at any time to which the hearing may be continued, the board shall consider all written and oral objections to the proposed project or joint project. On the conclusion of the hearing, the board may abandon or proceed with the proposed project or joint project unless written protests against the proposed project or joint project, signed by a majority in number of the electors, as defined in article VII, section 13, Constitution of Arizona, of the project zone or any of the zones in a proposed joint project, are filed with the board of directors before the conclusion of the hearing, in which event the project or joint project shall be abandoned.

C. After a zone project or a joint project has been authorized and adopted, the board may, without the necessity of any further hearing, make such changes in the project as it may deem desirable to facilitate the program, consistent with the objects, purposes and powers of the district prescribed by section 48-3603.

48-3621. Right-of-way

A right-of-way in, under, along or across a public highway, public street or public property within a flood control district shall be granted to the district if found by the board to be necessary or convenient for performing any work authorized by this article and if designs for district works and designs for highway, street and public property improvements are mutually satisfactory to controlling public agencies. If necessary to carry out such work, the board may bring actions to condemn any needed property, which suits may be brought under any statute applicable to the bringing of condemnation suits by municipal corporations or other political subdivisions of this state.

48-3622. Permission required to connect to storm water drain; fee; violation; classification

A person desiring to make a connection to any storm water drain of a flood control district or to cause floodwaters or storm or other waters to be emptied into any ditch or drain of the district shall first apply to the district for permission to make the connection. The district may require the connection to be made in such manner as it directs and may impose reasonable conditions and such reasonable connection fee as it deems proper or, if reasonably justified by the circumstances, may refuse permission. In addition, the district may require any action or impose any restriction that the district considers reasonably necessary to meet the district's obligations, if any, to comply with local, state or federal water quality laws. A person making a connection which causes floodwaters to be so discharged without first having obtained permission is guilty of a class 2 misdemeanor.

48-3623. Authority to issue refunding bonds; procedure; disposition of proceeds

Any bond issued under this article may be refunded pursuant to resolution adopted by the board of directors in the manner provided in this article for the issuance of other bonds, except that an engineer's report or hearing need not be obtained or held, and it is not necessary to submit the question of the issuance of the refunding bonds at an election. Refunding bonds so authorized may be sold and the proceeds of sale applied to or escrowed for the payment of the bonds to be refunded in such manner as may be provided in the authorizing resolution, or may be delivered in exchange for the bonds to be refunded, or may be in part sold and in part exchanged. No bonds may

be refunded under this section unless they either mature or are recallable for redemption under their terms within twelve months from the date of the issuance of the refunding bonds or unless the holders voluntarily surrender them for exchange or payment.

48-3624. Cooperation in flood control projects

A district may cooperate with the United States and this state or any instrumentality, department, agency or political or municipal subdivision of either in the construction, maintenance and operation of flood control projects and the enforcement of this article and regulations adopted pursuant to it. To that end, the district may:

1. Enter into appropriate agreements.
2. Acquire and provide without cost to the cooperating entity land, easements, rights-of-way and services necessary for the construction of flood control projects and the regulation of floodplains.
3. Hold and save any cooperating entity free from any claim for damages arising from the construction, maintenance and operation of flood control projects and the regulation of floodplains.
4. Maintain and operate all works according to regulations prescribed by the cooperating entity.
5. Establish and enforce flood channel limits and floodplain regulations, if any, satisfactory to the cooperating entity.

48-3625. Limitation on powers

A county flood control district may not exercise any power or authority granted by this article, nor may it undertake or cooperate in planning, authorizing, constructing, acquiring, extending, improving, maintaining or operating any flood control structures, dam systems or projects on any portion of a watershed supplying water to any dam and reservoir existing within this state having a designed water storage capacity of fifty thousand acre feet or more, or to any existing diversion dam and canal system having facilities within this state designed to divert and carry not less than one thousand cubic feet per second, without first obtaining the written consent of the agency, district, association, company or organization owning or operating or being served by such dam, reservoir, diversion dam or canal system. Such consent, however, is only required from irrigation districts and agricultural improvement districts organized pursuant to the laws of this state and defined under this title, and any other associations or organizations operating such dams, reservoirs, diversion dams and canal systems as part of a federal reclamation project. This section does not prohibit the district from adopting and enforcing such regulations as are duly enacted pursuant to this article.

48-3626. Compliance; enforcement

If any board, district or governing body fails to comply with or violates the requirements of this article, the attorney general shall take prompt and appropriate legal action to compel compliance by the jurisdiction and its elected officials. The attorney general may, in his discretion, seek the following remedies under this section:

1. An order compelling the offending jurisdiction and its elected officials to comply with the requirements of this article or cease the violation.
2. An order vesting the powers and duties under this article in the district in the event that an incorporated city or town has assumed the powers and duties pursuant to section 48-3610.

48-3627. Reimbursement for county services

Services provided by a county to a county flood control district are subject to reimbursement pursuant to section 11-251.06.

48-3628. Condemnation actions; interest

Interest on a judgment in a condemnation proceeding instituted by the district or by a power district or an agricultural improvement district pursuant to chapter 11 or 17 of this title, including interest that is payable pursuant to section 12-1123, subsection B, shall be calculated for each month or portion of a month that interest is owed and shall be either:

1. The prime rate charged by banks on short-term business loans as determined for publication in the bulletin of the board of governors of the federal reserve system, as of the first day of that month.
2. In the absence of a determination by the board of governors of the federal reserve system, calculated in the same manner based on comparable data as determined by the United States department of commerce, bureau of economic analysis, for publication in "survey of current business".

3. If the prime rate cannot be determined from publication as provided in paragraph 2 of this section, determined by a federal agency that is annually designated by the respective district and that makes and publishes data sufficient to determine the prime rate of interest.

F[illegible]OD CONTROL DISTRICT OF MARICOPA COUN

AGENDA FORM

H/T/90

Contract/Lease for ☐ NEW ☐ RENEWAL ☐ AMENDMENT ☐ CANCELLATION
(for existing, record Encumbrance No below)

W ORG. NO. 6900 DEPARTMENT: Flood Control District CONTROL NUMBER: FCD-1457

ENCUMBRANCE NO. _____ AGENCY: _____ CONTROL NUMBER: PW-183

1. BRIEF DESCRIPTION OF PROPOSAL AND REQUESTED BOARD ACTION: It is requested that the Board of Directors adopt Resolution FCD 88-8A, amending the General Policies Concerning the Allocation of Fiscal resources to Accomplish the District's Functions and Responsibilities, as recommended by the Flood Control Advisory Board at their July 28, 1993, meeting.

The County's Strategic Plan affirms our responsibility for protecting our residents' health, safety and welfare and calls for ensuring a capacity and quality of physical infrastructure sufficient to meet the needs of current and future development. While the County's population is projected to grow by 1.3 million residents between 1990 and 2010, Federal funding for the planning, design and construction of flood control and stormwater management infrastructure is on the decline. Therefore, staff projects that the majority of future flood control improvements will be developed through the District's Area Drainage Master Study program or through municipal and state drainage planning efforts. The need to address this trend toward a locally-sponsored, streamlined project planning and development process was identified in the District's Strategic Plan and the Arthur Andersen & Company performance audit (1992). Resolution FCD 88-8A proposes to amend the District's current Fiscal Policy by authorizing staff to evaluate and prioritize future CIP projects on the basis of merit as defined by specific project criteria. It is proposed that the Procedure for Identifying and Prioritizing Potential 5-Year CIP Projects be utilized to implement Resolution FCD 88-8A. This procedure is the result of a Total Quality Management effort completed by District staff. In addition to Advisory Board review, the prioritization criteria incorporate comments received from a mailout to 37 municipal and government agencies.

2. COMPLIANCE WITH MARICOPA COUNTY PROCUREMENT CODE N/A article, N/A paragraph. Procurement Officer

SOLE SOURCE JUSTIFICATION _____

3. CONTINUED FROM MEETING OF _____
DISCUSSED IN MEETING OF _____

4. ☐ THIS DEPARTMENT WILL CAUSE PUBLICATION
☐ CLERK OF THE BOARD TO CAUSE PUBLICATION

5. MOTION: It is moved that the Flood Control District of Maricopa County Board of Directors . . . adopt Resolution FCD 88-8A, amending the General Policies Concerning the Allocation of Fiscal resources to Accomplish the District's Functions and Responsibilities to allow the Chief Engineer and General Manager and the Flood Control Advisory Board to evaluate, prioritize and recommend funding for future Capital Improvement Program projects on the basis of defined project criteria.

6. FINANCIAL: ☐ Expenditure ☐ Revenue ☐ Budgeted ☐ Contingency ☐ Budget Amendment ☐ Transfer ☐ Grant or other

$ 0 (Total) CIP FLOOD CONTROL (Fund) Financial Officer 8/6/93 (Date)

7. PERSONNEL:
Personnel Director _____ Date _____

8. FLOOD CONTROL DISTRICT:
Action Recommended by 7/29/93 Date

9. MATERIALS MANAGEMENT:
A. Materials Management Director _____ Date _____
B. W/MBE Representative _____ Date _____

10. LEGAL: Approved as to form and within the powers and authority granted under the laws of the state of Arizona to the Flood Control District of Maricopa County Board of Directors.
General Counsel 7/30/93 Date

11. OTHER: _____
Signature _____ Date _____

12. APPROVED FOR AGENDA:
Approving Official 8-2-95 Date

13. OTHER: _____
Signature _____ Date _____

14. BOARD OF DIRECTORS: Action taken:
☒ Approved ☐ Amended ☐ Disapproved ☐ Deleted
Continued to: _____ (Date and type of meeting)
Clerk of the Board DEPUTY CLERK 9-7-93 Date

15. RECOMMENDATION OF COUNTY MANAGER:
☐ Approve ☐ Disapprove
Comments:
County Manager Date

6910-001 R5-90

RESOLUTION FCD 88-8

General Policies Concerning
the Allocation of Fiscal Resources to
Accomplish the District's Functions and Responsibilities

WHEREAS, the purpose of Flood Control District of Maricopa County is to prevent loss of life or injury to residents and the elimination or minimizing of damages to real and personal property from flooding; and

WHEREAS, the activities of the District are funded by a Flood Control Tax Levy assessed on all real property within Maricopa County; and

WHEREAS, in order to make the District more proactive in the resolution of flooding problems within Maricopa County, policies are needed for the allocation of fiscal resources; and

WHEREAS, such policies are published in a document entitled: General Policies Concerning the Allocation of Fiscal Resources to Accomplish the District's Function and Responsibilities (attached) and which define and delineate Flood Control District policy in the areas of maintenance, planning, flood warning, regulatory functions, public involvement, Comprehensive Plan projects, cost sharing in projects to be owned by others, Area Stormwater Management Plan, acceptance of facilities built by others, and groundwater recharge; and

WHEREAS, the policies allocate the fiscal resources of the District as follows:

Percentage	Description
As Required (Highest Priority)	Maintenance and repair to ensure safe operations and structural integrity in accordance with the design and constructed capabilities
2	Flood Warning
2	Floodplain Management (Aerial Mapping and Topography)
75	Comprehensive Plan Projects
5	Projects to be Owned by Others
10	Area Stormwater Management Plans
2	Groundwater Recharge

NOW, THEREFORE BE IT RESOLVED THAT the policies published in the document titled General Policies Concerning the Allocation of Fiscal Resources to Accomplish the District's Functions and Responsibilities are hereby adopted.

DATED this 14th day of July, 1988

Thomas S. Greenstone

Chairman, Board of Directors
Flood Control District of Maricopa County

ATTEST:

Cheri Lemmington

Clerk of the Board

FILE: Resolution FCD 88-8A

RESOLUTION FCD 88-8A

AMENDMENT 1 TO THE GENERAL POLICIES CONCERNING
THE ALLOCATION OF FISCAL RESOURCES TO ACCOMPLISH THE DISTRICT'S
FUNCTIONS AND RESPONSIBILITIES

WHEREAS, the Strategic Plan for Maricopa County affirms the County's responsibility to protect our residents' health, safety and welfare and calls for ensuring a capacity and quality of physical infrastructure sufficient to meet the needs of current and future residential, commercial and industrial development; and,

WHEREAS, the 1992 growth forecast by the Maricopa County Department of Planning and Development projects the population of Maricopa County to increase by 1.3 million residents between 1990 and 2010; and,

WHEREAS, the Board of Directors adopted the General Policies Concerning the Allocation of Fiscal Resources to Accomplish the District's Functions and Responsibilities, Resolution FCD 88-8, on July 11, 1988, in order to become more proactive in the resolution of flooding and stormwater management problems within Maricopa County; and,

WHEREAS, in accordance with these policies, Capital Improvement Program (CIP) projects are categorized and prioritized by the following definitions:

1) Comprehensive Plan Projects - projects that have a benefit to cost ratio calculated to be greater than one. The District has historically funded these projects one hundred percent (100%). Up to seventy-five percent (75%) of the District's revenues may be budgeted for these projects;

2) Area Stormwater Management Plan (ASMP) Projects - projects identified during the conduct of an Area Drainage Master Study (ADMS) that are needed to mitigate flooding damages. Funding by the District is not to exceed fifty percent (50%). Up to ten percent (10%) of the District's revenues may be budgeted for these projects;

3) Projects to be Owned by Others - projects costing no more than $2 million developed by a city, that are not the result of an ADMS, which are part of the city's stormwater management plan. Funding by the District is not to exceed fifty percent (50%). Up to five percent (5%) of the District's revenues may be budgeted for these projects, but no more than thirty percent (30%) of the funds budgeted may be cost shared in one city; and,

WHEREAS, there has been a continued reduction in the availability of Federal funds to plan, design and construct CIP projects that meet the definition of Comprehensive Plan Projects provided above; and,

WHEREAS, the majority of future Flood Control District CIP projects that serve the County's residents will be developed either through the District's ADMS program or through the planning efforts of our agency customers; and,

WHEREAS, the Flood Control District's Strategic Plan calls for the development and implementation of a procedure for identifying and prioritizing flood control and stormwater management CIP projects; and,

WHEREAS, Flood Control District staff have employed Total Quality Management (TQM) techniques to develop the Procedure for Identifying and Prioritizing Potential 5-Year CIP Projects and have incorporated review comments from the cities into the procedure; and,

WHEREAS, based on the aforementioned trend toward locally-sponsored CIP project planning and development, it is appropriate to amend the General Policies Concerning the Allocation of Fiscal Resources to Accomplish the District's Functions and Responsibilities to evaluate, prioritize and fund future CIP projects on the basis of defined project criteria, as recommended through the TQM process.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the Flood Control District of Maricopa County hereby amends the General Policies Concerning the Allocation of Fiscal Resources to Accomplish the District's Functions and Responsibilities, as adopted in Resolution FCD 88-8, for the purpose of allowing the Chief Engineer and General Manager and the Flood Control Advisory Board to evaluate, prioritize and recommend funding for future Capital Improvement Program projects on the basis of defined project criteria, rather than by project type; and,

BE IT FURTHER RESOLVED that the Flood Control District shall utilize the Procedure for Identifying and Prioritizing Potential 5-Year CIP Projects, or a comparable method, for evaluating and prioritizing future CIP projects that are to be funded either partially or wholly by the District. The criteria and methodology to be used in this process shall be reviewed and updated, as necessary, by District staff at a minimum of every two years.

Dated this 7 day of September, 1993.

Jim Brown
Chairman, Board of Directors

ATTEST:

Ed Hogue DEPUTY CLERK
Clerk of the Board

RESOLUTION 93-03

Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects

WHEREAS, the Flood Control District of Maricopa County desires to preserve and enhance the beauty, and other aesthetic qualities of our natural and human environments; and,

WHEREAS, the Flood Control District of Maricopa County (District) desires to improve the quality of the aesthetic treatment and landscaping of flood control structures and incidental properties thereto; and,

WHEREAS, the Flood Control District's current policy entitled, "A General Policy for Aesthetic Treatment and Landscaping of Flood Control Structures," dated January 2, 1979 is outdated and has been rewritten as the "Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects," dated December 16, 1992; and,

WHEREAS, the Flood Control Advisory Board has reviewed this policy and recommends that the Board of Directors approve the "Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects," dated December 16, 1992.

NOW, THEREFORE BE IT RESOLVED, that the Board of Directors of Maricopa County rescinds the former policy entitled, "A General Policy for Aesthetic Treatment and Landscaping of Flood Control Structures," dated January 2, 1979; and adopts the document entitled "Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects," dated December 16, 1992 as an official policy of the Flood Control District of Maricopa County.

BE IT FURTHER RESOLVED, the Chief Engineer and General Manager of the Flood Control District of Maricopa County is authorized and directed to administer the "Policy for the Aesthetic Treatment and Landscaping of Flood Control Projects," dated December 16, 1992, and to review, and update the Cost-Ceiling charts on tables 1 and 2 in the policy using the construction cost index and other applicable consumer price indices, once every three years, or as determined necessary by the Chief Engineer and General Manager, and to approve the updated figures as part of the policy.

Dated this 5th day of May, 1993.

Jim Bruner

Chairman, Board of Directors

ATTEST:

Joan McCarroll

Clerk of the Board

APPENDIX B

Watershed Information

LOWER ACDC WATERSHED[1]

Table SE 1-1
Land Use in Lower ACDC Watershed

	Acres	Sq. Mi.	Percent
Medium/High Density Residential	52,790	82.48	35.23%
Low Density Residential	4,750	7.42	3.17%
Commercial & Industrial	21,384	33.41	14.27%
Agricultural	28,116	43.93	18.76%
Open Space	3,336	5.21	2.23%
Vacant	23,482	36.69	15.67%
Water	4,989	7.80	3.33%
Other	10,987	17.17	7.33%
Out of County/Not Classified			
Total Area	149,834	234.12	100.00%

Table SE 1-2
Land Ownership in Lower ACDC Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
PRIVATE	16.0	229.59	0.50%	0.50%
PARKS	975.3	1.52	0.06%	0.06%
FEDERAL	754.0	1.18	0.31%	0.31%
STATE	606.8	0.95	0.65%	0.65%
MILITARY	466.8	0.73	98.07%	98.07%
INDIAN	91.7	0.14	0.40%	0.40%
OUT OF COUNTY/NOT CATEGORIZED	0.0	0.00		
Total	2,910.6	234.12	100.00%	100.00%

[1] ACDC stands for Arizona Canal Drainage Channel

Table SE 1-3
Flood Damage History for Lower ACDC Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan- 8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	200 families evacuated in Holly Acres. Erosion of Tri-City landfill sent about 55,000 cu. yds. of debris washed down river. 71 roads, streets and bridges reported closed. Sand and gravel operations damaged. Erosion of riverbanks.	2 deaths-countywide, Public and private damages exceeded $38 million. Downstream cleanup costs $4 million.
14-Oct-88	8:00 AM/ 4:00 PM	Metro Phoenix and Carefree.	2.32 in. at Sky Harbor Airport. 2.6 in. in Carefree./8 hr./ 15 yr. storm.	General flooding throughout Metro Phoenix. Arizona Canal overtopped due to inflows from Cave Creek.	Data not available.
High runoff from 13-22 Feb 80	13 Feb- 10:00 AM/ 22 Feb- 12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Heavy commercial losses between 48th St & 35th Ave along Salt River, residential damages severe between 67th Ave. and 115 Ave, especially to Holly Acres. Extensive damage to roads and bridges, Sky Harbor Airport, sewers, flood control structures.	Salt River: 115th Ave.-48th St.: $14 million-public, $.627 million-residential, $3.6 million-commercial/ industrial.
High runoff from 18-22 Dec 78	18 Dec- 12:00 PM/ 20 Dec- 12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Heavy damage to area along Salt River from 48th St-35th Ave, moderate damage to area from 35th Ave-115th Ave. Light damage to residential, moderate damage to agriculture, commercial and industrial. Severe damage to roads and bridges. Nine sand and gravel operations damaged along Agua Fria River, five along Salt River.	4 deaths-countywide. $7.8 million-industry, $.75 million-commercial, $16.3 million-public, $3.1million-residential, $1.3-million-sand & gravel on Agua Fria River, $3.9 on million-Salt River.
High runoff from 28 Feb 78- 3 Mar 78	1 Mar- 4:00 PM/ 2 Mar- 4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Flooding occured along irrigation canals on north side of metro area, tributaries of the Gila River and Agua Fria. Extensive damage to Sky Harbor Airport, commercial, industrial, agriculture and public facilities. Holly Acres severely flooded.	1 death-countywide. Total damage costs: $37 million: 2 million-residential: Holly Acres and Allenville, $16 million-public, $3.2 million-Sky Harbor Airport.
22-Jun-72	Midnight/ 6:00 AM	Northeast Phoenix, affecting cities of Paradise Valley, Scottsdale, Tempe and Phoenix	3.85 in./6 hr./70 yr. storm.	Breaks and overtopping of Arizona and Grand Canal, and Indian Bend Wash. Extensive damage to residential, agriculture, parks, telephone utilities, streets, roads and bridges.	Total damages: $10.5 million in Phoenix Metro Area. $1.6 million-residential.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Flood Report, October 14, 1988 Storm", Flood Control District of Maricopa County.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.
7. "Report on Flood of 22 June 1972, Phoenix Metropolitan Area, Arizona", U.S. Army Corps of Engineers, Los Angeles District, October 1972.

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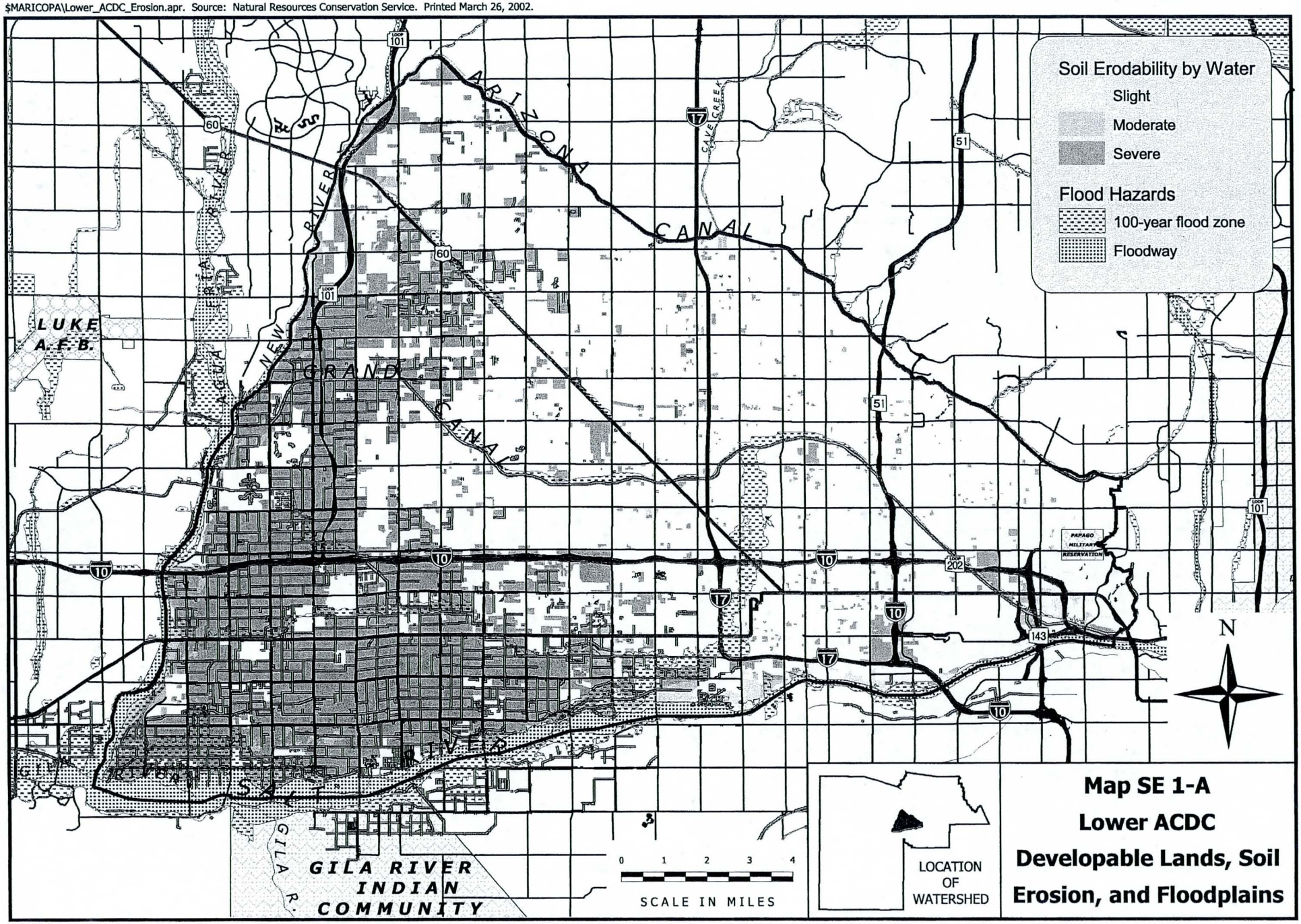
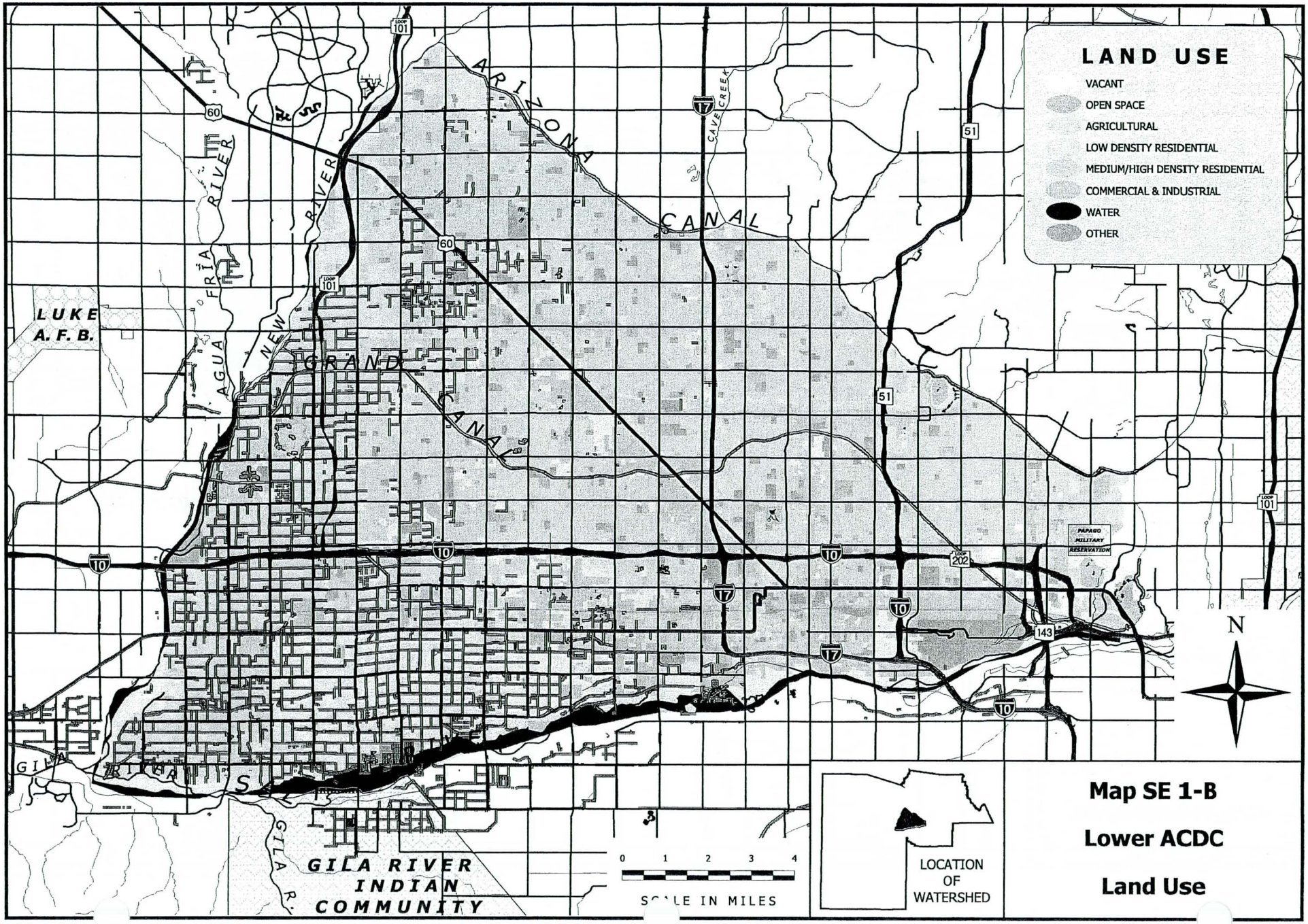
$MARICOPA\Lower_ACDC_Erosion.apr. Source: Natural Resources Conservation Service. Printed March 26, 2002.



$MARICOPA\Lower_ACDC_Landuse.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Lower_ACDC_Landownership.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

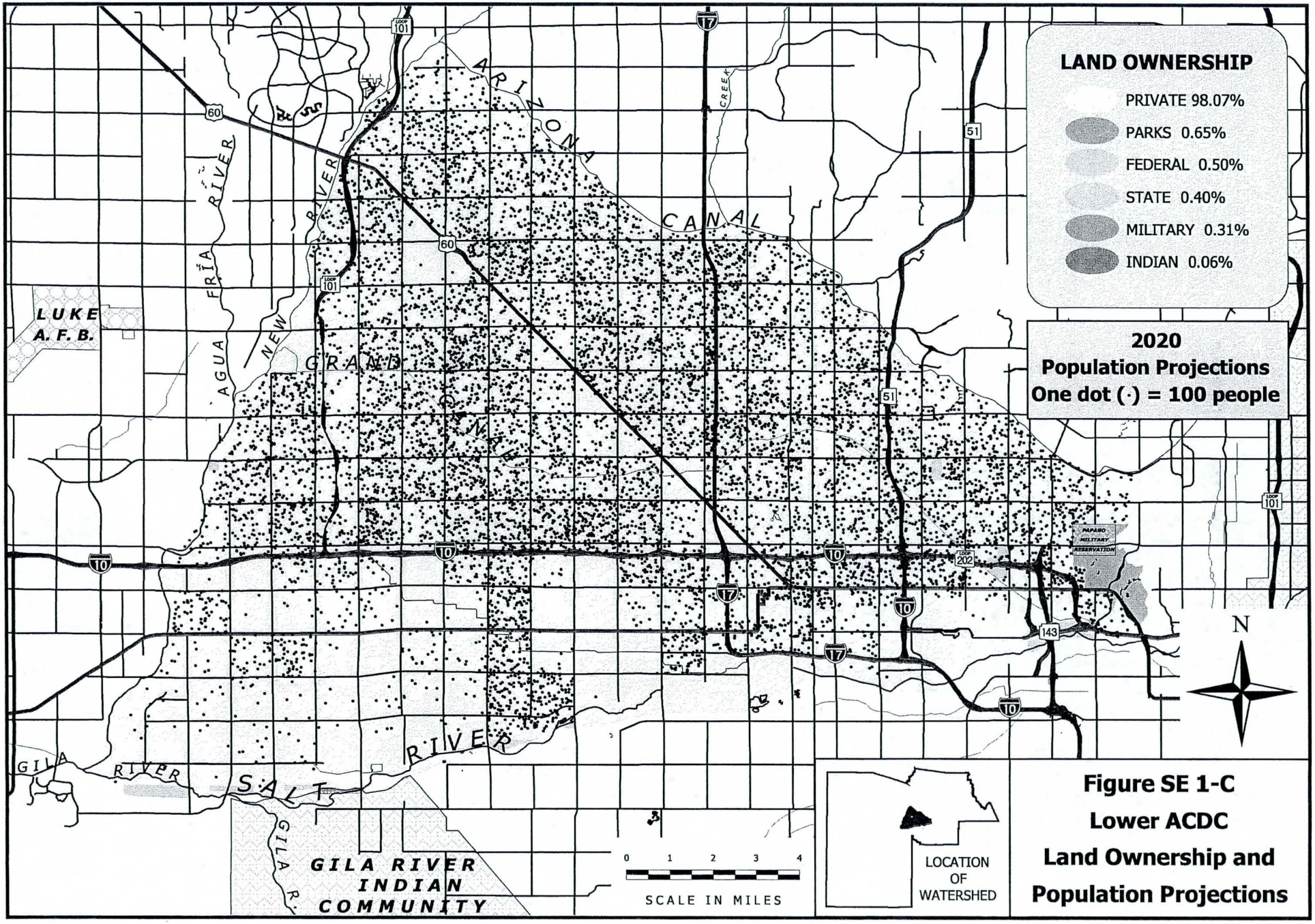
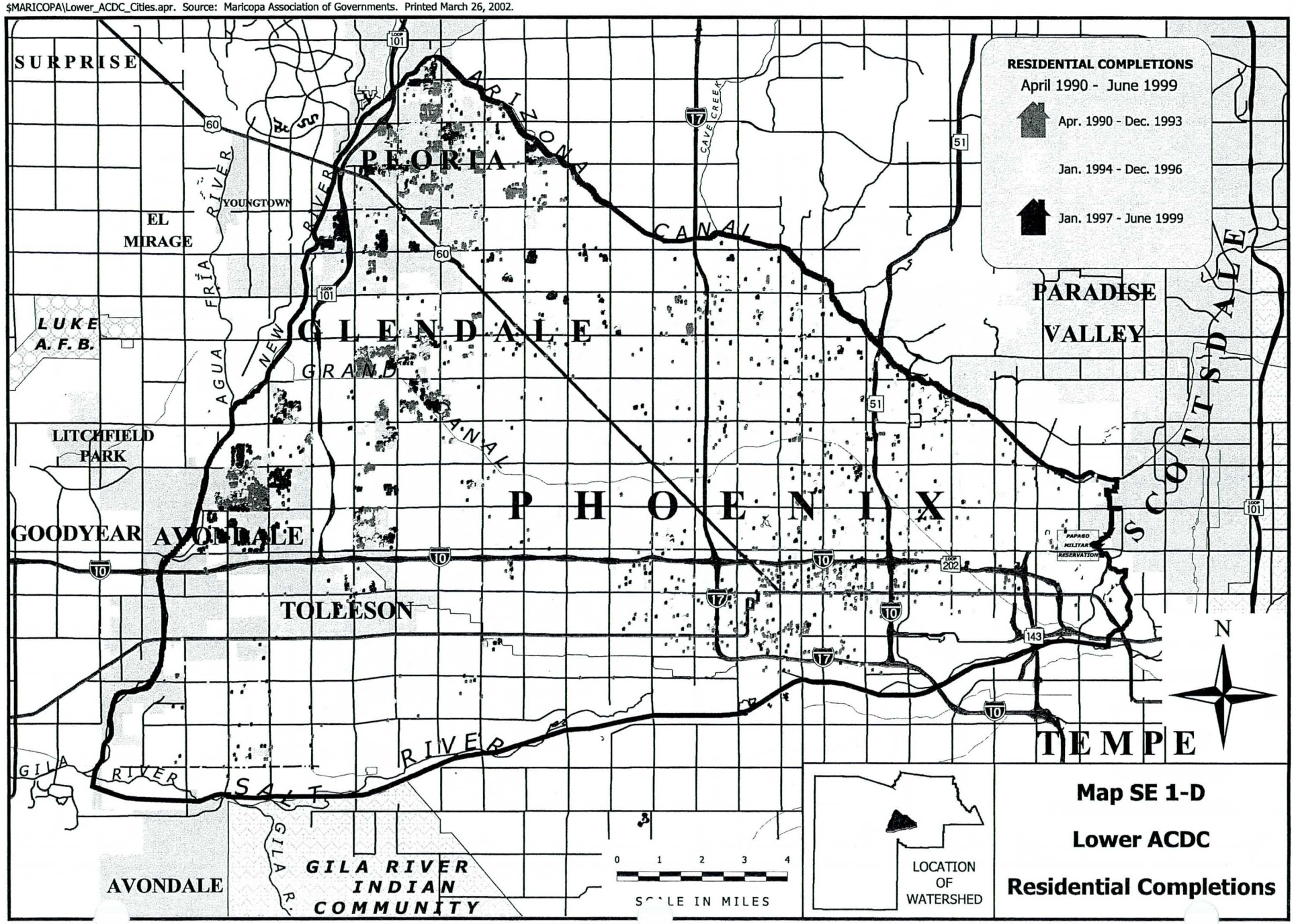


Figure SE 1-C
Lower ACDC
Land Ownership and Population Projections

$MARICOPA\Lower_ACDC_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



SOUTH MOUNTAIN WATERSHED

Table SE 2-1
Land Use in South Mountain Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	16,095	25.15	10.27%
Low Density Residential	5,522	8.63	3.52%
Commercial & Industrial	8,192	12.80	5.23%
Agricultural	24,429	38.17	15.59%
Open Space	28,964	45.26	18.48%
Vacant	65,020	101.59	41.49%
Water	5,682	8.88	3.63%
Other	2,826	4.41	1.80%
Out of County/Not Classified			
Total Area	156,730	244.89	100.00%

Table SE 2-2
Land Ownership in South Mountain Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
PRIVATE	68,434	106.93	1.96%	1.96%
INDIAN	59,358	92.75	37.87%	37.87%
PARKS	24,298	37.97	15.50%	15.50%
FEDERAL	3,068	4.79	43.66%	43.66%
STATE	1,573	2.46	1.00%	1.00%
OUT OF COUNTY (NOT CATEGORIZED)				
Total	156,730	244.89	100.00%	100.00%

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SE 2-3

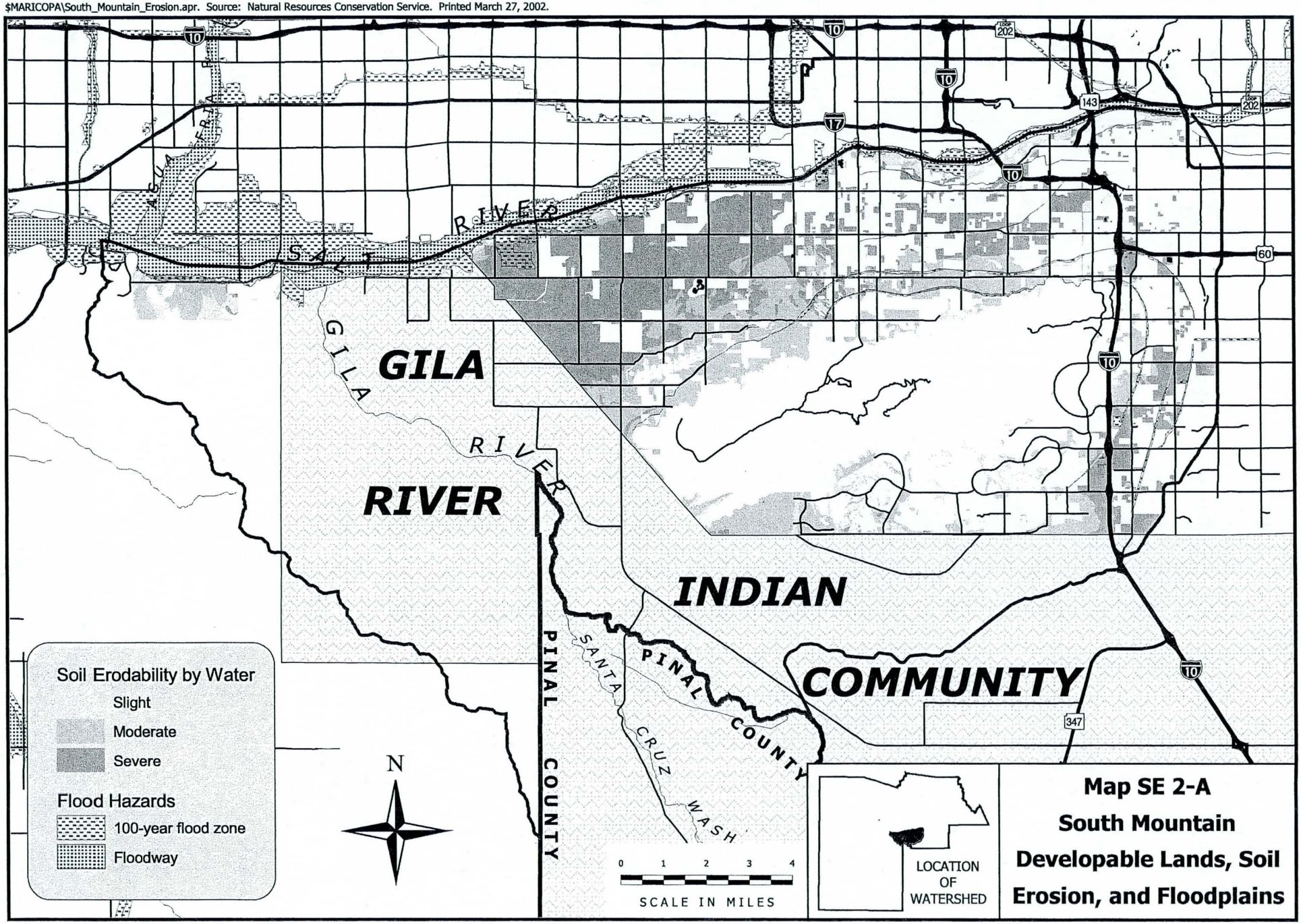
Flood Damage History for South Mountain Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan- 8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	Mill Ave. bridge, under construction, 5 of the 9 spans destroyed or damaged. Erosion of Tri-City landfill sent about 55,000 cu. yds. of debris washed down river. 71 roads, streets and bridges reported closed. Severe flooding in Laveen. Public health advisory warning issued.	2 deaths-countywide, Public and private damages exceeded $38 million. Downstream cleanup costs $4 million.
14-Oct-88	8:00 AM/ 4:00 PM	Metro Phoenix and Carefree	2.32 in. at Sky Harbor Airport/8 hr./ 15 yr. storm.	General flooding throughout Metro Phoenix. Arizona Canal overtopped due to inflows from Cave Creek.	Data not available.
High runoff from 13-22 Feb 80	13 Feb- 10:00 AM/ 22 Feb- 12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix/ Heavy to light rainfall from 13-22 Feb.	Heavy commercial losses between 48th St & 35th Ave along Salt River, residential damages severe between 67th Ave. and 115 Ave. Extensive damage to roads and bridges, Sky Harbor Airport, sewers, flood control structures. Agricultural damage.	Salt River: 115th Ave.-48th St.: $14 million-public, $.627 million-residential, $3.6 million-commercial/ industrial, $1 million-agri-culture, So. Mtn. area.
High runoff from 18-20 Dec 78	18 Dec- 12:00 PM/ 20 Dec- 12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Heavy damage to area along Salt River from 48th St-35th Ave, moderate damage to area from 35th Ave-115th Ave. Light residential damage, moderate damage to agriculture, commercial and industrial; severe damage to roads and bridges. Damage to 5 sand and gravel operations.	4 deaths-countywide, $7.8 million-industry, $.75 million-commercial $16.3 million-public, $3.1million-residential, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar- 4:00 PM/ 2 Mar- 4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding also occured along tributaries of the Gila River and Agua Fria. Extensive damage to Sky Harbor Airport, commercial, industrial, agriculture and public facilities.	Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

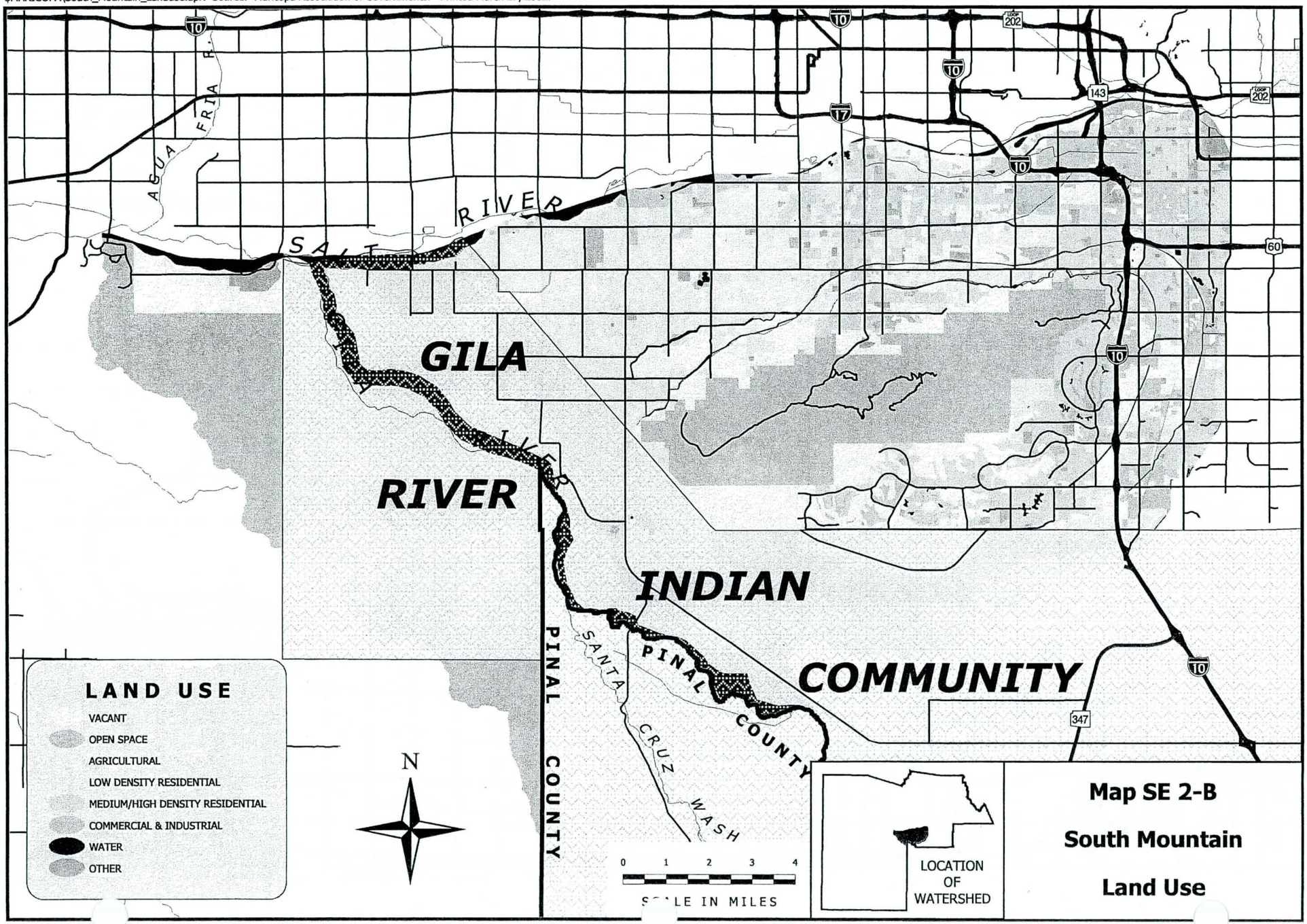
Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Flood Report, October 14, 1988 Storm", Flood Control District of Maricopa County.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

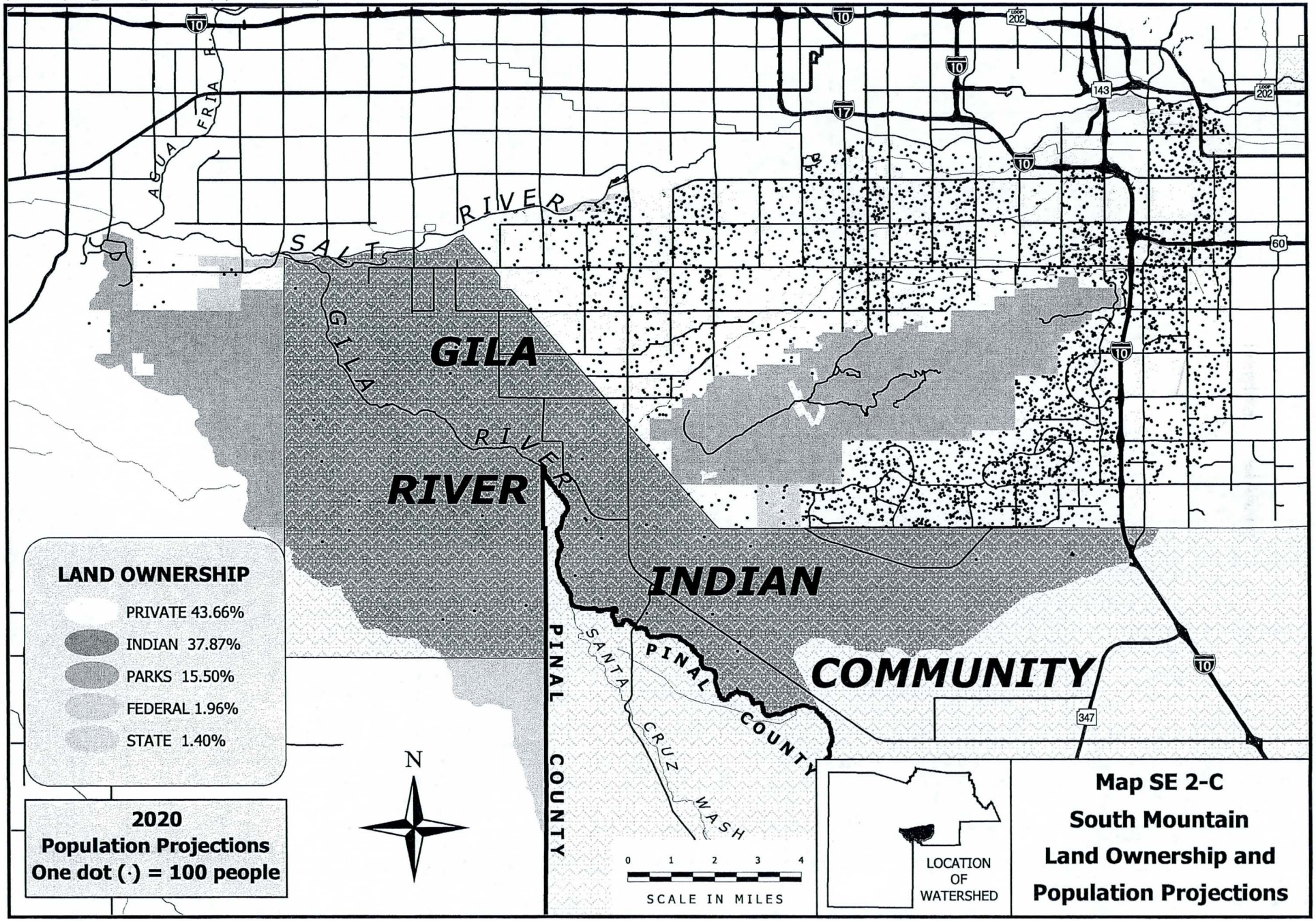
$MARICOPA\South_Mountain_Erosion.apr. Source: Natural Resources Conservation Service. Printed March 27, 2002.

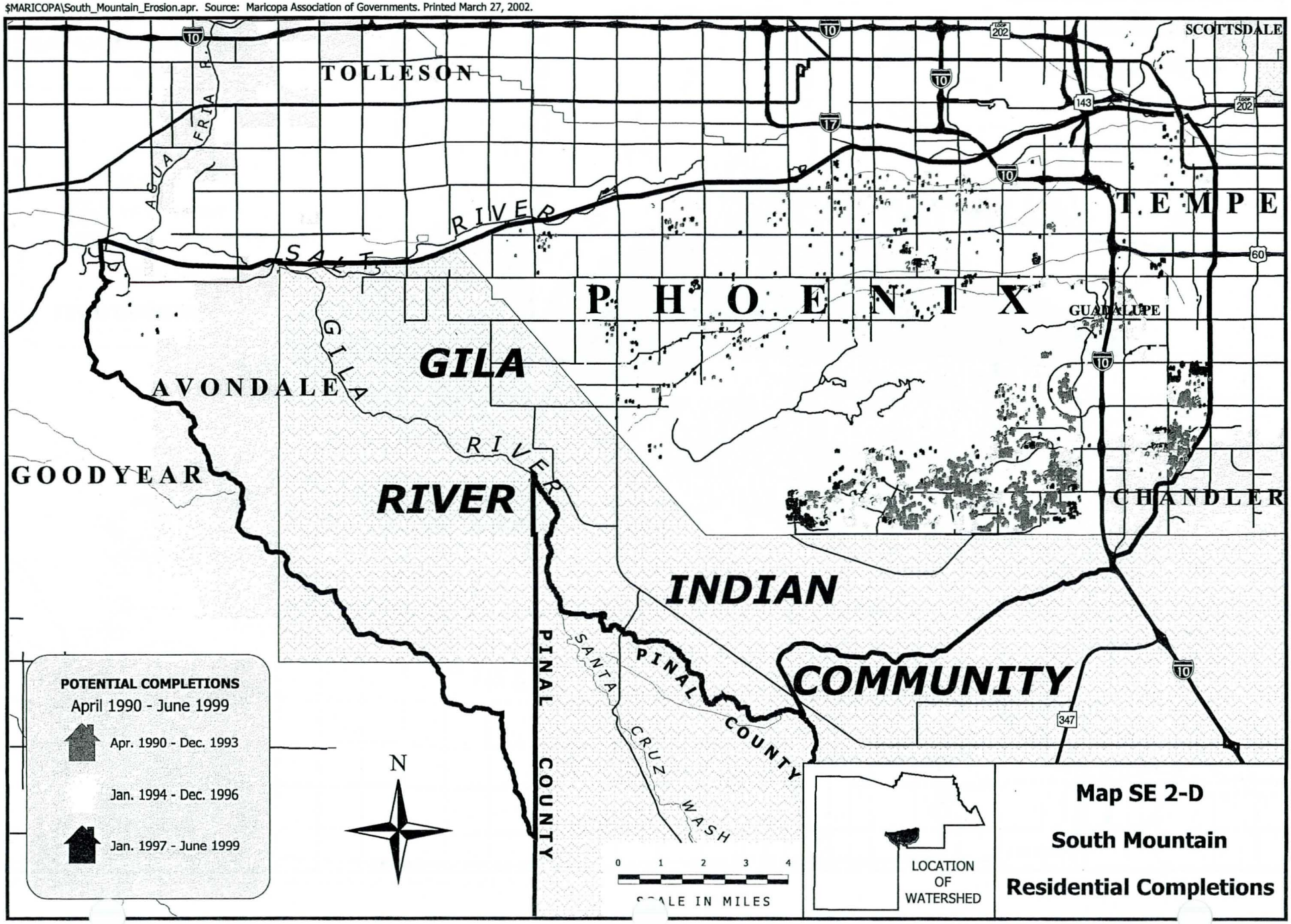


$MARICOPA\South_Mountain_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\South_Mountain_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.




$MARICOPA\South_Mountain_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.
TOLLESON
AGUA FRIA R.
SALT RIVER
SCOTTSDALE
TEMPE
PHOENIX
GUADALUPE
GILA RIVER
AVONDALE
GOODYEAR
CHANDLER
INDIAN COMMUNITY
PINAL COUNTY
SANTA CRUZ WASH
POTENTIAL COMPLETIONS
April 1990 - June 1999
Apr. 1990 - Dec. 1993
Jan. 1994 - Dec. 1996
Jan. 1997 - June 1999
N
0 1 2 3 4
SCALE IN MILES
LOCATION OF WATERSHED
Map SE 2-D
South Mountain
Residential Completions

LOWER EAST MARICOPA FLOODWAY WATERSHED

Table SE 3-1

Area of Land in Lower EMF Watershed, by Classification

	Acres	Sq. Mi.	Percent
Medium/High Density Residential	42,255	66.02	24.91%
Low Density Residential	10,449	16.33	6.16%
Commercial & Industrial	10,673	16.68	6.29%
Agricultural	59,254	92.58	34.93%
Open Space	4,701	7.35	2.36%
Vacant	32,582	50.91	16.35%
Water	2,406	3.76	1.21%
Other	7,322	11.44	3.67%
Out of County/Not Classified	29,676	46.37	14.89%
Total Area	199,317	311.43	100.00%

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Table SE 3-2

Land Ownership in Lower East Maricopa Floodway Watershed

	Land Area by Ownership Category		Percent of Total Area	
Land Ownership Category	Acres	Sq. Mi.	County Land Only	Entire Watershed
PRIVATE	130,856.8	204.46	0.02%	0.02%
INDIAN	36,130.5	56.45	0.02%	0.02%
OTHER	2,334.5	3.65	21.30%	18.13%
STATE	245.7	0.38	1.38%	1.17%
FEDERAL	41.6	0.06	77.14%	65.65%
COUNTY	31.7	0.05	0.14%	0.12%
OUT OF COUNTY/NOT CATEGORIZED	29,675.8	46.37		14.89%
Total	199,316.5	311.43	100.00%	100.00%

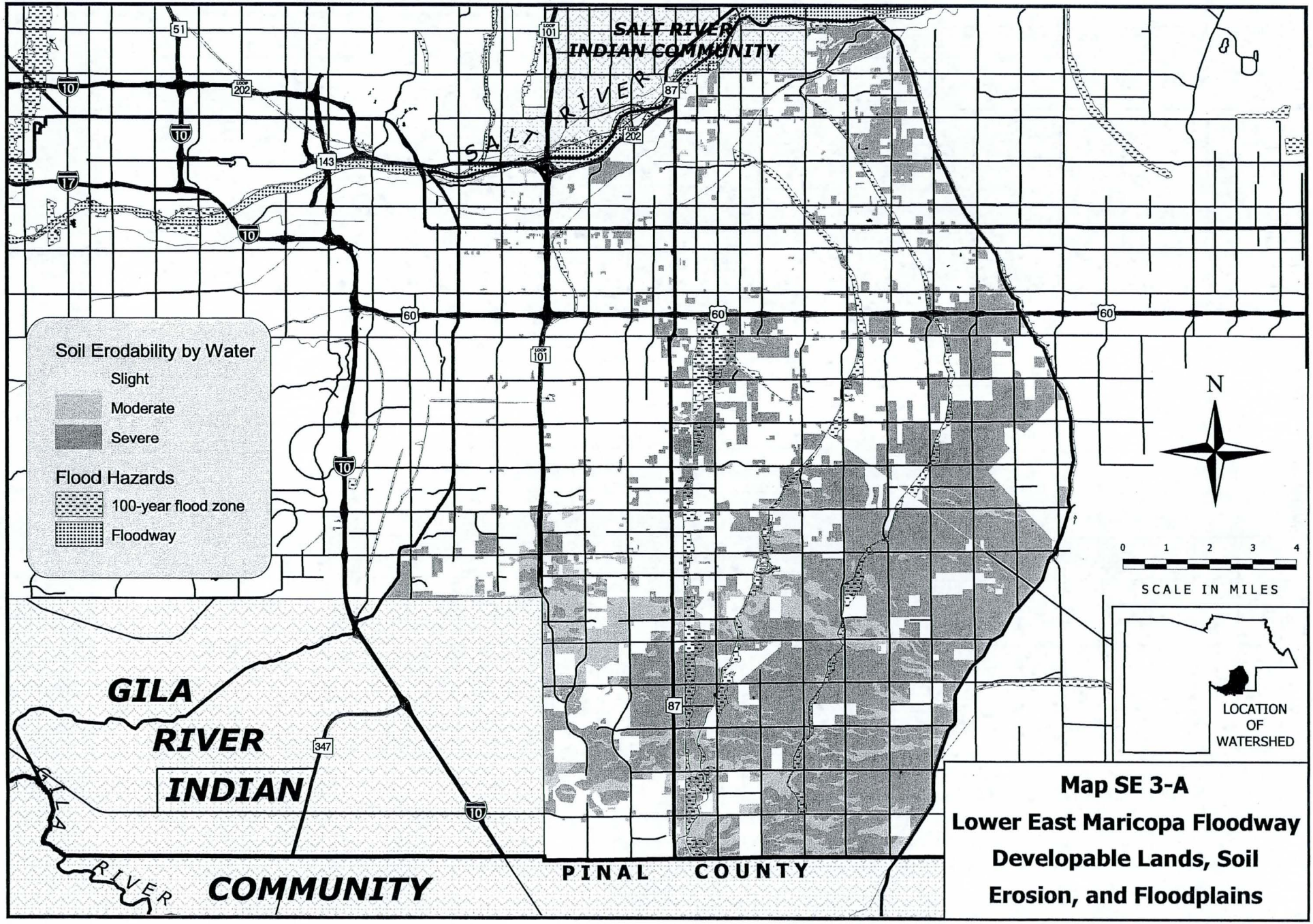
Table SE 3-3
Flood Damage History of Lower EMF Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	Flows from Queen Creek breached the north levee and flowed northwest through farmland. Erosion of Tri-City landfill sent about 55,000 cu. yds. of debris washed down river. 71 roads, streets and bridges reported closed. 6 Mesa families forced to evacuate their homes east of Country Club Dr.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges. Commercial and public lands incurred physical damages.	Salt River: 48th St.-Country Club Dr.: $9.4 million-public, $1.67 million commercial/industrial.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges. 4 sand and gravel operations damaged. Also, 5 damaged sand and gravel operations on Salt-River-Pima-Maricopa Indian Comm. Reported.	4 deaths-countywide, $16.3 million-public, $3.1million-residential, $5 million-agriculture, $3.9 million-sand & gravel on Salt River.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along Queen Creek.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

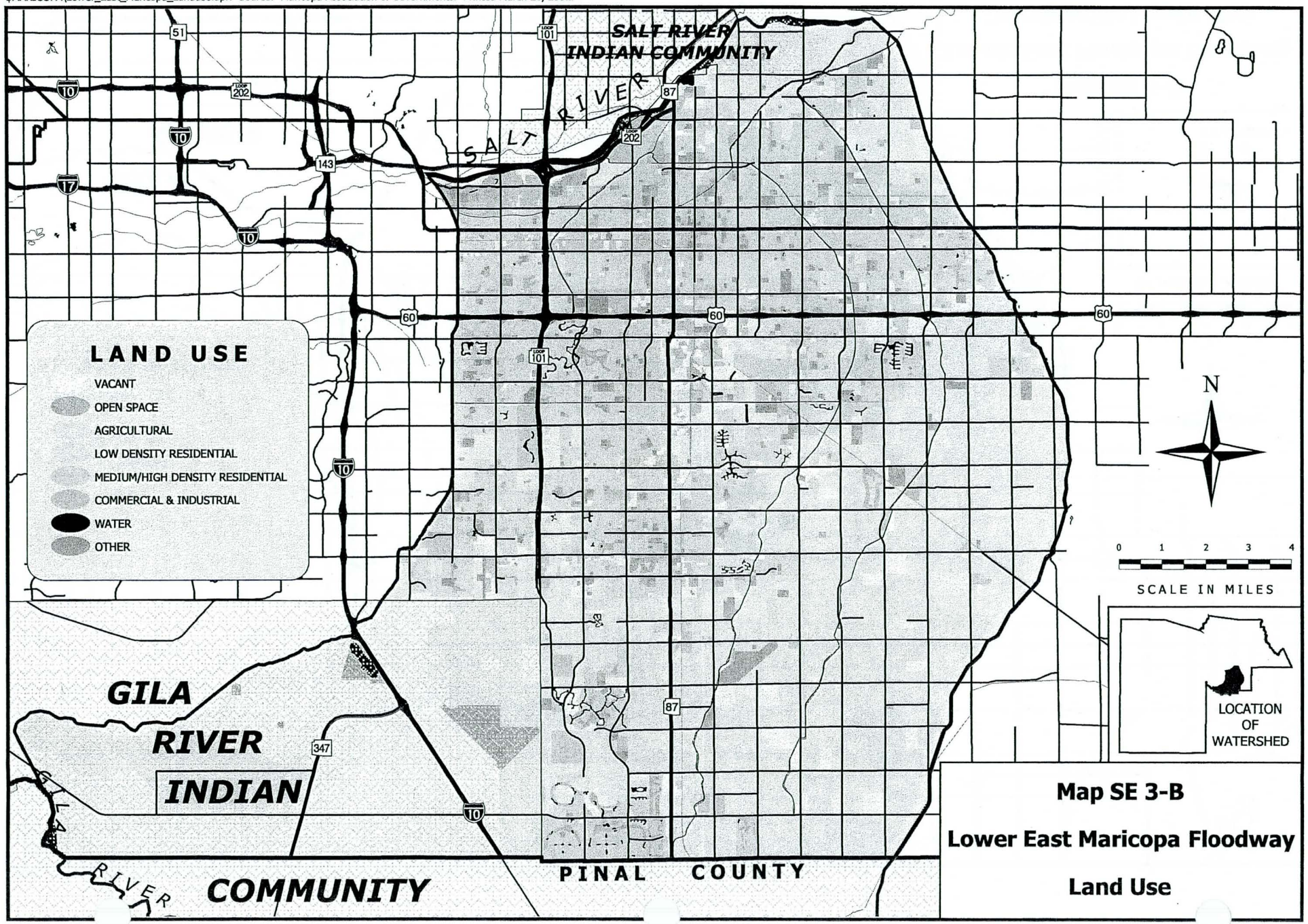
Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

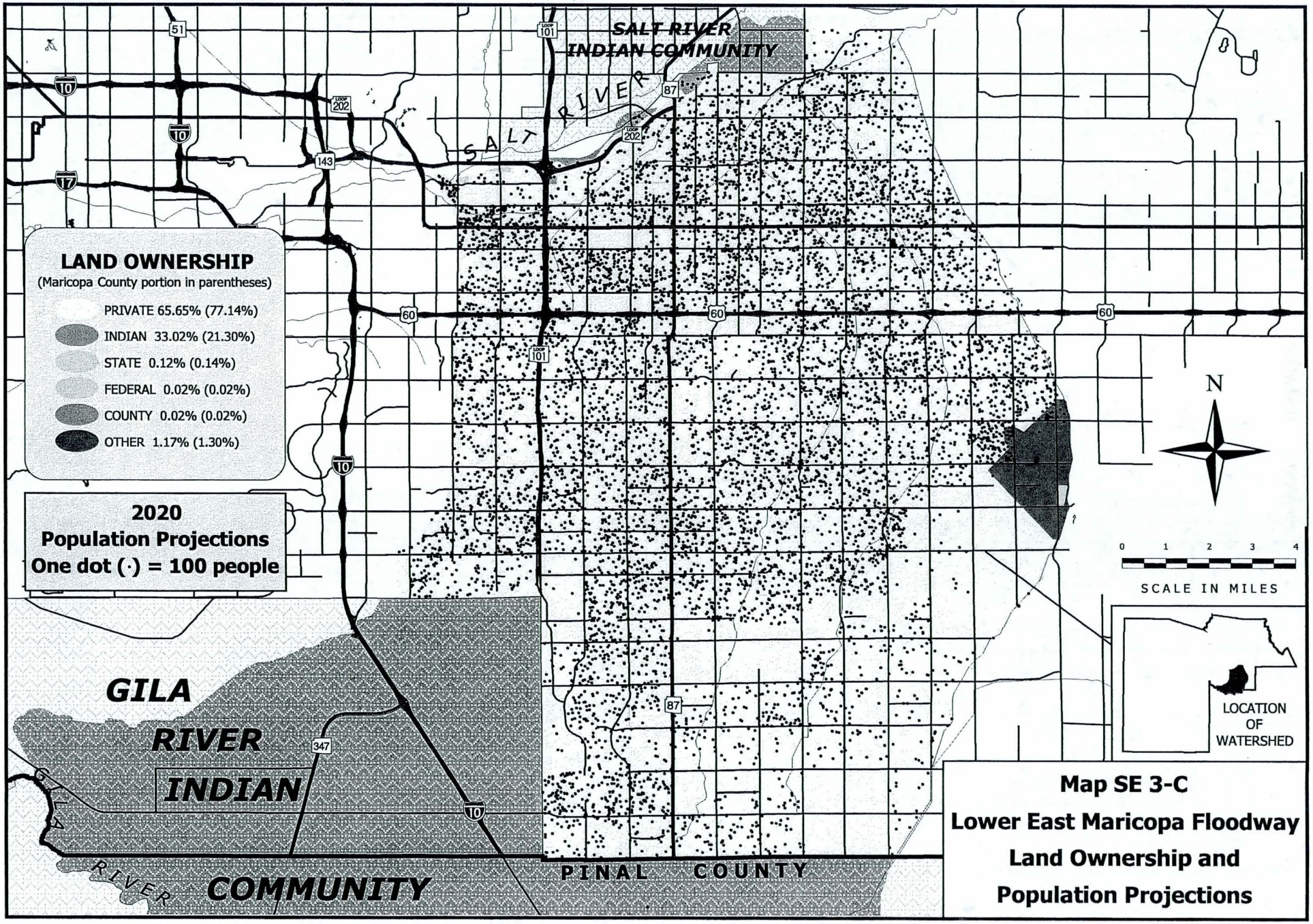
$MARICOPA\Lower_East_Maricopa_Erosion.apr. Source: Natural Resources Conservation Service. Printed March 26, 2002.



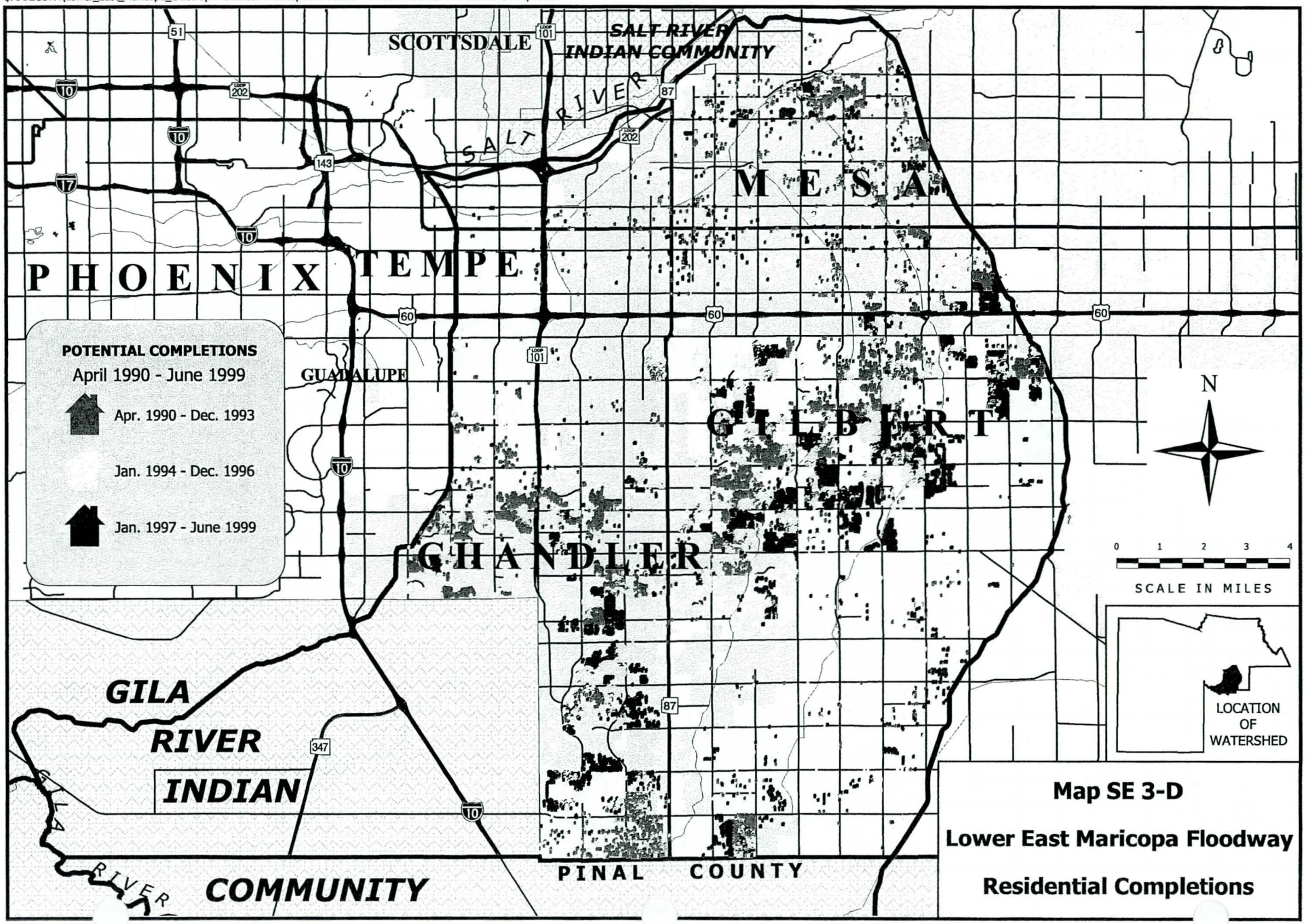
$MARICOPA\Lower_East_Maricopa_Landuse.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Lower_East_Maricopa_Landownership.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Lower_East_Maricopa_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



UPPER EAST MARICOPA FLOODWAY WATERSHED

Table SE 4-1

Land Use in the Upper EMF Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	13,885	21.70	3.57%
Low Density Residential	8,627	13.48	2.22%
Commercial & Industrial	7,374	11.52	1.90%
Agricultural	30,303	47.35	7.79%
Open Space	6,000	9.37	1.54%
Vacant	43,349	67.73	11.14%
Water	522	0.82	0.13%
Other	5,016	7.84	1.29%
Out of County/Not Classified	273,983	428.10	70.42%
Total Area	389,059	607.90	100.00%

Table SE 4-2

Land Ownership in Upper East Maricopa Floodway Watershed

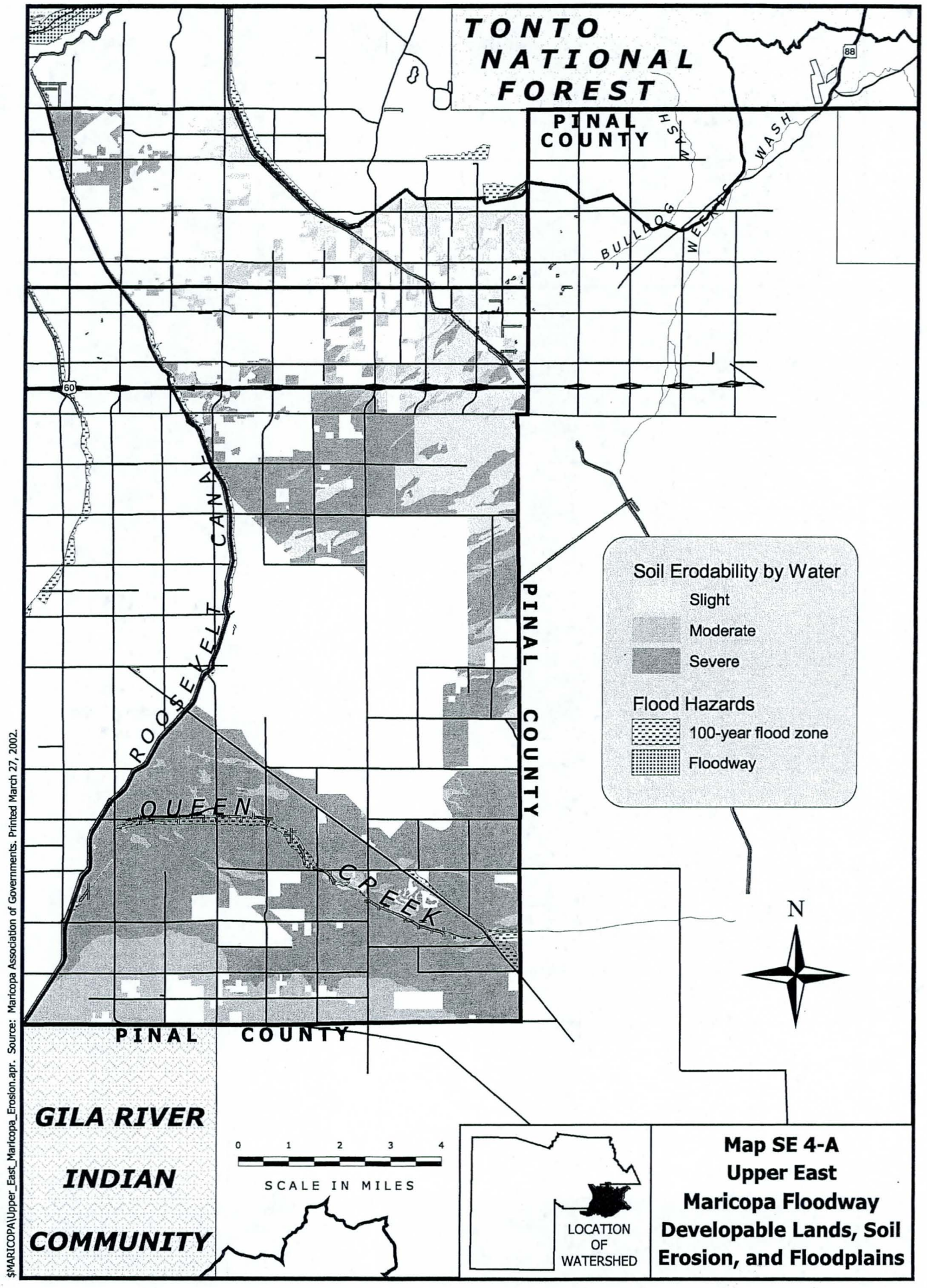
Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. M.	County Land Only	Entire Watershed
PRIVATE	64,265.9	100.42	0.85%	0.18%
OTHER (Williams Gateway Airport)	12,639.7	19.75	4.13%	0.89%
NATIONAL FOREST	3,467.6	5.42	15.04%	3.25%
STATE	2,466.1	3.85	0.61%	0.13%
FEDERAL	712.0	1.11	76.45%	16.52%
PARKS	510.1	0.80	2.93%	0.63%
OUT OF COUNTY/NOT CATEGORIZED	304,997.5	476.56		78.39%
Total	389,058.8	607.90	100.00%	100.00%

Table SE 4-3
Flood Damage History for the Upper EMF Watershed

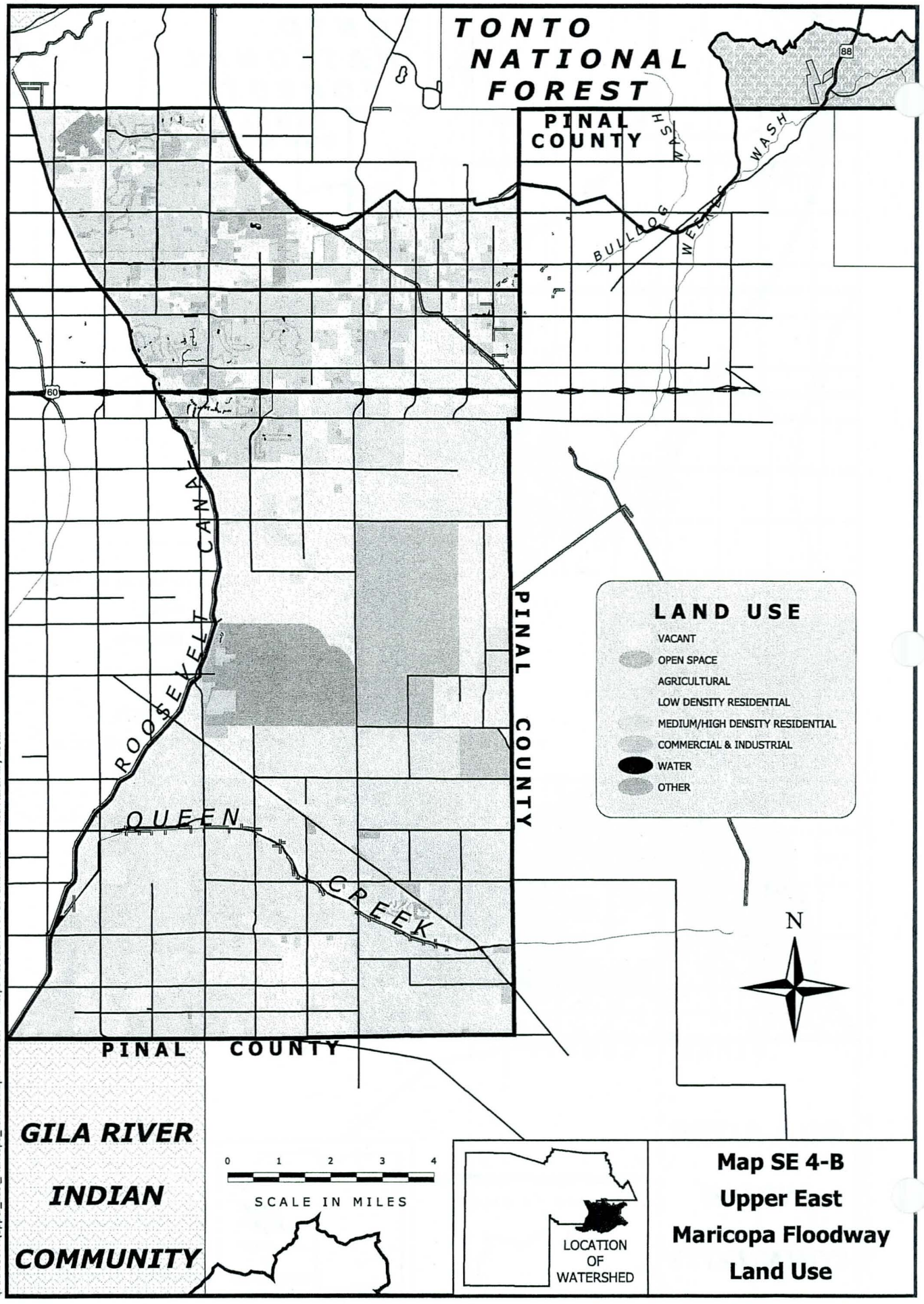
Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan- 8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	Flows from Queen Creek breached the north levee and flowed northwest through farmland. Erosion of Tri-City landfill sent about 55,000 cu. yds. of debris washed down river. 71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
17-18 Jul 84	17 Jul- 10:30 PM/ 18 Jul-1:00 AM	High intensity storm East Mesa to Apache Junction, centered over area between CAP Canal and Usury Mountain Park.	3.24 in. NW corner of Spook Hill drainage; 2.27in.-weighted average for region./ 3 hr./ 20 yr. storm.	Signal Butte Floodway, filled and overtopped its south berm in three locations, causing flooding. Mainly residential damages to houses and contents, sheds and garages, cars and trailers, landscaping, driveways and fences.	Over $2 million residential damages.
High runoff from 13-22 Feb 80	13 Feb- 10:00 AM/ 22 Feb- 12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec- 12:00 PM/ 20 Dec- 12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar- 4:00 PM/ 2 Mar- 4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along Queen Creek.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

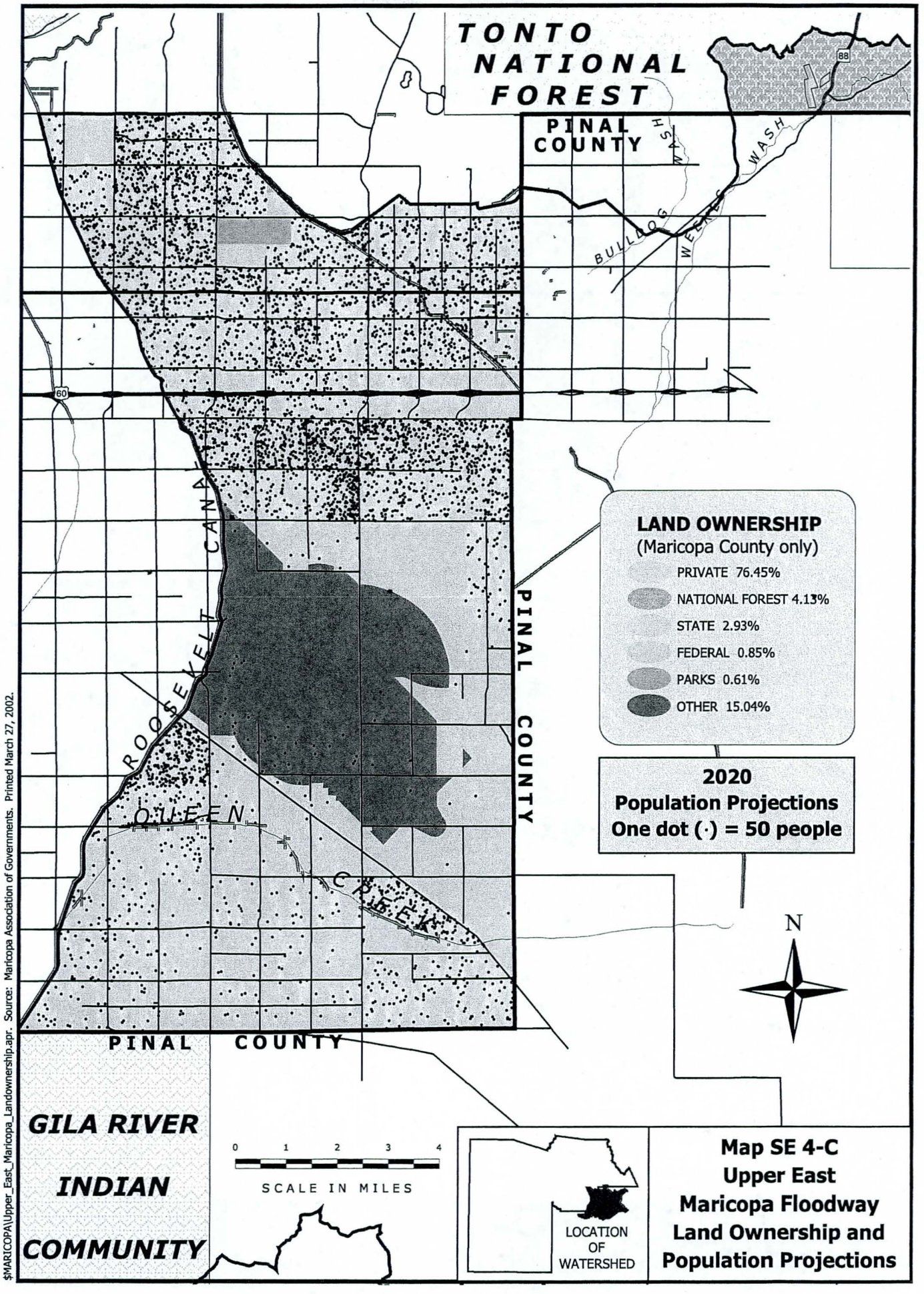
1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, LosAngeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Assessment of Flood Damages, Salt-Gila Aqueduct Reach 1B, July 17-18, 1984", October 1984, U.S. Bureau of the Interior, International Engineering Co., Inc.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.



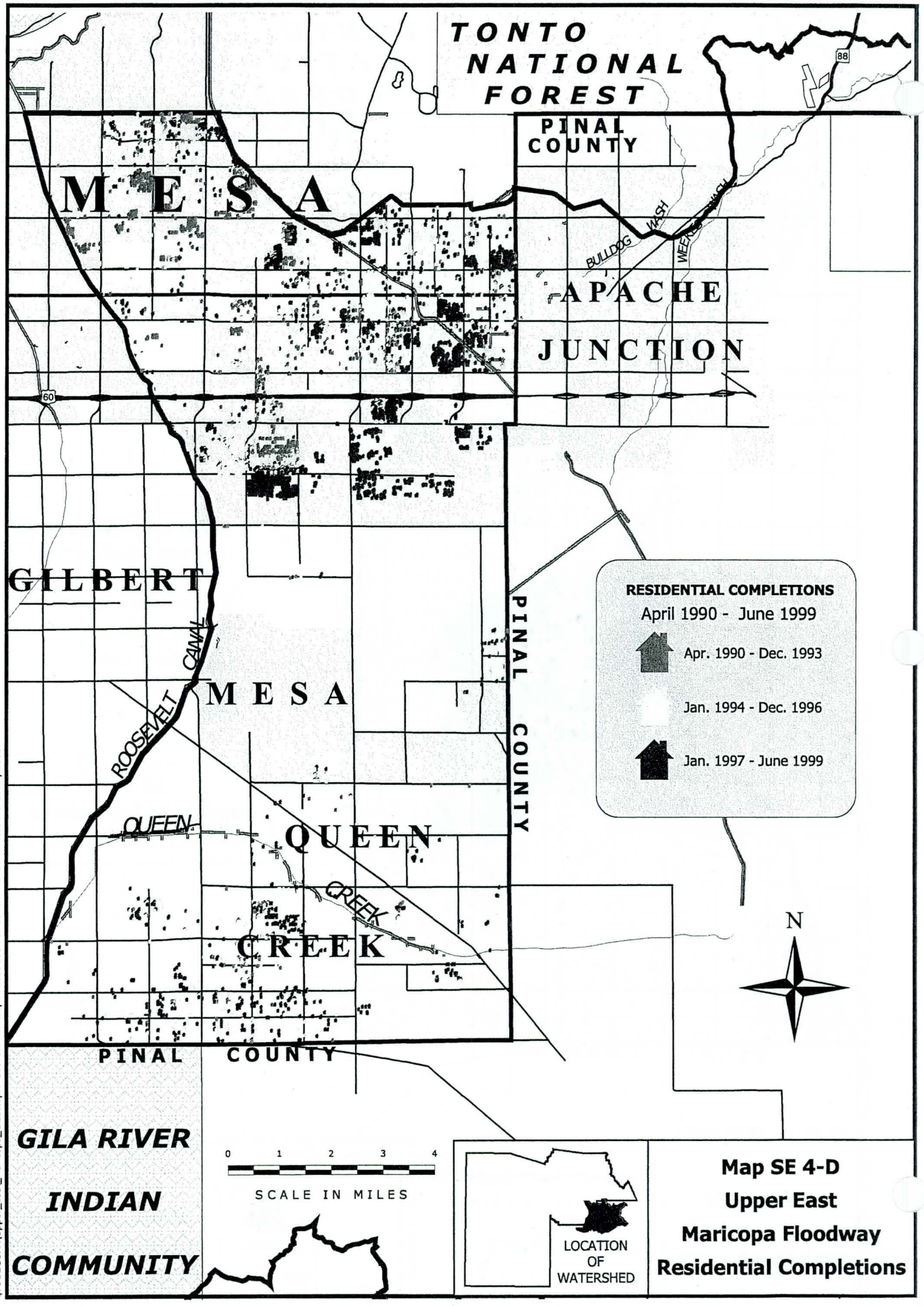
$MARICOPA\Upper_East_Maricopa_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_East_Maricopa_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_East_Maricopa_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_East_Maricopa_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

UPPER QUEEN CREEK WATERSHED

The Upper Queen Creek Watershed is the area that contributes flows to ..... This Watershed is located in Townships ....., Ranges ..... Runoff from the Upper Queen Creek Watershed runs into Queen Creek entering southeast Maricopa County. Runoff from this Watershed could contribute to floodwater and/or erosion damages in the Town of Queen Creek and surrounding areas. Flooding in this Watershed can have some impact on location of development and develpment of flood prevention measures in Maricopa County.

The Upper Queen Creek Watershed is about 143 square miles. The entire Watershed is located outside of Maricopa County in northeast Pinal County. Most of the Watershed is located in the southern portion of the Tonto National Forest. Information on population projections, land use, floodwater or erosion hazards for this Watershed were not developed for this Report.

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CAVE CREEK WATERSHED

Table NE 1-1

Land Use in Cave Creek Watershed

Classification	Acres	Sq. M.	Percent
Medium/High Density Residential	1,934	3.02	1.51%
Low Density Residential	16,363	25.57	12.79%
Commercial & Industrial	457	0.71	0.36%
Agricultural	42	0.07	0.03%
Open Space	46,164	72.13	36.09%
Vacant	56,236	87.87	43.96%
Water	2,481	3.88	1.94%
Other	219	0.34	0.17%
Out of County/Not Classified	4,018	6.28	3.14%
Total Area	127,914	199.87	100.00%

Table NE 1-2

Land Ownership in Cave Creek Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. M.	County Land Only	Entire Watershed
PRIVATE	55,796	87.18	45.03%	43.61%
NATIONAL PARKS	40,699	63.59	32.85%	31.81%
STATE	13,176	36.21	18.70%	18.12%
PARKS	2,989	4.67	2.41%	2.34%
FEDERAL	1,104	1.73	0.89%	0.86%
COUNTY	147	0.23	0.12%	0.11%
OUT OF COUNTY/NOT CATEGORIZED	4,018	6.28		3.14%
Total	127,929.2	199.89	100.00%	100.00%

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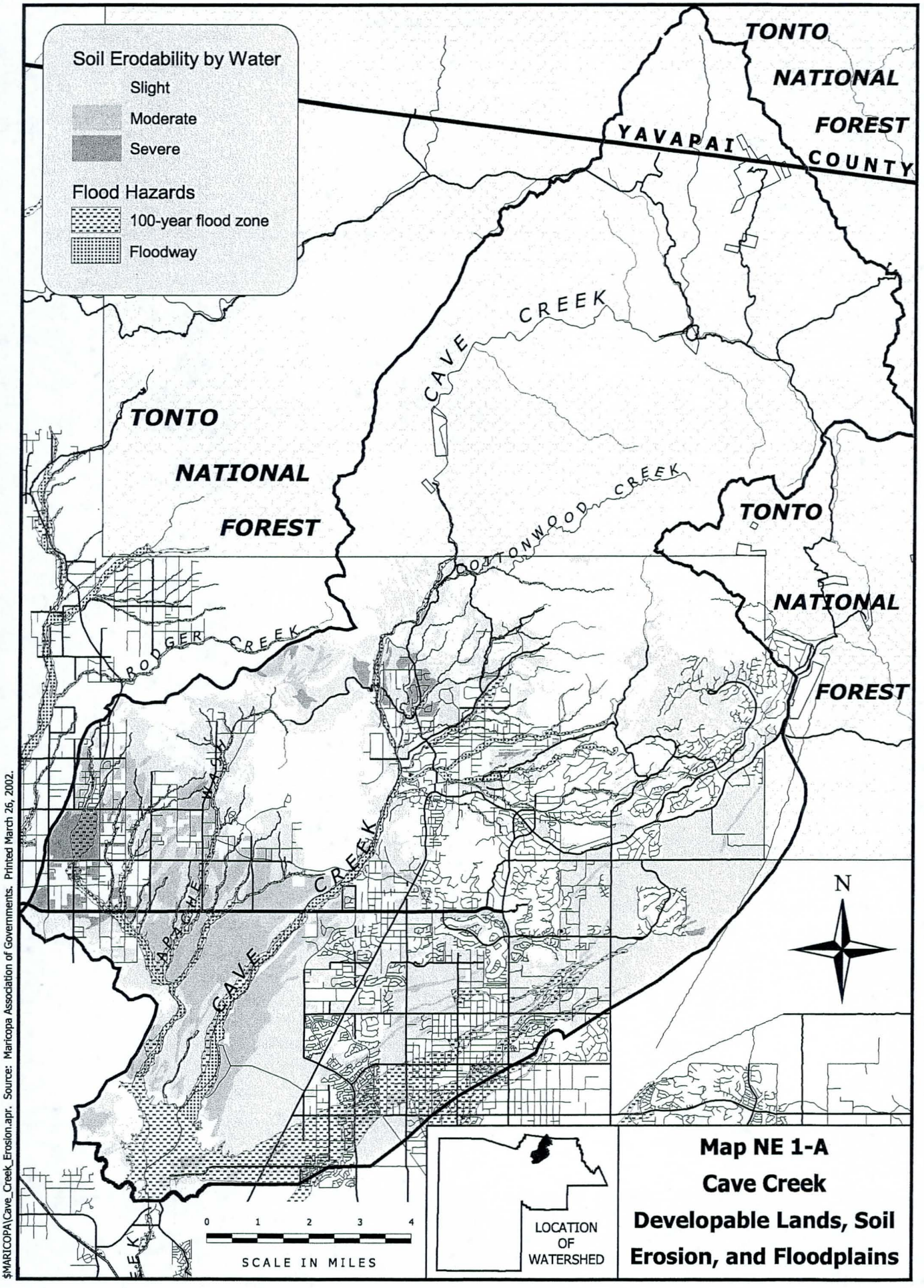
Table NE 1-3
Flood Damage History for Cave Creek Watershed

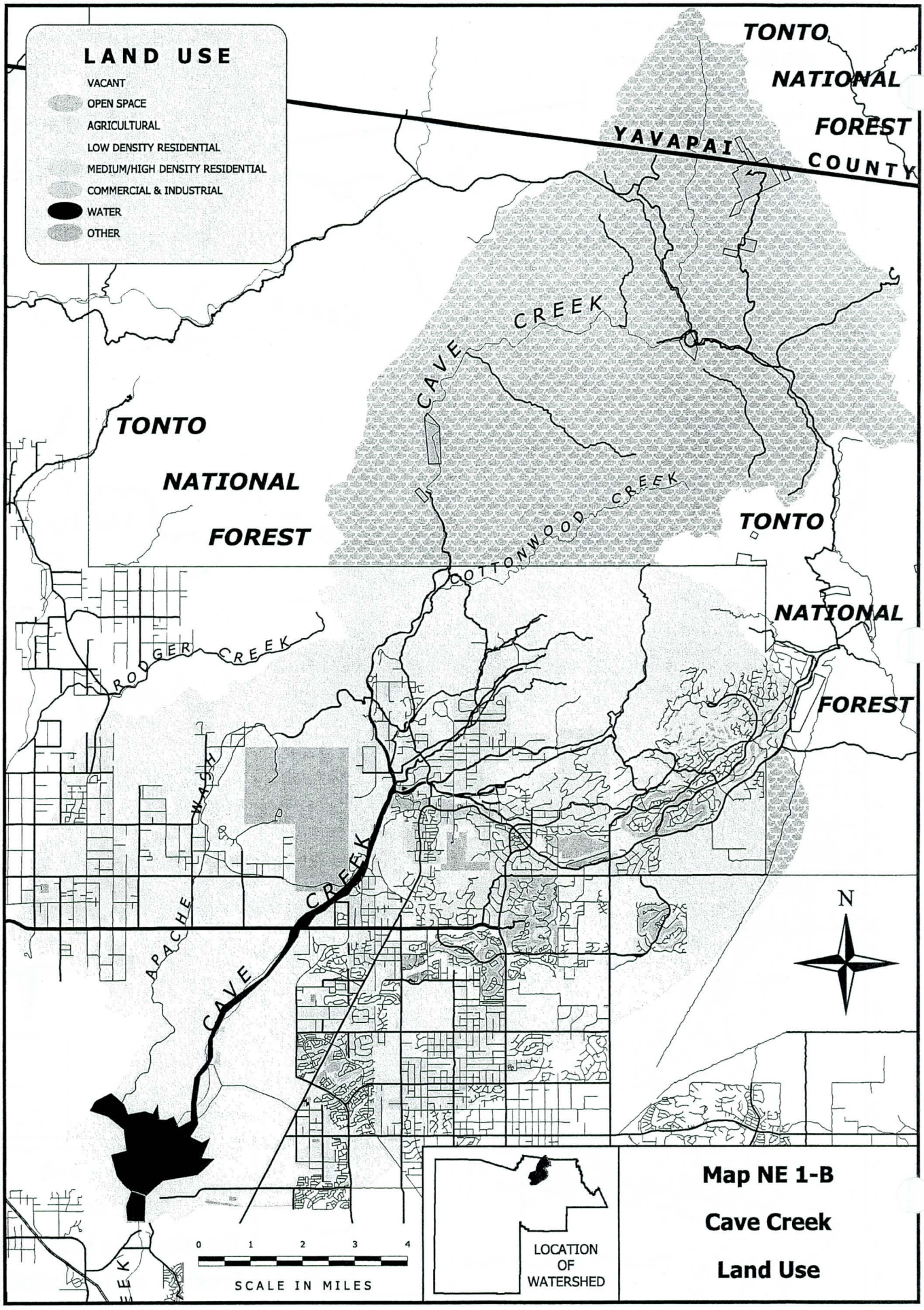
Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers and Rillito Creek.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
14-Oct-88	8:00 AM/ 4:00 PM	Metro Phoenix and Carefree.	2.32 in. at Sky Harbor Airport. 2.6 in. in Carefree./8 hr./ 15 yr. storm.	General flooding throughout Metro Phoenix. Arizona Canal overtopped due to inflows from Cave Creek.	Data not available.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix, 3-4 in. in northern foothills./Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	Total damages: $63.7 million-Phoenix Metro Area.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. NE of Phoenix-Mazatzal Mountains. 5 in.-Central Mountains/ 16-20 Dec.	Severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding along irrigation canals on north side of metro area, peak flow occurred on 2 Mar. 1 death occurred in City of Cave Creek.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential ($0.25 million in Cave Creek) $16 million-public.

Sources of Information:

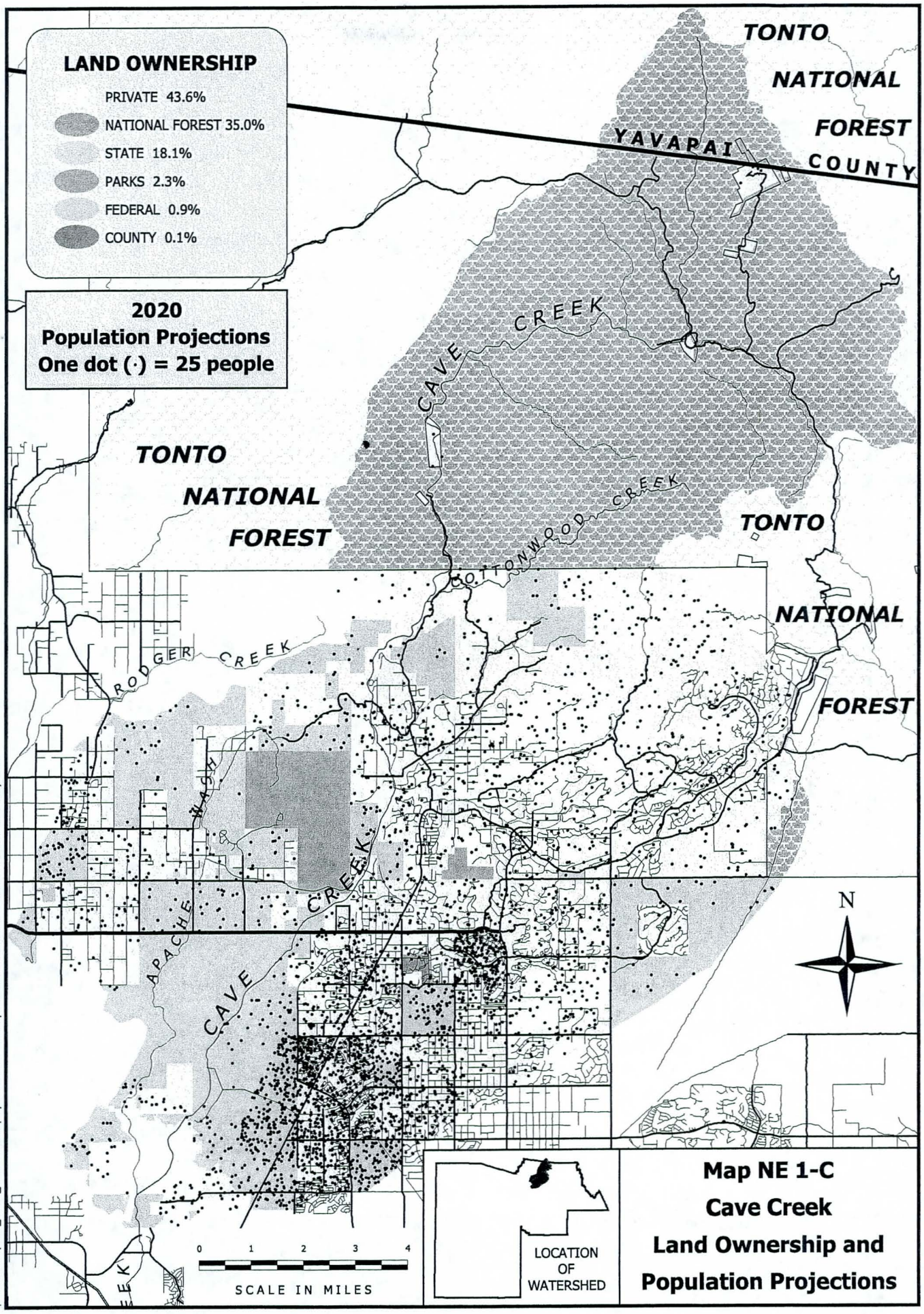
1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Flood Report, October 14, 1988 Storm", Flood Control District of Maricopa County.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", U.S. Army Corps of Engineers, November 1979.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.



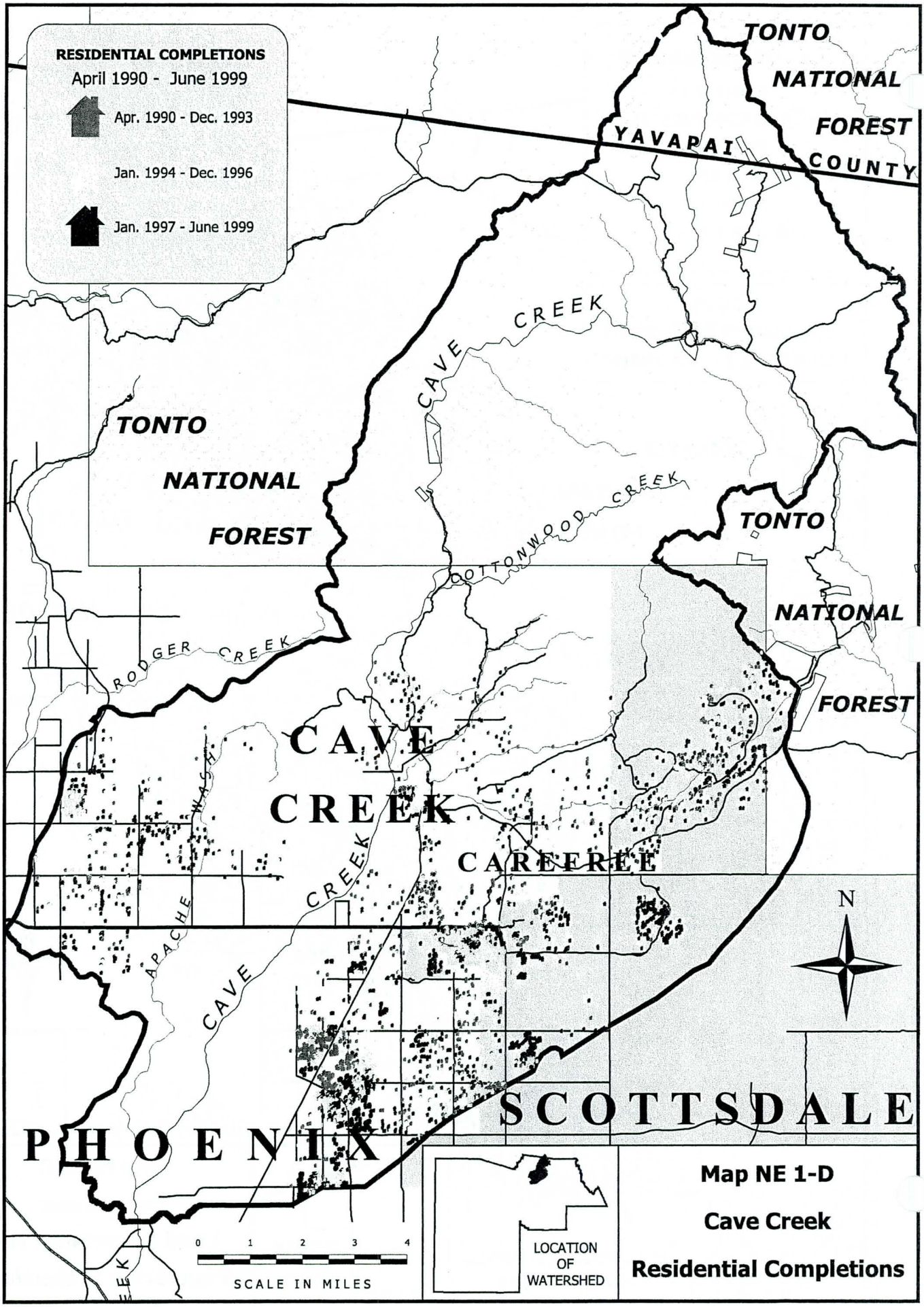
$MARICOPA\Cave_Creek_Erosion.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Cave_Creek_Landuse.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Cave_Creek_Landownership.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Cave_Creek_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

EVERGREEN WATERSHED

Table SE 2-1

Land Use in the Evergreen Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	276	0.43	1.12%
Low Density Residential	251	0.39	1.02%
Commercial & Industrial	61	0.09	0.25%
Agricultural	10	0.01	0.04%
Open Space	991	1.55	4.01%
Vacant	21,252	33.21	86.04%
Water	1,811	2.83	7.33%
Other	50	0.08	0.20%
Out of County/Not Classified			
Total Area	24,701	38.59	100.00%

Table SE 2-2

Land Ownership in the Evergreen Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
NATIVE AMERICAN	20,213	31.58	81.83%	81.83%
PRIVATE	4,092	6.39	16.57%	16.57%
FEDERAL	358	0.56	1.45%	1.45%
STATE	37	0.06	0.15%	0.15%
Total	24,701	38.59	100.00%	100.00%

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Table NE 2-3
Flood Damage Report for Evergreen Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges. Damage to Granite Reef Dam, city sewer systems, irrigation and flood control works. Landfill on the Salt River-Pima-Maricopa Indian Community damaged.	Salt River: Country Club Dr.-Granite Reef Dam: $0.23 million-commercial, $2.12 million-public.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Light residential damage, moderate damage to agriculture, commercial and industrial; severe damage to roads and bridges. Sand and gravel operations damaged: 1-Gila River, 9-Agua Fria River, 17-Salt River.	4 deaths-countywide, $16.3 million-public, $3.1million-residential, $5 million-agriculture, $3.9 million-sand & gravel on Salt River.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along tributaries of the Gila River, Queen Creek. 17 sand and gravel operations damaged along Salt River.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

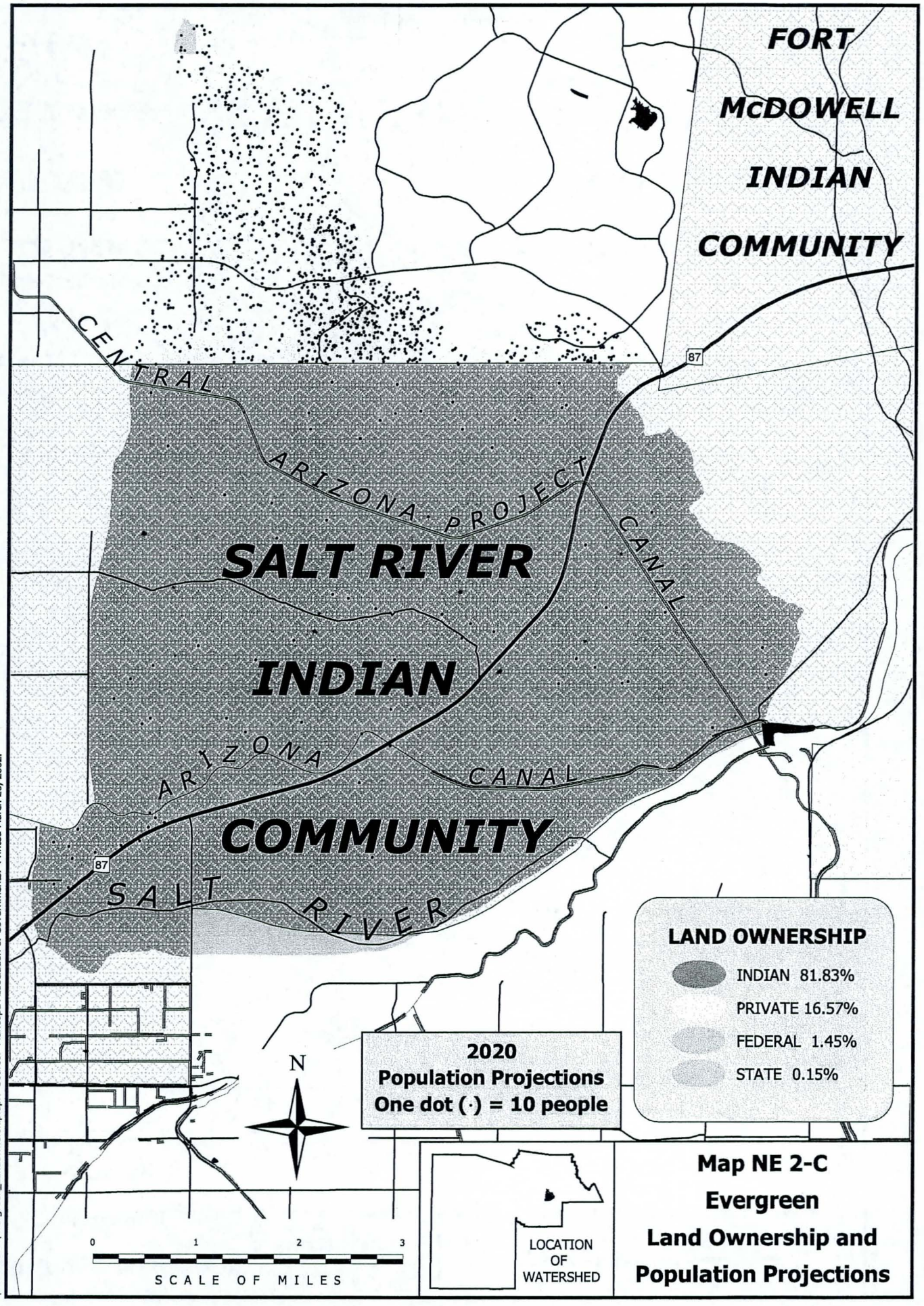
Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

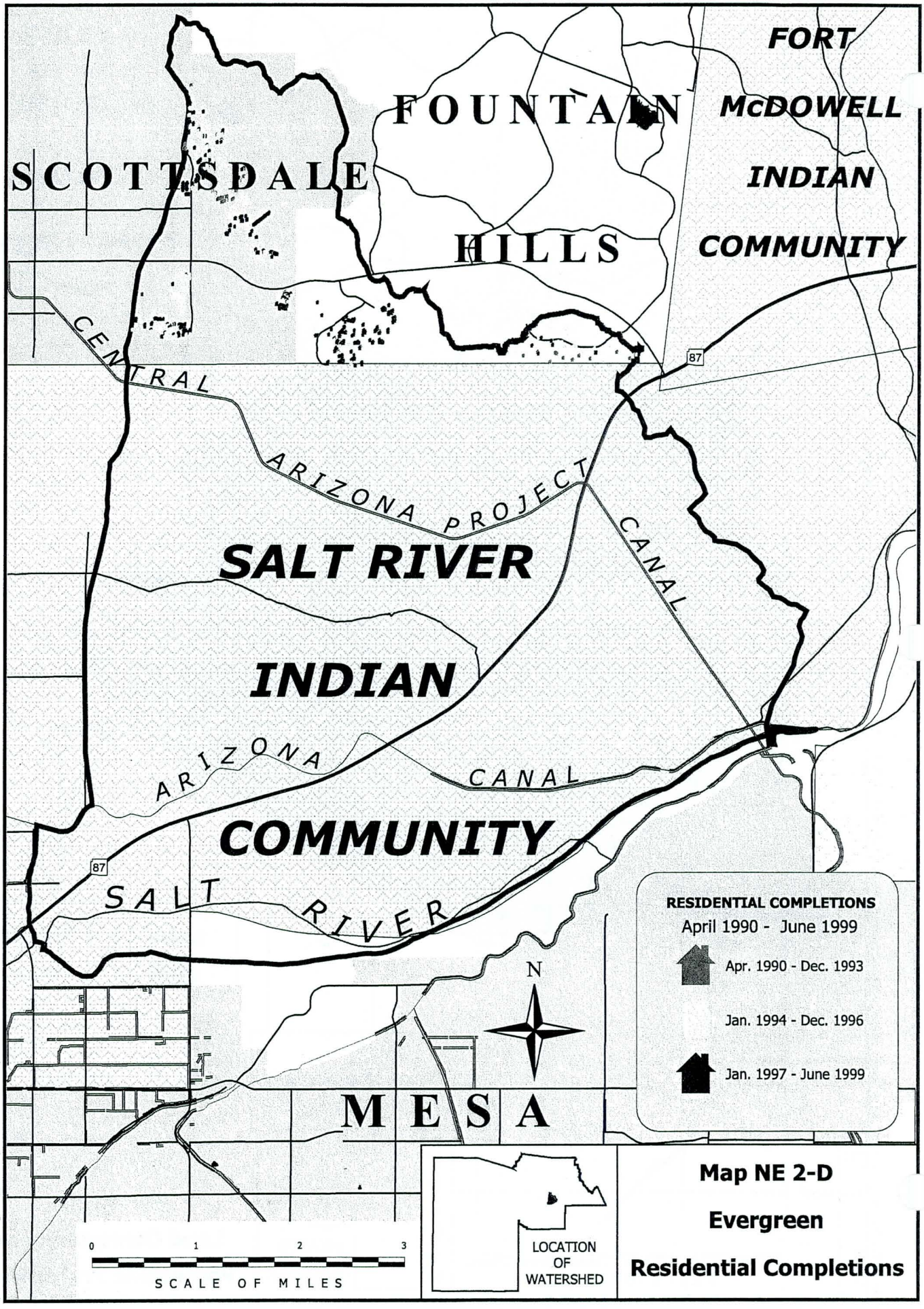
Map NE 2-A
Evergreen
Developable Lands, Soil Erosion, and Floodplains

$MARICOPA\Evergreen_Erosion.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

$MARICOPA\Evergreen_Landuse.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Evergreen_Landownership.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Evergreen_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

LOWER INDIAN BEND WATERSHED

Table NE 3-1
Land Use in the Lower Indian Bend Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	6,911	10.80	25.78%
Low Density Residential	1,672	2.61	6.24%
Commercial & Industrial	2,233	3.49	8.33%
Agricultural	9,371	14.64	34.95%
Open Space	1,581	2.47	5.90%
Vacant	2,998	4.68	11.18%
Water	1,068	1.67	3.98%
Other	977	1.53	3.65%
Out of County/Not Classified			
Total Area	26,810	41.89	100.00%

Table NE 3-2
Land Ownership in the Lower Indian Bend Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
INDIAN	13,947	21.79	52.02%	52.02%
PRIVATE	12,170	19.02	45.39%	45.39%
PARKS	525	0.82	1.96%	1.96%
FEDERAL	132	0.21	0.49%	0.49%
STATE	24	0.04	0.09%	0.09%
MILITARY	12	0.02	0.04%	0.04%
Total	26,811	41.89	100.00%	100.00%

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Table NE 3-3
Flood Damage History for Lower Indian Bend Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona.	1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	Erosion of Tri-City landfill sent about 55,000 cu. yds. of debris washed down river. 71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges (11 of 13 bridges or crossings were destroyed or damaged), Sky Harbor Airport, sewers, flood control structures. Landfill damaged on Salt River-Pima-Maricopa Indian Community.	Salt River: 48th St.-Country Club Dr.: $9.4 million-public, $1.67 million commercial/industrial.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Light residential damage, moderate damage to agriculture, commercial and industrial; severe damage to roads and bridges. 17 sand and gravel operations damaged along the Salt River.	4 deaths-countywide. $16.3 million-public, $3.1million-residential, $5 million-agriculture, $3.9 million-sand & gravel on Salt River.
High runoff from 28 Feb 78-3 Mar 78	1 Mar- 4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity. Extensive damage to commercial, industrial and public facilities.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $0.75 million - commercial.
22-Jun-72	Midnight/ 6:00 AM	Northeast Phoenix, affecting cities of Paradise Valley, Scottsdale, Tempe and Phoenix	3.85 in./6 hr./70 yr. storm.	14 miles of Indian Bend Wash and 16 miles of Arizona Canal from Cave Creek to Indian Bend Wash. Breaks and overtopping of Arizona and Grand Canal, and Indian Bend Wash. Extensive damage to residential, agriculture, parks, telephone utilities, streets, roads and bridges.	Total damages: $10.5 million in Phoenix Metro Area. $1.6 million-residential, $0.5 million-public, $0.47 million commercial.

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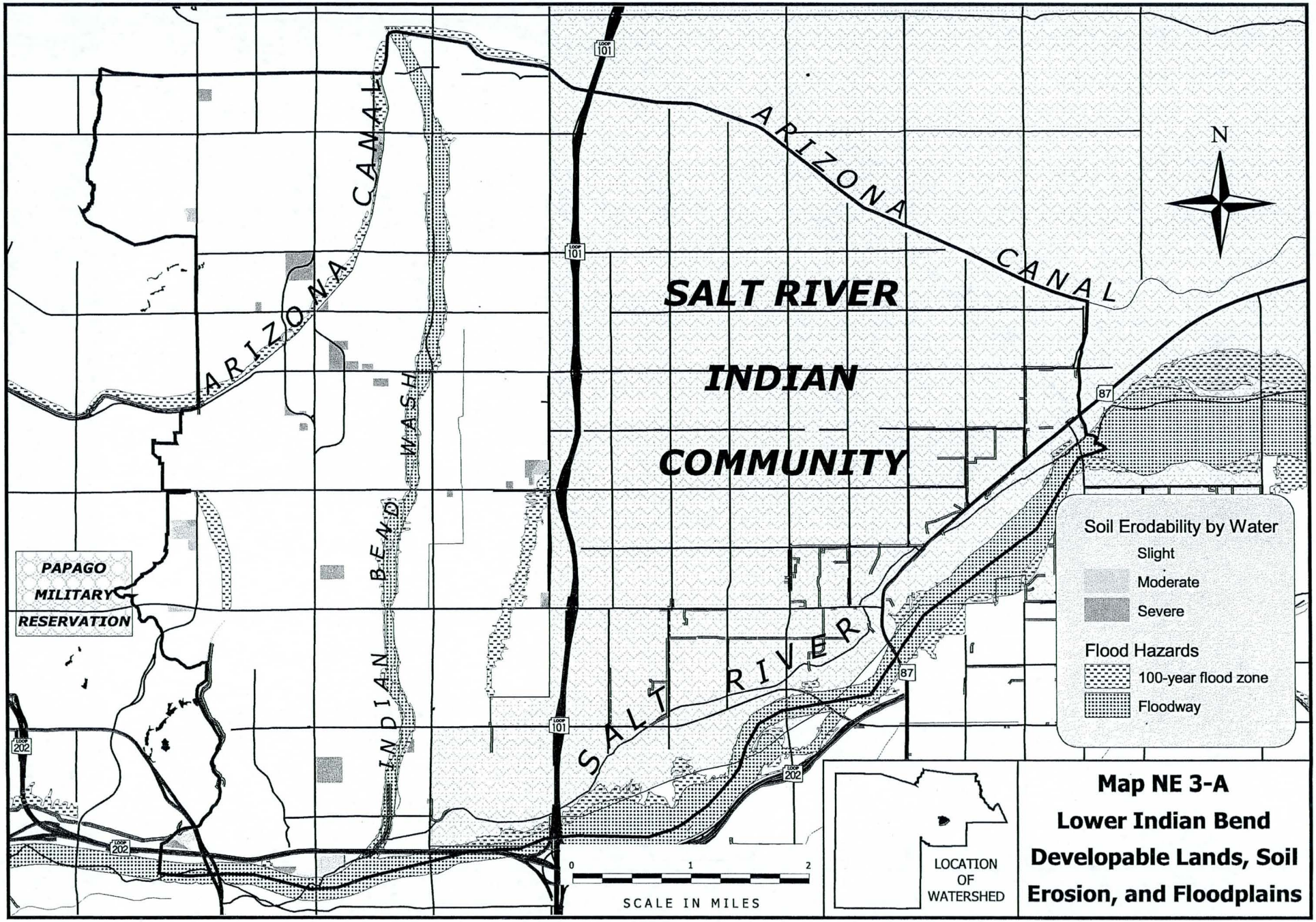
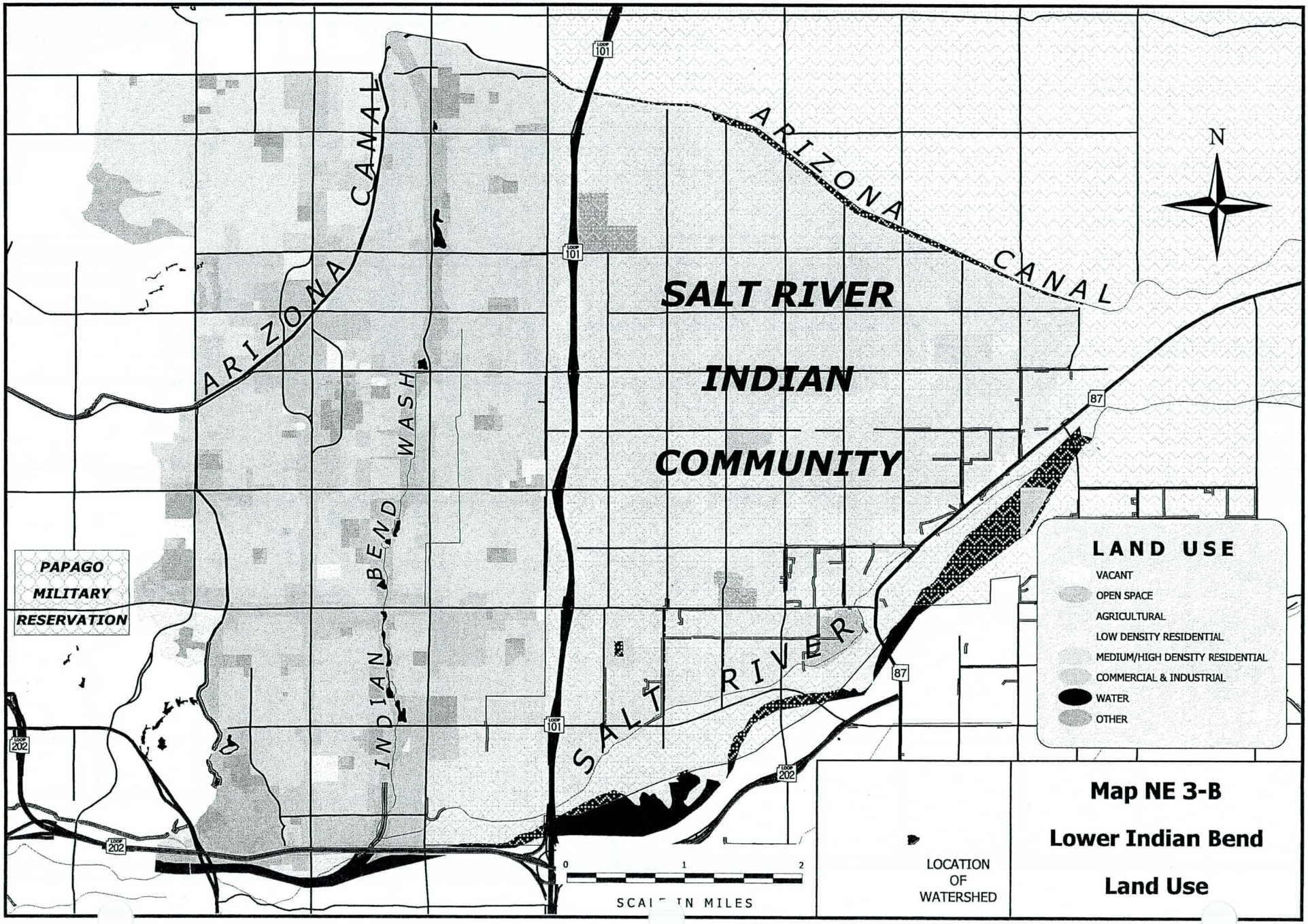
Sources of Information:
1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.
6. "Report on Flood of 22 June 1972, Phoenix Metropolitan Area, Arizona", U.S. Army Corps of Engineers, Los Angeles District, October 1972.

$MARICOPA\Lower_Indian_Bend_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

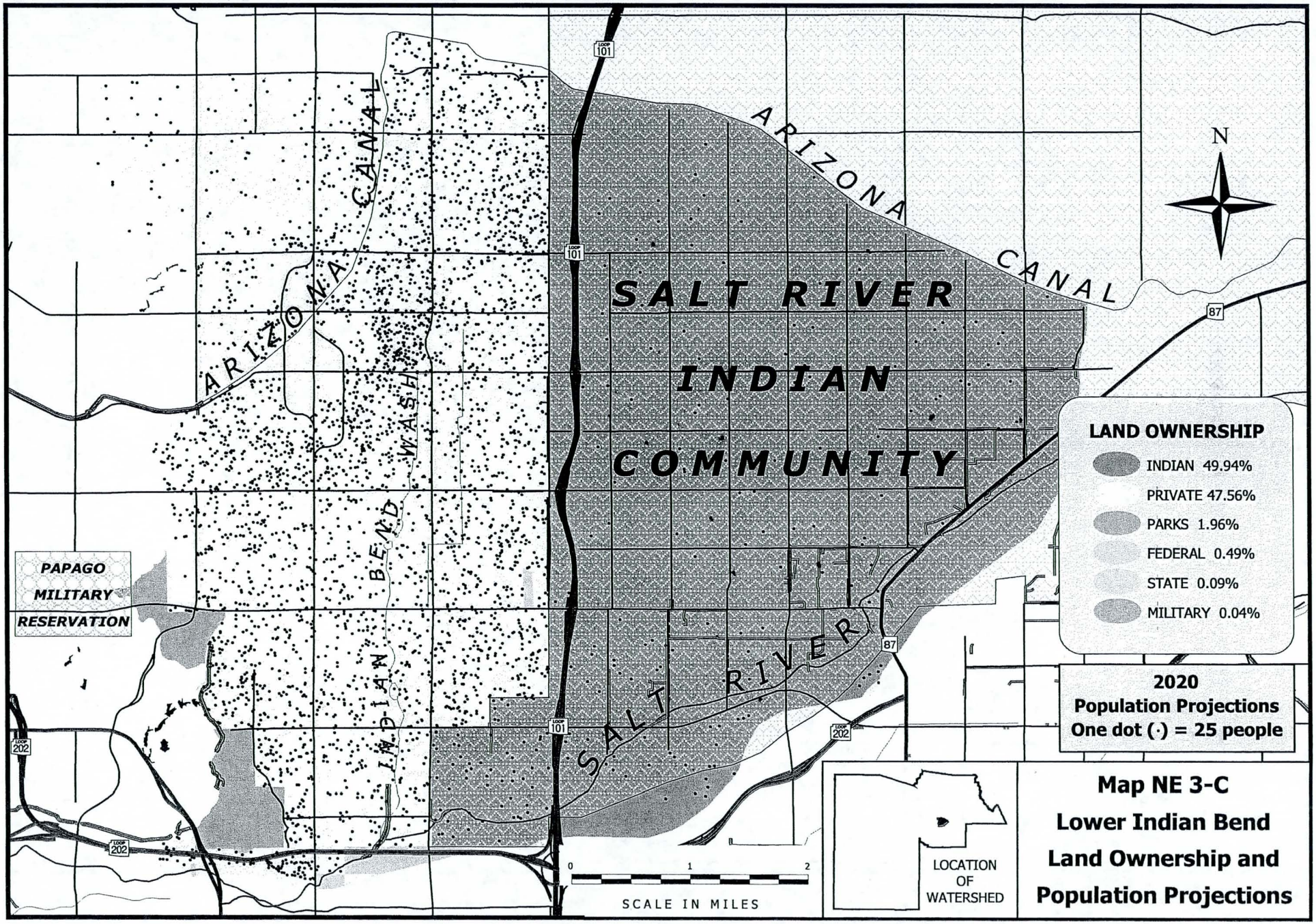


Map NE 3-A
Lower Indian Bend Developable Lands, Soil Erosion, and Floodplains

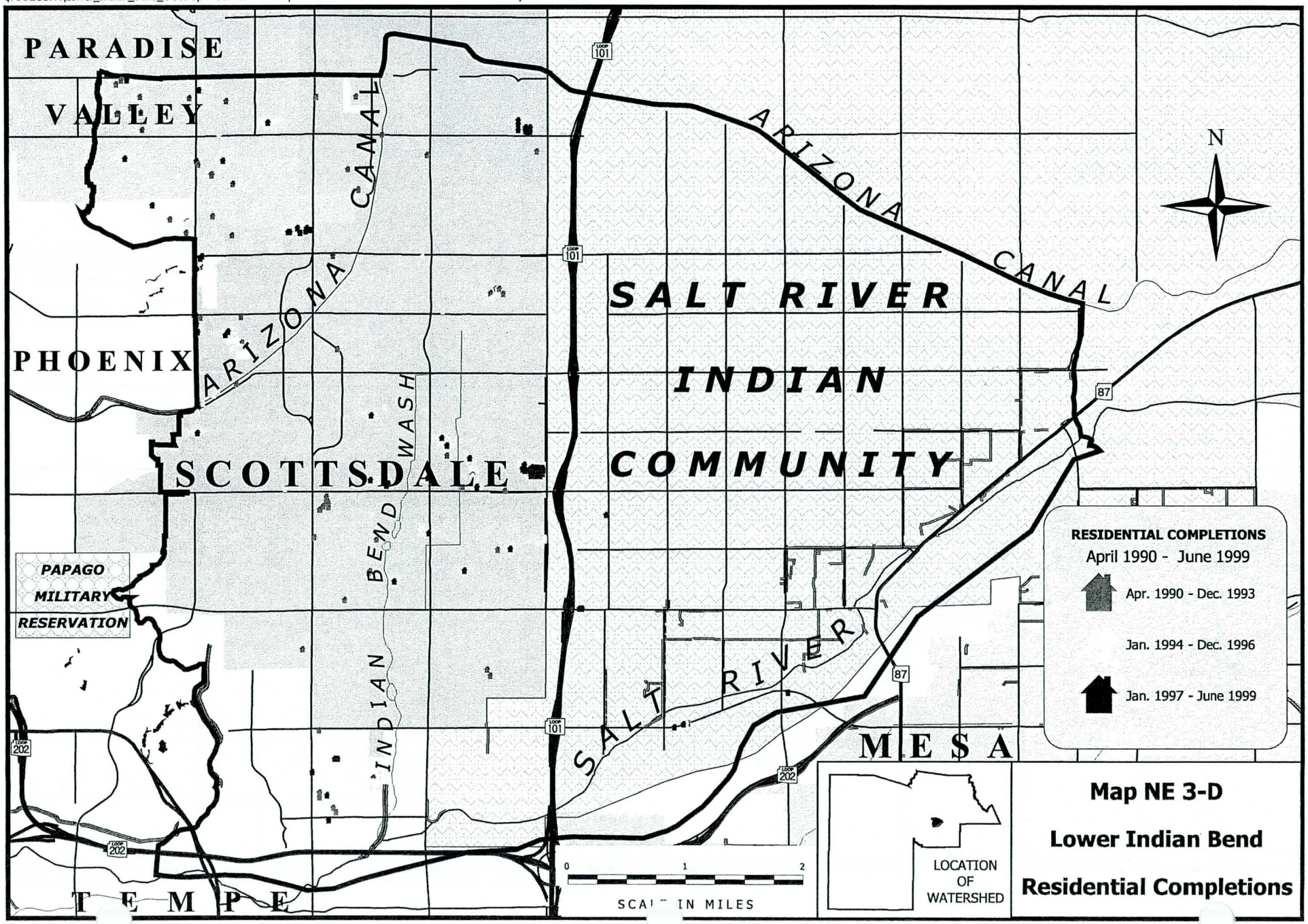
$MARICOPA\Lower_Indian_Bend_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Lower_Indian_Bend_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Lower_Indian_Bend_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



LOWER NEW RIVER WATERSHED

Table NE 4-1

Land Use in the Lower New River Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	8,200	12.81	30.93%
Low Density Residential	1,934	3.02	7.30%
Commercial & Industrial	950	1.48	3.58%
Agricultural	1,453	2.27	5.48%
Open Space	1,749	2.73	6.60%
Vacant	10,346	16.17	39.03%
Water	1,100	1.72	4.15%
Other	775	1.20	2.92%
Out of County/Not Classified			
Total Area	26,508	41.42	100.00%

Table NE 4-2

Land Ownership in the Lower New River Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
PRIVATE	23,951	37.42	90.36%	90.36%
STATE	2,387	3.73	9.00%	9.00%
PARKS	147	0.23	55.00%	55.00%
FEDERAL	24	0.04	0.09%	0.09%
Total	26,509	41.42	100.00%	100.00%

Table NE 4-3
Flood Damage History for Lower New River Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers and Rillito Creek.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges. Extensive residential damage averaging $2,000 per household.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in.-Central Mountains	Severe damage to roads and bridges. 9 sand and gravel operations damaged along Agua Fria River.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture, $1.3-million-sand & gravel on Agua Fria River.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila and Agua Fria Rivers.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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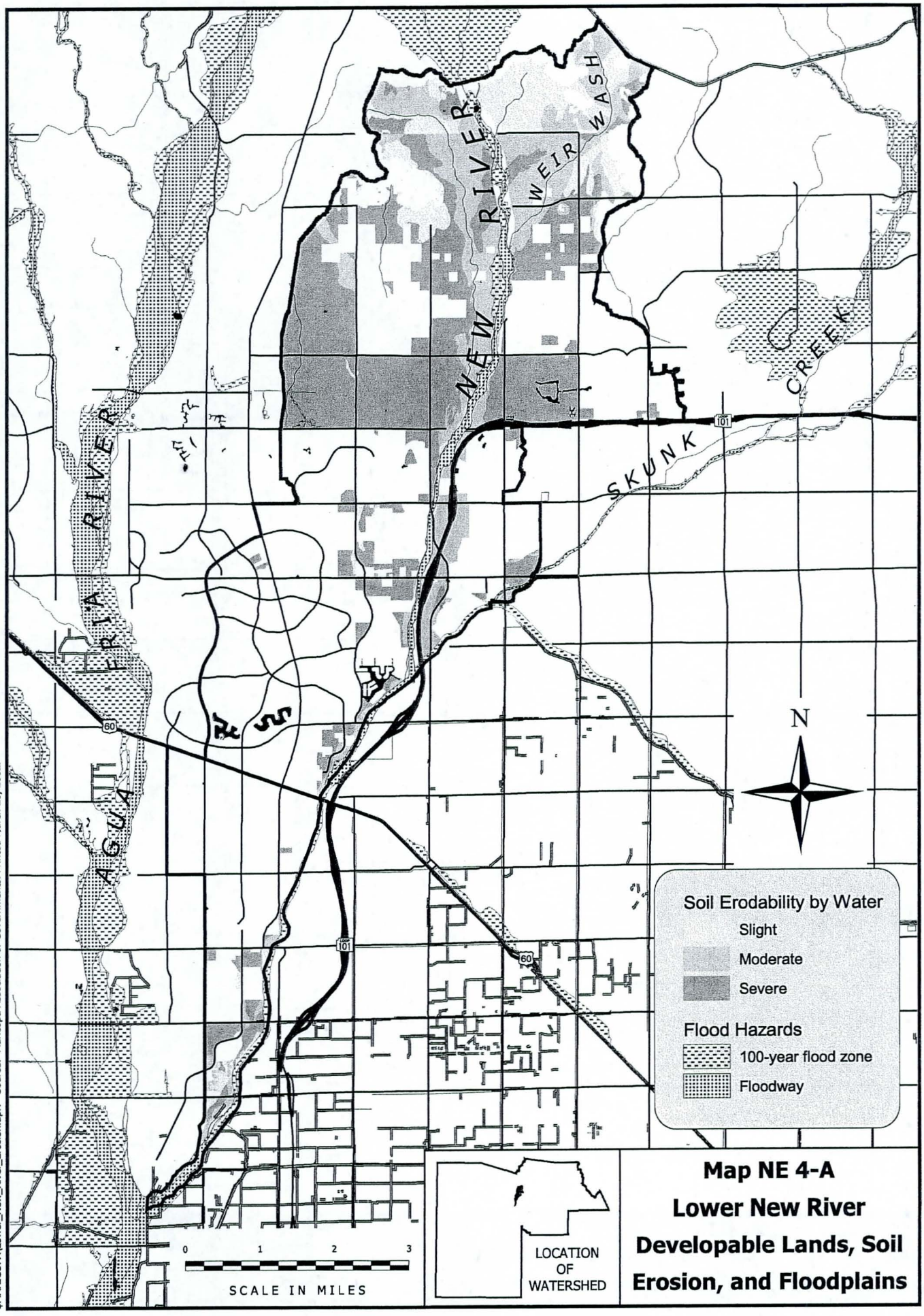
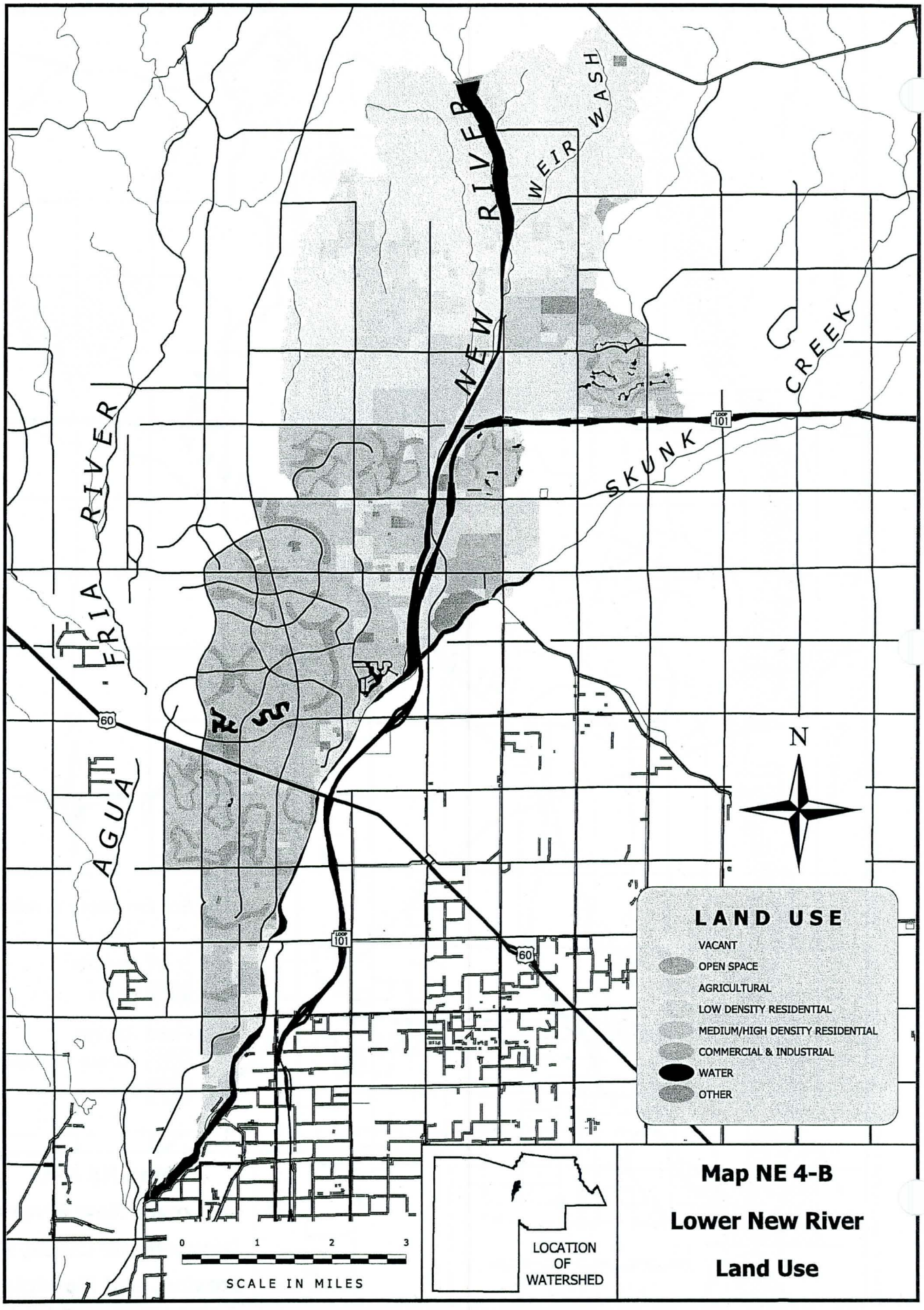
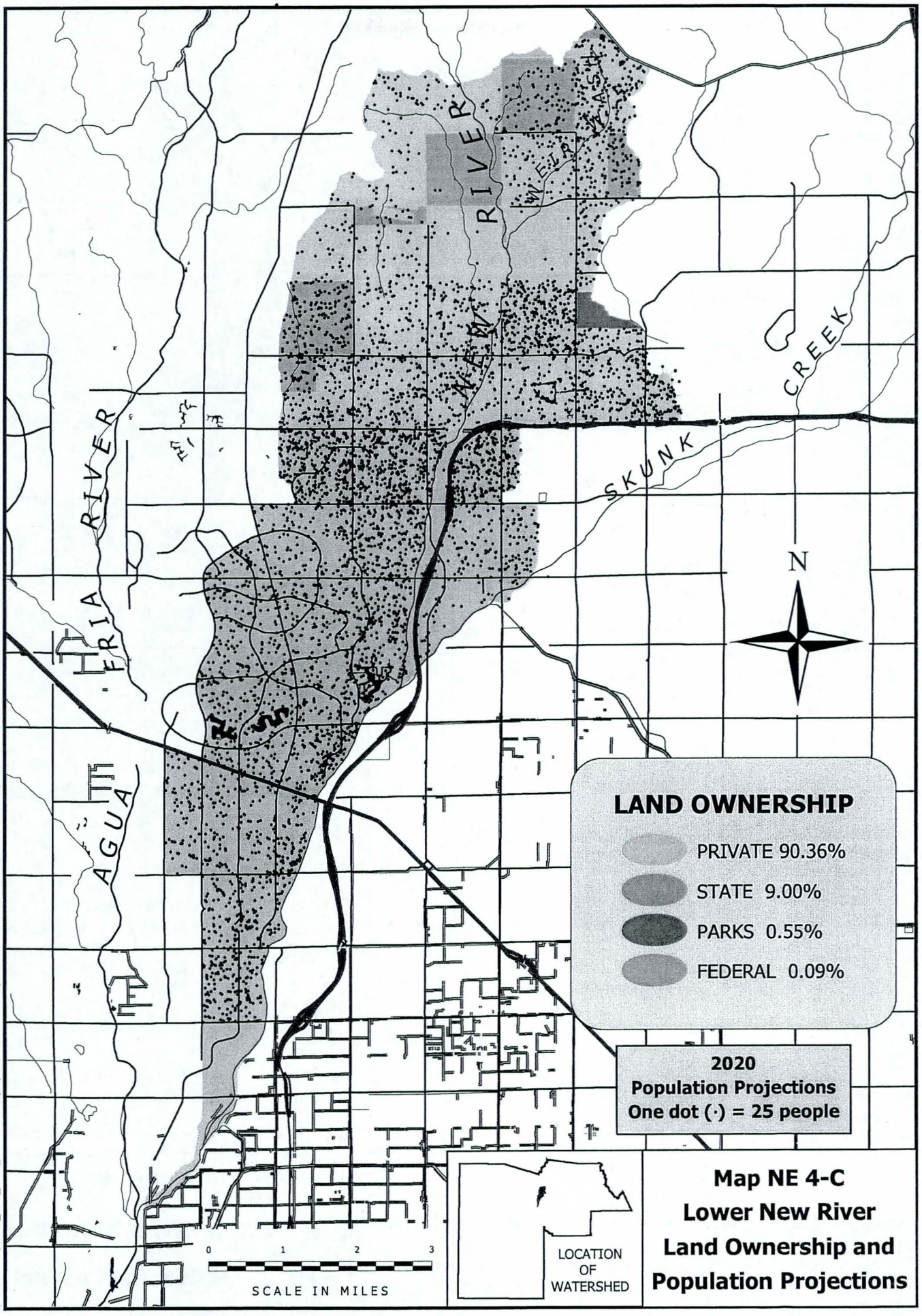


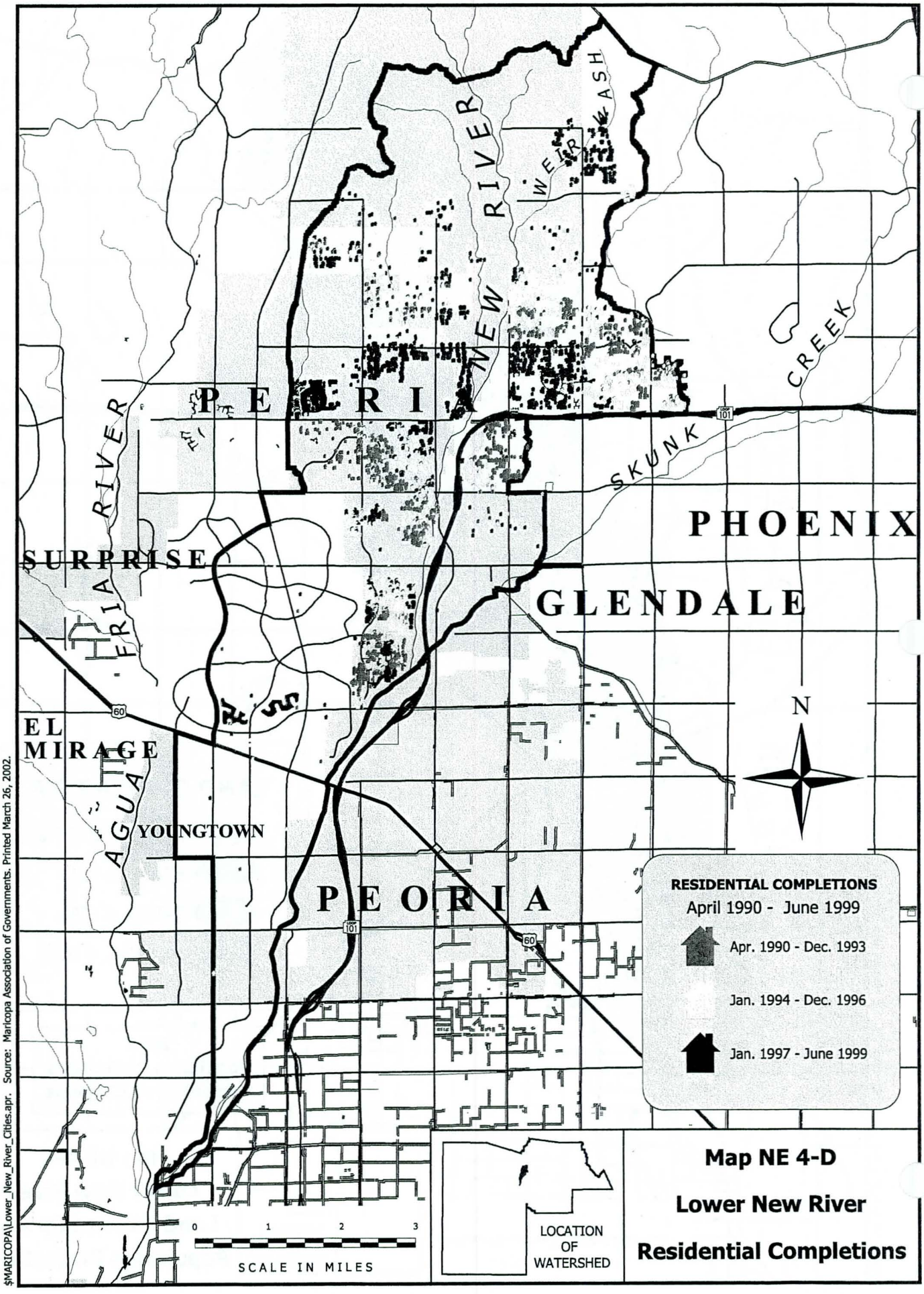
$MARICOPA\Lower_New_River_Erosion.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Lower_New_River_Landuse.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Lower_New_River_Landownership.apr. Source: Maricopa Association of Governments. Printed May 13, 2002.



$MARICOPA\Lower_New_River_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

LOWER VERDE WATERSHED

Table NE 5-1

Land Use in Lower Verde Watershed (Maricopa County Portion Only)

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	4,201	6.56	1.16%
Low Density Residential	8,215	12.84	2.26%
Commercial & Industrial	953	1.49	0.26%
Agricultural	1,367	2.14	0.38%
Open Space	267,460	417.91	73.74%
Vacant	70,893	110.77	19.54%
Water	4,360	6.81	1.20%
Other	233	0.36	0.06%
Out of County/Not Classified	5,035	7.87	1.39%
Total Area	362,717	566.75	100.00%

Table NE 5-2

Land Ownership in the Lower Verde Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
NATIONAL FOREST	239,189	373.73	66.87%	65.94%
PRIVATE	50,243	78.50	14.05%	13.85%
INDIAN	30,835	48.18	8.62%	8.50%
PARKS	24,584	38.41	6.87%	6.78%
STATE	10,348	16.17	2.89%	2.85%
FEDERAL	1,530	2.39	0.43%	0.42%
COUNTY	958	1.49	0.27%	0.26%
OUT OF COUNTY	5,035	7.87		1.39%
Total	362,718	566.75	100.00%	100.00%

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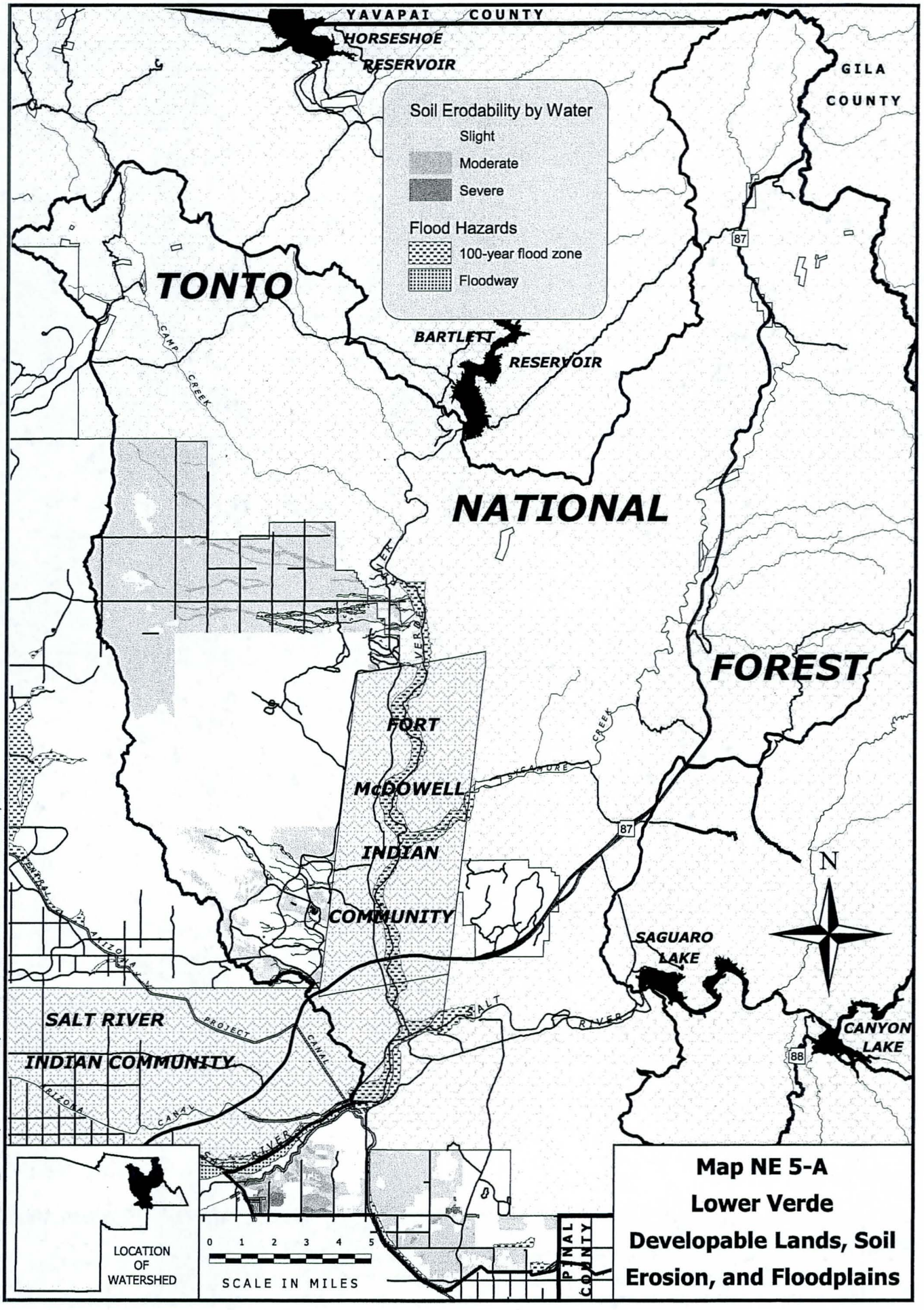
Table NE 5-3
Flood History for Lower Verde Watershed

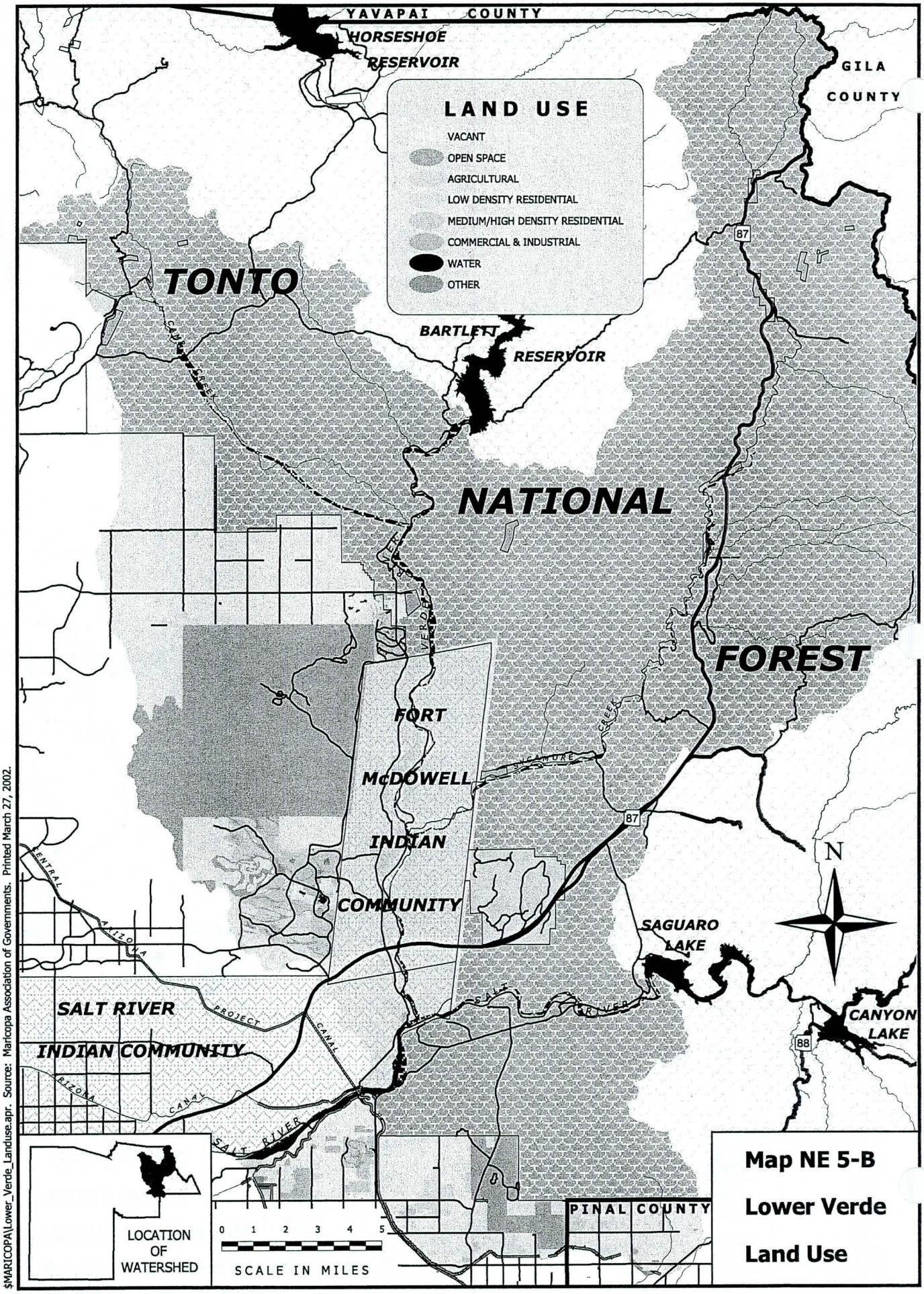
Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	Verde Water Treatment Plant received high water damage.	2 deaths-countywide, Public and private damages exceeded $38 million. $1 million repair to Verde Water Treatment Plant.
17-18 Jul 84	17 Jul-10:30 PM/ 18 Jul-1:00 AM	High intensity storm East Mesa to Apache Junction, centered over area between CAP Canal and Usury Mountain Park.	3.24 in. NW corner of Spook Hill drainage; 2.27in.-weighted average for region./ 3 hr./ 20 yr. storm.	Signal Butte Floodway, filled and overtopped its south berm in three locations, causing flooding. Mainly residential damages to houses and contents, sheds and garages, cars and trailers, landscaping, driveways and fences.	Over $2 million residential damages.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges. Granite Reef Dam damaged.	Salt River: Country Club Dr.-Granite Reef Dam: $0.23 million-commercial, $2.12 million-public.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Light residential damage, moderate damage to agriculture, commercial and industrial; severe damage to roads and bridges. Sand and gravel operations damaged: 1-Gila River, 9-Agua Fria River, 17-Salt River.	4 deaths-countywide, $16.3 million-public, $3.1million-residential, $5 million-agriculture, $3.9 million-sand & gravel on Salt River.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Major agricultural damage along Salt Rivers. 17 sand and gravel operations damaged.	1 death-countywide Total damage costs: $37 million: $16 million-public, $4 million-agriculture.

Sources of Information:

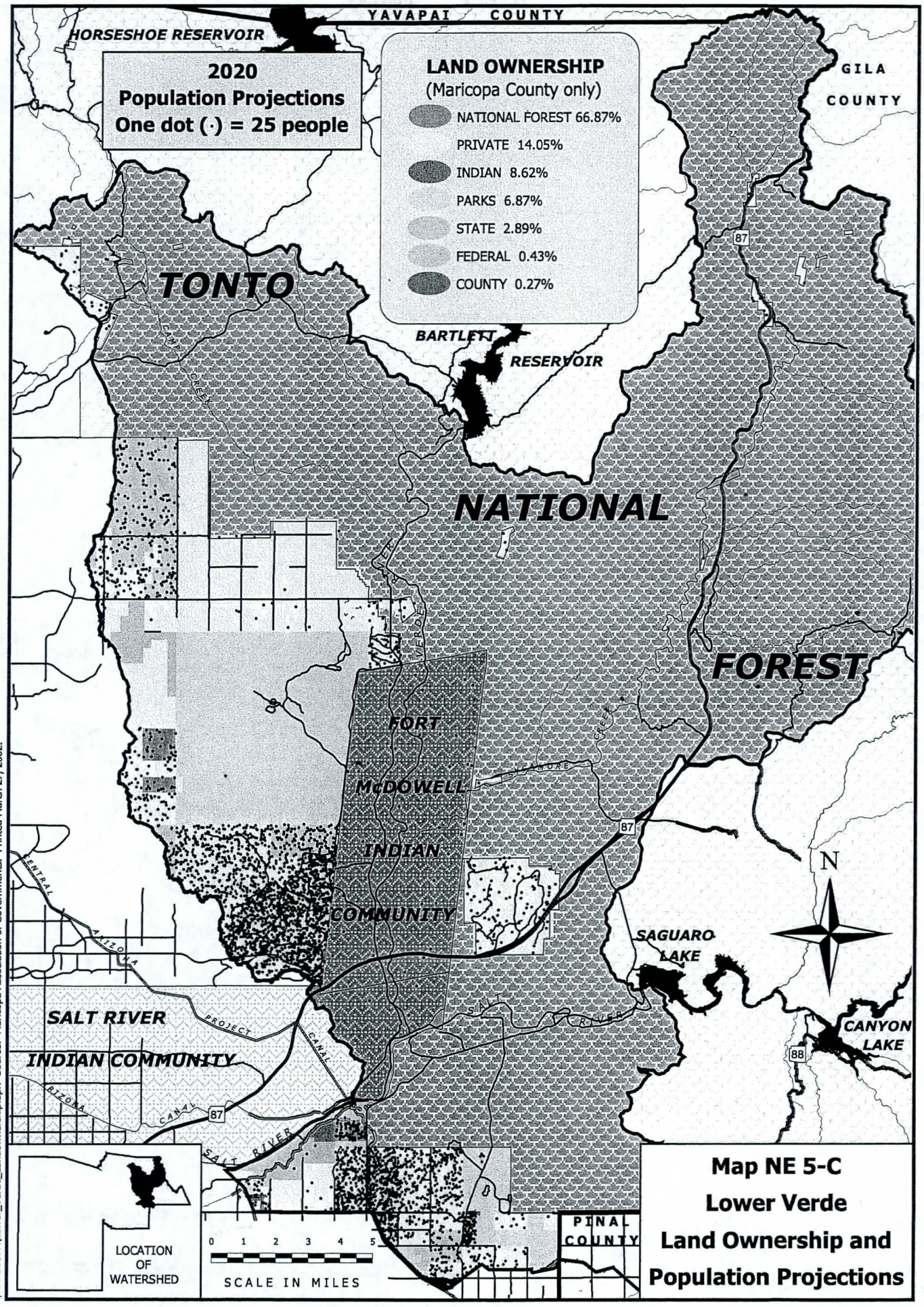
1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Assessment of Flood Damages, Salt-Gila Aqueduct Reach 1B, July 17-18, 1984", October 1984, U.S. Bureau of the Interior, International Engineering Co., Inc.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.



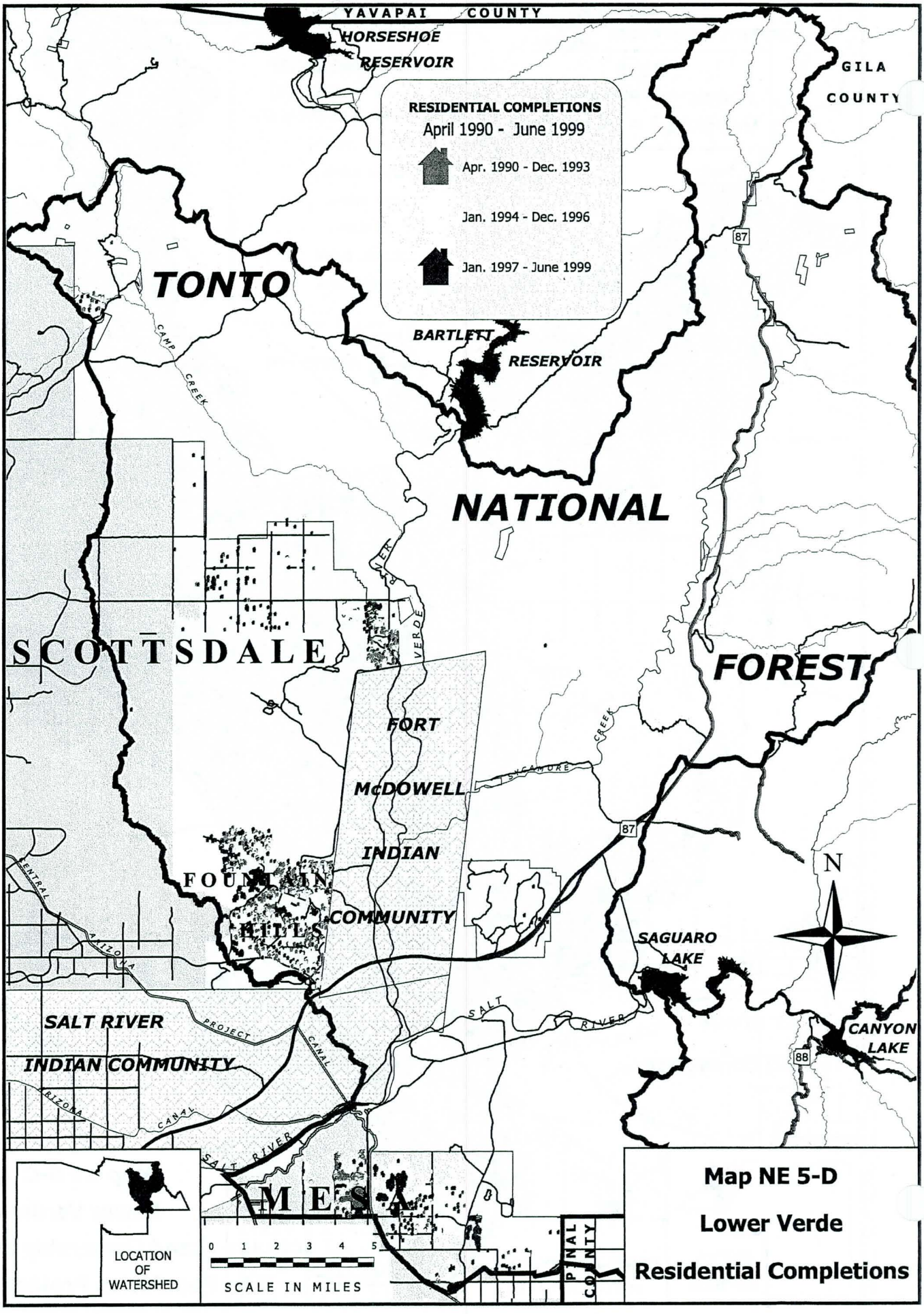
$MARICOPA\Lower_Verde_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Lower_Verde_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Lower_Verde_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Lower_Verde_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

MIDDLE INDIAN BEND WATERSHED

Table NE 6-1

Land Use in Middle Indian Bend Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	17,231	26.92	28.92%
Low Density Residential	12,703	19.85	21.32%
Commercial & Industrial	2,972	4.64	4.99%
Agricultural	3,633	5.68	6.10%
Open Space	7,166	11.20	12.03%
Vacant	13,668	21.36	22.94%
Water	532	0.83	0.89%
Other	1,675	2.62	2.81%
Out of County/Not Classified			
Total Area	59,581	93.10	100.00%

Table NE 6-2

Land Ownership in the Middle Indian Bend Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
PRIVATE	46,648	72.89	78.29%	78.29%
INDIAN	11,600	18.13	19.47%	19.47%
STATE	1,087	1.70	1.83%	1.83%
PARKS	95	0.15	0.16%	0.16%
COUNTY	76	0.12	0.13%	0.13%
FEDERAL	75	0.12	0.13%	0.13%
Total	59,580	93.11	100.00%	100.00%

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Table NE 6-3
Flood History for Middle Indian Bend Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	Total damages: $63.7 million-Phoenix Metro Area. Salt River damages: $49.5 million.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along irrigation canals on north side of metro area.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $0.75 million-commercial.
22-Jun-72	Mdnight/ 6:00 AM	Northeast Phoenix, affecting cities of Paradise Valley, Scottsdale, Tempe and Phoenix	3.85 in./6 hr./70 yr. storm.	14 miles of Indian Bend Wash and 16 miles of Arizona Canal from Cave Creek to Indian Bend Wash. Breaks and overtopping of Arizona and Grand Canal, and Indian Bend Wash. Extensive damage to residential, agriculture and public facilities.	Total damages: $10.5 million in Phoenix Metro Area. $1.6 million-residential, $0.5 million-public, $0.47 million commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.
6. "Report on Flood of 22 June 1972, Phoenix Metropolitan Area, Arizona", U.S. Army Corps of Engineers, Los Angeles District, October 1972.

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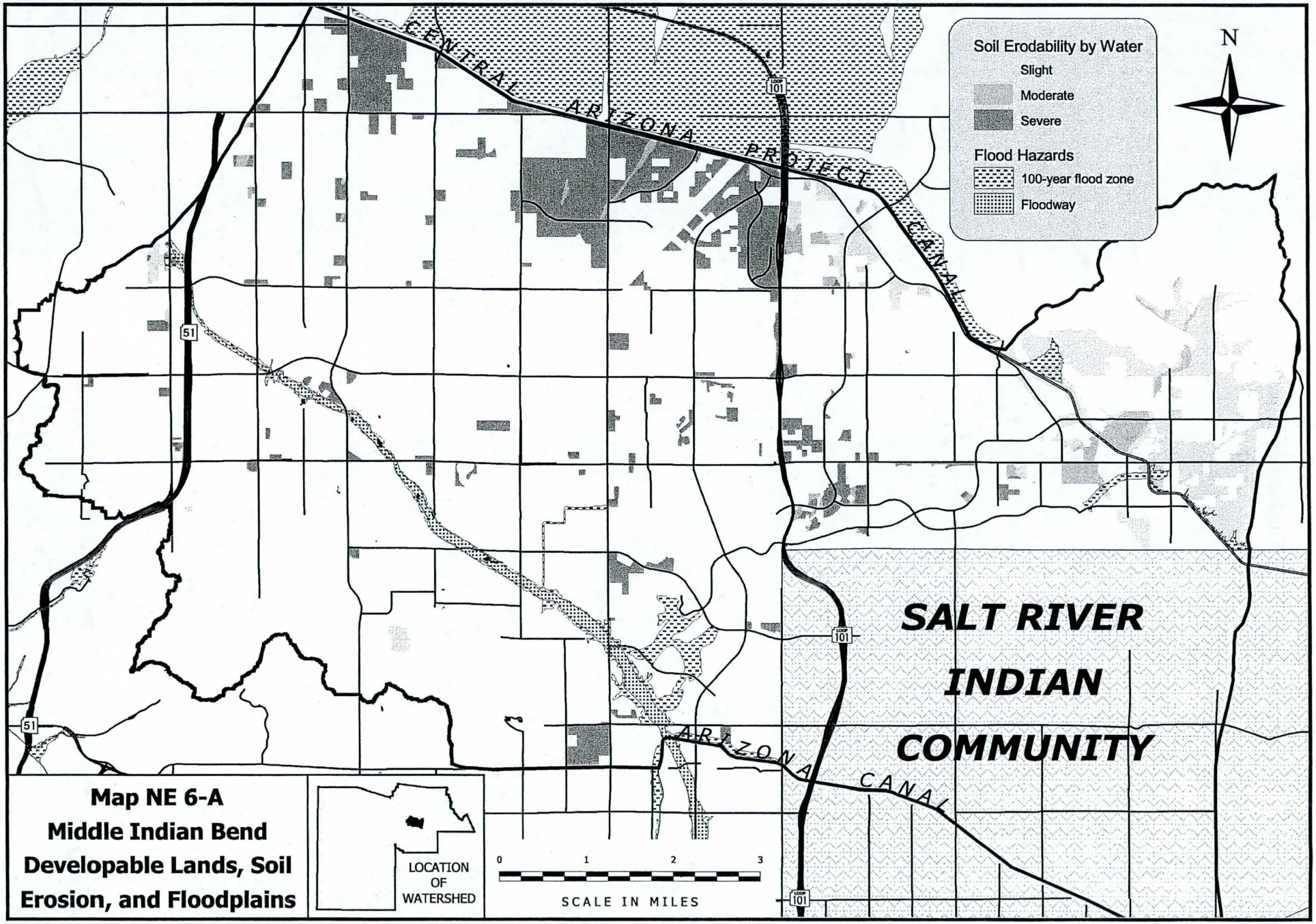
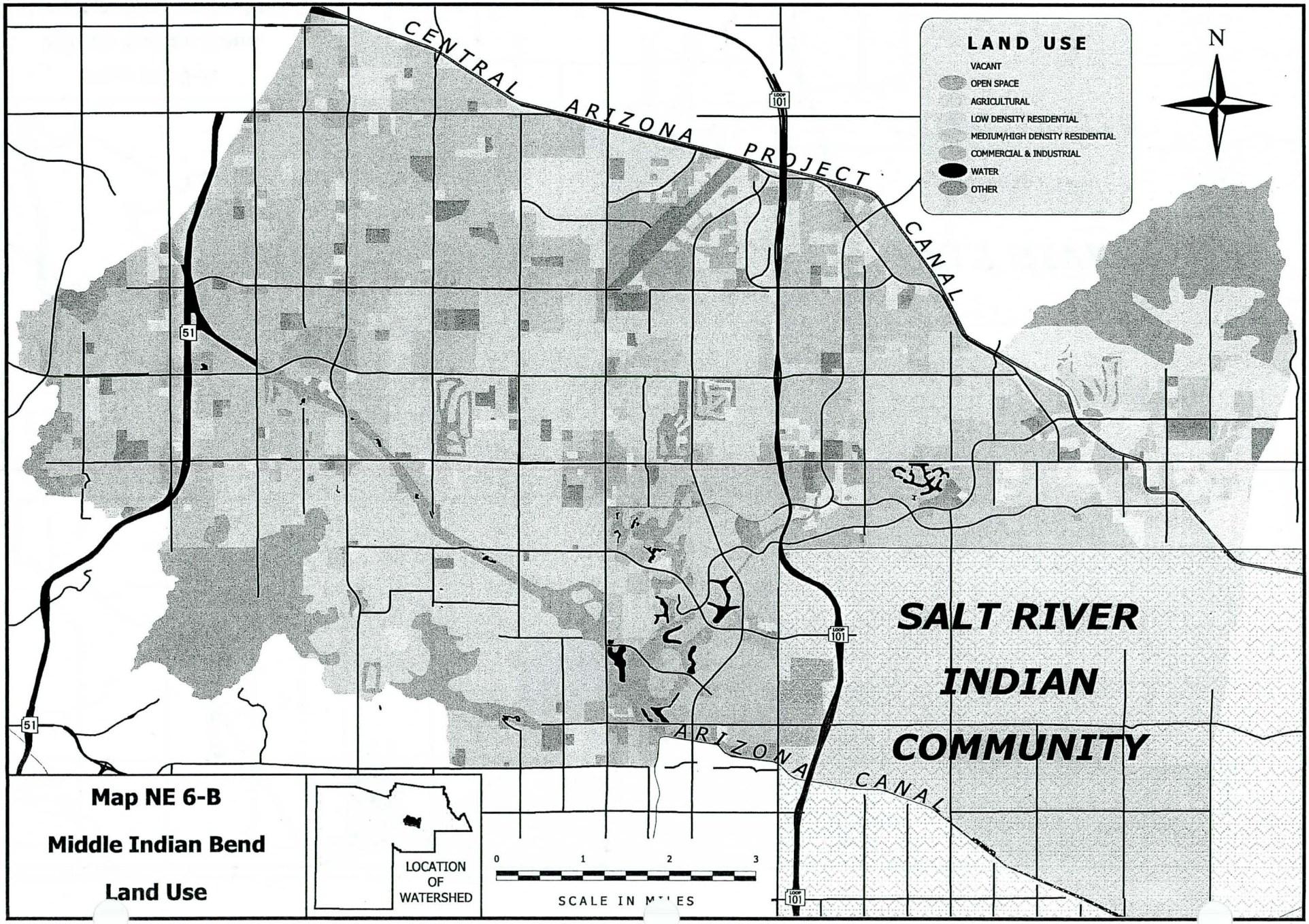
$MARICOPA\Middle_Indian_Bend_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

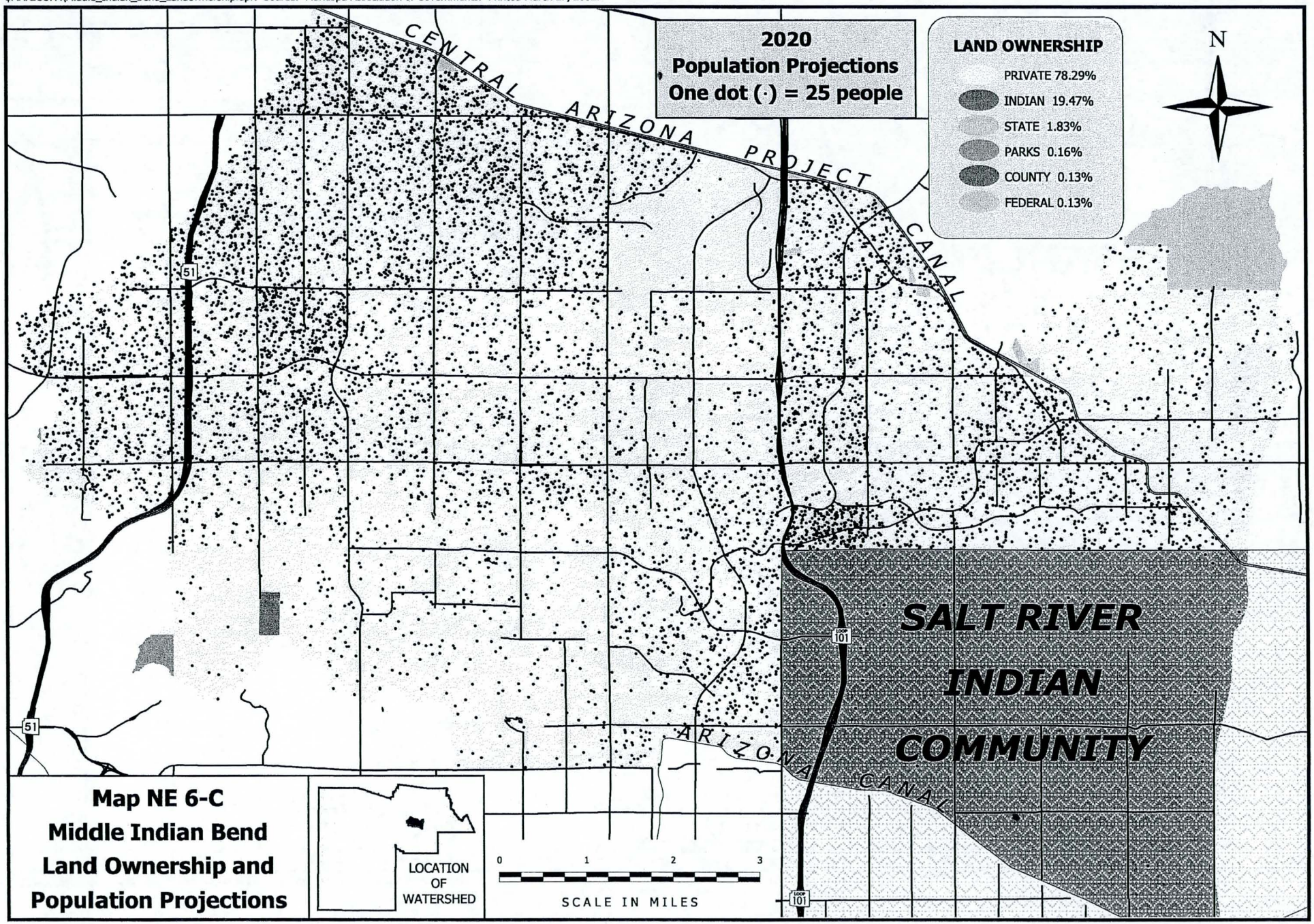


Map NE 6-A
Middle Indian Bend Developable Lands, Soil Erosion, and Floodplains

$MARICOPA\Middle_Indian_Bend_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

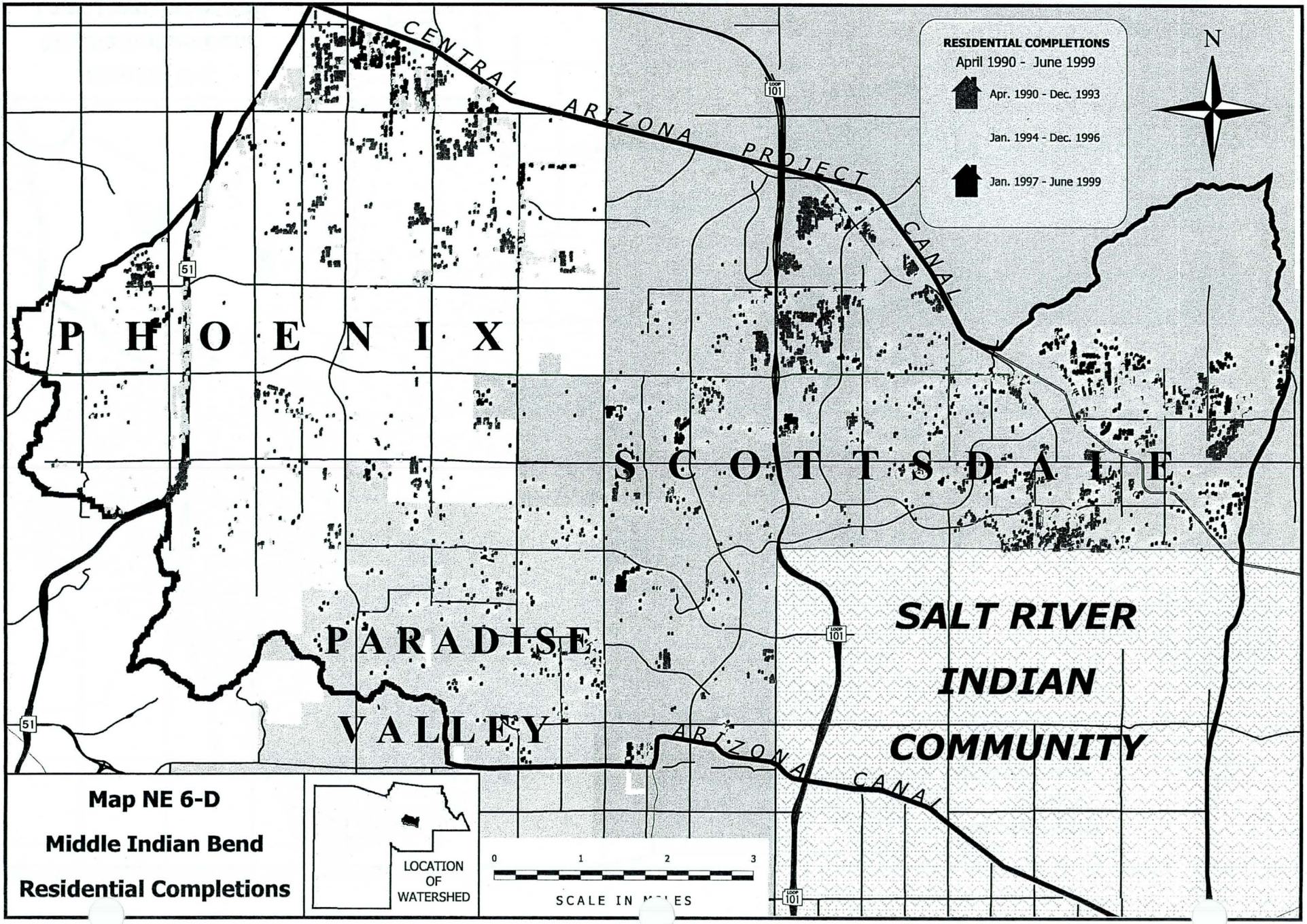


$MARICOPA\Middle_Indian_Bend_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



Map NE 6-C
Middle Indian Bend
Land Ownership and
Population Projections

$MARICOPA\Middle_Indian_Bend_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



SKUNK CREEK WATERSHED

Table NW 7-1
Land Ownership in the Skunk Creek Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
STATE	23,623	36.91	41.89%	41.89%
PRIVATE	20,690	32.33	36.69%	36.69%
NATIONAL FOREST	10,332	16.14	18.32%	18.32%
COUNTY	972	1.52	1.72%	1.72%
PARKS	738	1.15	1.31%	1.31%
FEDERAL	42	0.07	0.07%	0.07%
Total	56,397	88.12	100.00%	100.00%

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Table NW 7-2
Land Use in the Skunk Creek Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	630	0.98	1.12%
Low Density Residential	5,305	8.29	9.41%
Commercial & Industrial	219	0.34	0.39%
Agricultural	50	0.08	0.09%
Open Space	12,236	19.12	21.70%
Vacant	35,901	56.10	63.66%
Water	1,259	1.97	2.23%
Other	796	1.24	1.41%
Out of County/Not Classified			
Total Area	56,396	88.12	100.00%

Table NW 7-3
Flood History for Skunk Creek Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan- 8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers and Rillito Creek.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
14-Oct-88	8:00 AM/ 4:00 PM	Metro Phoenix and Carefree	2.32 in. at Sky Harbor Airport. 2.6 in. in Carefree./8 hr./ 15 yr. storm.	General flooding throughout Metro Phoenix. Arizona Canal overtopped due to inflows from Cave Creek.	
High runoff from 13-22 Feb 80	13 Feb- 10:00 AM/ 22 Feb- 12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec- 12:00 PM/ 20 Dec- 12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in.-Central Mountains	Severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78- 3 Mar 78	1 Mar- 4:00 PM/ 2 Mar- 4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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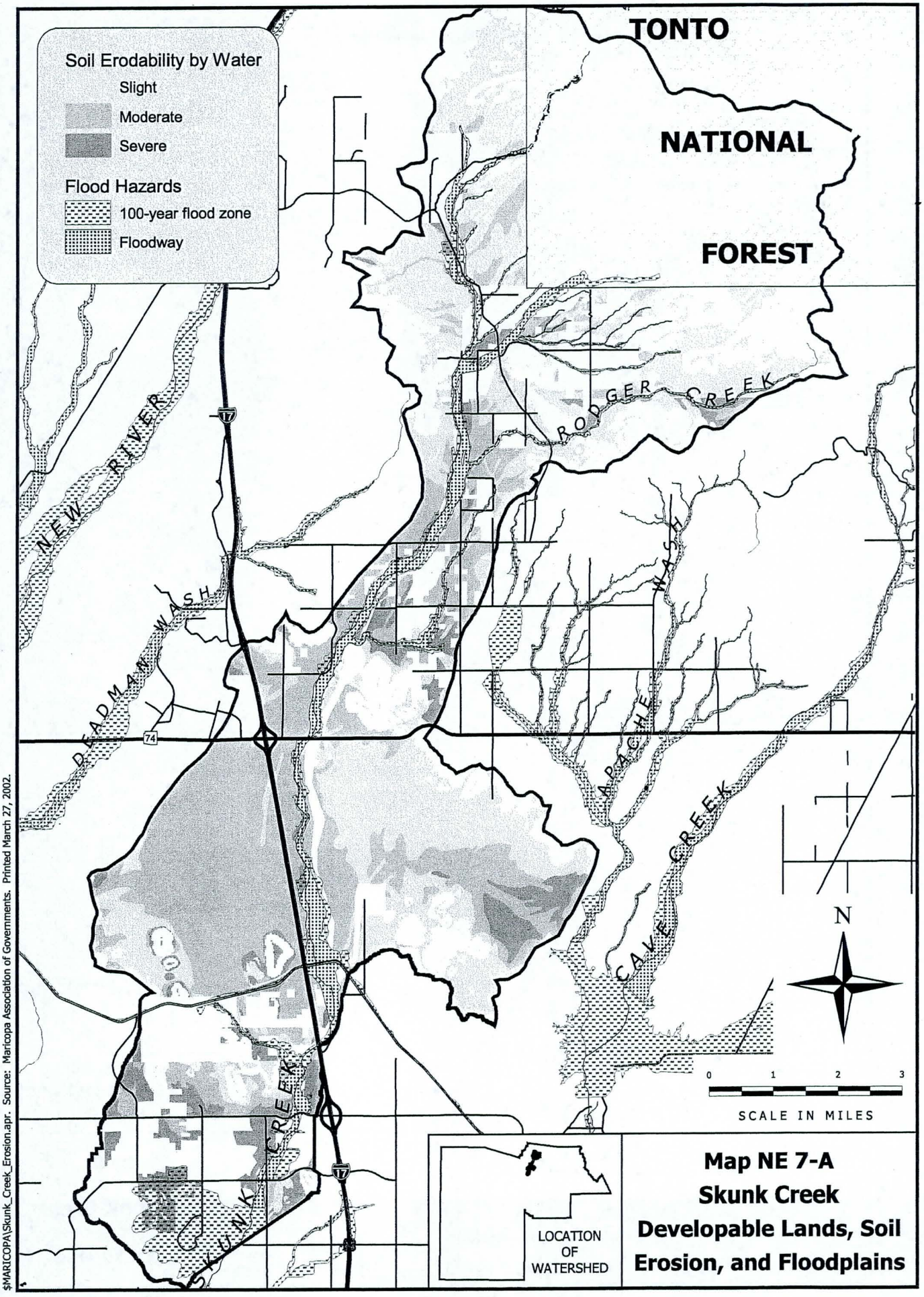
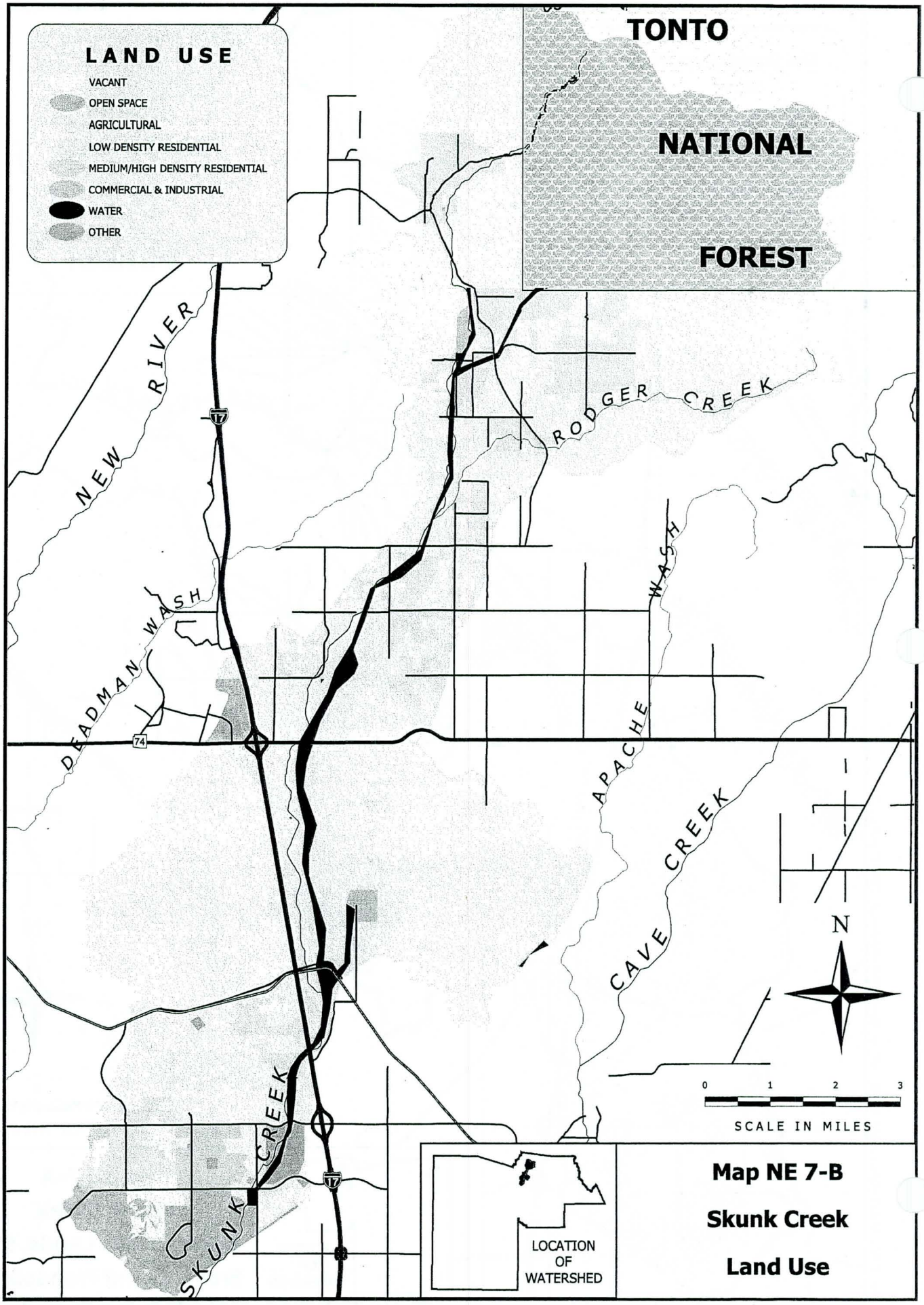
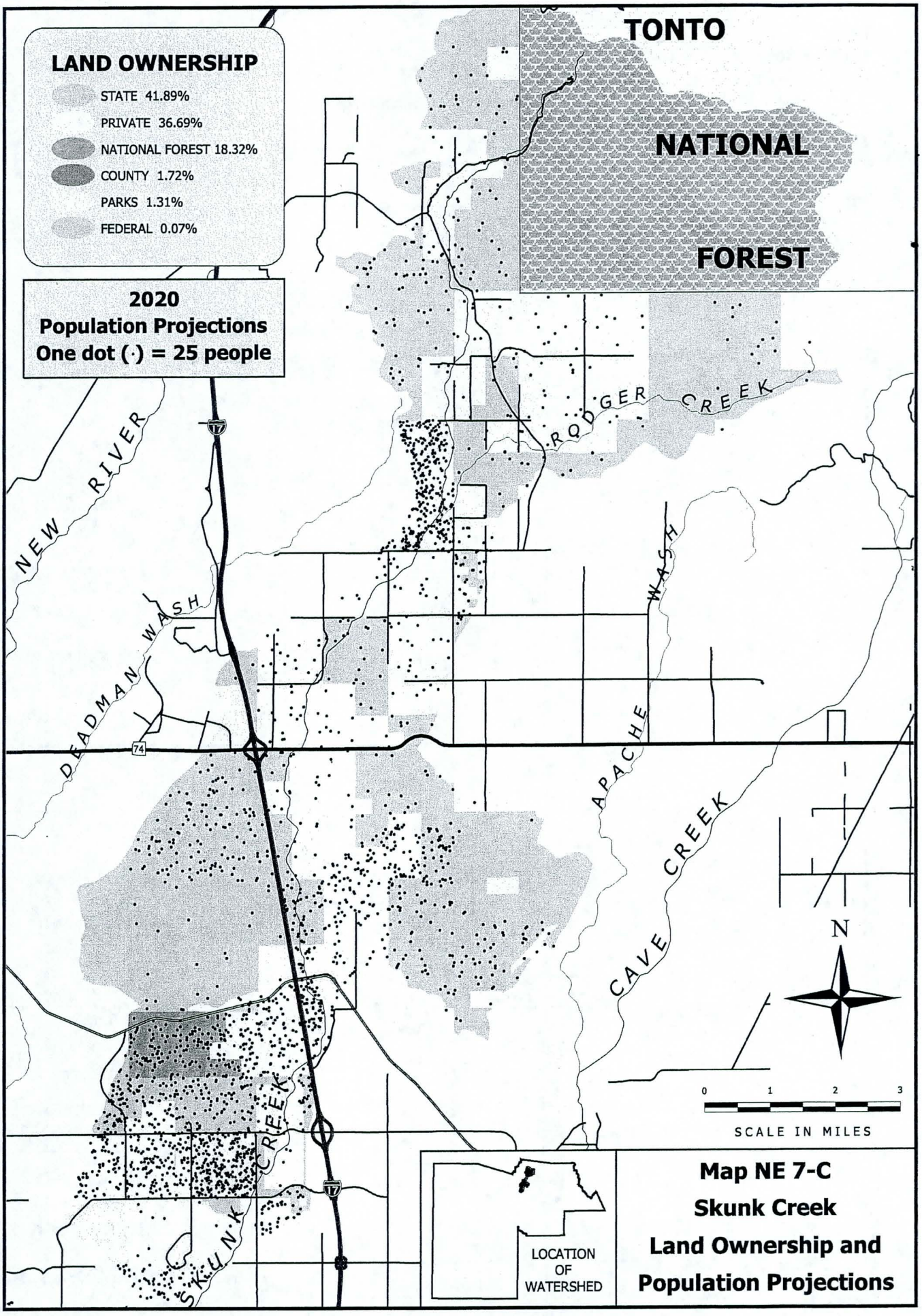


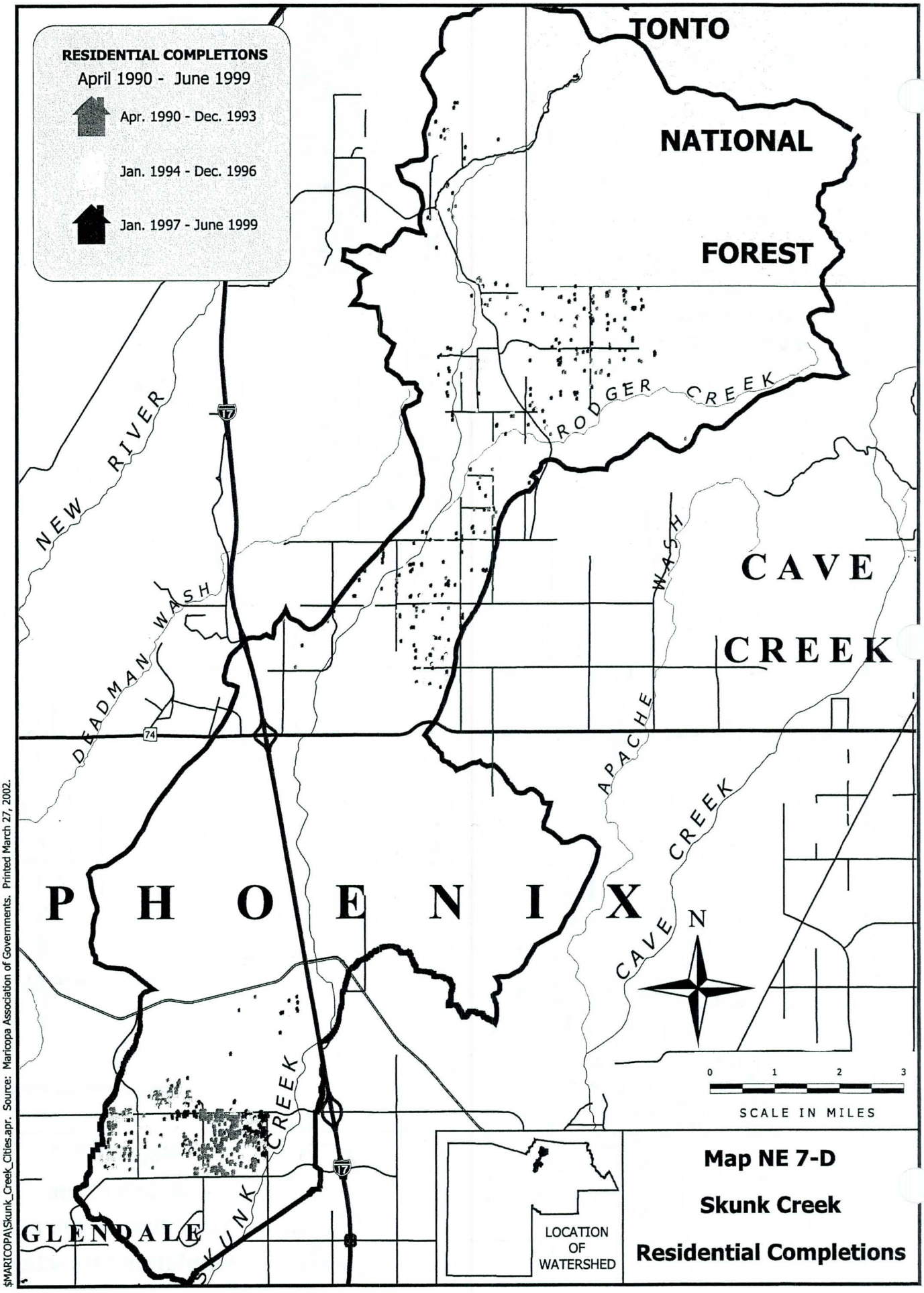
$MARICOPA\Skunk_Creek_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\SkunkCreek_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Skunk_Creek_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Skunk_Creek_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

UPPER ACDC WATERSHED[1]

Table NE 8-1
Land Use in the Upper ACDC Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	27,620	43.16	36.42%
Low Density Residential	8,447	13.20	11.14%
Commercial & Industrial	5,989	9.36	7.90%
Agricultural	108	0.17	0.14%
Open Space	9,531	14.89	12.57%
Vacant	18,791	29.36	24.78%
Water	1,251	1.95	1.65%
Other	4,095	6.40	5.40%
Out of County/Not Classified			
Total Area	75,831	118.49	100.00%

Table NE 8-2
Land Ownership in the Upper ACDC Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
PRIVATE	65,478	102.31	86.35%	86.35%
STATE	7,061	11.03	9.31%	9.31%
PARKS	2,179	3.40	2.87%	2.87%
FEDERAL	982	1.53	1.29%	1.29%
COUNTY	132	0.21	0.17%	0.17%
Total	75,831	118.49	100.00%	100.00%

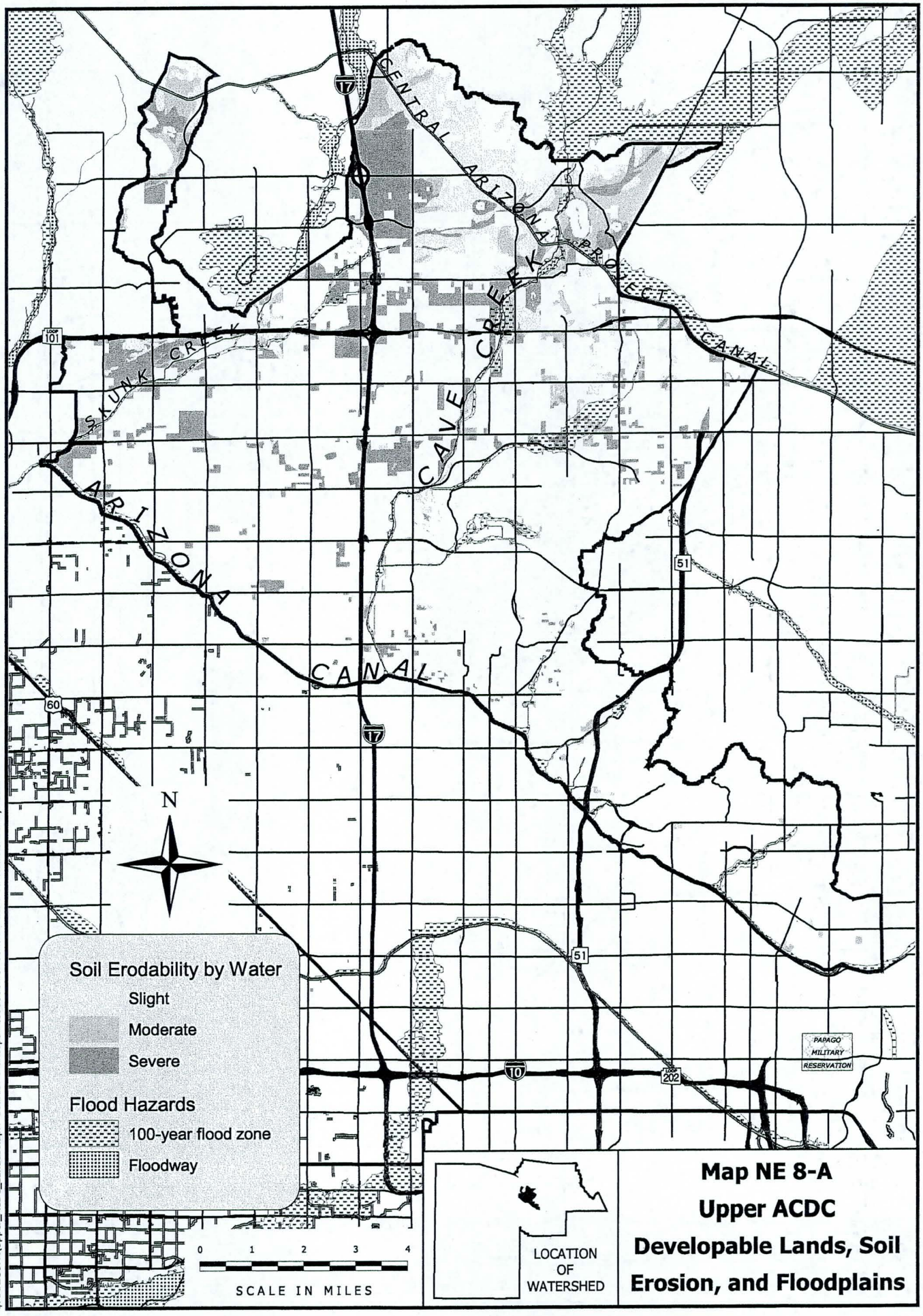
[1] ACDC stands for Arizona Canal Diversion Channel.

Table NE 8-3
Flood Damage History for Upper ACDC Watershed

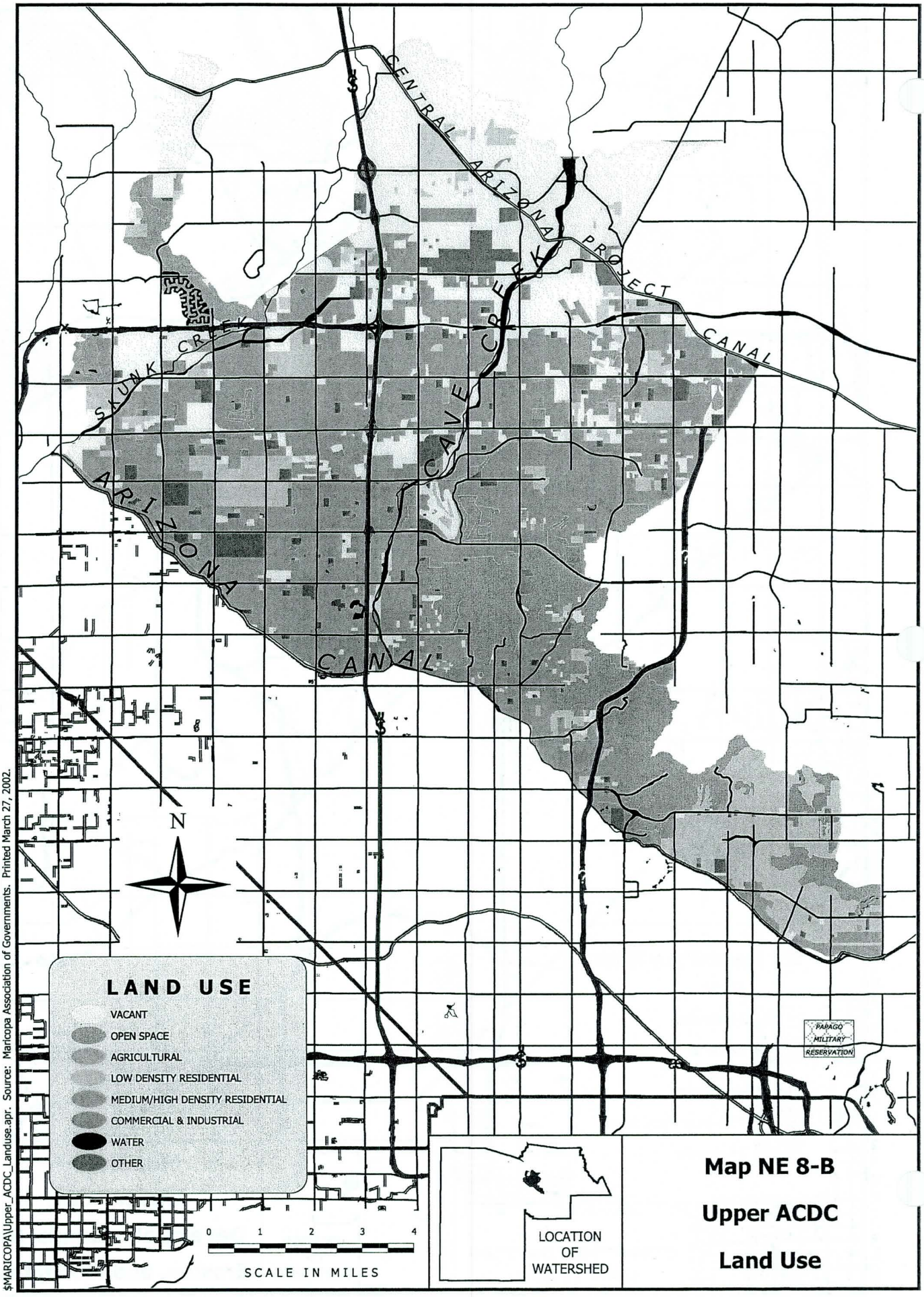
Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona.	1.94 in. at Sky Harbor Airport./24 hr./25 yr. storm.	MCDOT closed 64 roads and placed 1,000 barricades. Roads and streets closed throughout the county due to extensive flooding.	2 deaths reported, countywide. Public and private damages exceeded $38 million.
14-Oct-88	8:00 AM/ 4:00 PM	Metro Phoenix and Carefree	2.32 in. at Sky Harbor Airport. 2.6 in. in Carefree./8 hr./ 15 yr. storm.	General flooding throughout Metro Phoenix. Arizona Canal overtopped due to inflows from Cave Creek.	Data not available.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	3-4 in. in northern foothills/Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. NE of Phoenix-Mazatzal Mountains, 5 in.-Central Mountains/ 16-20 Dec.	Light residential damage, moderate damage to agriculture, commercial and industrial; severe damage to roads and bridges.	4 death-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding also occured along irrigation canals on north side of metro area.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture.
22-Jun-72	Midnight/ 6:00 AM	Northeast Phoenix, affecting cities of Paradise Valley, Scottsdale, Tempe and Phoenix	3.85 in./6 hr./70 yr. storm.	14 miles of Indian Bend Wash;16 miles of Arizona Canal from Cave Creek to Indian Bend Wash; breaks and overtopping of Arizona and Grand Canals and Indian Bend Wash. Extensive damage to residential, agriculture, parks, telephone utilities, streets, roads and bridges.	Total damages:$10.56 million. $7.975 million-physical damages, $2.583 million-business loss and emergency costs.

Sources of Information:

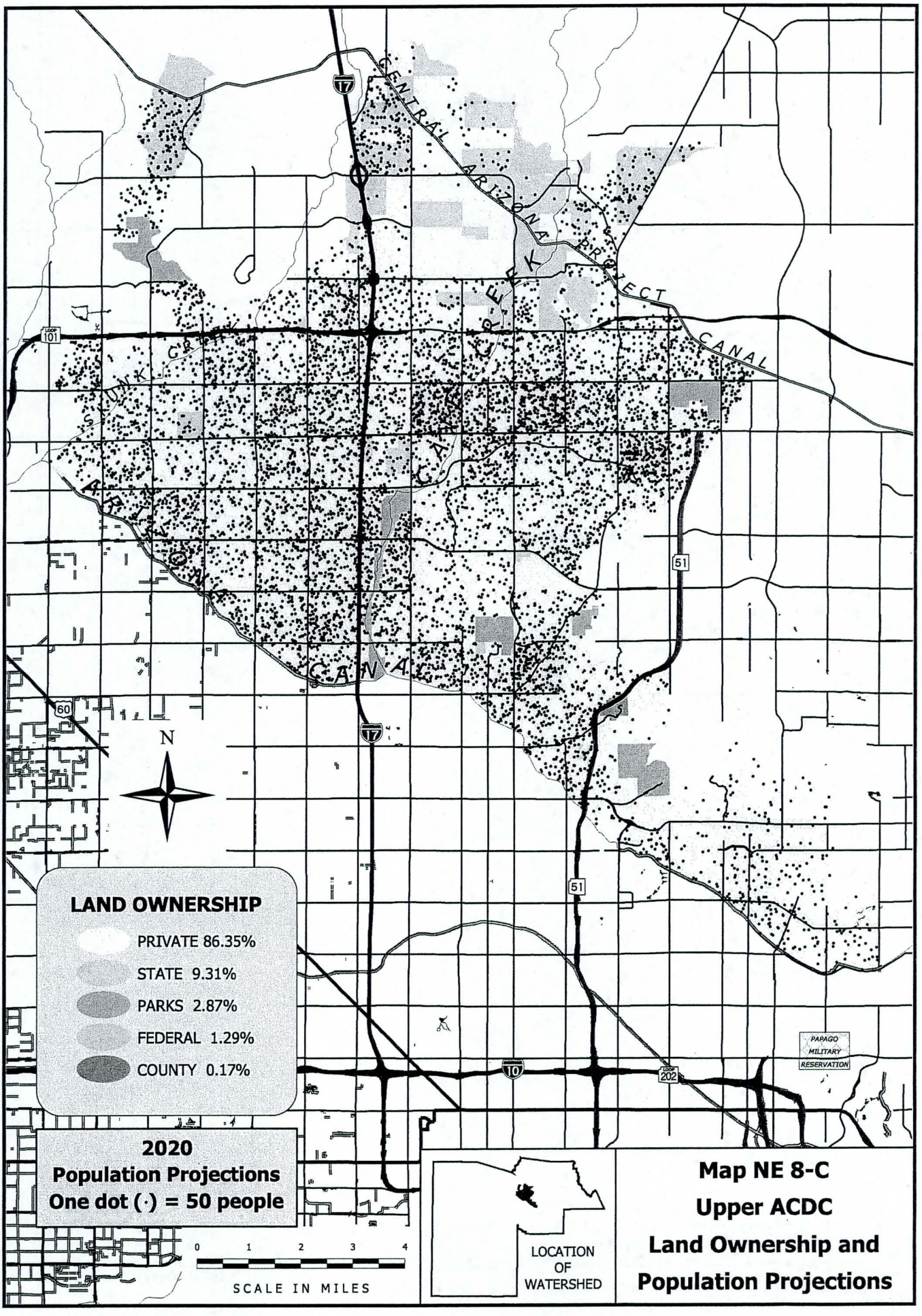
1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Flood Report, October 14, 1988 Storm", Flood Control District of Maricopa County.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.
7. "Report on Flood of 22 June 1972, Phoenix Metropolitan Area, Arizona", U.S. Army Corps of Engineers, Los Angeles District, October 1972.



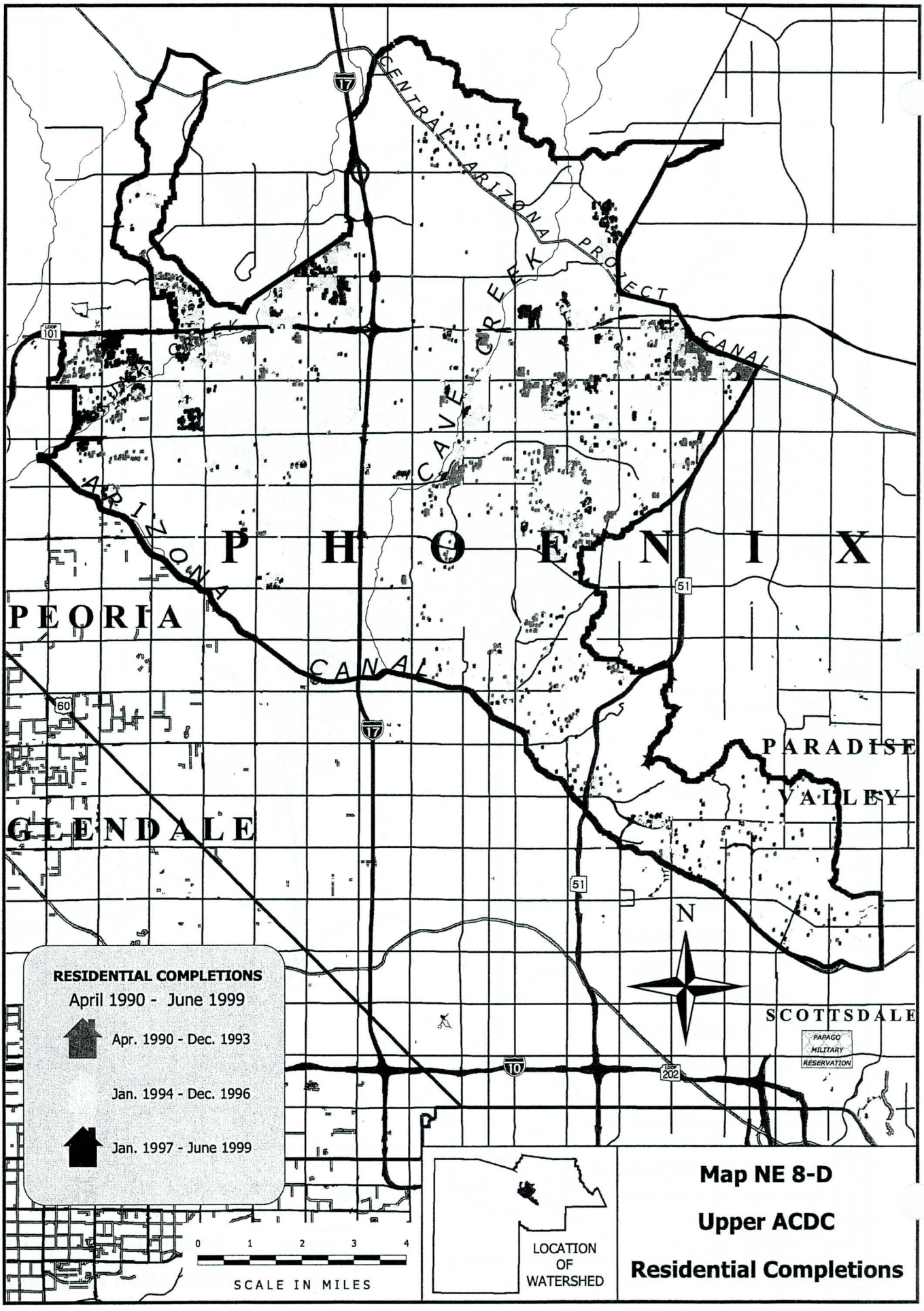
$MARICOPA\Upper_ACDC_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_ACDC_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_ACDC_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_ACDC_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

UPPER AGUA FRIA WATERSHED

Table NE 9-1
Land Use in the Upper Agua Fria Watershed

Classification	Acres	Sq. M.	Percent
Medium/High Density Residential			
Low Density Residential			
Commercial & Industrial			
Agricultural	13	0.02	
Open Space	8,421	13.16	
Vacant	28,032	43.80	
Water	1,591	2.49	
Other	1,280	2.00	
Out of County/Not Classified			
Total Area	*Undefined Boundaries*		

Table NE 9-2
Land Ownership in the Upper Agua Fria Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
			County	Entire
	Acres	Sq. M.	Land Only	Watershed
FEDERAL	22,317	34.87	56.73%	4.27%
STATE	12,897	20.15	32.79%	2.47%
NATIONAL FOREST	1,656	2.59	4.21%	32.00%
PRIVATE	1,453	2.27	3.69%	28.00%
COUNTY	1,008	1.58	2.56%	19.00%
PARKS	5	0.01	0.01%	
OUT OF COUNTY	483,637	755.68		
Total	522,973	817.15	100.00%	100.00%

Table NE 9-3
Flood History for Lower Upper Agua Fria Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges. Major utilities	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding also occured along tributaries of the Gila River and Agua Fria, Hassayampa River and Centennial Wash. Extensive damage to commercial, industrial, agriculture and public facilities.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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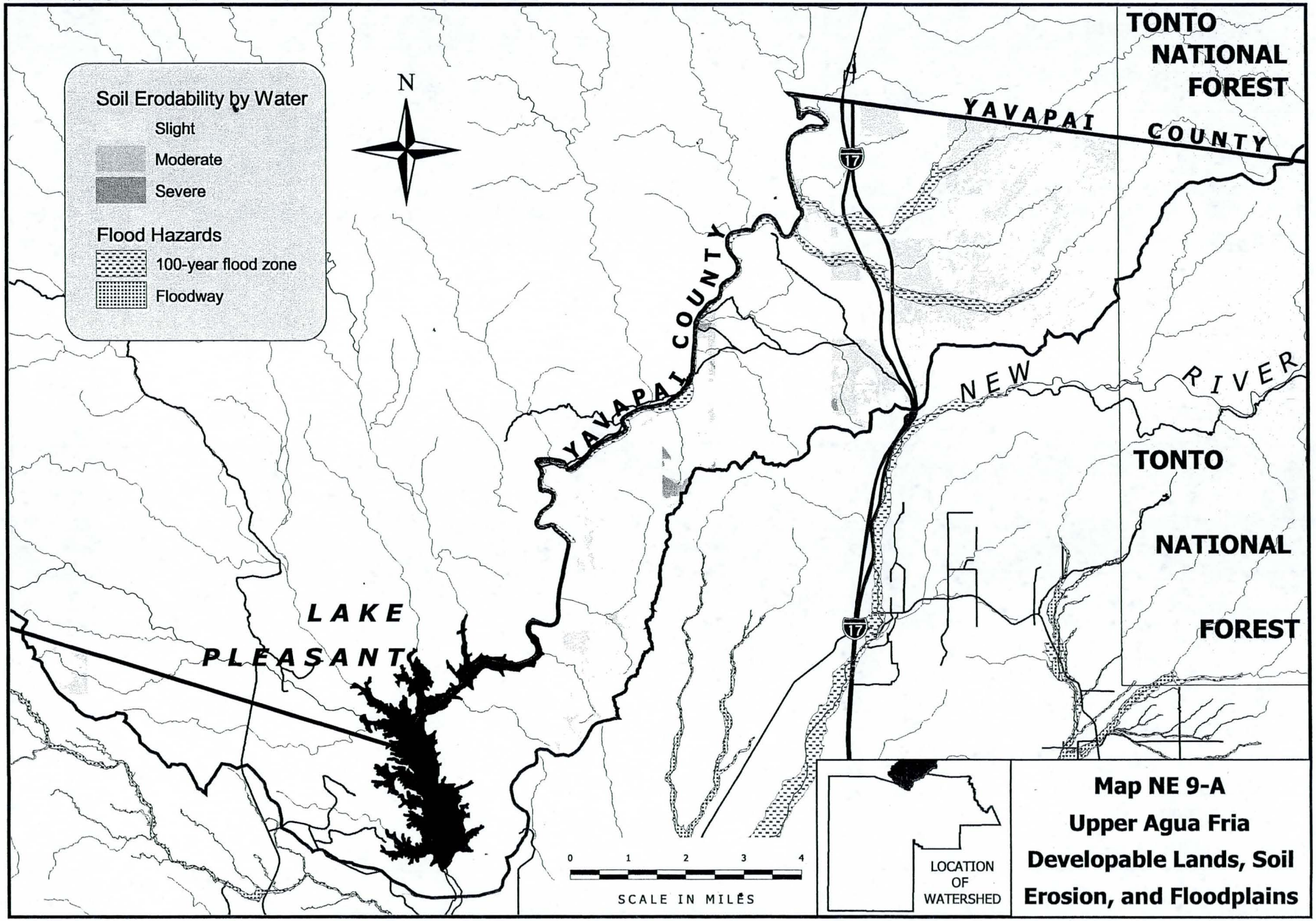
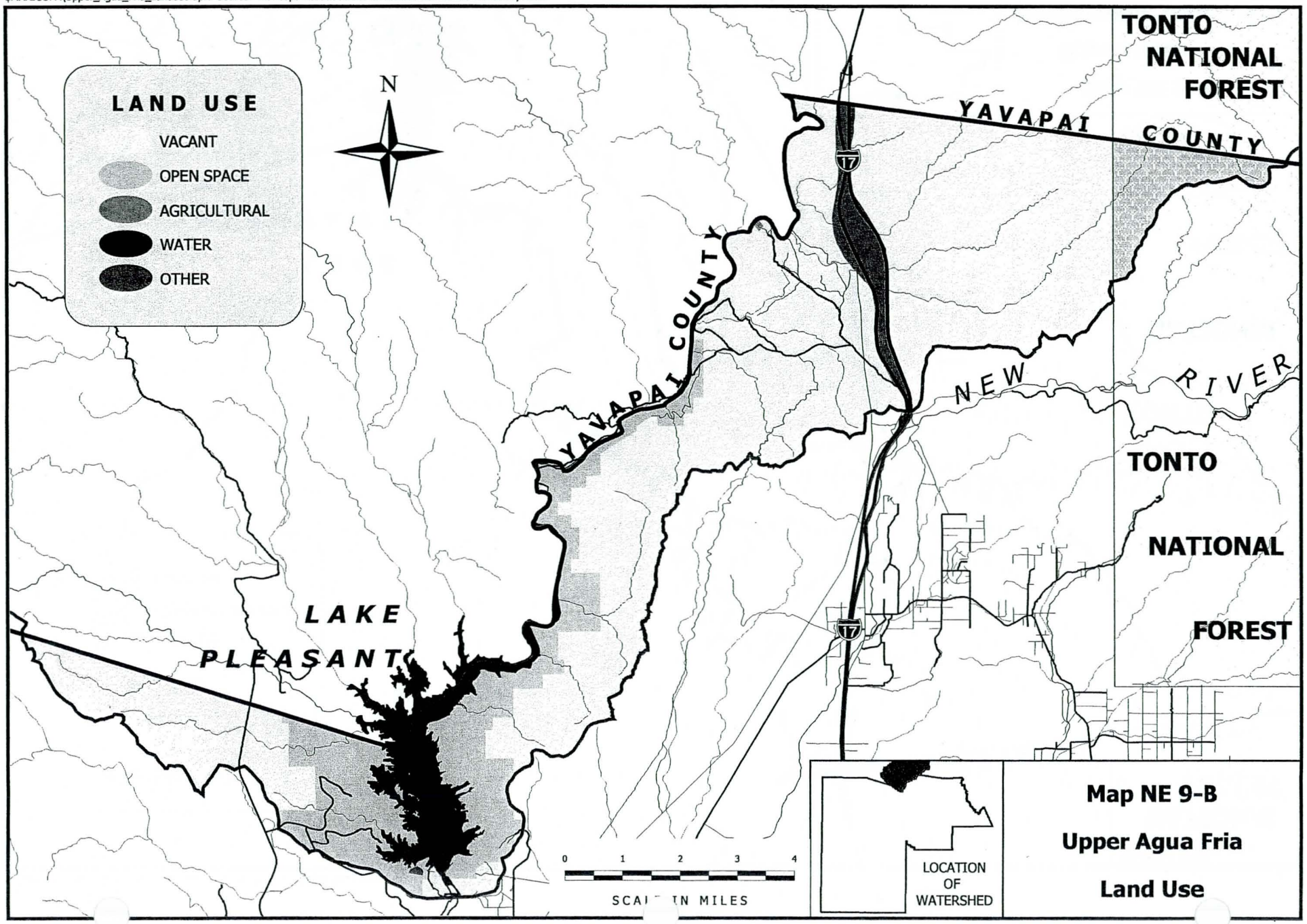
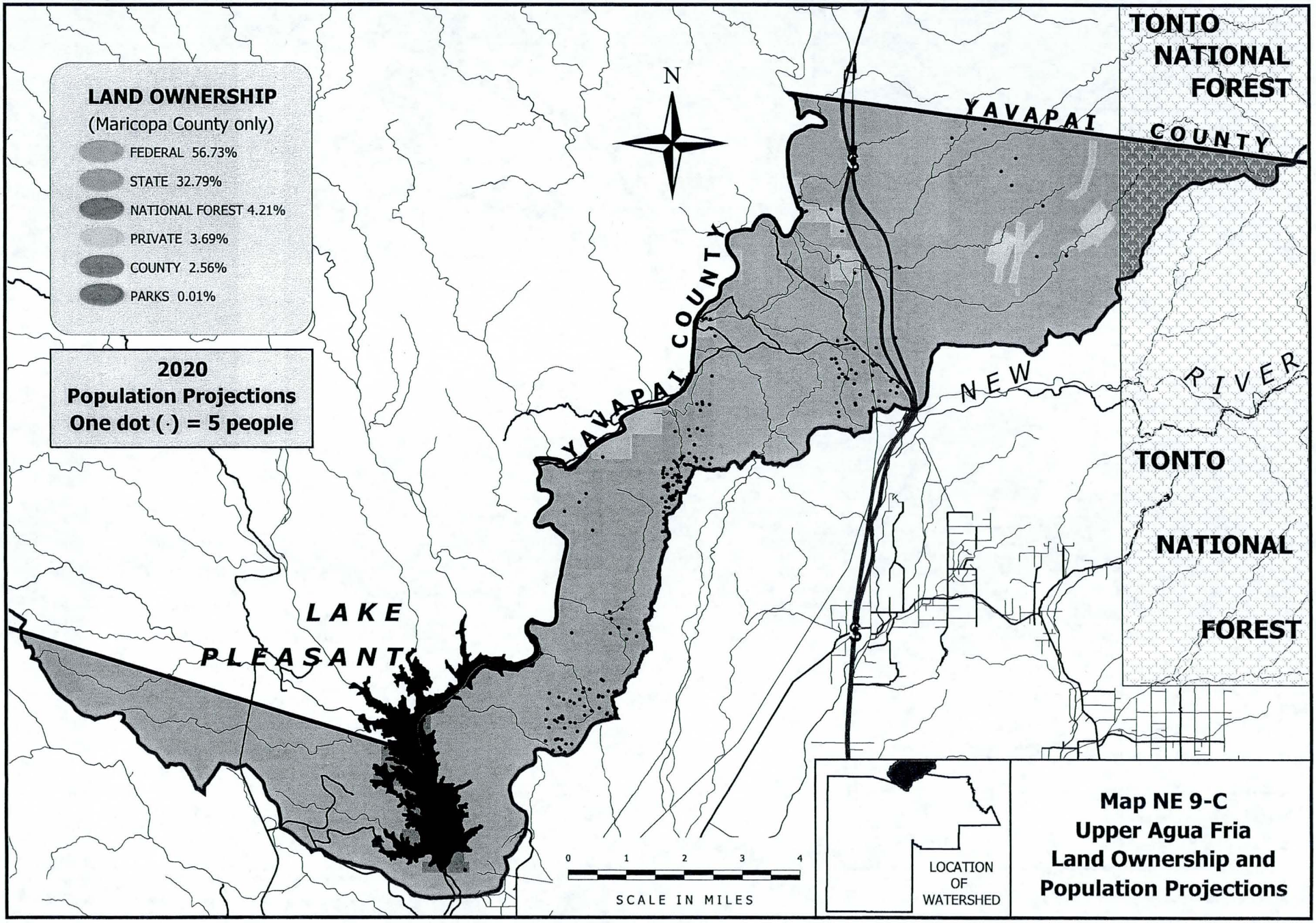
$MARICOPA\Upper_Agua_Fria_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



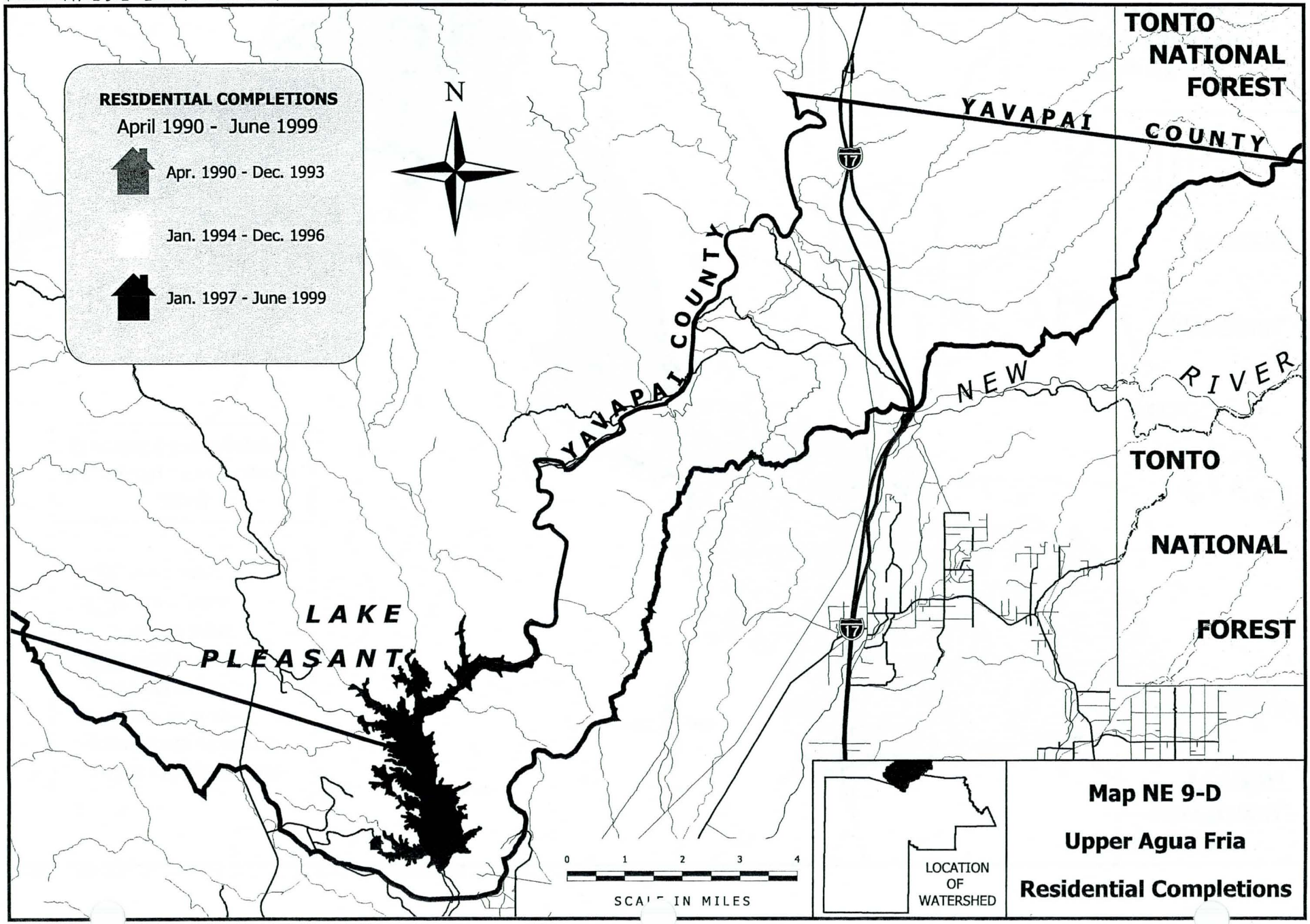
$MARICOPA\Upper_Agua_Fria_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_Agua_Fria_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_Agua_Fria_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



UPPER INDIAN BEND WATERSHED

Table NE 10-1
Land Use in the Upper Indian Bend Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	1,942	3.03	3.07%
Low Density Residential	6,543	10.22	10.36%
Commercial & Industrial	266	0.42	0.42%
Agricultural	221	0.34	0.35%
Open Space	9,900	15.47	15.67%
Vacant	43,626	68.17	69.07%
Water	230	0.36	0.36%
Other	432	0.67	0.68%
Out of County/Not Classified			
Total Area	63,160	98.69	100.00%

Table NE 10-2
Land Ownership in the Upper Indian Bend Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
PRIVATE	37,287	58.26	59.04%	59.04%
STATE	24,274	37.93	38.43%	38.43%
FEDERAL	1,250	1.95	1.98%	1.98%
NATIONAL FOREST	349	0.54	0.55%	0.55%
Total	63,159	98.68	100.00%	100.00%

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Table NE 10-3
Upper Indian Bend Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	Total damages: $63.7 million-Phoenix Metro Area.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix-Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries, Queen Creek, Hassayampa River and Centennial Wash.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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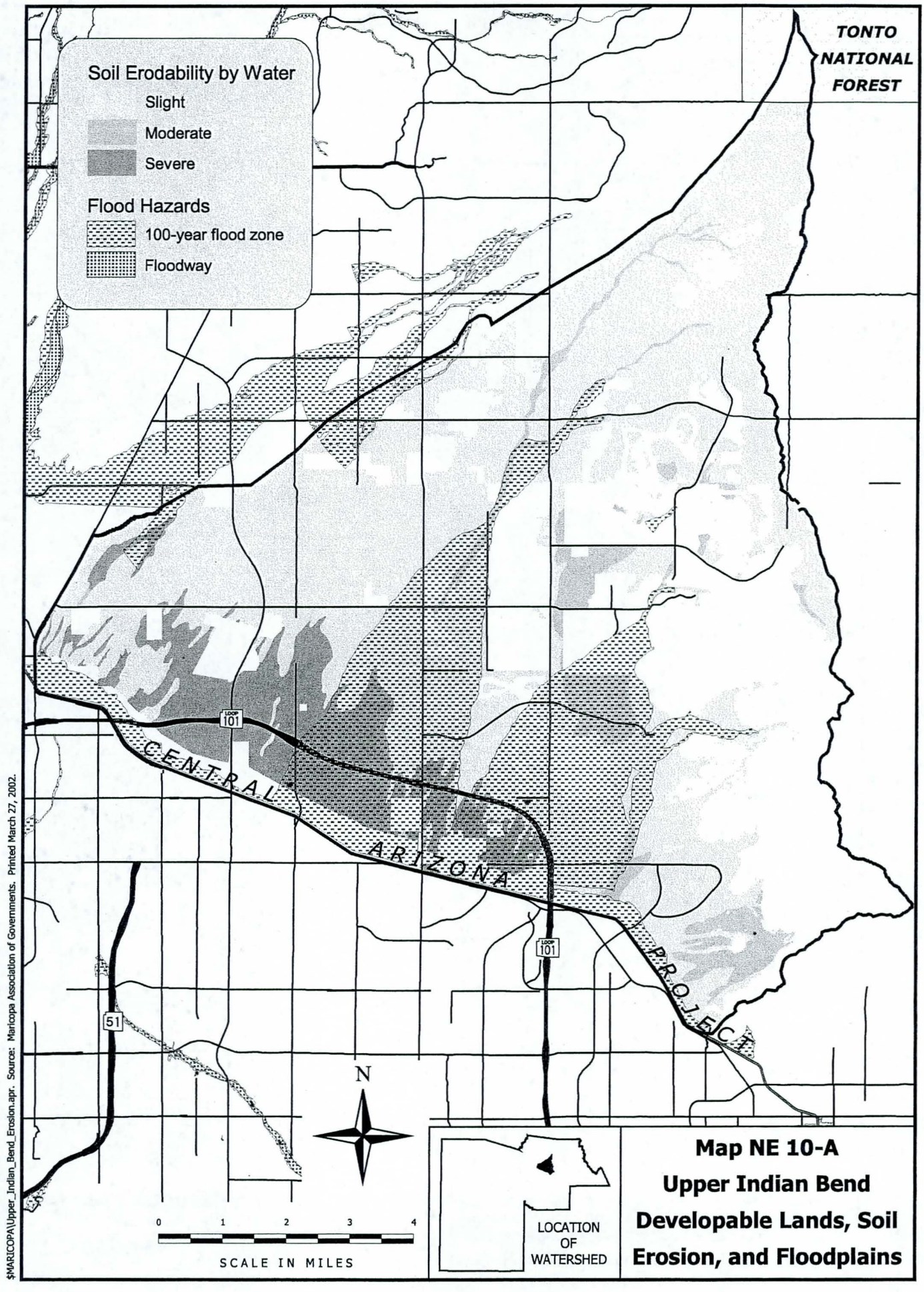
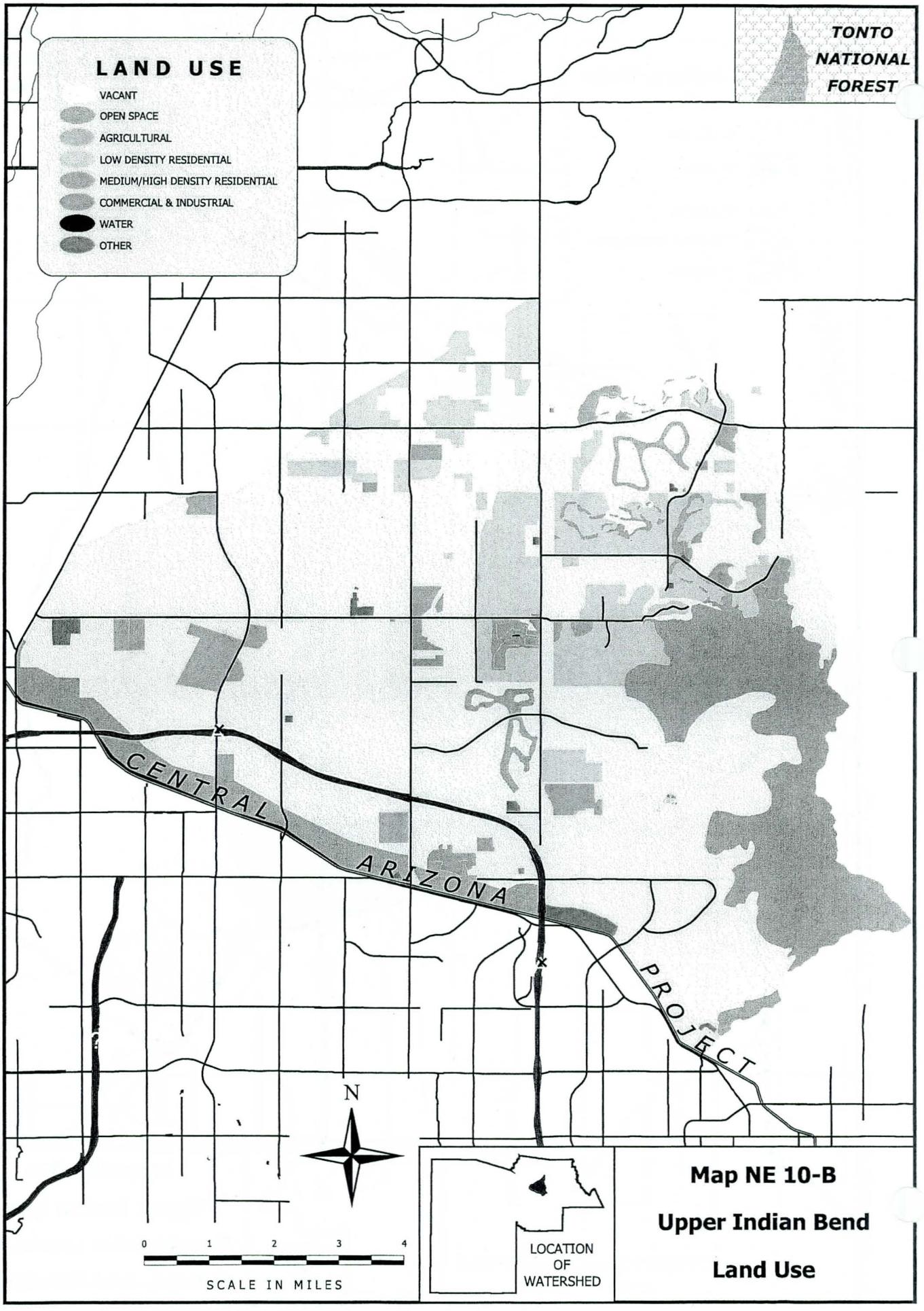
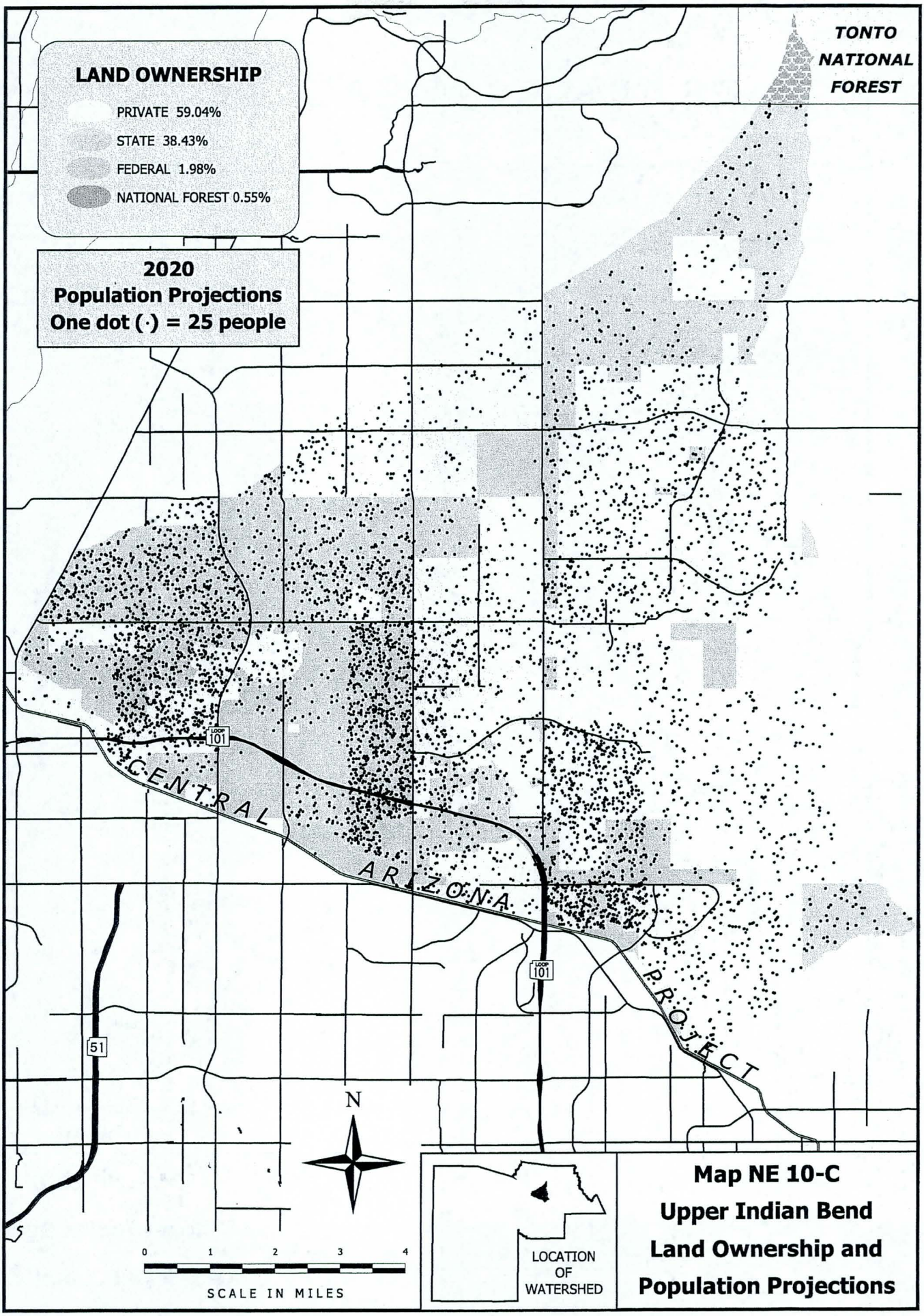


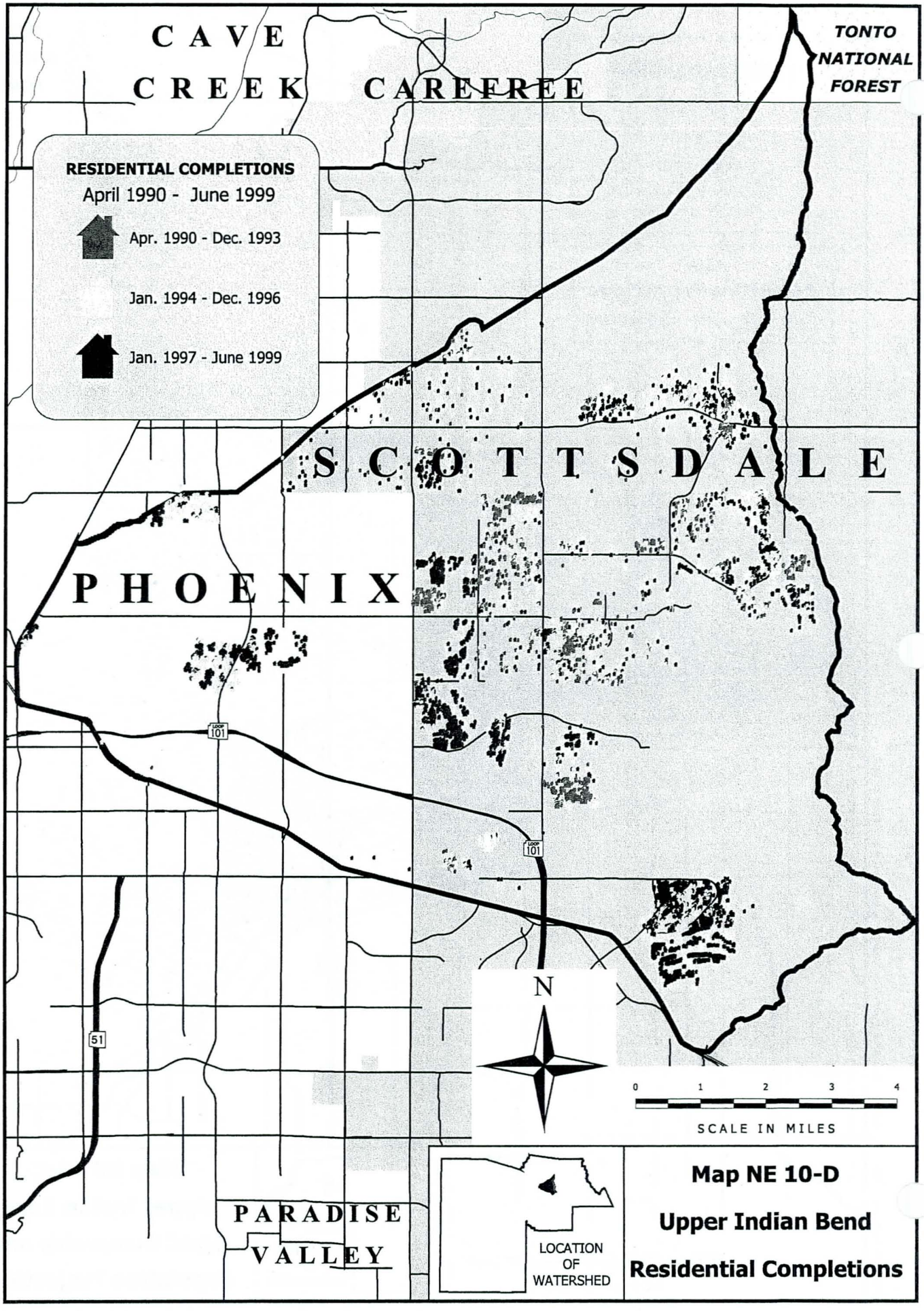
$MARICOPA\Upper_Indian_Bend_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_Indian_Bend_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_Indian_Bend_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_Indian_Bend_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

UPPER NEW RIVER WATERSHED

Table NE 11-1
Land Use in the Upper New River Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	273	0.43	0.25%
Low Density Residential	2,041	3.19	1.88%
Commercial & Industrial	90	0.14	0.08%
Agricultural			
Open Space	26,037	40.68	24.01%
Vacant	59,236	92.56	54.63%
Water	2,711	4.24	2.50%
Other	1,163	1.82	1.07%
Out of County/Not Classified	16,883	26.38	15.57%
Total Area	108,434	169.43	100.00%

Table NE 11-2
Land Ownership in the New River Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
STATE	45,526	71.13	49.73%	41.98%
NATIONAL FOREST	25,120	39.25	27.44%	23.17%
PRIVATE	14,103	22.04	15.40%	13.01%
FEDERAL	5,571	8.70	6.08%	5.14%
PARKS	1,231	1.92	1.34%	1.14%
OUT OF COUNTY	16,883	26.38		15.57%
Total	108,434	169.43	100.00%	100.00%

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Table NE 11-3
Flood Damage History for Upper New River Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages/ 24 hr./25 yr. storm.	Sixteen families stranded in New river due to roads and bridges being washed out. 71 roads, streets and bridges closed throughout county.	2 deaths-countywide. Public and private damages exceeded $38 million.
14-Oct-88	8:00 AM/ 4:00 PM	Metro Phoenix and Carefree	2.6 in. in Carefree/ 8 hr./ 15 yr. storm.	General flooding throughout Metro Phoenix. Arizona Canal overtopped due to inflows from Cave Creek.	Data not available.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges (11 of 13 bridges or crossings were destroyed or damaged), sewers, flood control structures.	$17 million-public, $5 million-commercial, $2 million-residential.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Light residential damage, moderate damage to agriculture, commercial and industrial; severe damage to roads and bridges.	4 deaths-countywide, $7.8 million-industry, $.75 million-commercial, $16.3 million-public, $3.1million-residential, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar- 4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River and Agua Fria. Extensive damage to commercial, industrial, agriculture and public facilities.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

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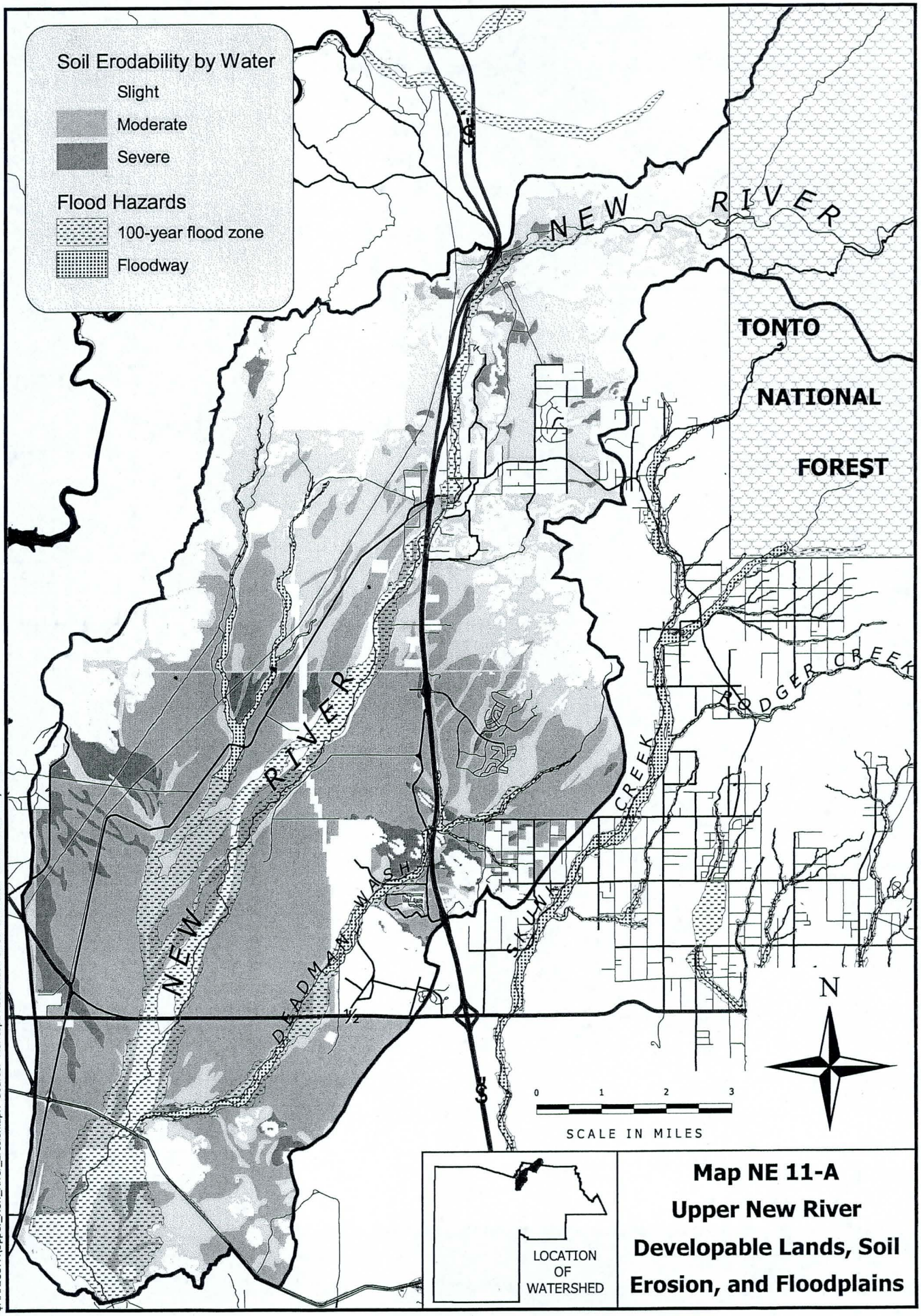
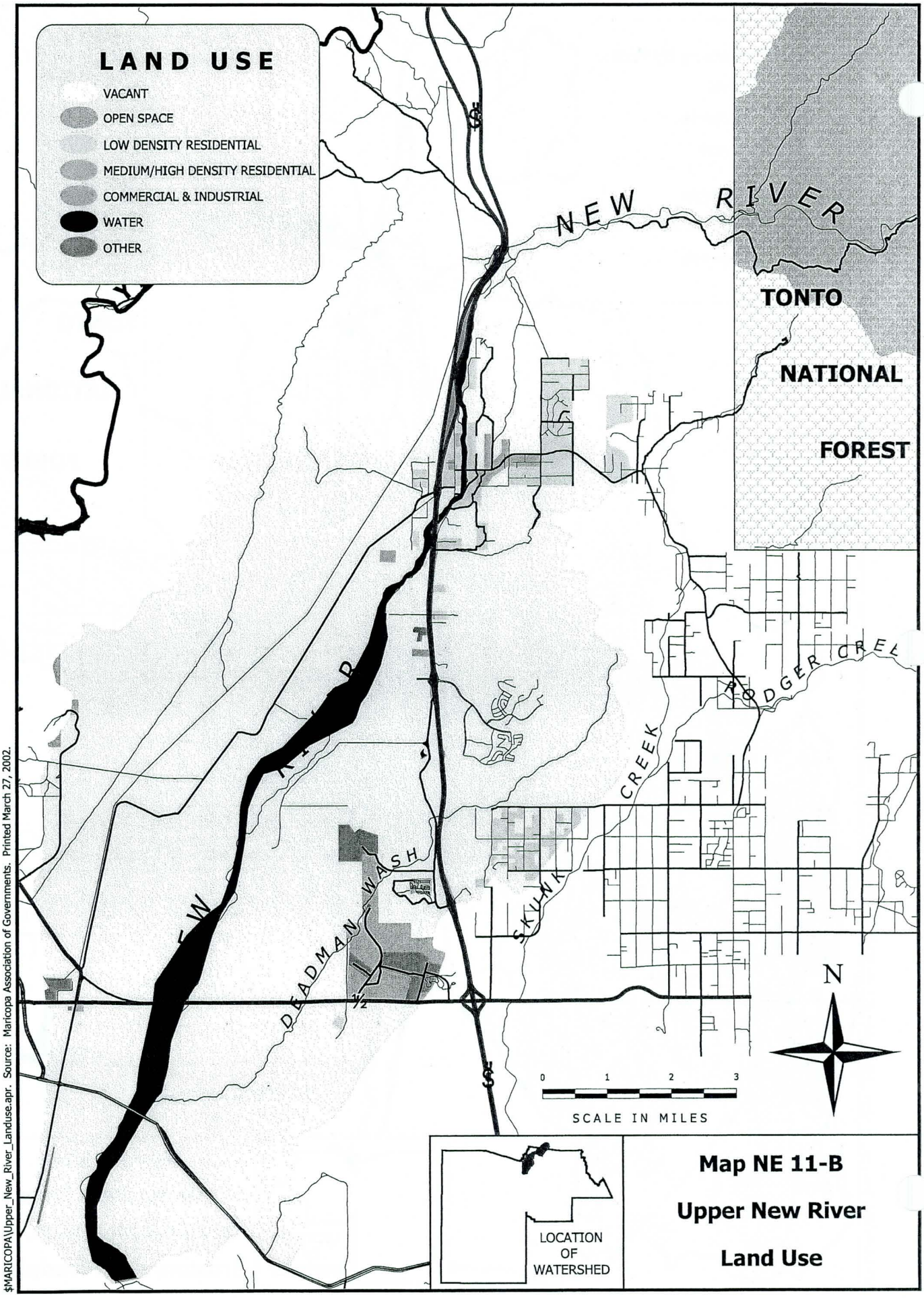
Sources of Information:

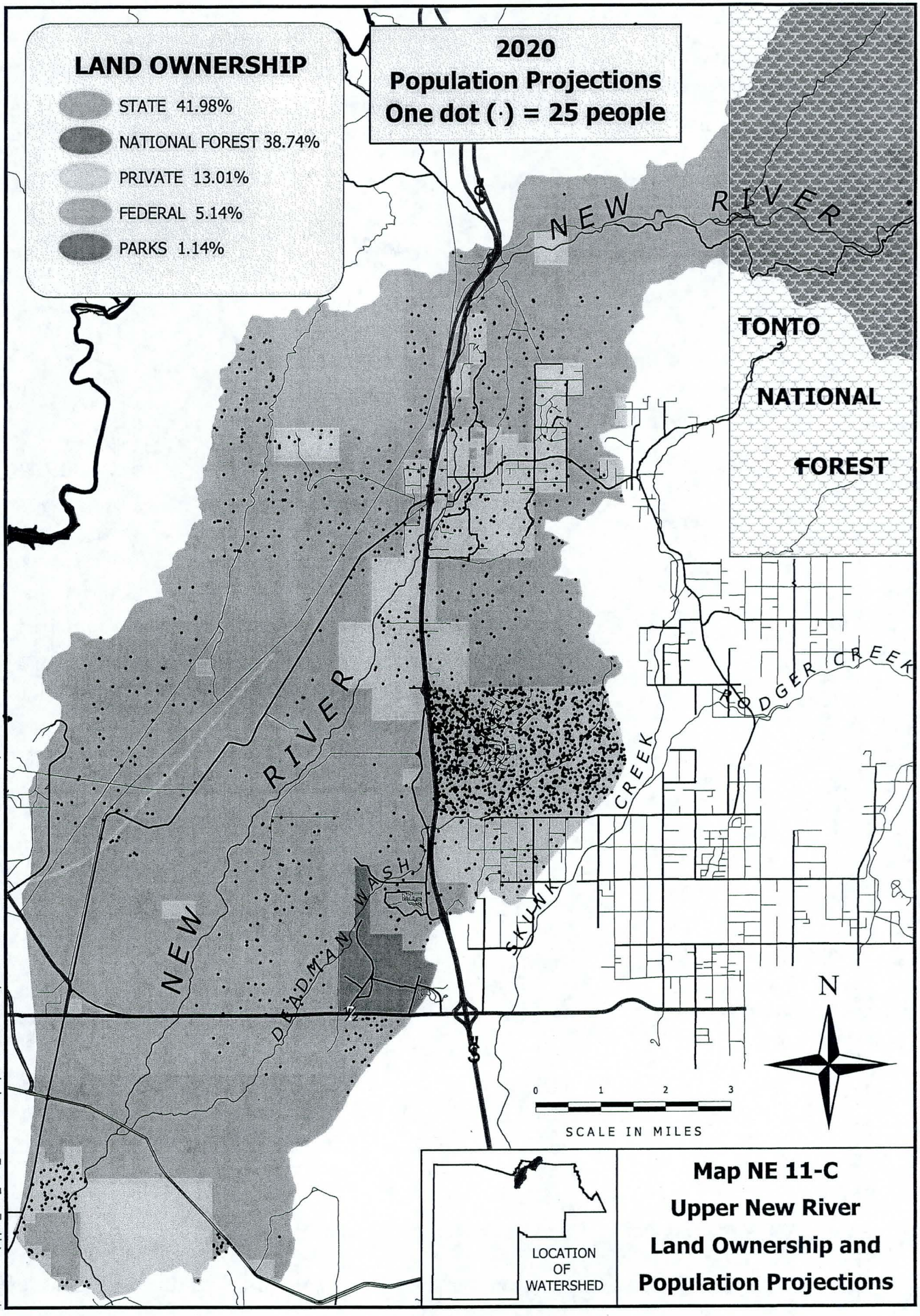
1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.



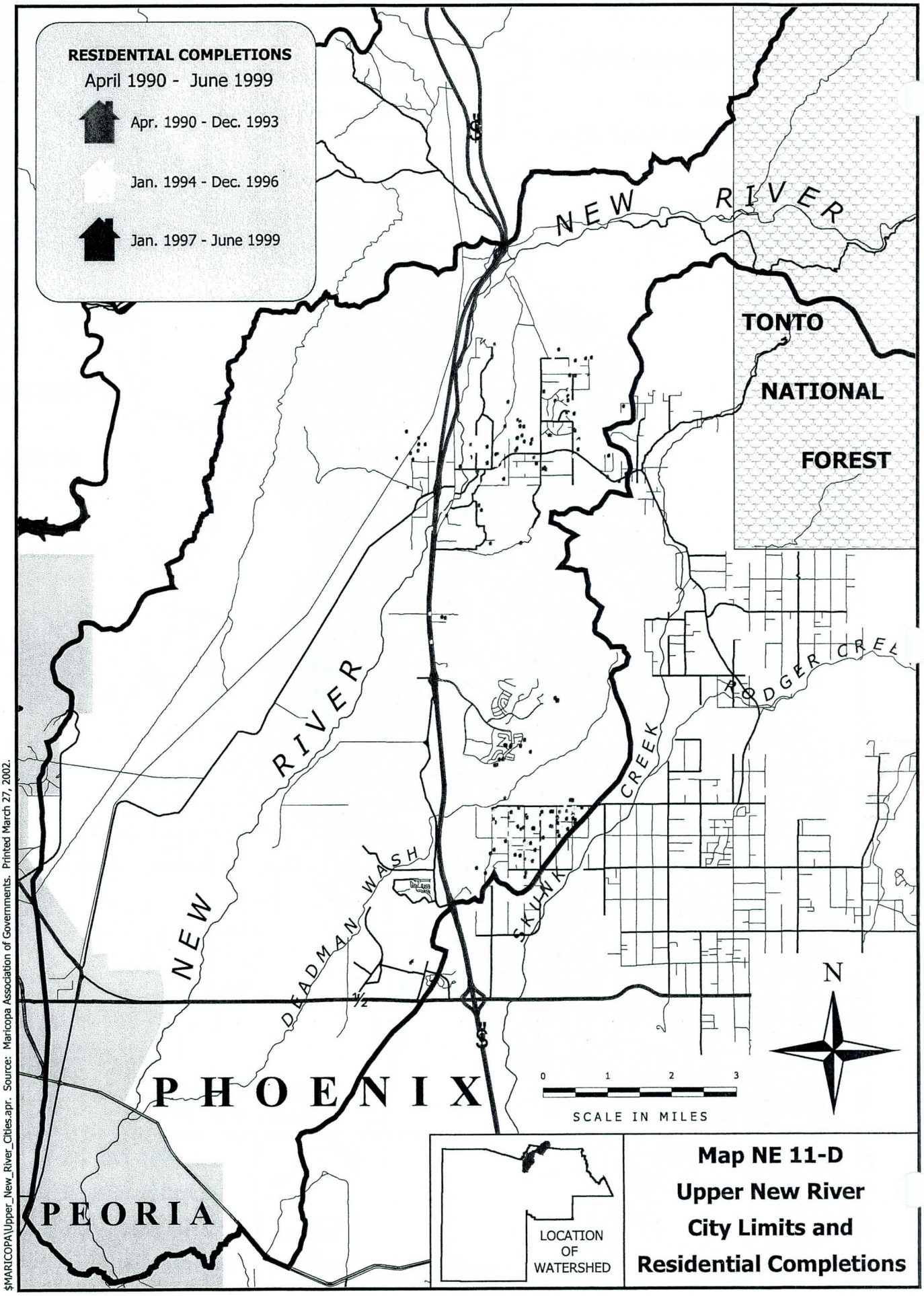
$MARICOPA\Upper_New_River_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_New_River_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_New_River_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_New_River_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

UPPER SALT RIVER WATERSHED

The Upper Salt River Watershed is an area that contributes flows to ..... This Watershed is located in Townships ..... , Ranges .....

The Maricopa County portion is primarily located in the Tonto national Forest. Runoff from this area eventually enters the Salt River and could contribute to floodwater and/or erosion damages to the eastern portion of the Phoenix Metropolitan Area.

What happens in this Watershed can have some impact on location of development and location and size of flood prevention measures in Maricopa County. However, no development is projected for this Watershed so conditions are not expected to change during the time period covered by this study.

The Upper Salt River Watershed includes 228,627 acres or about 357 square miles in northeastern Maricopa County. The majority of this Watershed is in Gila County with small portions in Pinal and Yavapai Counties.

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UPPER VERDE WATERSHED

The Upper Verde Watershed is an area that contributes flows to ….. This Watershed is located in Townships ….., Ranges ……

The Maricopa County portion is primarily located in the Tonto National Forest. Runoff from this area eventually enters the Verde River and could contribute to floodwater and/or erosion damages to the eastern portion of the Phoenix Metropolitan Area. Thus, what happens in this Watershed can have some impact on the location of development and the location and size of flood prevention measures in Maricopa County. However, no development is projected for this Watershed so conditions are not expected to change during the time period that is covered by this Study.

The Upper Verde Watershed includes 107,627 acres or about 168 square miles in Maricopa County. The majority of this Watershed is located in Yavapai County and this area has not been measured for this report.

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ARLINGTON WATERSHED

Table NW 1-1
Land Ownership in the Arlington Watershed

Land Ownership in Arlington Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. M.	County Land Only	Entire Watershed
PRIVATE	30,055	46.96	71.27%	71.27%
STATE	11,588	18.11	27.48%	27.48%
FEDERAL	525	0.82	1.24%	1.24%
Total	42,168	65.88	100.00%	100.00%

Table NW 1-2
Land Use in Arlington Watershed

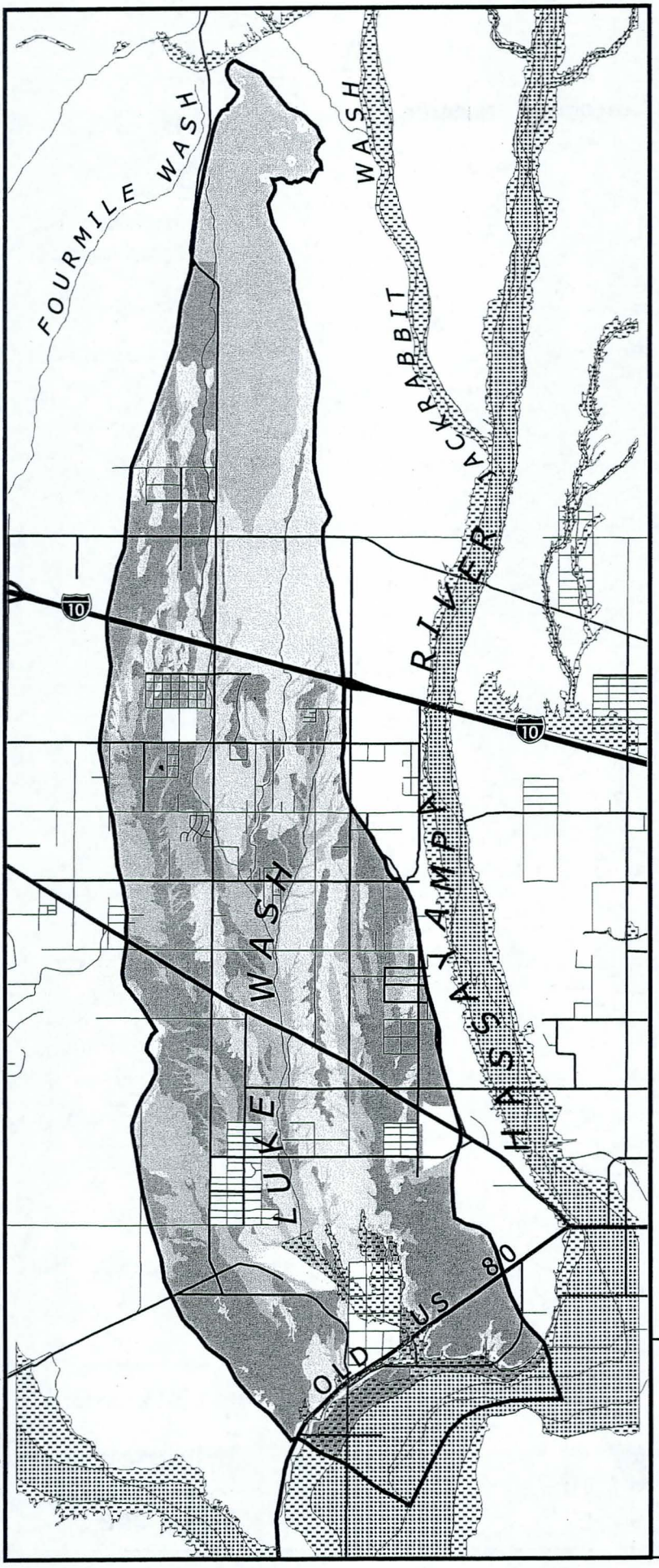
	Acres	Sq. M.	Percent
Medium/High Density Residential			
Low Density Residential	1,523	2.38	3.61%
Commercial & Industrial	15	0.02	0.04%
Agricultural	2,740	4.28	6.50%
Open Space			
Vacant	36,734	57.40	45.01%
Water	895	1.40	2.12%
Other	254	0.40	0.60%
Out of County/Not Classified			
Total Area	42,168	65.89	100.00%

Table NW 1-3
Flood Damage Report for Arlington Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
27-Oct-00	10:00 AM/ 2:00 PM	West and Northwest Maricopa County. Main band of rain moved slowly east across county. Ground already saturated from storm events of Oct. 10 and Oct. 21-23.	2.56 in. Centenial Wash/6 hr./30 yr. storm.	Jackrabbit Wash recorded a 50 yr. flood event; Hassayampa @ I-10 a 70 yr. event; Cassandro Wash a 40 yr.event; Sols and Tiger Washes 10 yr. events; Hartman Wash a 6 yr. event and Skunk Creek a 2 yr.event.	Data not available.
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages/ 24 hr./25 yr. storm.	Arlington School, 6 farmhouses in the area flooded to 2 ft. deep. Several farms, feedlots, and dairies in the western county were damaged by high water; loss and drowning of livestock. 71 roads, streets and bridges reported closed.	2 deaths-countywide, Public and private damages exceeded $38 million. Downstream cleanup costs $4 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges, sewers and flood control structures. 2,000 acres of crops and land affected, plus equipment damage.	Gila River: US 80-Watson Rd.: $2 million-agriculture, $1 million-public.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Residential, agricultural, commercial and industrial; severe damage to roads and bridges.	4 deaths-countywide, $.75 million-commercial $16.3 million-public, $3.1million-residential, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Flooding due to Verde River runoff, volume exceeded reservoir storage. Flooding also along tributaries of the Gila River and Agua Fria, Hassayampa River and Centennial Wash. Extensive damage to commercial, industrial, agricultural and public facilities.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Storm Report, Summer/Autumn Storms of 2000", Flood Control District of Maricopa County.
2. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
3. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.



Soil Erodability by Water
Slight
Moderate
Severe

Flood Hazards
100-year flood zone
Floodway

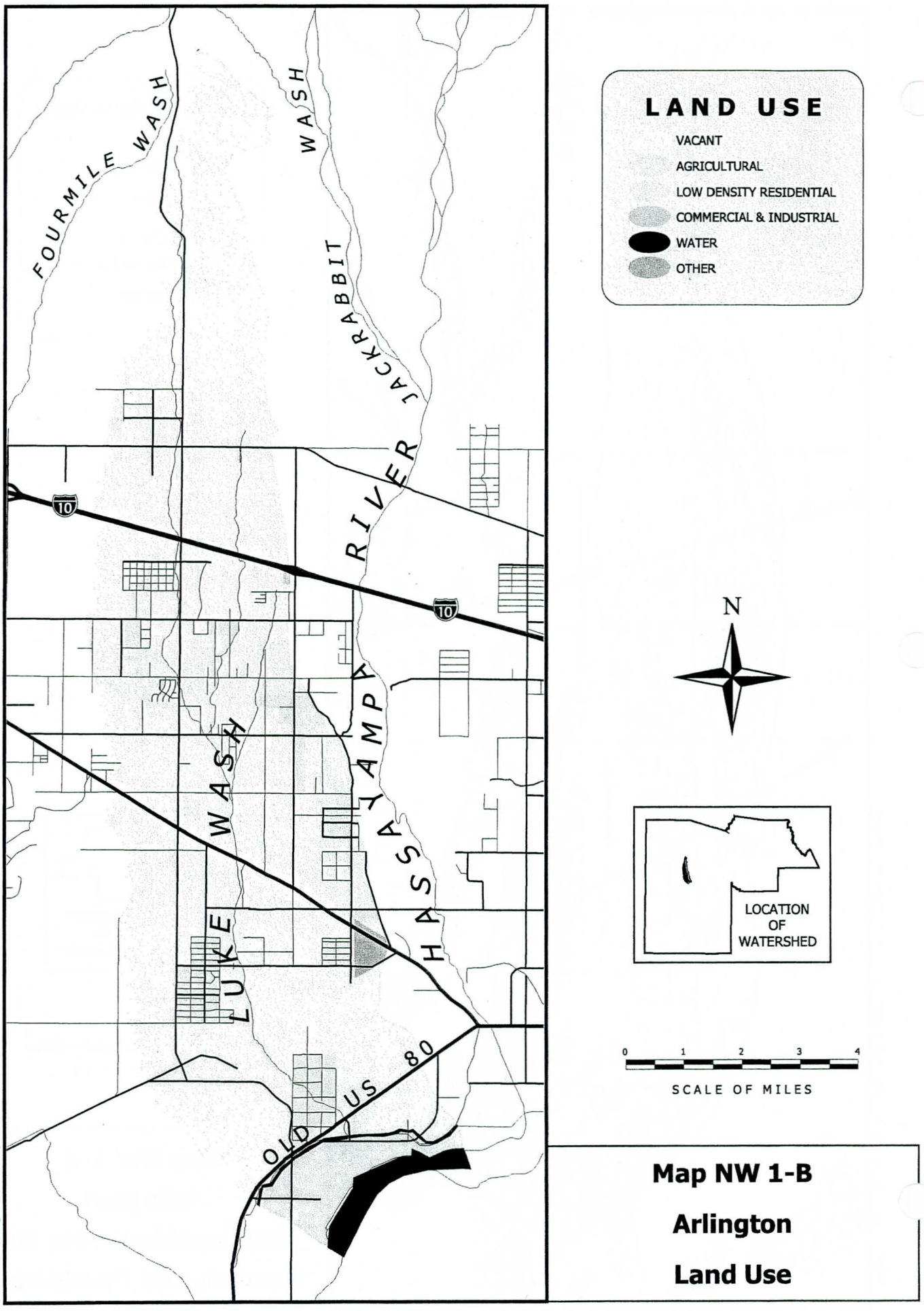
N

LOCATION OF WATERSHED

0 1 2 3 4
SCALE OF MILES

Map NW 1-A
Arlington
Developable Lands, Soil Erosion, and Floodplains

$MARICOPA\Arlington_Erosion.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

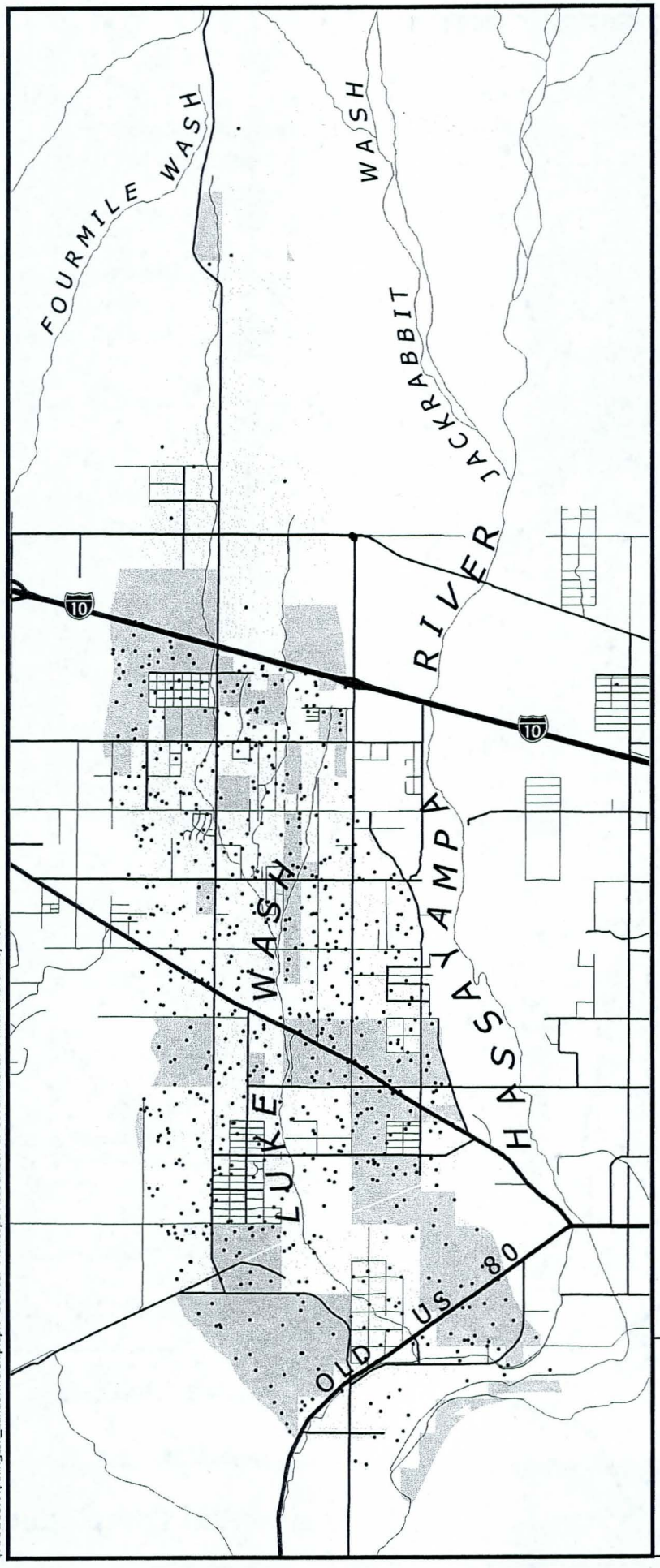


$MARICOPA\Arlington_Landuse.apr. Source: Maricopa Association of Governments. Printed Printed March 26, 2002.

Map NW 1-B

Arlington

Land Use



LAND OWNERSHIP

PRIVATE 71.27%

STATE 27.48%

FEDERAL 1.24%

2020
Population Projections
One dot (·) = 5 people

N

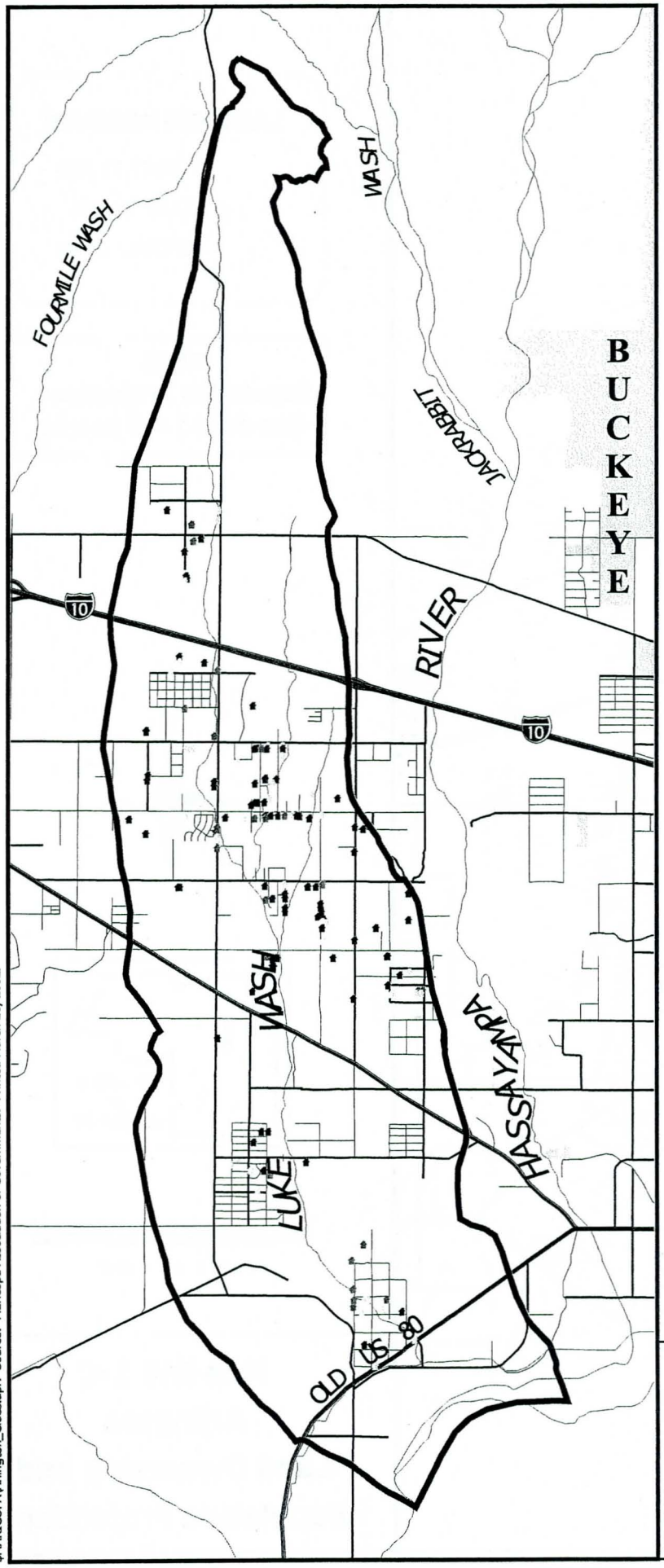
LOCATION OF WATERSHED

0 1 2 3 4

SCALE OF MILES

Map NW 1-C
Arlington
Land Ownership and Population Projections

$MARICOPA\Arlington_Landownership.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



RESIDENTIAL COMPLETIONS

April 1990 - June 1999

Apr. 1990 - Dec. 1993

Jan. 1994 - Dec. 1996

Jan. 1997 - June 1999

N

LOCATION OF WATERSHED

0 1 2 3 4

SCALE OF MILES

Figure NW 1-D

Arlington

Residential Completions

$MARICOPA\Arlington_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

BUCKEYE HILLS AND BUCKEYE VALLEY WATERSHEDS

Table NW 2-1
Land Ownership in the Buckeye Valley/Hills Watersheds

Land Ownership Category	Land Area by Ownership Category		Percent of Each Watershed		
	Acres	Sq. Mi.	Buckeye Valley	Buckeye Hills	Both Combined
PRIVATE: Buckeye Valley	41,334	64.59	92.35%		54.05%
FEDERAL: Buckeye Hills	26,034	40.68		70.65%	34.58%
STATE: Buckeye Hills	4,150	6.48		11.25%	6.59%
PARKS: Buckeye Hills	3,893	6.08		10.56%	4.77%
PRIVATE: Buckeye Hills	2,775	4.34		7.53%	54.05%
FEDERAL: Buckeye Valley	2,190	3.42	4.89%		34.58%
STATE: Buckeye Valley	1,235	1.93	2.76%		6.59%
Total	81,611	127.51	100.00%	100.00%	

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Table NW 2-2
Land Use in the Buckeye Valley/Hills Watershed

	Acres	Sq. Mi.	Percent
Medium/High Density Residential			
Low Density Residential	1,987	3.11	2.44%
Commercial & Industrial	348	0.54	0.43%
Agricultural	31,251	48.83	38.29%
Open Space	4,837	7.56	5.93%
Vacant	36,734	57.40	45.01%
Water	5,930	9.27	7.27%
Other	521	0.81	0.64%
Out of County/Not Classified			
Total Area	81,609	127.51	100.00%

Table NW 2-3
Flood Damage Report for Buckeye Valley/Buckeye Hills Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
27-Oct-00	10:00 AM/ 2:00 PM	West and Northwest Maricopa County. Main band of rain moved slowly east across county. Ground already saturated from storm events of Oct. 10 and Oct. 21-23.	2.56 in. Centenial Wash/6 hr./30 yr. storm.	Centennial Wash (flow into Wenden), Wickenburg (Sols Wash) and Skunk Creek.	Data not available.
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	Several farms, feedlots, and dairies in the western county were damaged by high water; loss and drowning of livestock. Erosion of Tri-City landfill sent about 55,000 cu. yds. of debris washed down river.	2 deaths-countywide, Public and private damages exceeded $38 million. Downstream cleanup costs $4 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges, sewers and flood control structures. 2,000 acres of crops and land affected, plus equipment damage.	Gila River: US 80-Watson Rd.: $2 million-agriculture, $1 million-public.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Light residential damage, moderate damage to agriculture, commercial and industrial; severe damage to roads and bridges.	4 deaths-countywide, $.75 million-commercial, $16.3 million-public, $3.1million-residential, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding also occured along tributaries of the Gila River and Agua Fria, Hassayampa River and Centennial Wash. Extensive damage to commercial, industrial, agriculture and public facilities.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Storm Report, Summer/Autumn Storms of 2000", Flood Control District of Maricopa County.
2. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
3. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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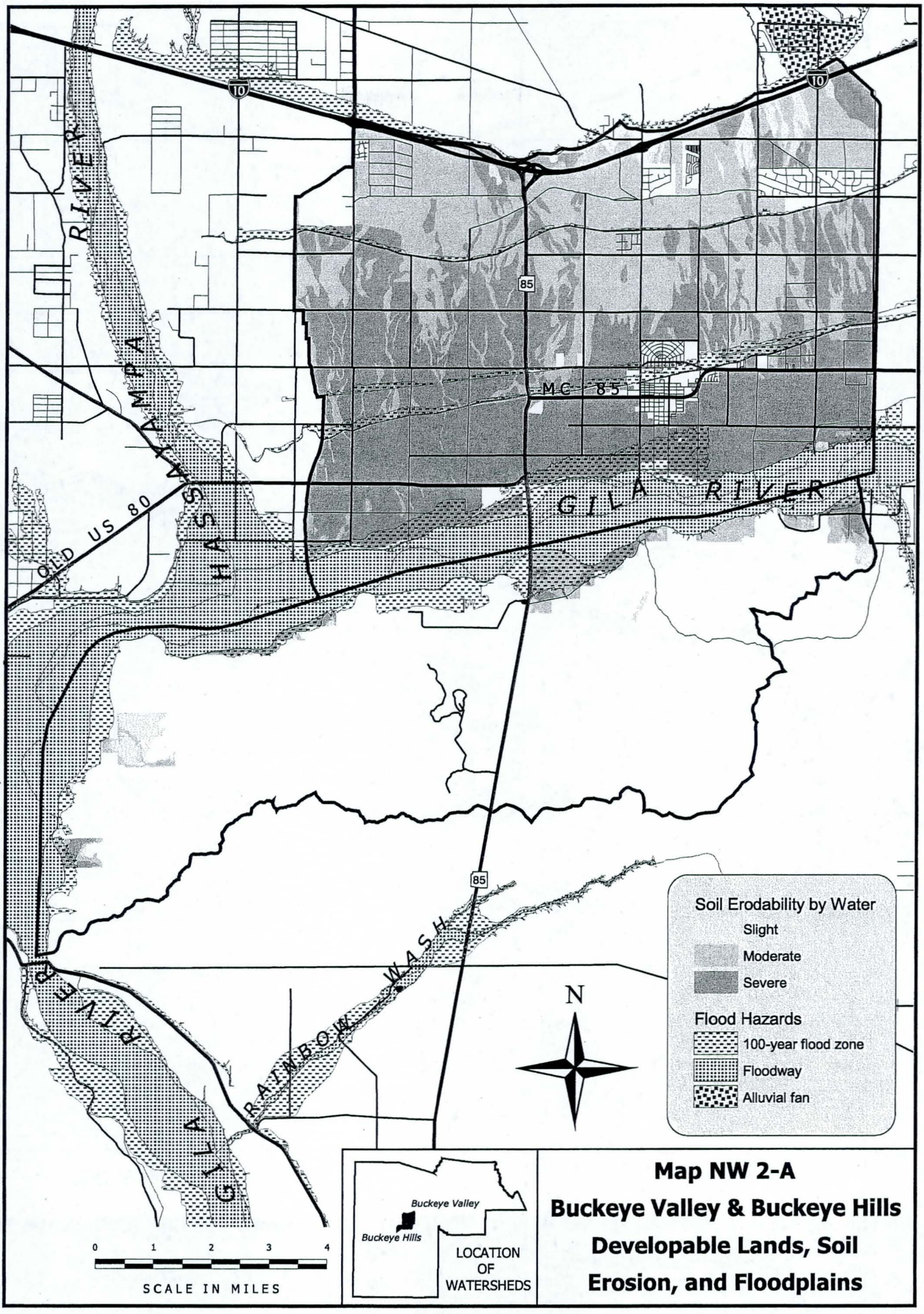
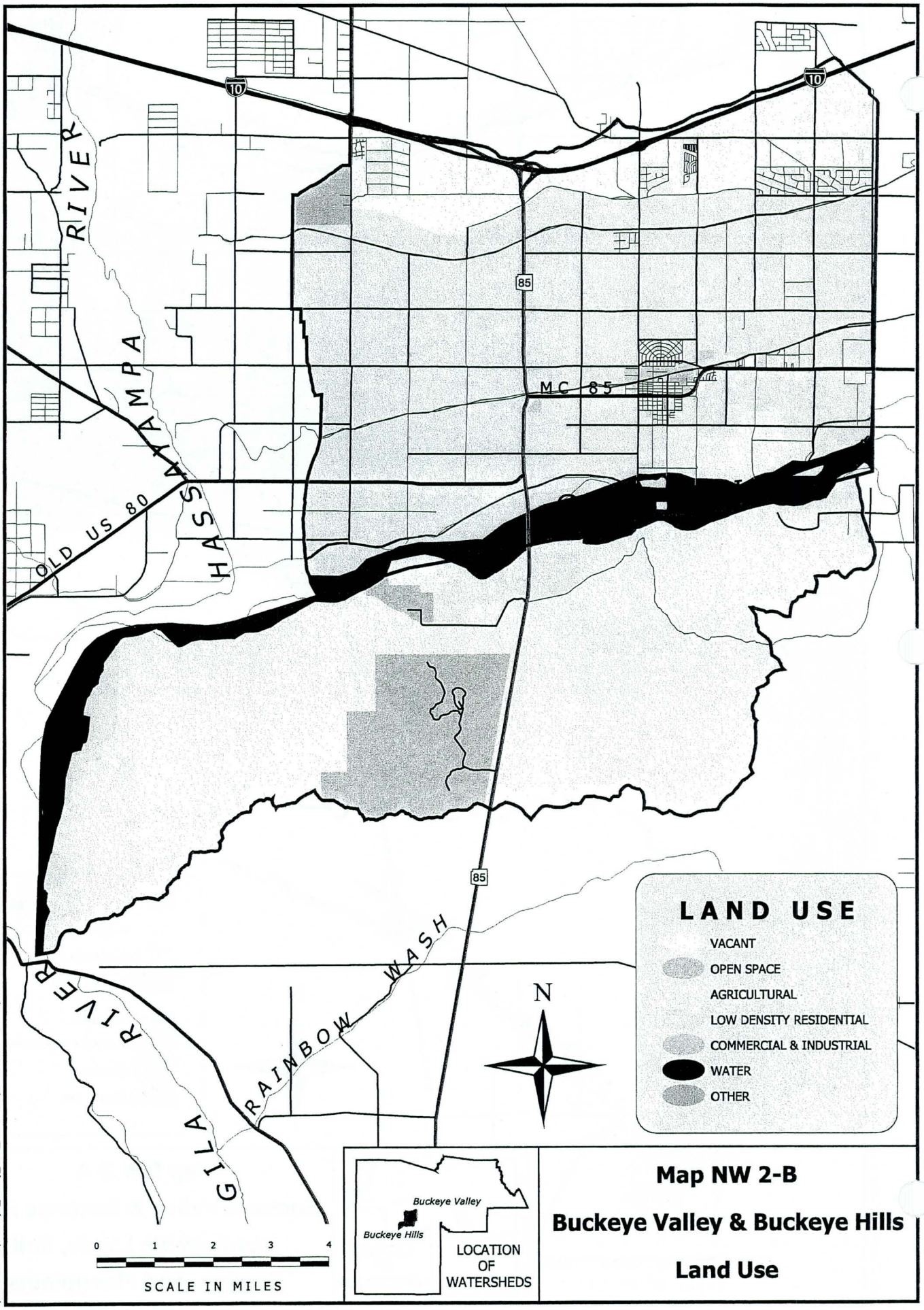
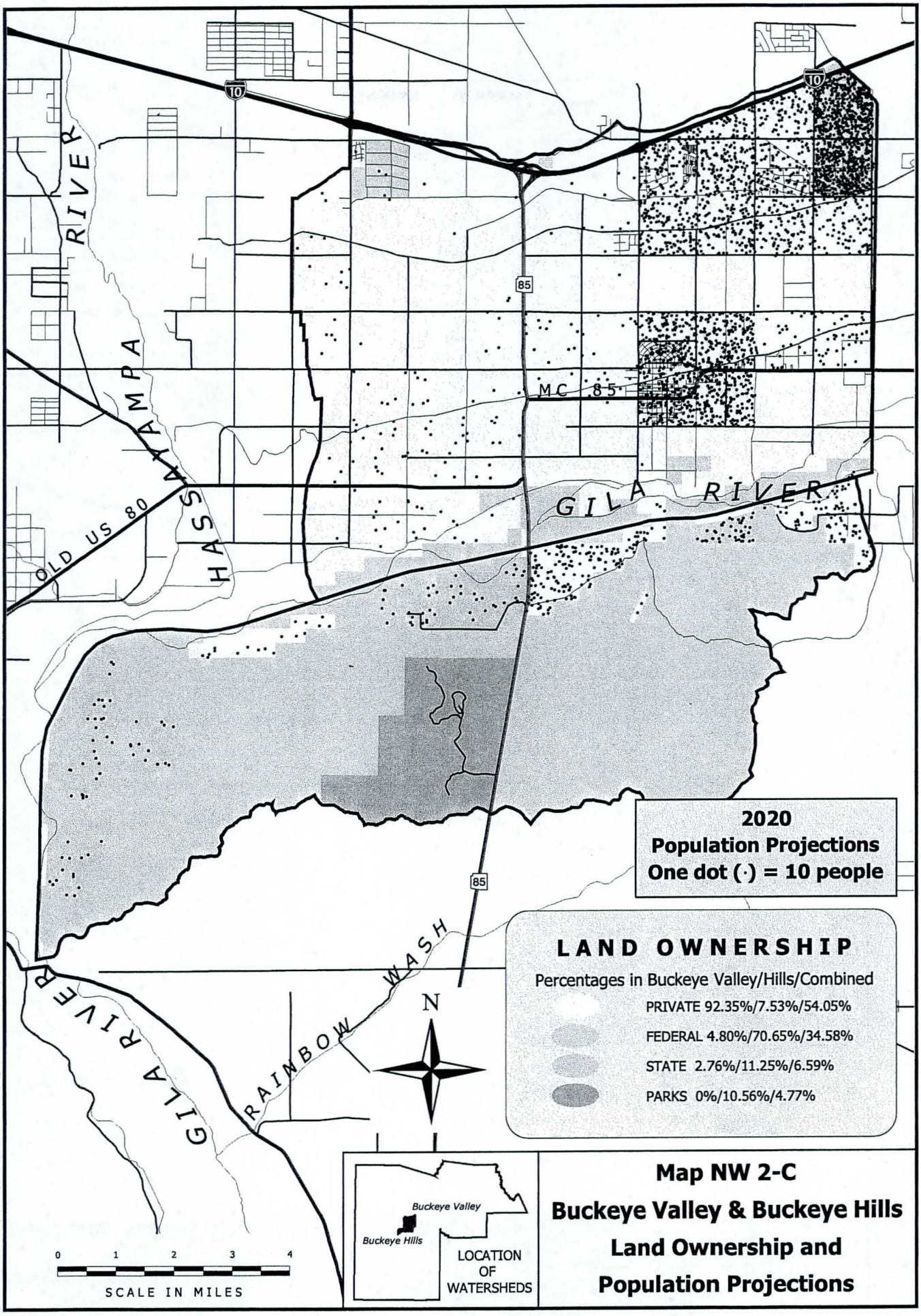


Map NW 2-A
Buckeye Valley & Buckeye Hills Developable Lands, Soil Erosion, and Floodplains

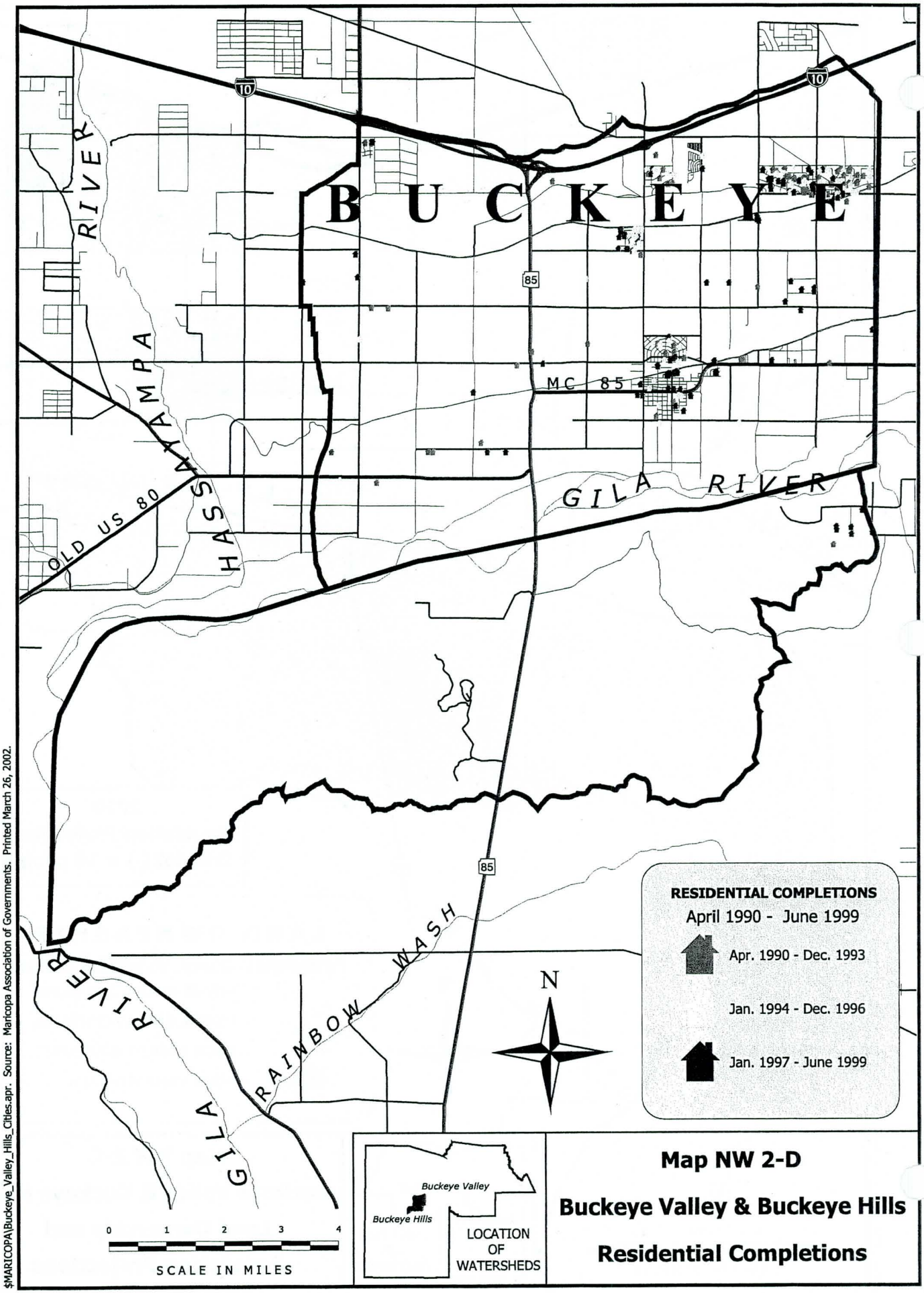
$MARICOPA\Buckey_Valley_Hills_Erosion.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Buckeye_Valley_Hills_Landuse.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Buckey_Valley_Hills_Landownership.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Buckeye_Valley_Hills_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

LOWER AGUA FRIA WATERSHED

Table NW 3-1

Land Ownership in the Lower Agua Fria Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
PRIVATE	28,526	44.57	42.21%	41.40%
PARKS	20,099	31.41	29.74%	29.17%
FEDERAL	18,957	29.62	28.05%	27.51%
STATE	1,324	2.07		1.92%
Total	68,906	107.66		100.00%

Table NW 3-2

Land Use in the Lower Agua Fria Watershed, by Classification

	Acres	Sq. M.	Percent
Medium/High Density Residential	3,156	4.93	4.58%
Low Density Residential	317	0.50	0.46%
Commercial & Industrial	721	1.13	1.05%
Agricultural	747	1.17	1.08%
Open Space	1,735	2.71	2.52%
Vacant	56,348	88.04	81.78%
Water	3,837	6.00	5.57%
Other	719	1.12	1.04%
Out of County/Not Classified	1,324	2.07	1.92%
Total Area	68,906	132.11	100.00%

Table NW 3-3
Flood Damage History for Lower Agua Fria Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages/ 24 hr./25 yr. storm	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges. Two sand and gravel operations damaged. Hound Dog Acres and Hatfield Acres flooded. $2,000 average damage per household.	$1.4 million-roads,bridges and parks, $0.17 million-residential.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in.-Central Mountains	Severe damage to roads and bridges. 9 sand and gravel operations damaged along Agua Fria River.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture, $1.3-million-sand & gravel on Agua Fria River.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angles District.
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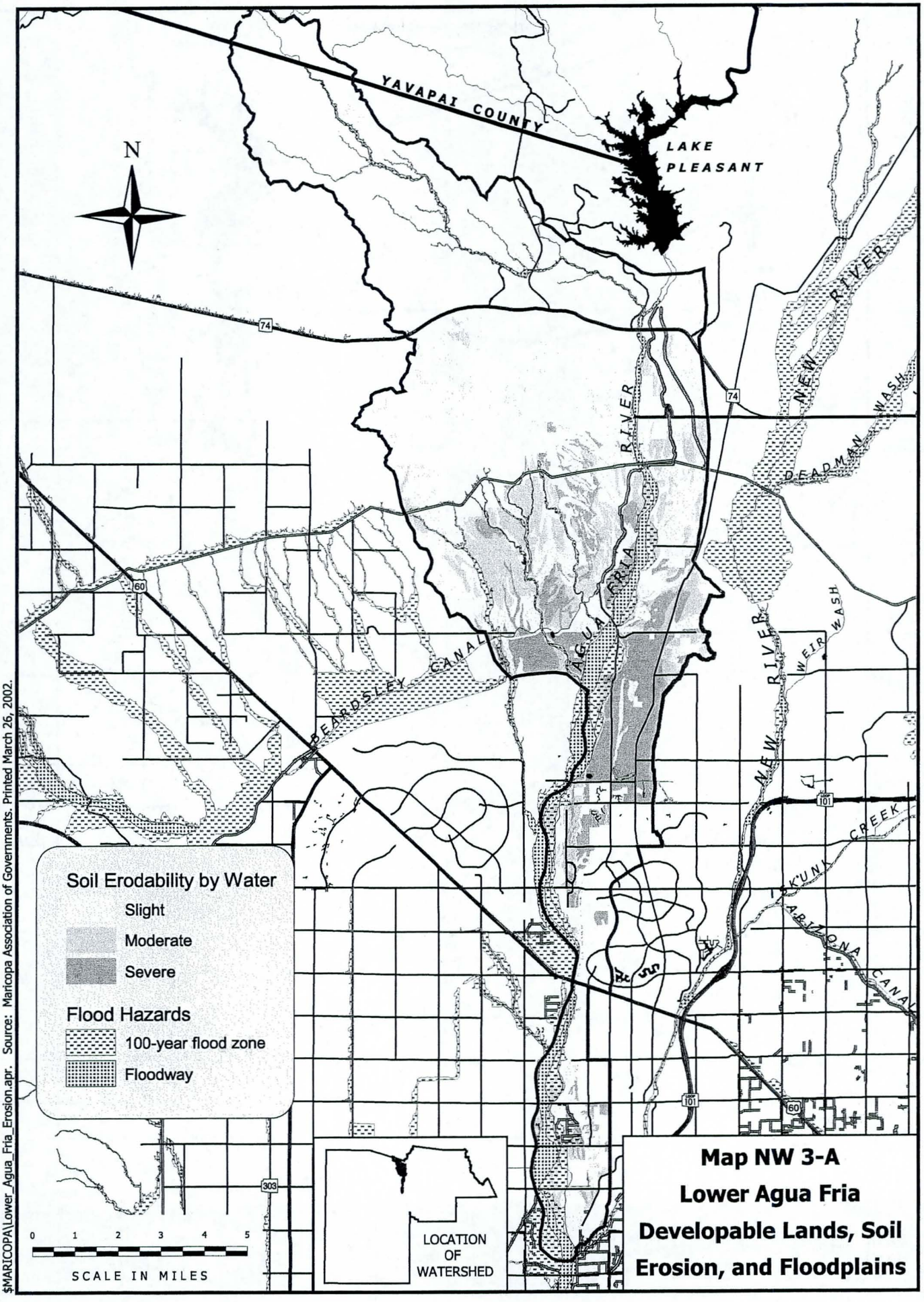
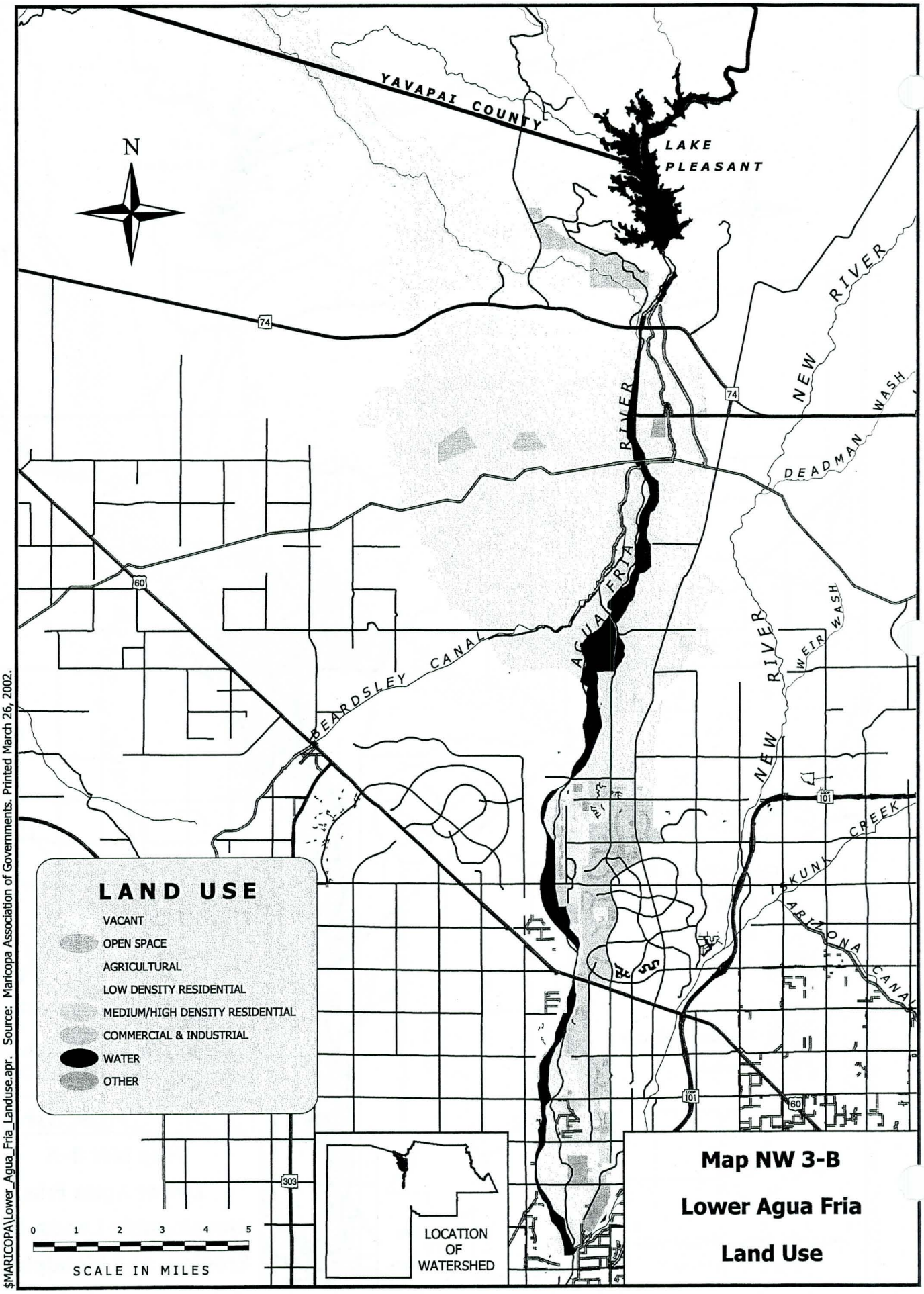
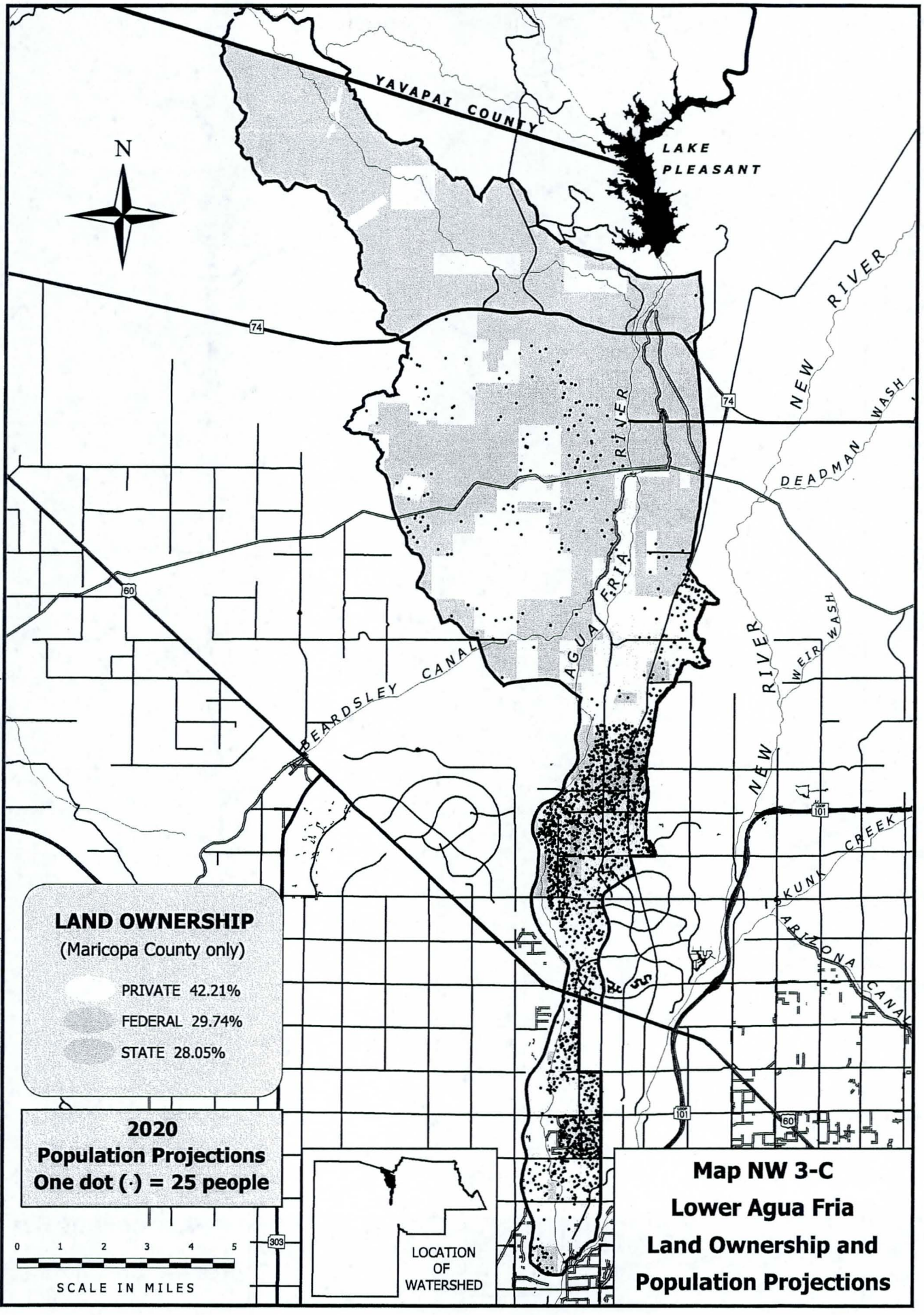


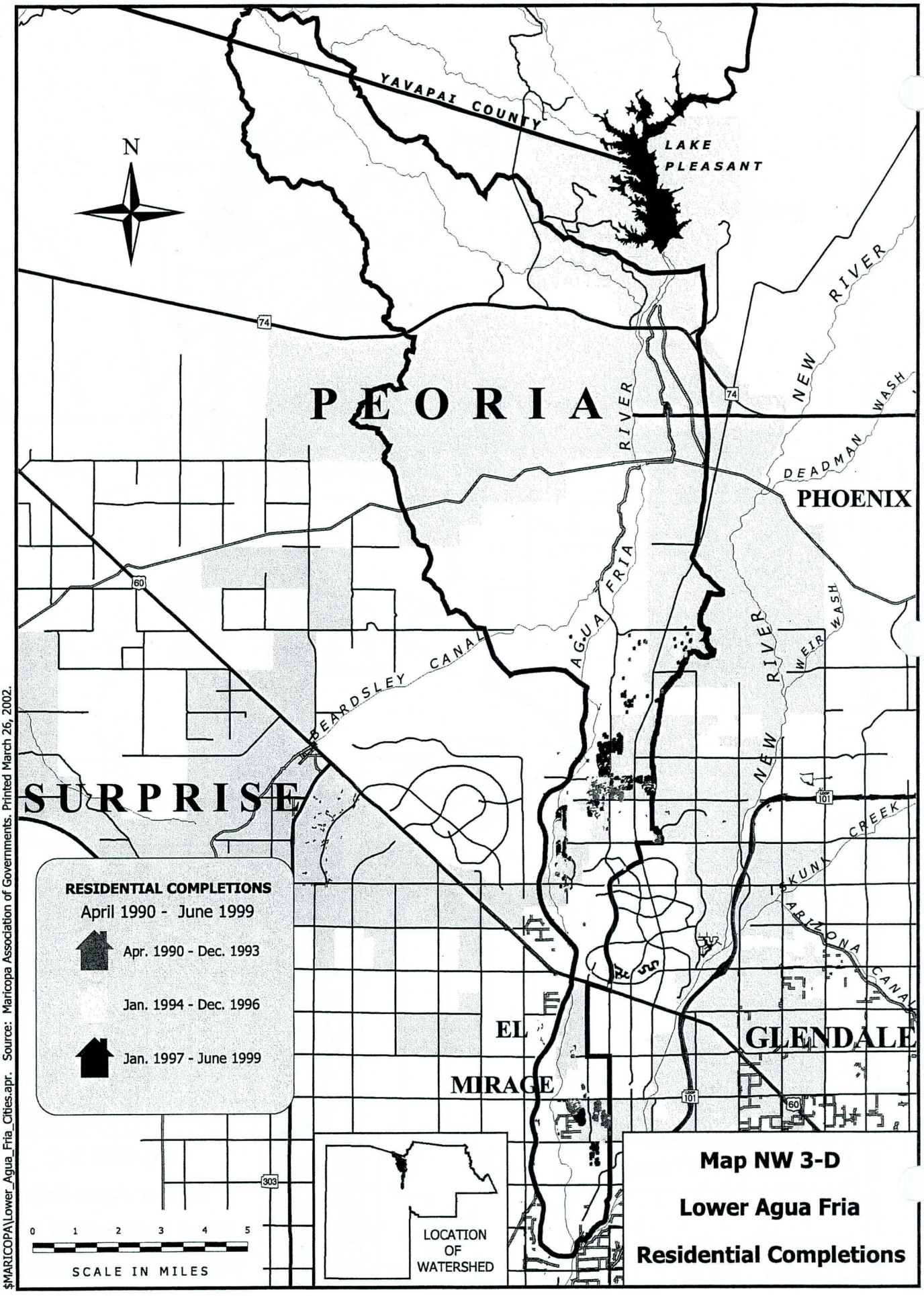
$MARICOPA\Lower_Agua_Fria_Erosion.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Lower_Agua_Fria_Landuse.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Lower_Agua_Fria_Landownership.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Lower_Agua_Fria_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

LOWER CENTENNIAL WATERSHED

Table NW 4-1

Land Ownership in the Lower Centennial Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. M.	County Land Only	Entire Watershed
FEDERAL	385,822.90	602.38	60.88%	49.28%
PRIVATE	190,098.90	297.03	30.02%	24.30%
STATE	57,671.70	90.11	9.11%	7.37%
OUT OF COUNTY	149,006.10	232.82		19.05%
Total	782,599.60	1,222.34		100.00%

Table NW 4-2

Area of Land in Lower Centennial Watershed, by Classification

	Acres	Sq. M.	Percent
Medium/High Density Residential			
Low Density Residential	2,609	4.08	0.33%
Commercial & Industrial	32	0.05	0.00%
Agricultural	56,250	87.89	7.19%
Open Space	87,136	136.15	11.14%
Vacant	479,944	749.91	61.35%
Water	2,333	3.65	0.30%
Other	4,814	7.52	0.62%
Out of County/Not Classified	149,158	233.06	19.07%
Total Area	782,276	1222.31	100.00%

Table NW 4-3
Flood Damage Report for Lower Centennial Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
27-Oct-00	10:00 AM/ 2:00 PM	West and Northwest Maricopa County. Main band of rain moved slowly east across county. Ground already saturated from storm events of Oct. 10 and Oct. 21-23.	2.56 in. Centenial Wash/6 hr./30 yr. storm	Jackrabbit Wash recorded a 50 yr. flood event; Hassayampa @ I-10 a 70 yr. event; Cassandro Wash a 40 yr.event; Sols and Tiger Washes 10 yr. events; Hartman Wash a 6 yr. event and Skunk Creek a 2 yr.event.	Data not available.
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages/ 24 hr./25 yr. storm	Arlington School, 6 farmhouses in the area flooded to 2 ft. deep. Several farms, feedlots, and dairies in the western county were damaged by high water; loss and drowning of livestock. 71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges, sewers and flood control structures. 2,000 acres of crops and land affected, plus equipment damage.	Gila River: US 80-Watson Rd.: $2 million-agriculture, $1 million-public.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec, covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Residential, agricultural, commercial and industrial; severe damage to roads and bridges.	4 deaths-countywide, $.75 million-commercial $16.3 million-public, $3.1million-residential, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm	Flooding due to Verde River runoff, volume exceeded reservoir storage. Flooding also along tributaries of the Gila River and Agua Fria, Hassayampa River and Centennial Wash. Extensive damage to commercial, industrial, agricultural and public facilities.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

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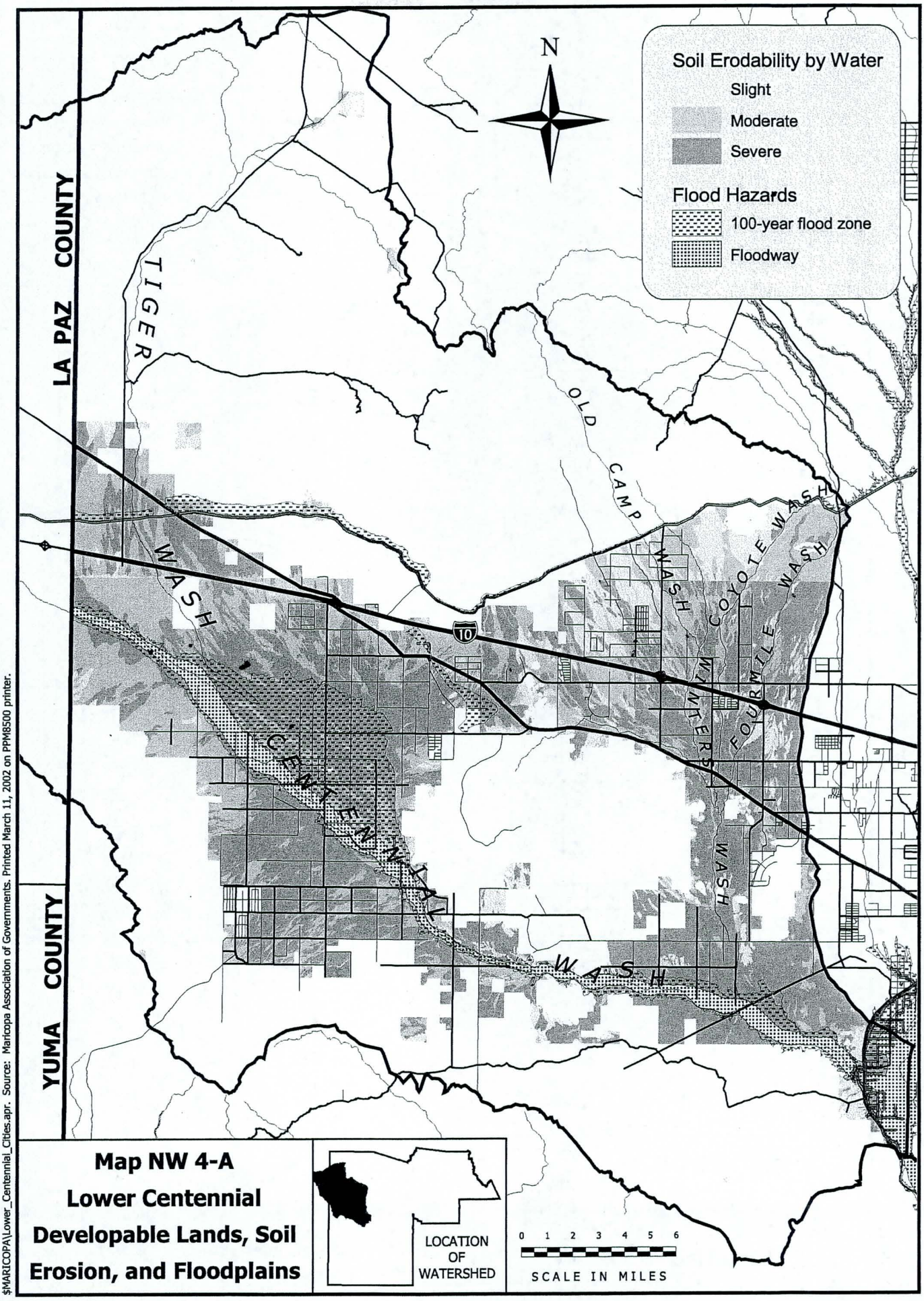
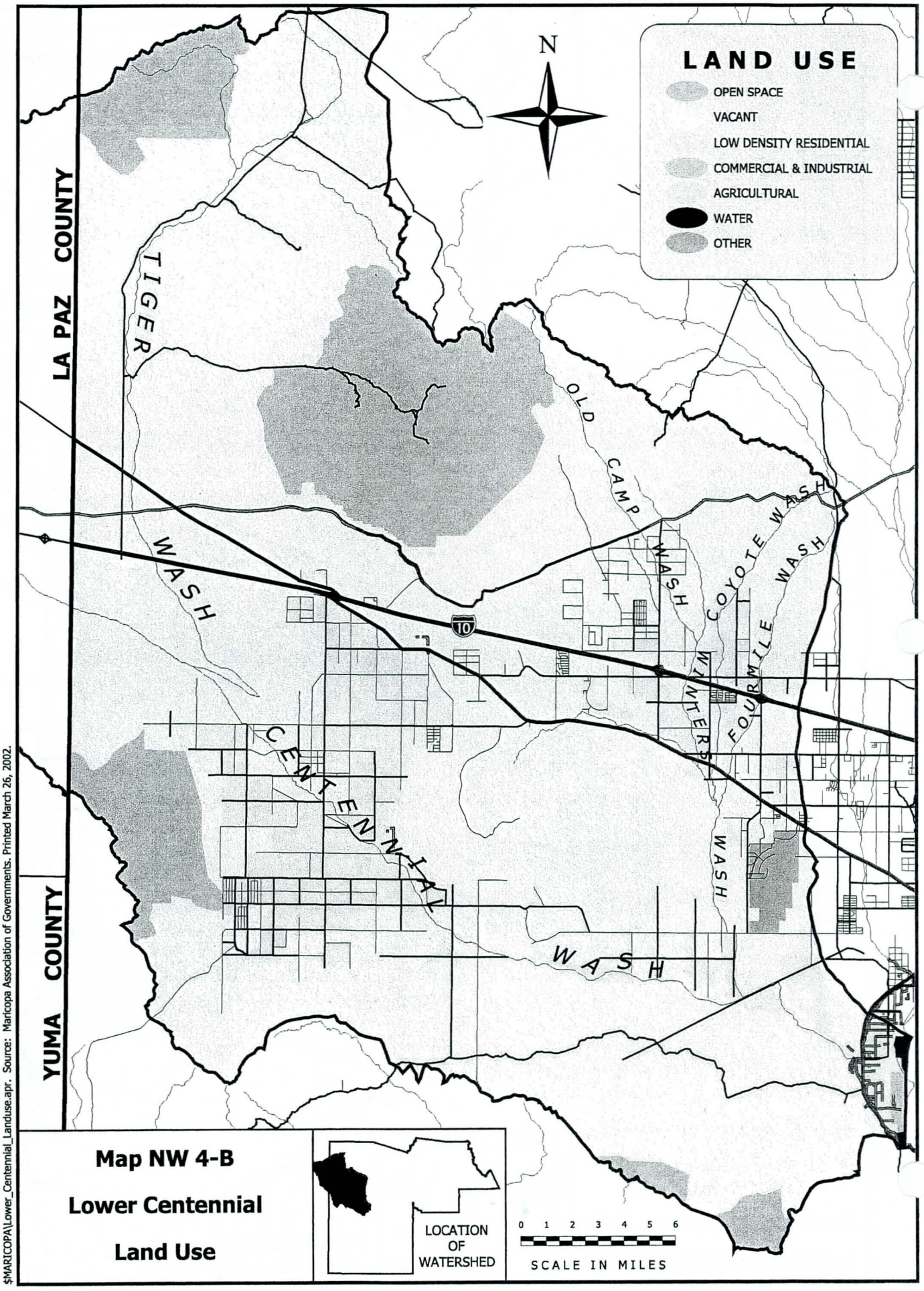
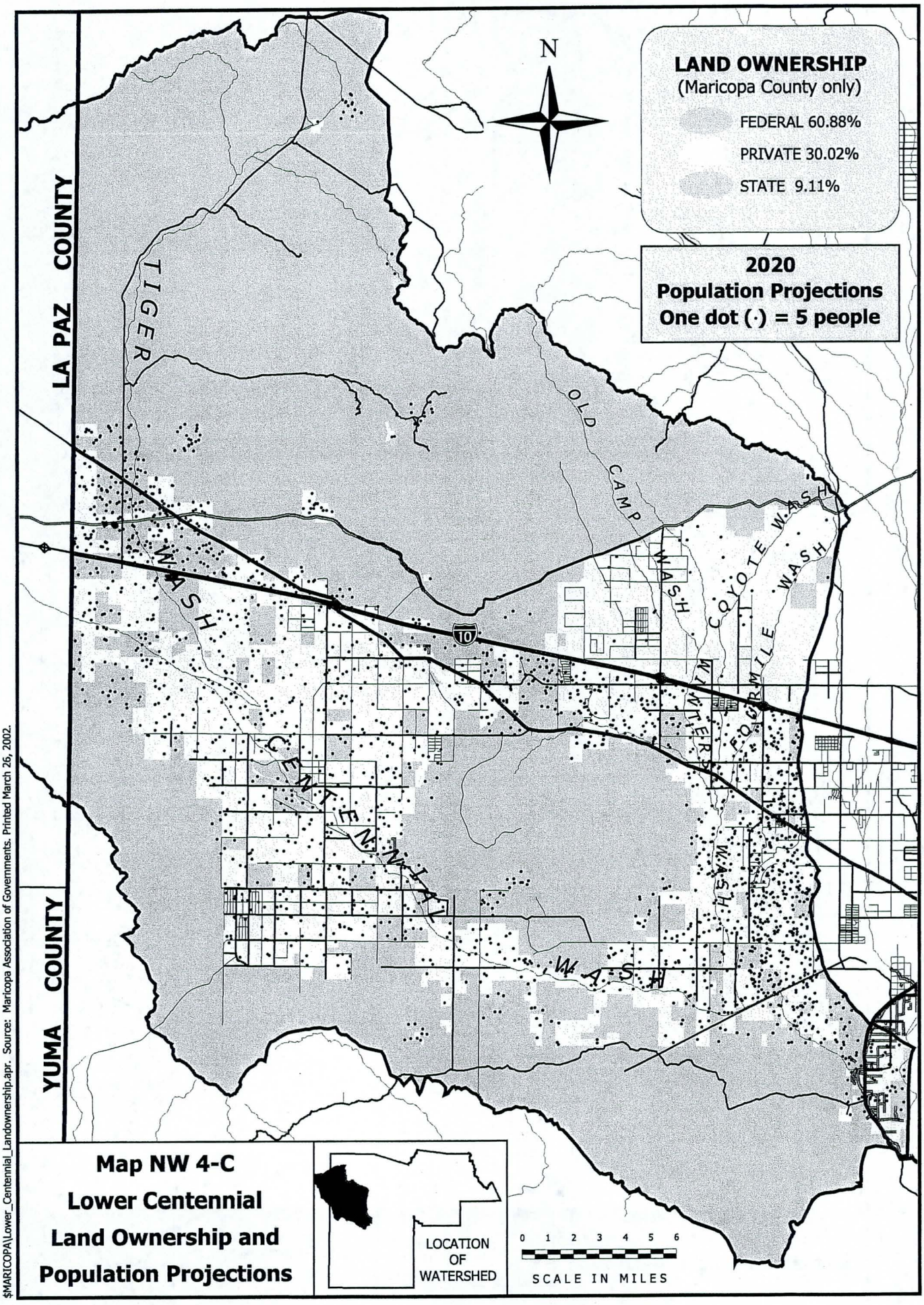


Map NW 4-A
Lower Centennial
Developable Lands, Soil Erosion, and Floodplains

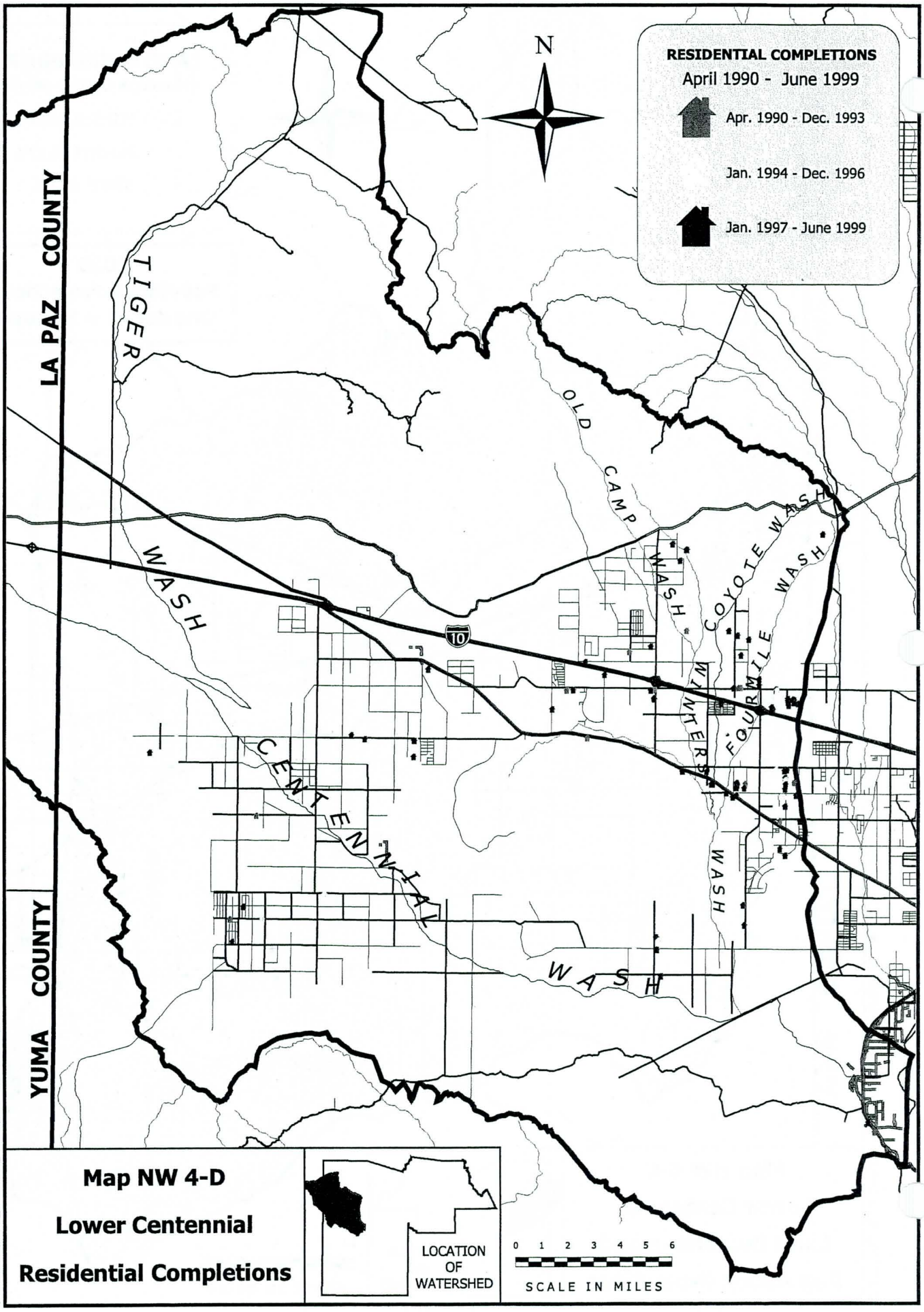
$MARICOPA\Lower_Centennial_Cities.apr. Source: Maricopa Association of Governments. Printed March 11, 2002 on PPM8500 printer.



$MARICOPA\Lower_Centennial_Landuse.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Lower_Centennial_Landownership.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Lower_Centennial_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

LOWER HASSAYAMPA WATERSHED

Table NW 5-1

Land Ownership in the Lower Hassayampa Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
FEDERAL	207,475.30	324.18	40.53%	30.51%
PRIVATE	190,589.70	297.80	37.23%	28.02%
STATE	108,126.10	168.95	21.12%	15.90%
PARKS	3,938.60	6.15	0.77%	0.58%
MILITARY	1,631.70	2.55	0.32%	0.24%
COUNTY	154.50	0.24	0.03%	0.02%
OUT OF COUNTY	168,182.00	262.78		24.73%
Total	680,097.90	1062.65	100.00%	100.00%

Table NW 5-2

Land Area in Lower Hassayampa Watershed, by Classification

	Acres	Sq. Mi.	Percent
Medium/High Density Residential	917	1.43	0.13%
Low Density Residential	9,607	15.01	1.41%
Commercial & Industrial	598	0.93	0.09%
Agricultural	8,310	12.98	1.22%
Open Space	8,849	13.83	1.30%
Vacant	476,781	744.97	70.10%
Water	6,612	10.33	0.97%
Other	242	0.38	0.04%
Out of County/Not Classified	168,182	262.78	24.73%
Total Area	680,098	1,062.65	100.00%

Table NW 5-3
Flood Damage History for Lower Hassayampa River Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
27-Oct-00	10:00 AM/ 2:00 PM	West and Northwest Maricopa County. Main band of rain moved slowly east across county. Ground saturated from storms of Oct. 10 and Oct. 21-23.	2.56 in. Centennial Wash/6 hr./30 yr. storm	15 families living 5 miles south of Wickenburg forced to relocate. Jackrabbit Wash recorded a 50 yr. flood event; Hassayampa @ I-10 a 70 yr. event; Cassandro Wash a 40 yr. event; Sols and Tiger Washes 10 yr. events. Farms, feedlots and dairies damaged.	Data not available.
8-Jan-93	6-Jan-8-Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport / 24 hr./25 yr. storm	Several farms, feedlots, and dairies in the western county were damaged by high water; loss and drowning of livestock. Erosion of Tri-City landfill sent about 55,000 cu. yds. of debris washed down river. 71 roads, streets and bridges reported closed.	2 deaths-countywide, Public and private damages exceeded $38 million. Downstream clean up costs $4 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges, sewers and flood control structures. 2,000 acres of crops and land affected, plus equipment damage.	Gila River: US 80-Watson Rd.: $2 million-agriculture, $1 million-public.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Light residential damage, moderate damage to agriculture, commercial and industrial; severe damage to roads and bridges.	4 deaths-countywide, $.75 million-commercial, $16.3 million-public, $3.1 million-residential, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding also occured along tributaries of the Gila River and Agua Fria, Hassayampa River and Centennial Wash. Extensive damage to commercial, industrial, agriculture and public facilities.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

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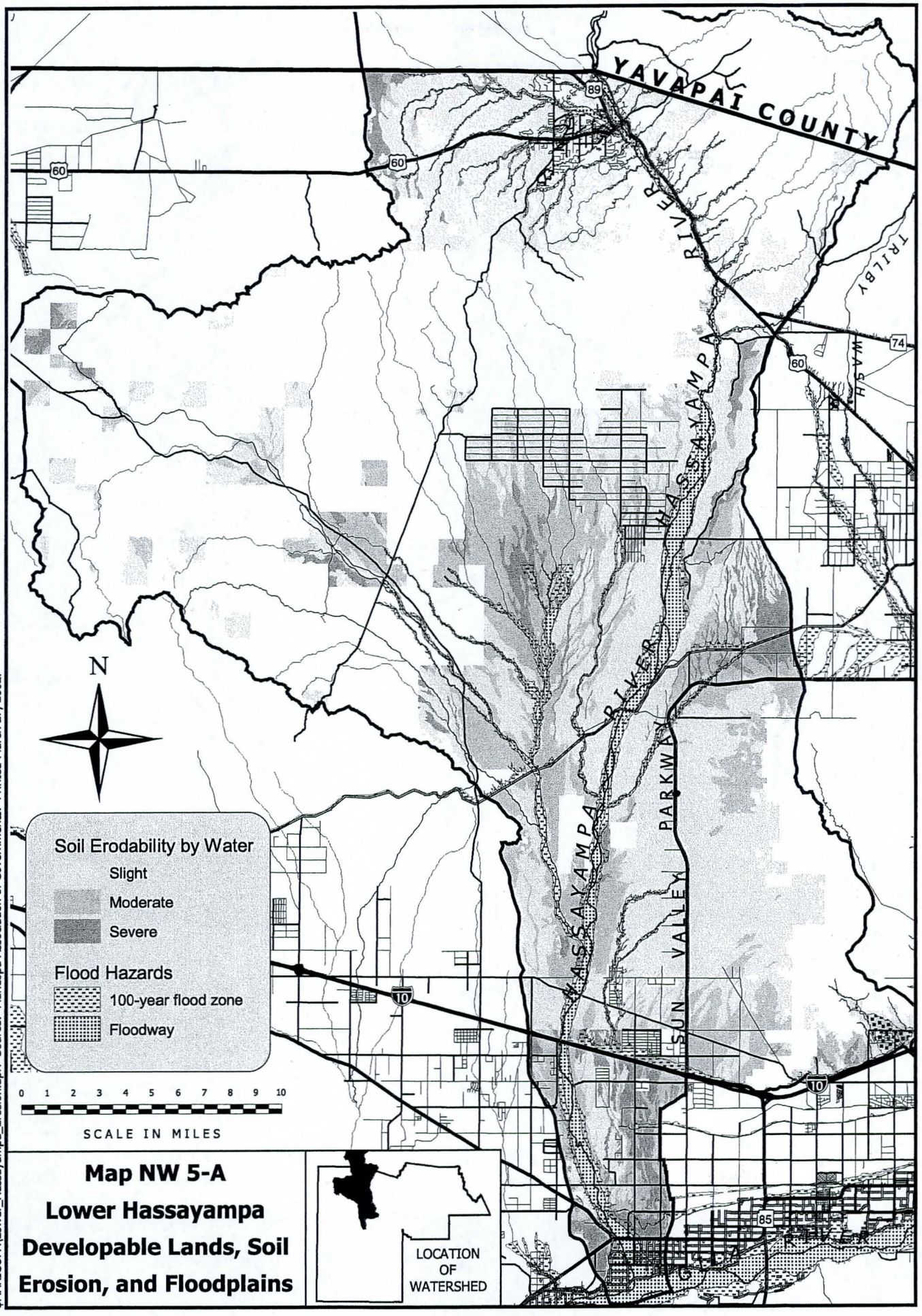
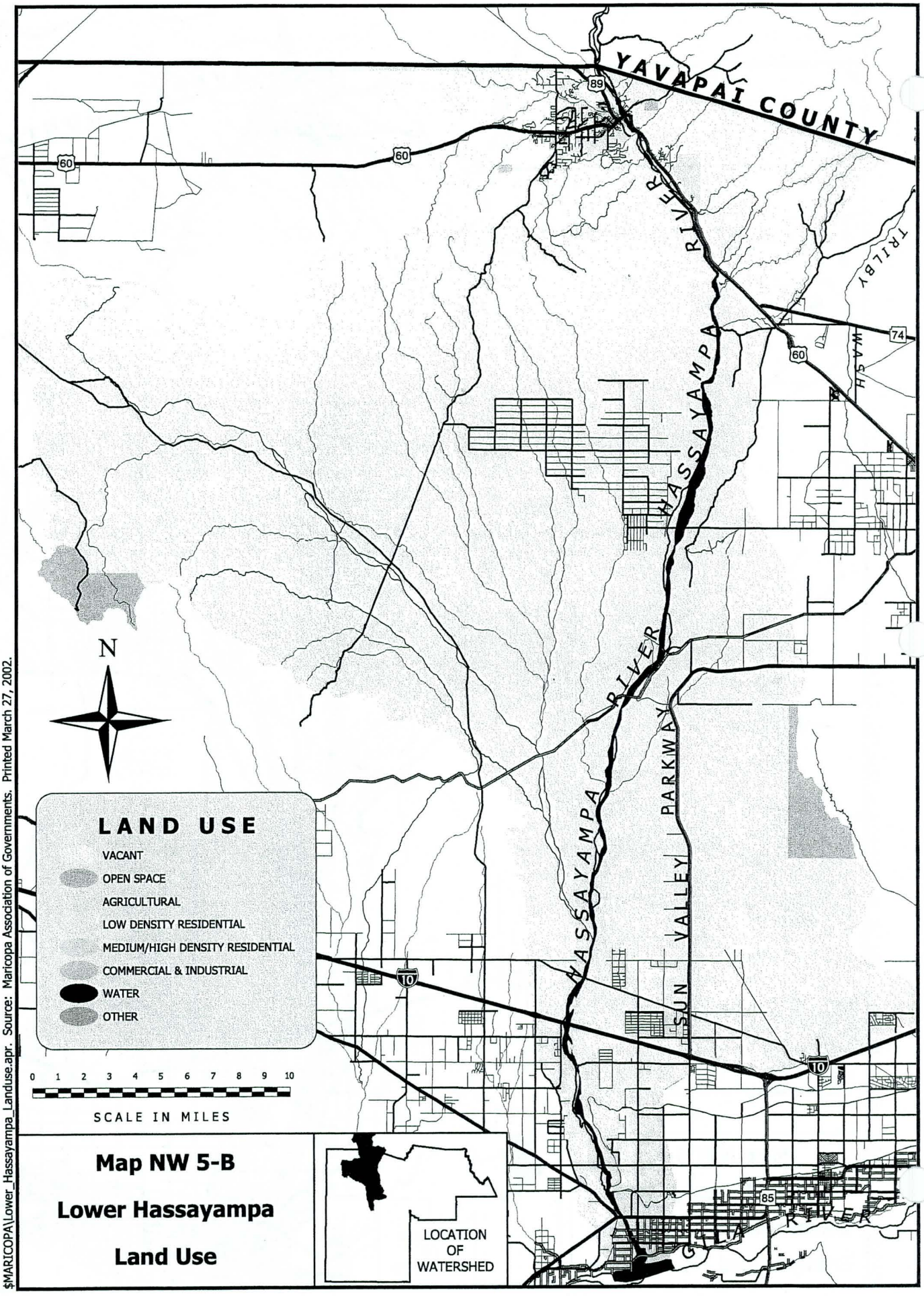
Sources of Information:

1. "Storm Report, Summer/Autumn Storms of 2000", Flood Control District of Maricopa County.
2. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
3. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.



Map NW 5-A
Lower Hassayampa Developable Lands, Soil Erosion, and Floodplains

$MARICOPA\Lower_Hassayampa_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

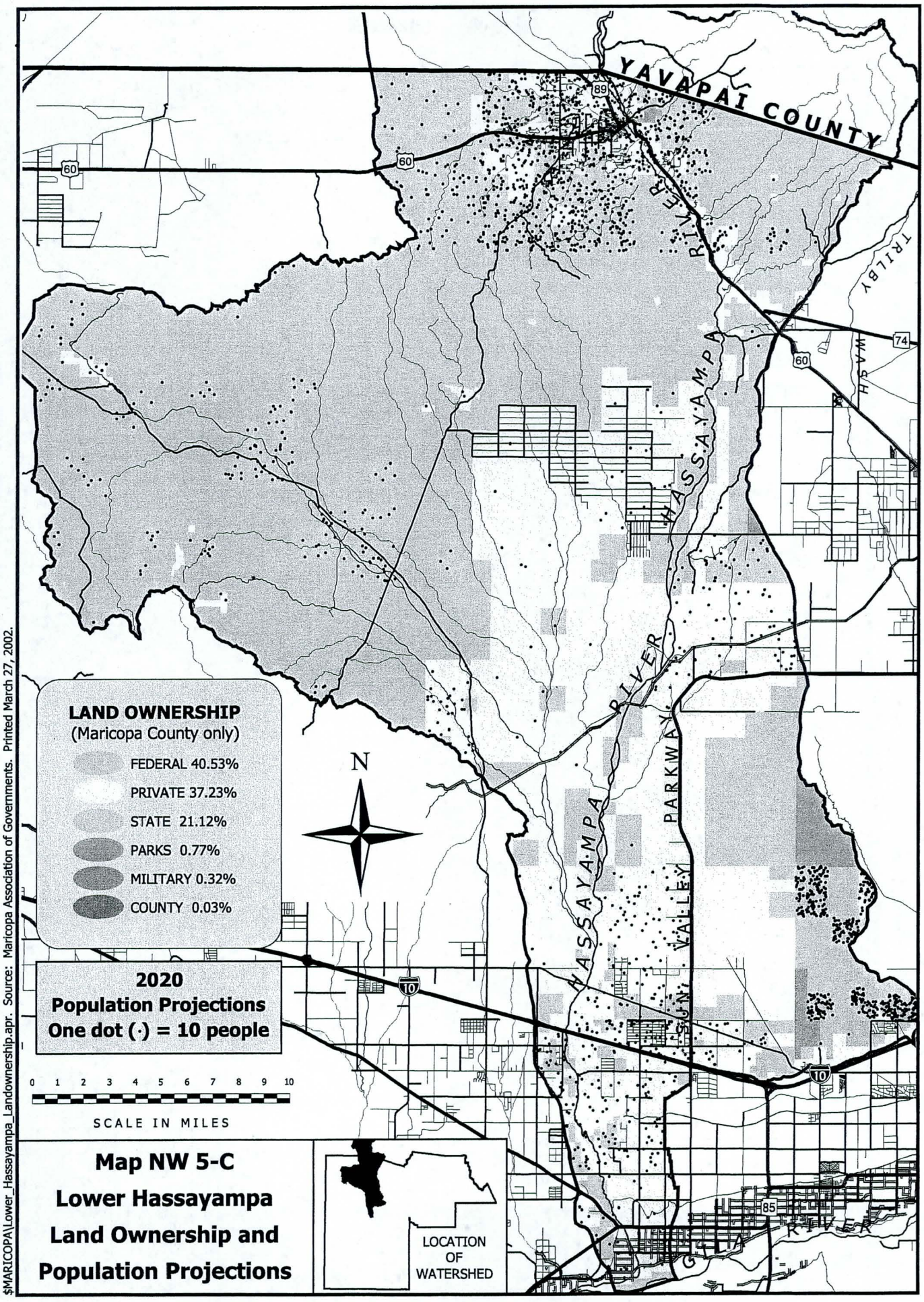


Map NW 5-B

Lower Hassayampa

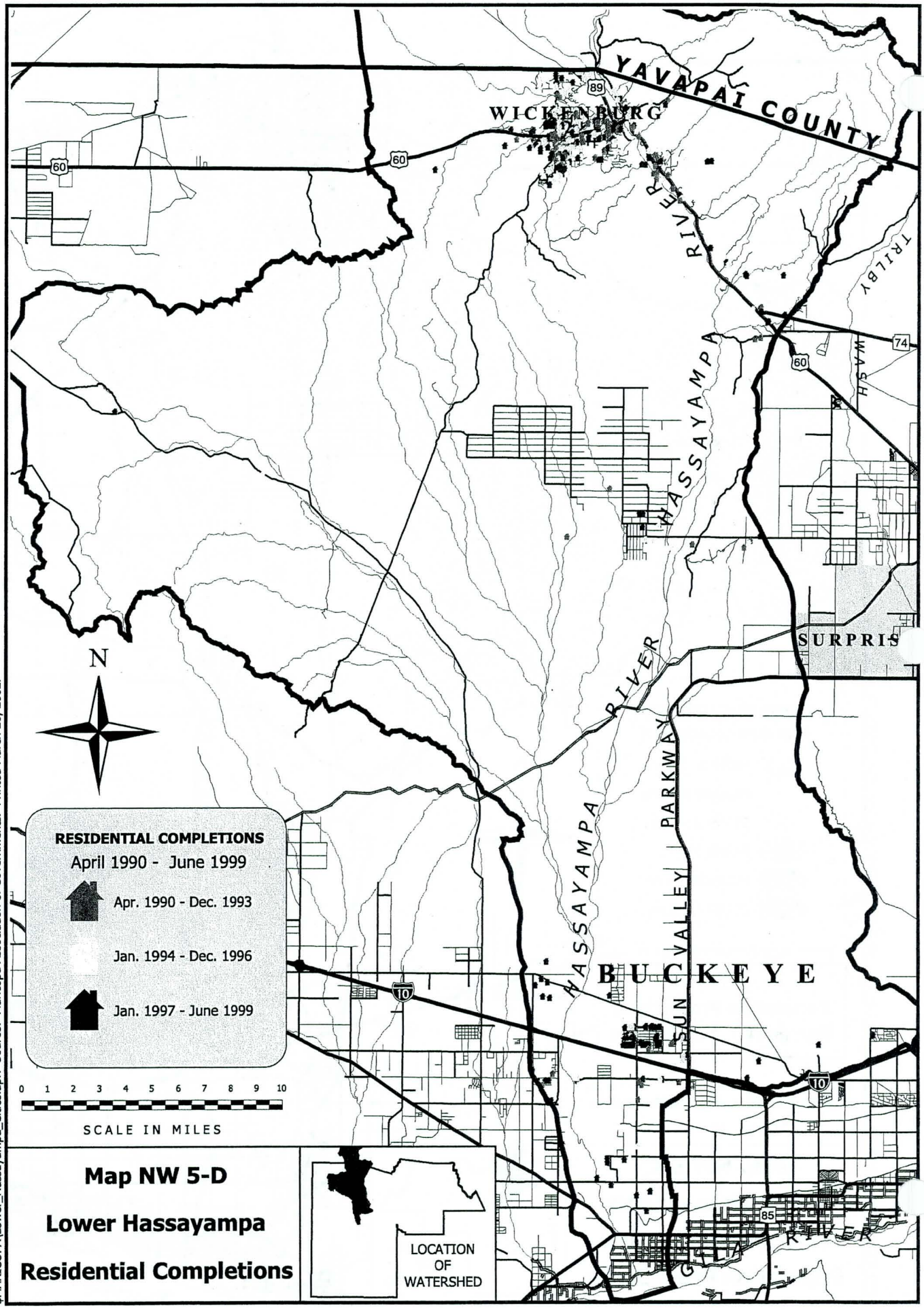
Land Use

$MARICOPA\Lower_Hassayampa_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



Map NW 5-C
Lower Hassayampa
Land Ownership and
Population Projections

$MARICOPA\Lower_Hassayampa_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



Map NW 5-D

Lower Hassayampa

Residential Completions

$MARICOPA\Lower_Hassayampa_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

TRILBY (WITTMANN) WATERSHED

Table NW 6-1
Land Ownership in Trilby Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
STATE	78,290.40	122.33	42.32%	40.64%
PRIVATE	73,725.40	115.20	39.86%	38.27%
PARKS	16,988.60	26.55	9.18%	8.82%
FEDERAL	15,587.40	24.36	8.43%	8.09%
MILITARY	345.40	0.54	0.19%	0.18%
COUNTY	45.50	0.07	0.02%	0.02%
OUT OF COUNTY	7,662.00	11.97		3.98%
Total	192,664.80	289.04	100.00%	100.00%

Table NW 6-2
Land Use in the Trilby Watershed

	Acres	Square Miles	Percent
Medium/High Density Residential			
Low Density Residential	2,107	3.29	1.09%
Commercial & Industrial	4,860	7.59	2.52%
Agricultural	968	1.51	0.50%
Open Space	17,062	26.66	8.86%
Vacant	158,327	247.39	82.19%
Water	615	0.96	0.32%
Other	1,053	1.65	0.55%
Out of County/Not Classified	7,662	11.97	3.98%
Total Area	192,645	301.01	100.00%

Table NW 6-3
Flood Damage History for Trilby Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages/ 24 hr./25 yr. storm	71 roads, streets and bridges reported closed.	2 deaths-countywide, Public and private damages exceeded $38 million. Downstream clean up costs $4 million.
20-Sep-92	19 Sept-11:00 PM/ 20 Sept-2:00 AM	Wittman area, Luke Air Force Base and vicinity of McMicken Dam	3.23 in./3 hr.	Trilby Wash, Mcken Dam area and Luke Air Force Base, including residential areas to the east.	
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec., covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in.-Central Mountains	Severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm	Trilby Wash carried significant flood flows. Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding also occurred along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries, Hassayampa River and Centennial Wash.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public,l $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Abbreviated Storm Report, Storm of 19-20 September, 1992", Flood Control District of Maricopa County.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood', November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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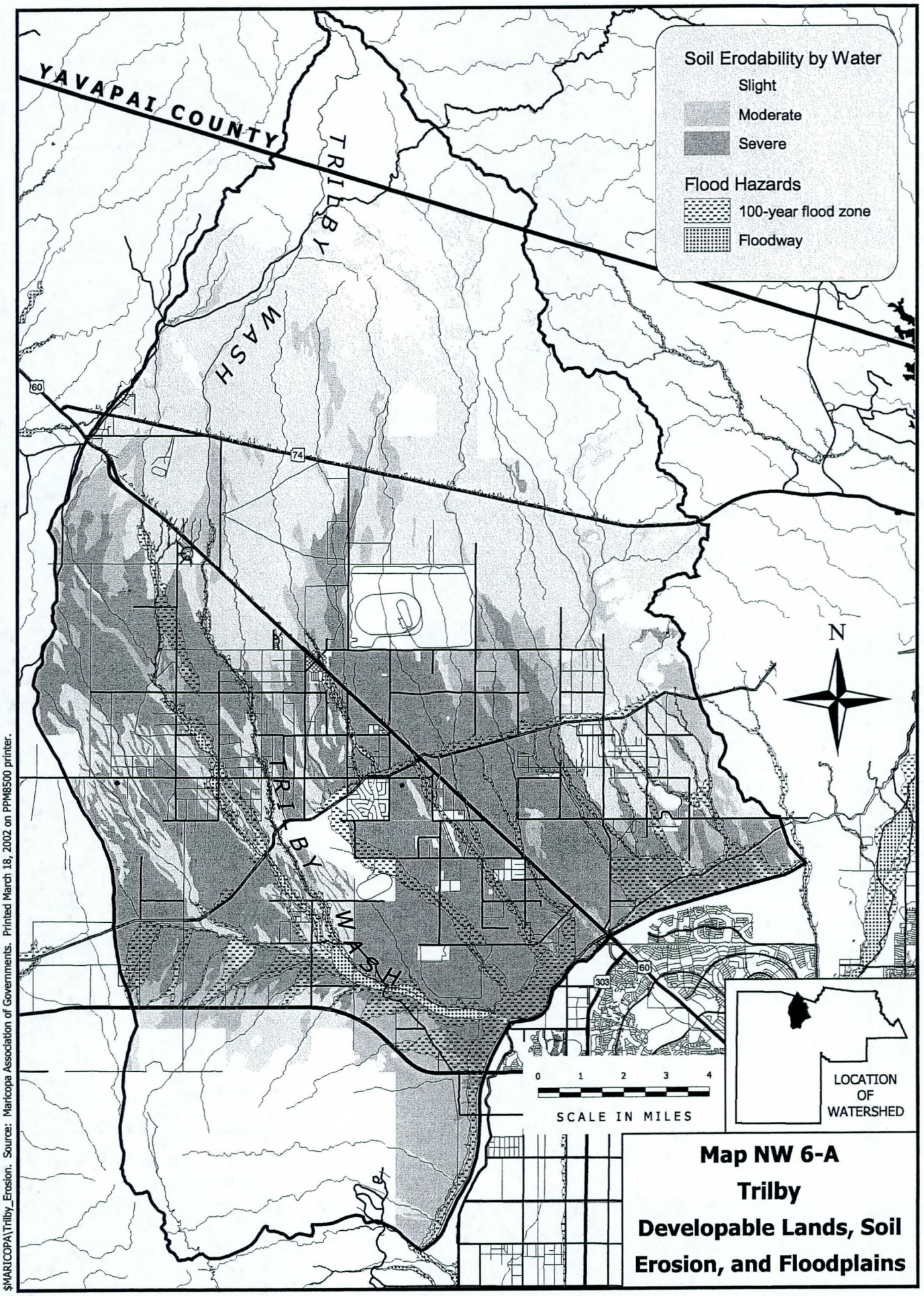
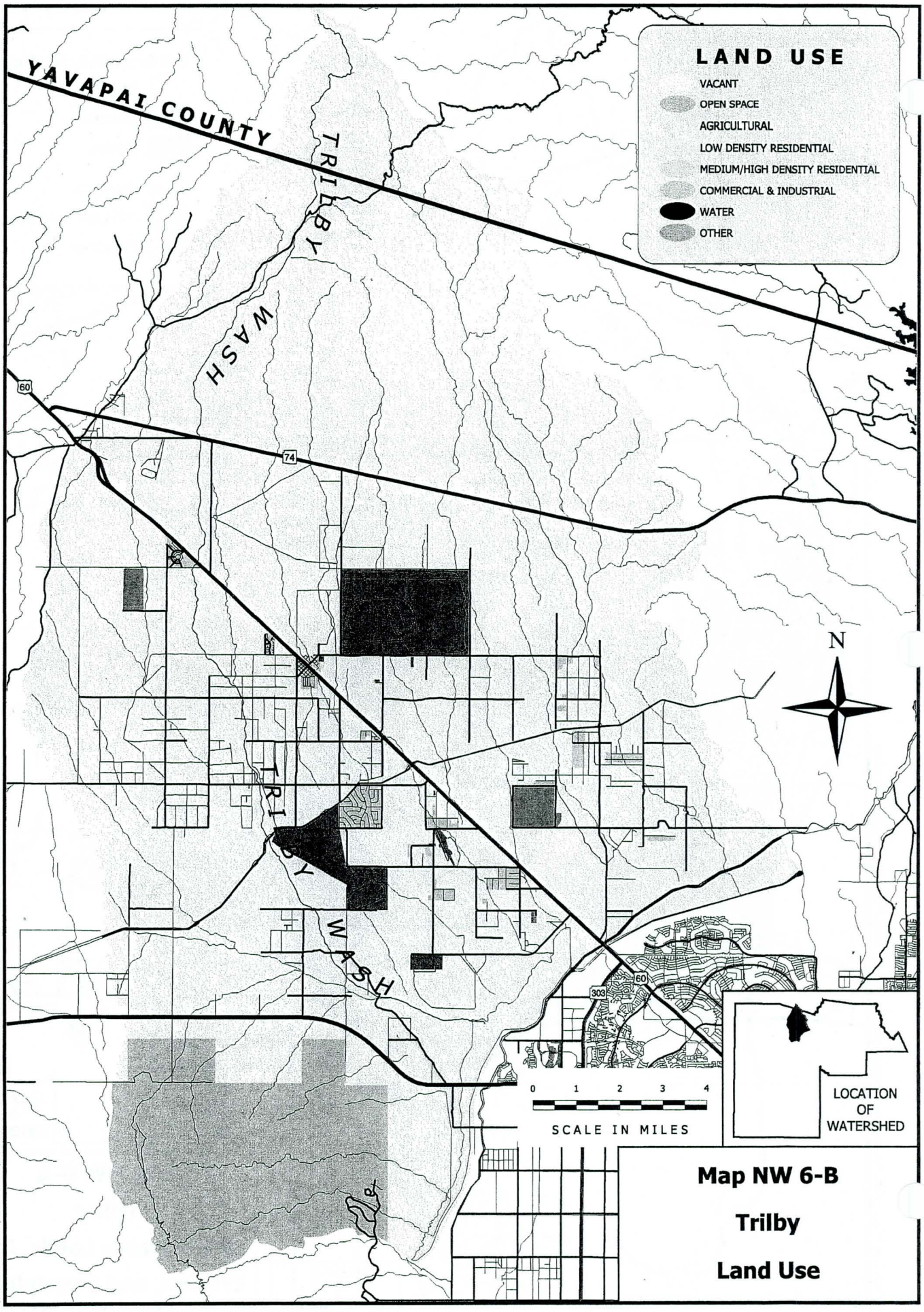
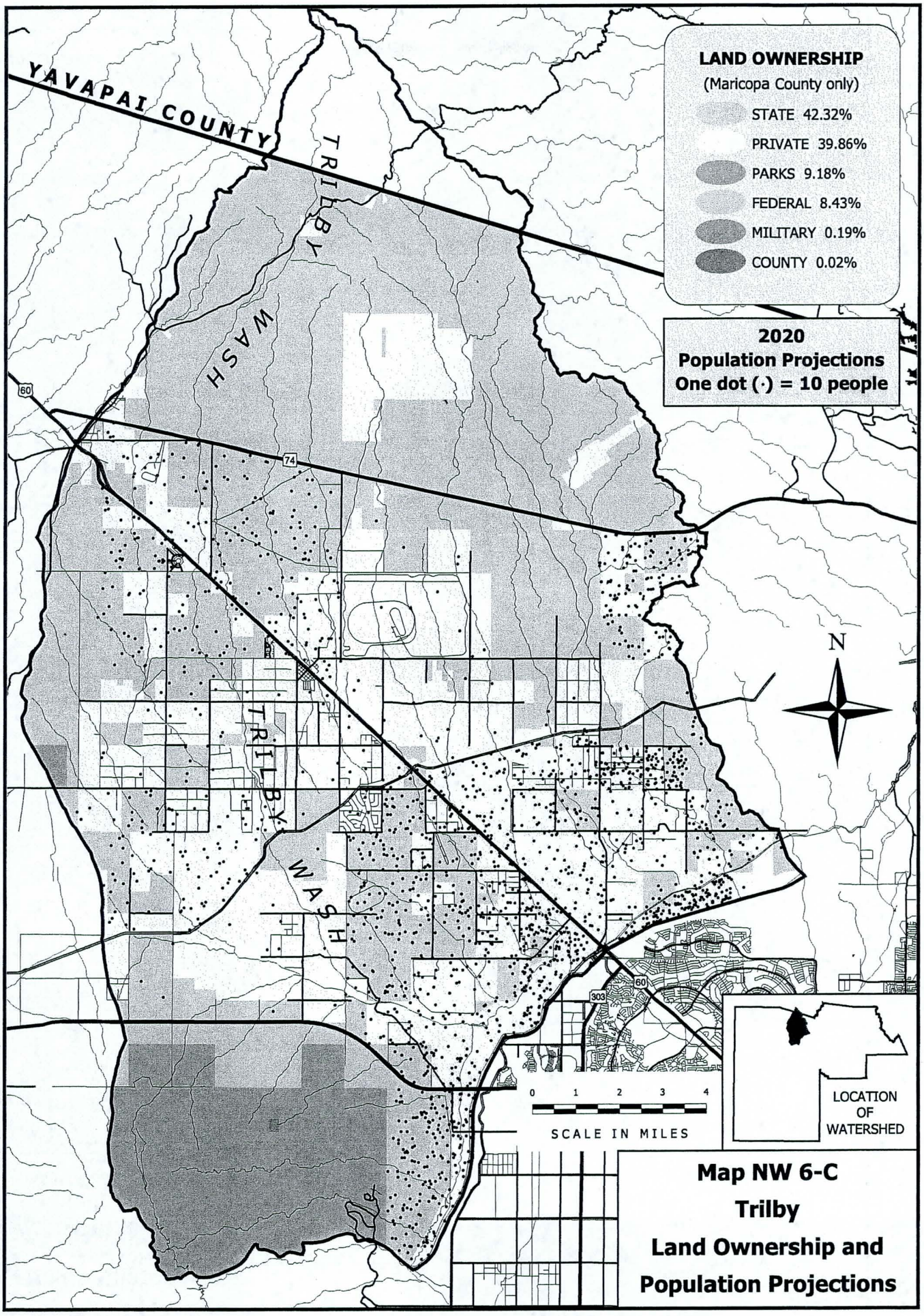


Map NW 6-A
Trilby
Developable Lands, Soil Erosion, and Floodplains

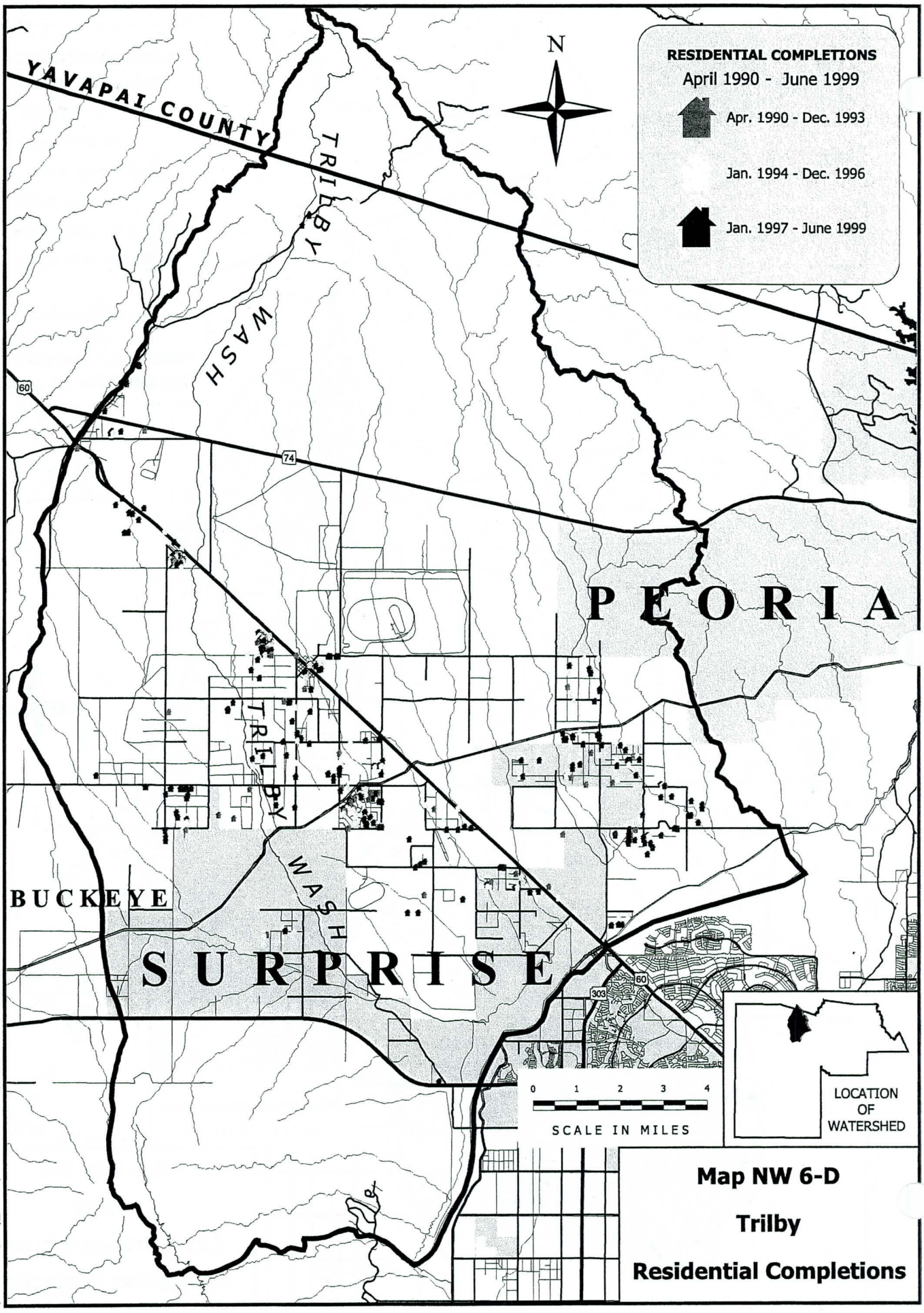
$MARICOPA\Trilby_Erosion. Source: Maricopa Association of Governments. Printed March 18, 2002 on PPM8500 printer.



$MARICOPA\Trilby_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Trilby_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Trilby_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

UPPER CENTENNIAL WATERSHED

Table NW 7-1

Land Ownership in the Upper Centennial Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
STATE	91,512	142.99	61.81%	19.57%
FEDERAL	28,381	44.35	19.17%	6.07%
PRIVATE	28,154	43.99	19.02%	6.02%
OUT OF COUNTY	319,481	499.19		68.33%
Total	467,527	730.51		100.00%

Table NW 7-2

Land Area in Upper Centennial Watershed, by Classification

	Acres	Sq. Mi.	Percent
Medium/High Density Residential			
Low Density Residential	189	0.30	0.04%
Commercial & Industrial	40	0.06	0.01%
Agricultural	19,011	29.71	4.07%
Open Space	3,878	6.06	0.83%
Vacant	124,739	194.90	26.68%
Water			
Other	324	0.51	0.07%
Out of County/Not Classified	319,346	498.98	68.31%
Total Area	467,527	730.51	100.00%

Table NW 7-3
Flood Damage Report for Upper Centennial Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
27-Oct-00	10:00 AM/ 2:00 PM	West and Northwest Maricopa County. Main band of rain moved slowly east across county. Ground already saturated from storm events of Oct. 10 and Oct. 21-23.	2.56 in. Centenial Wash/6 hr./30 yr. storm.	Jackrabbit Wash recorded a 50 yr. flood event; Hassayampa @ I-10 a 70 yr. event; Cassandro Wash a 40 yr.event; Sols and Tiger Washes 10 yr. events; Hartman Wash a 6 yr. event and Skunk Creek a 2 yr.event.	Data not available.
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages/ 24 hr./25 yr. storm.	Arlington School, 6 farmhouses in the area flooded to 2 ft. deep. Several farms, feedlots, and dairies in the western county were damaged by high water; loss and drowning of livestock. 71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges (11 of 13 bridges or crossings were destroyed or damaged), sewers, flood control structures.	$17 million-public, $5 million-commercial, $2 million-residential.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Residential, agricultural, commercial and industrial; severe damage to roads and bridges.	4 deaths-countywide, $.75 million-commercial $16.3 million-public, $3.1million-residential, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles northeast Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Flooding due to Verde River runoff, volume exceeded reservoir storage. Flooding also along tributaries of the Gila River and Agua Fria, Hassayampa River and Centennial Wash. Extensive damage to commercial, industrial, agricultural and public facilities.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Storm Report, Summer/Autumn Storms of 2000", Flood Control District of Maricopa County.
2. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
3. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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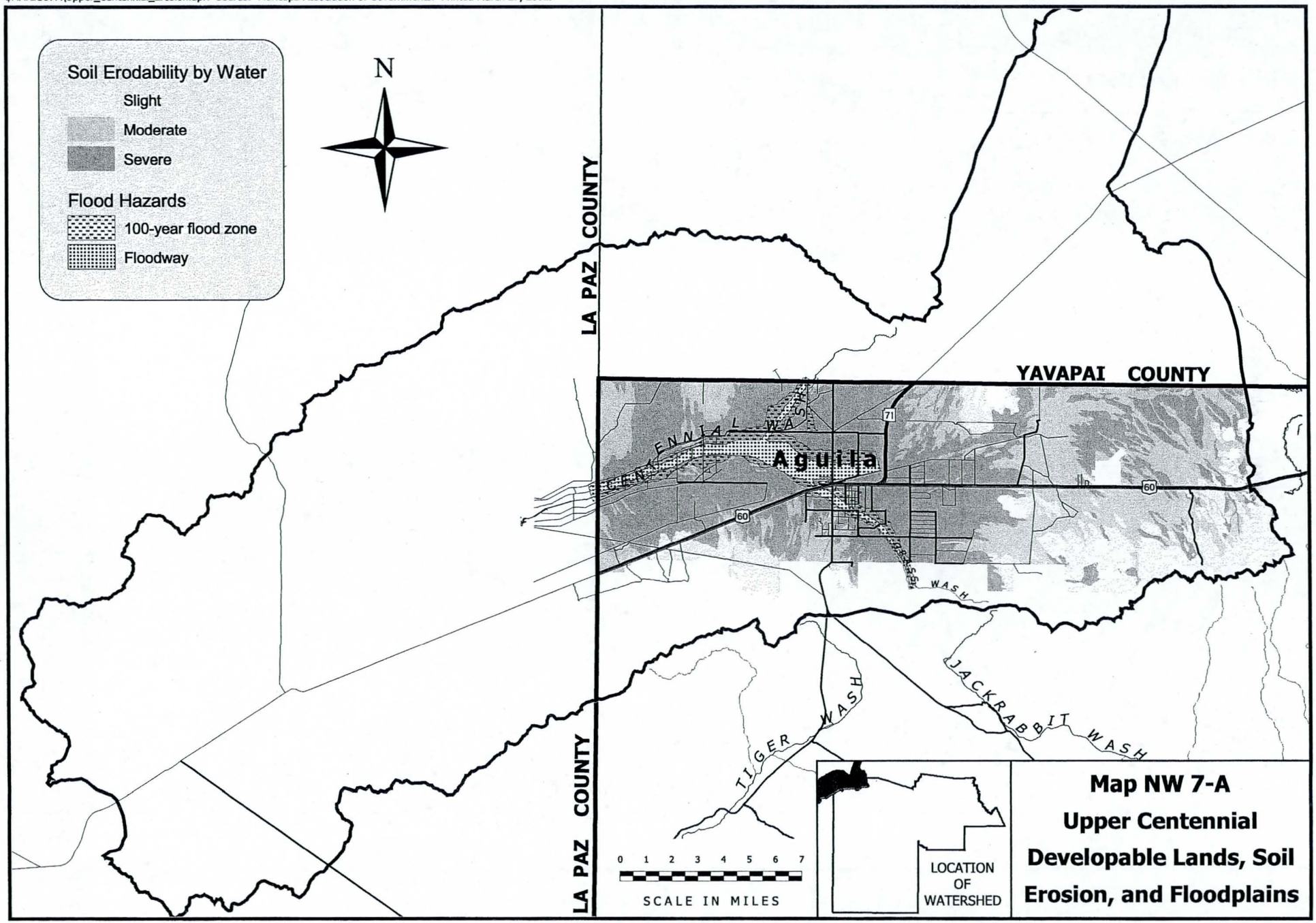
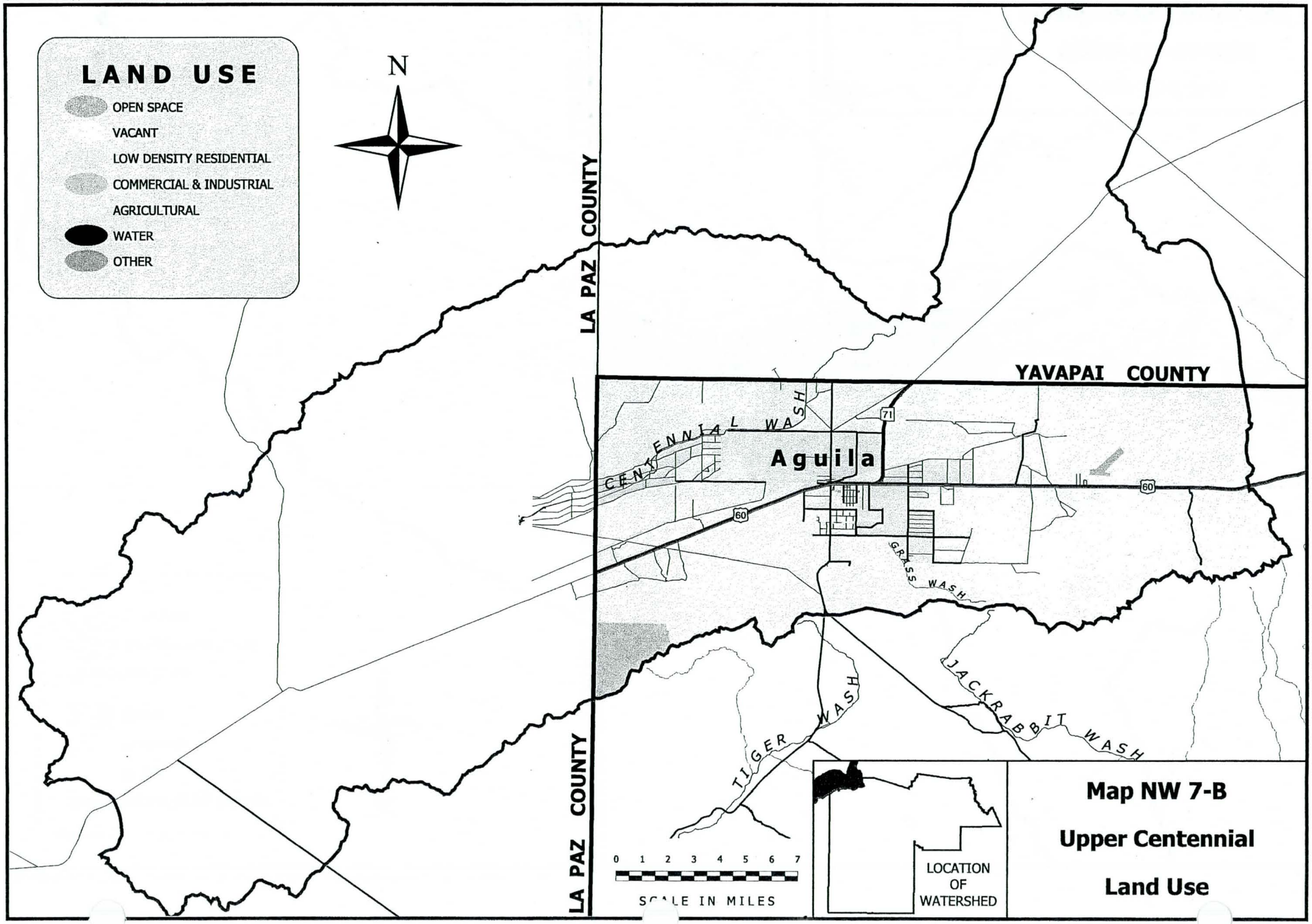
$MARICOPA\Upper_Centennial_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

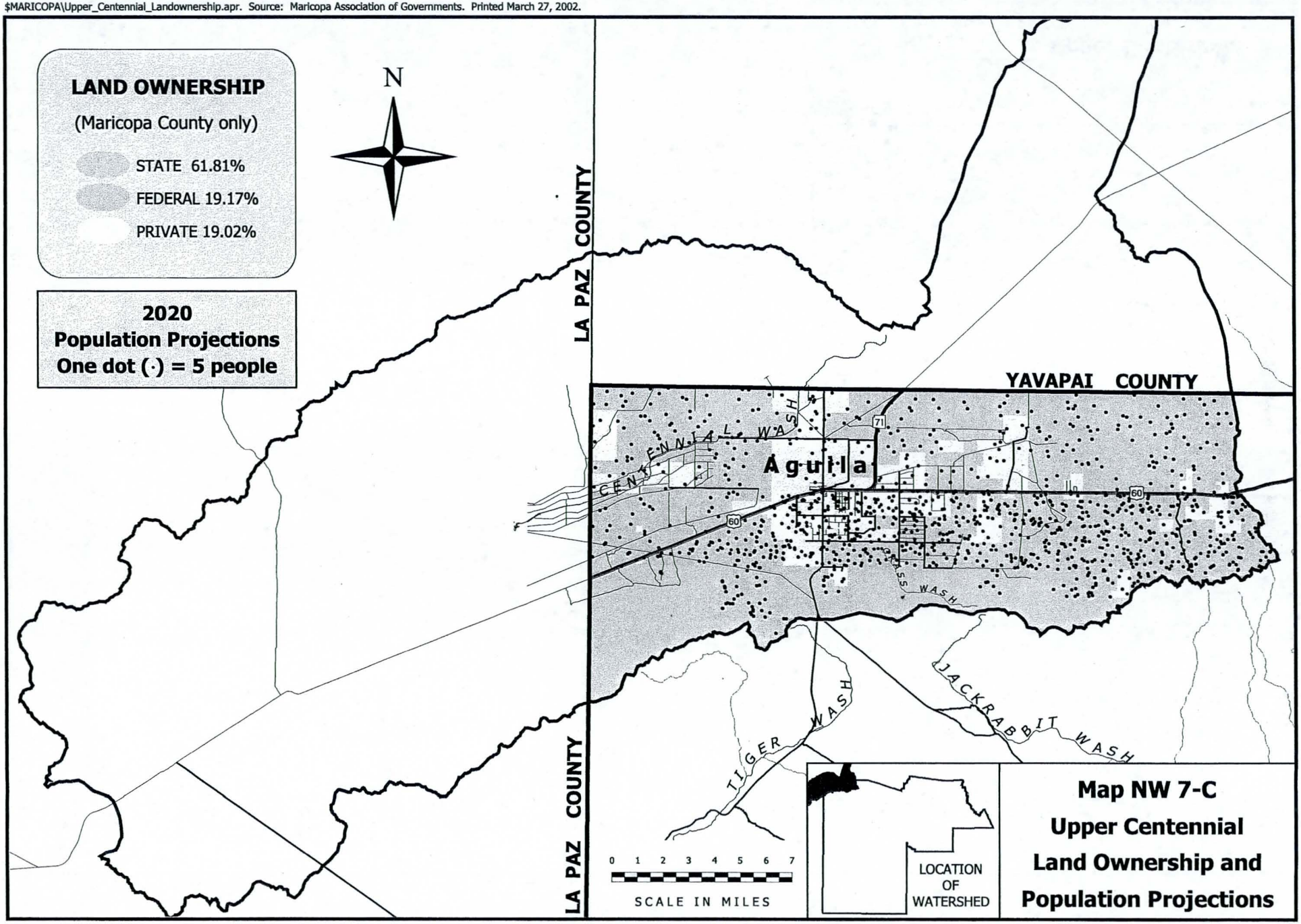


Map NW 7-A
Upper Centennial Developable Lands, Soil Erosion, and Floodplains

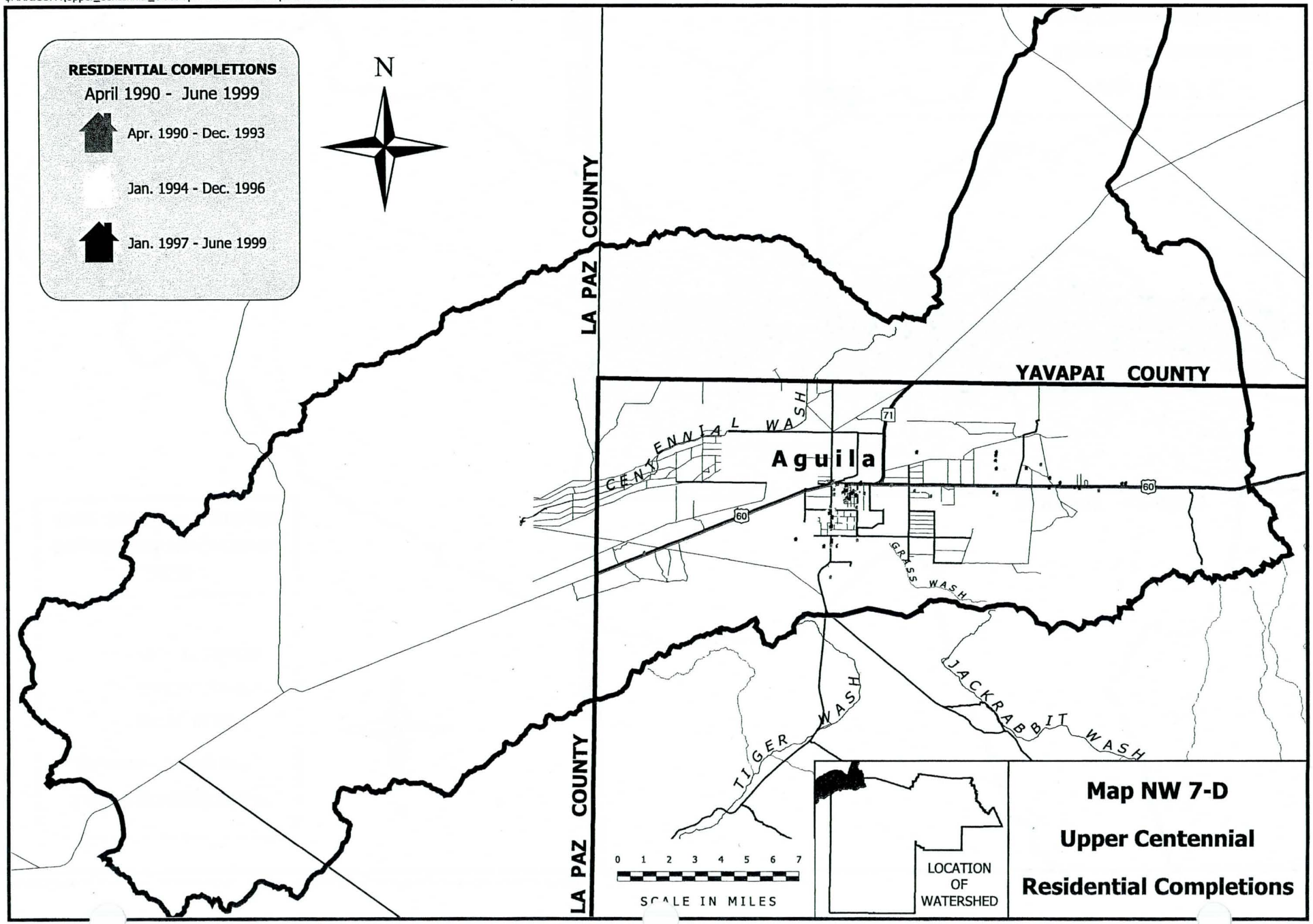
$MARICOPA\Upper_Centennial_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_Centennial_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Upper_Centennial_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



WHITE TANKS A WATERSHED

Table NW 8-1

Land Ownership in the White Tanks A Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
PRIVATE	75,735.10	118.34	89.57%	89.57%
STATE	3,240.00	5.06	3.83%	3.83%
PARKS	3,196.10	4.99	3.78%	3.78%
MILITARY	2,132.30	3.33	2.52%	2.52%
FEDERAL	249.90	0.39	0.30%	0.30%
Total	84,553.40	132.11	100.00%	100.00%

Table NW 8-2

Land Use in White Tanks A Watershed

	Acres	Sq. Mi.	Percent
Medium/High Density Residential	8,361	13.06	9.89%
Low Density Residential	3,861	6.03	4.57%
Commercial & Industrial	1,386	2.17	1.64%
Agricultural	37,479	58.56	44.33%
Open Space	5,928	9.26	7.01%
Vacant	22,511	35.17	26.62%
Water	2,007	3.14	2.37%
Other	3,021	4.72	3.57%
Out of County/Not Classified			
Total Area	84,553	132.11	100.00%

TABLE NW 8-3
Flood Damage History for White Tanks A Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
27-Oct-00	10:00:00 AM/2:00 PM	West and northwest Maricopa County. Main band of rain moved slowly east across county. Ground already saturated from storms of Oct. 10 and Oct. 21-23.	2.56 in. Centenial Wash/6 hr./30 yr. storm.	Centennial Wash (flow into Wenden), Wickenburg (Sols Wash) and Skunk Creek.	Data not available.
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages/ 24 hr./25 yr. storm.	Several farms, feedlots, and dairies in the western county were damaged by high water; loss and drowning of livestock. MCDOT closed 64 roads and placed 1,000 barricades.	2 deaths-countywide. Public and private damages exceeded $38 million.
20-Sep-92	19 Sept-11:00 PM/ 20 Sept-2:00 AM	Wittman area, Luke Air Force Base and vicinity of McMicken Dam.	3.23 in./3 hr.	Trilby Wash, Micken Dam area and Luke Air Force Base, including residential areas to the east.	Data not available.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Agua Fria River: Indian School Rd.-Bell Rd.: Some residential and agricultura damage. Commercial damage was moderate. Sand and gravel damage and emergency costs moderate Roads, bridges and utilities damage was moderate to high.	$0.23 million-Sand and gravel, $0.62 million-roads, bridges and utilities.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Residential, agriculture, commercial and industrial damage; severe damage to roads and bridges. 9 sand and gravel operations damaged along Agua Fria River.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture, $1.3-million-sand & gravel on Agua Fria River.
High runoff from 28 Feb 78-3 Mar 78	1 Mar- 4:00 PM/ 2 Mar- 4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Flooding occured along irrigation canals on north side of metro area and tributaries of the Gila and Agua Fria Rivers. Extensive damage to residential, commercial, industrial, agriculture and public facilities.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture.

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Sources of Information:

1. "Storm Report, Summer/Autumn Storms of 2000", Flood Control District of Maricopa County.
2. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
3. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
4. "Abbreviated Storm Report, Storm of 19-20 September, 1992", Flood Control District of Maricopa County.
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6. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
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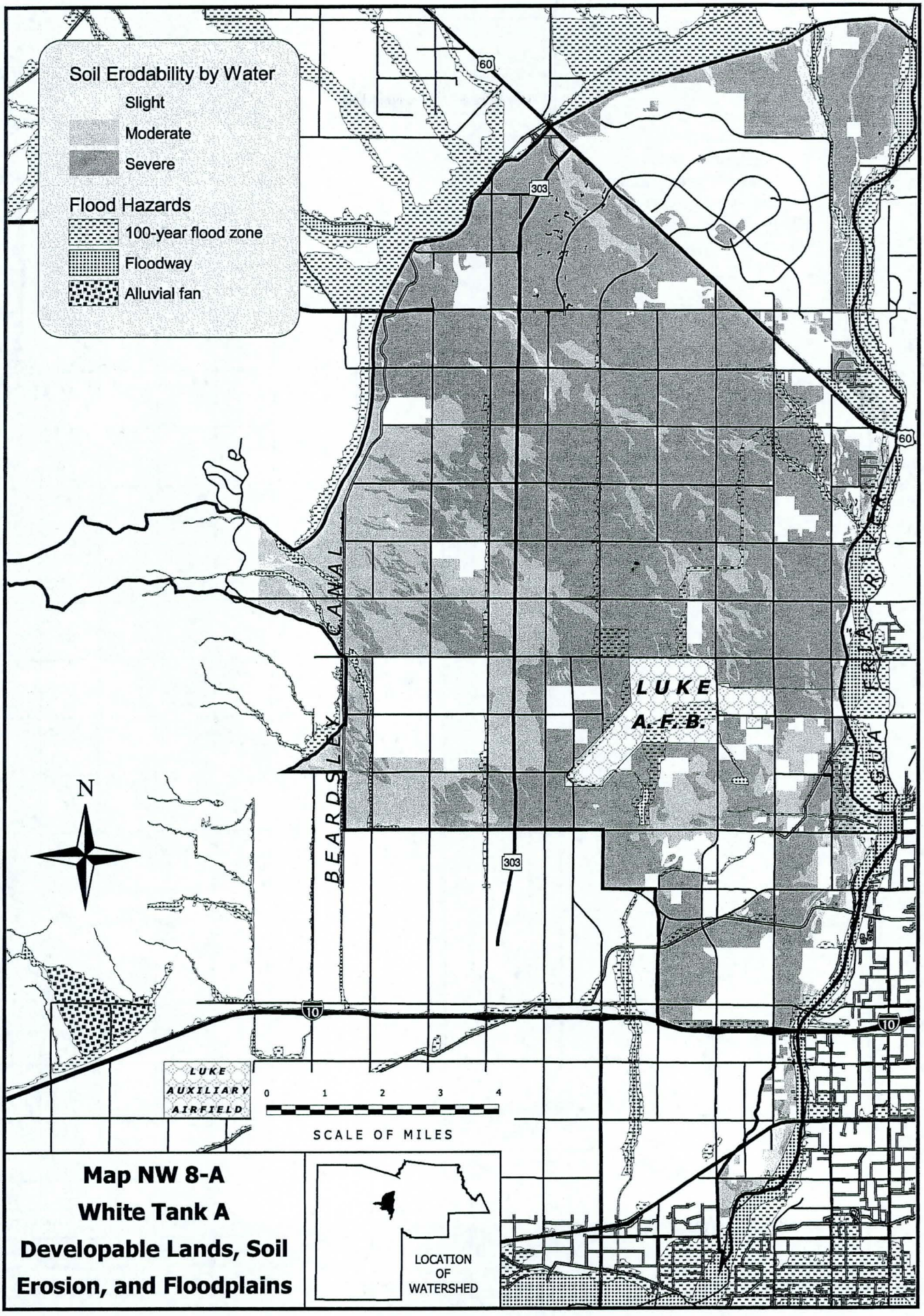
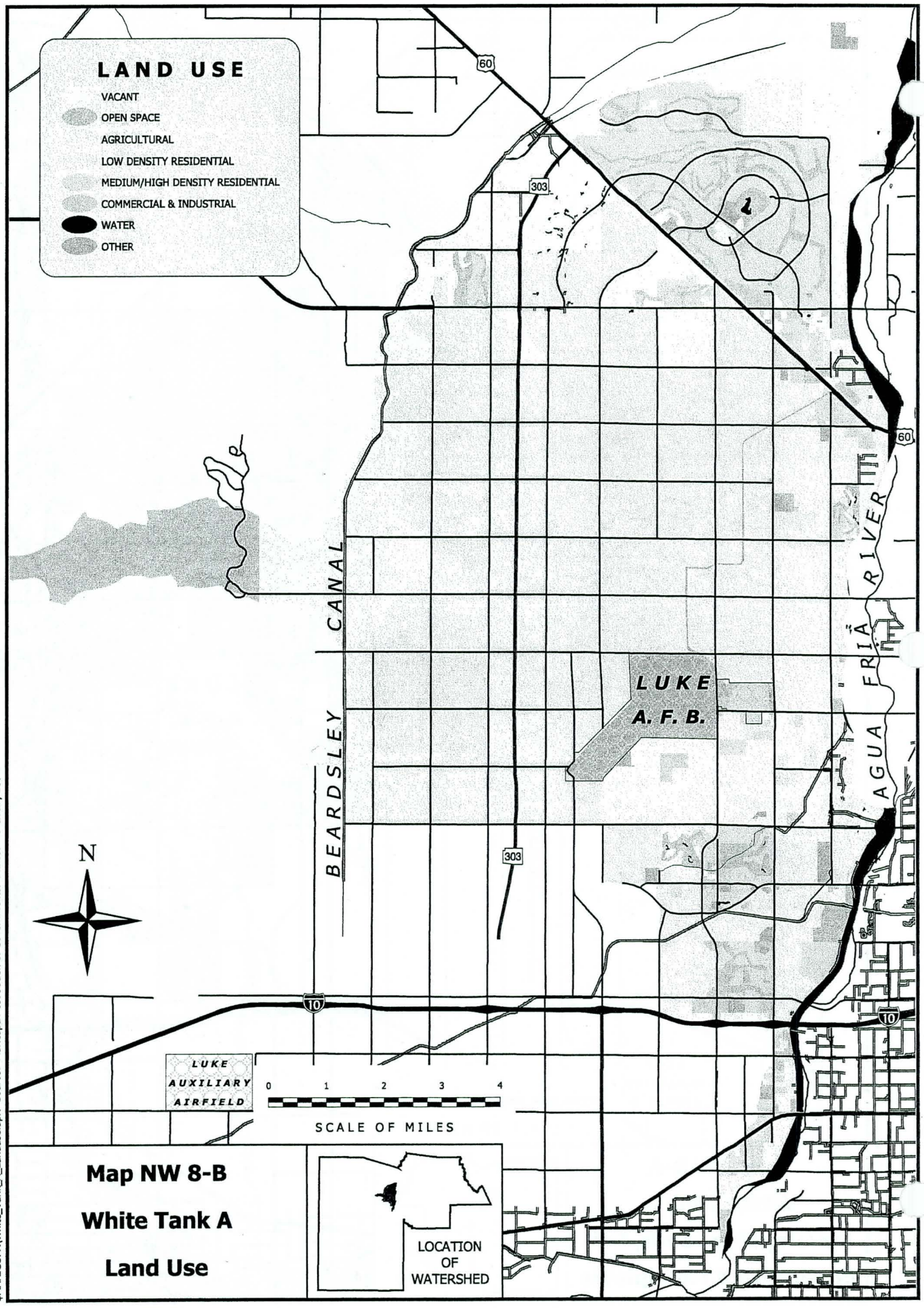
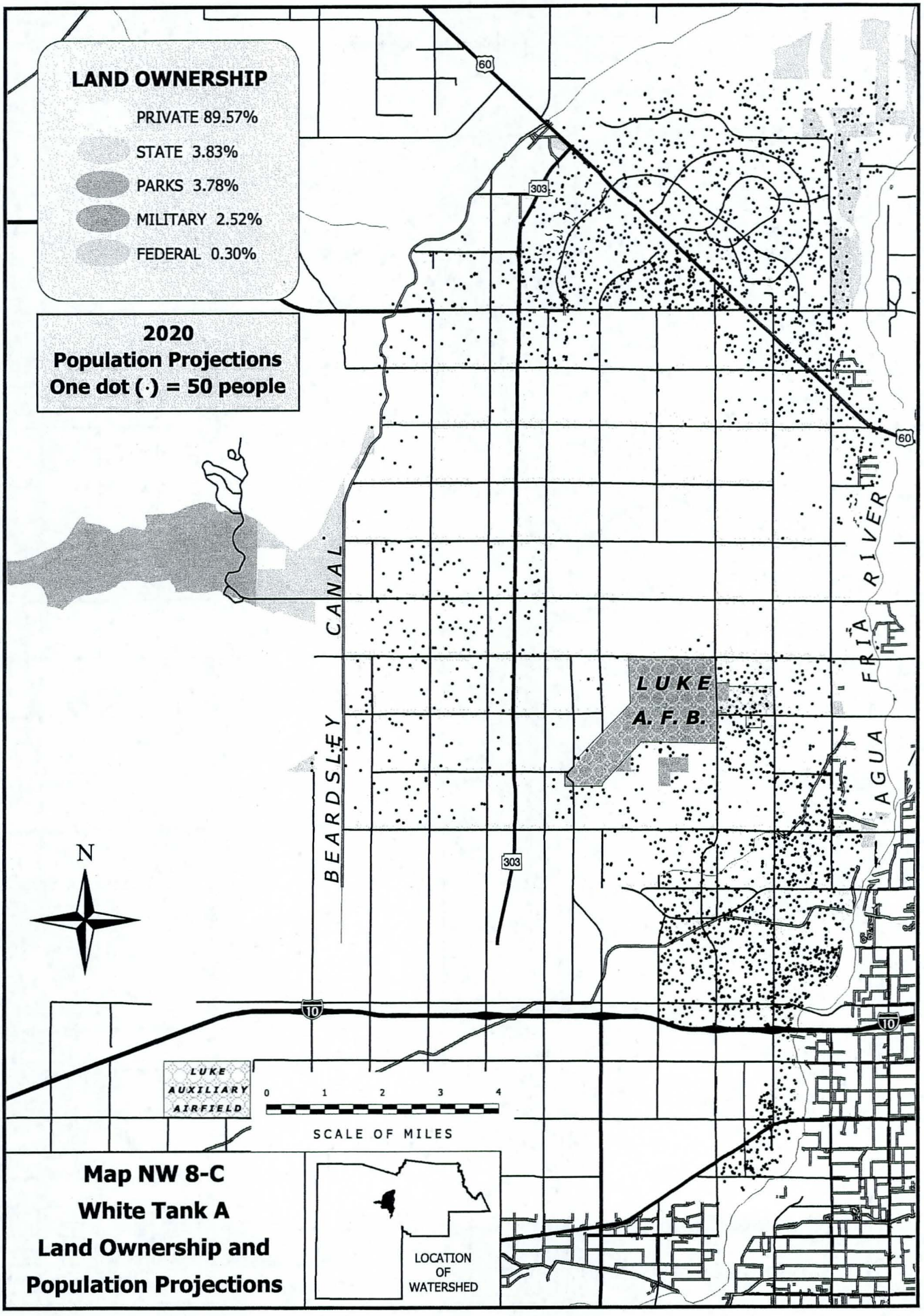


Map NW 8-A
White Tank A
Developable Lands, Soil Erosion, and Floodplains

$MARICOPA\White_Tank_A_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

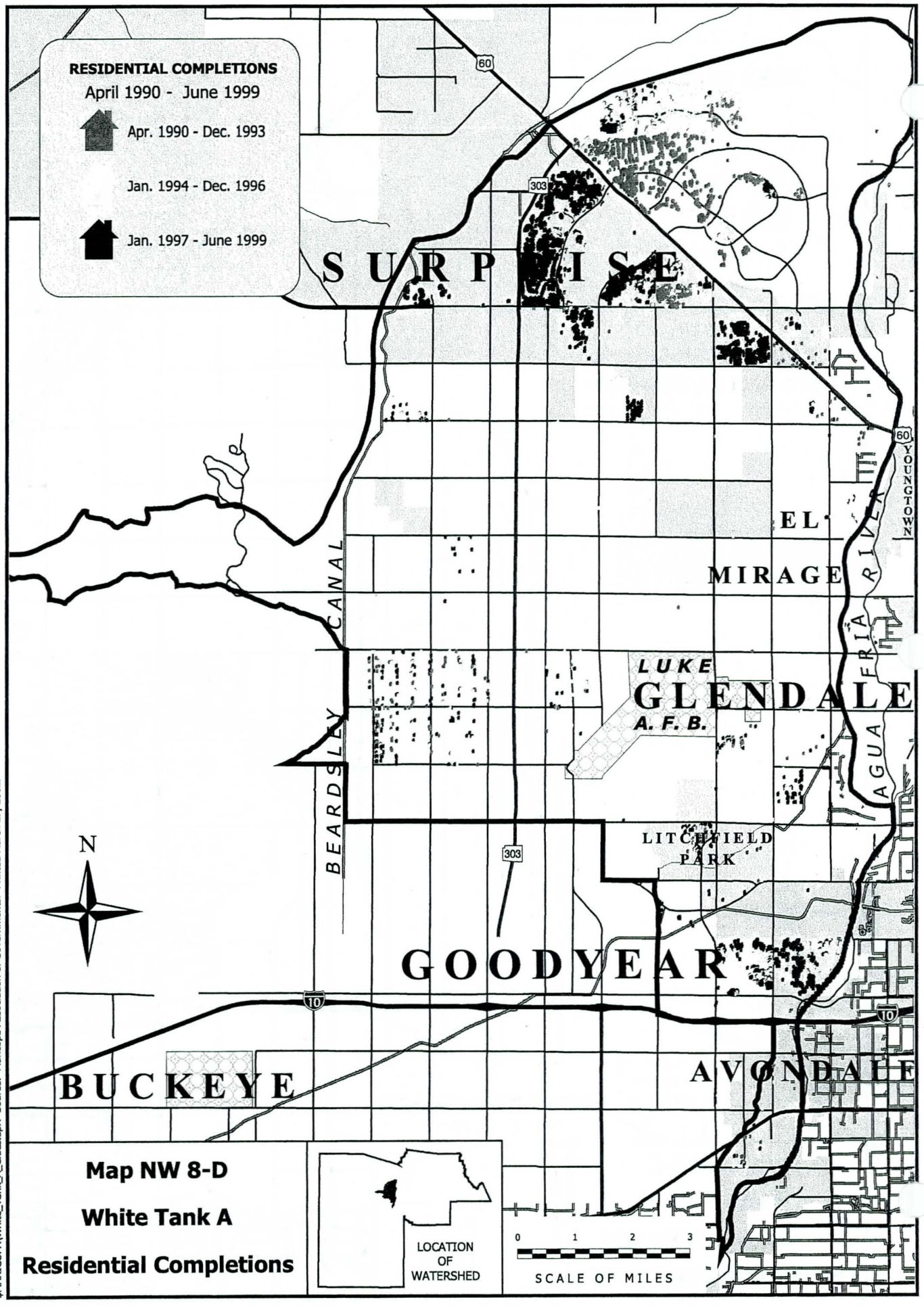


$MARICOPA\White_Tank_A_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



Map NW 8-C
White Tank A
Land Ownership and
Population Projections

$MARICOPA\White_Tank_A_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\White_Tank_A_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

WHITE TANKS B WATERSHED

Table NW 9-1

Land Ownership in the White Tanks B Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. M.	County Land Only	Entire Watershed
PRIVATE	56,831	88.80	81.54%	81.54%
STATE	7,602	11.88	10.91%	10.91%
PARKS	2,634	4.12	3.78%	3.78%
FEDERAL	2,627	4.11	3.77%	3.77%
Total	69,695	108.90	100.00%	100.00%

Table NW 9-2

Land Use in the White Tanks B Watershed

	Acres	Sq. M.	Percent
Medium/High Density Residential	969	1.51	1.39%
Low Density Residential	2,167	3.39	3.11%
Commercial & Industrial	752	1.18	1.08%
Agricultural	34,744	54.29	49.85%
Open Space	2,966	4.63	4.26%
Vacant	22,391	34.99	32.13%
Water	2,778	4.34	3.99%
Other	2,929	4.58	4.20%
Out of County/Not Classified			
Total Area	69,695	108.90	100.00%

Table NW 9-3
Flood Damage History for White Tanks B Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	Farms west of Tuthill Rd. on Beloat Rd. were damaged by high water; loss of livestock to a dairy near 195 th Ave and Hwy 85. Erosion of Tri-City landfill sent about 55,000 cu. yds. of debris washed down river. 71 roads, streets and bridges reported closed.	2 deaths-countywide, Public and private damages exceeded $38 million. Downstream cleanup costs $4 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Agua Fria River confluence with Gila River to Indian School Rd.: Light residential damage. Two sand and gravel operations damaged. Extensive damage to roads and bridges. Agricultural damages included 860 acres of crop damage and major loss of a dairy farm.	$3.31 million-roads and bridges and other public facilities, $1.53 million-agricultural, $78, 000-residential.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Damage to area from 35th Ave-115th Ave.: residential, agriculture, commercial and industrial; severe damage to roads and bridges. 9 sand and gravel operations damaged along Agua Fria River.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture, $1.3-million-sand & gravel on Agua Fria River.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Flooding along irrigation canals on north side of metro area, tributaries of the Gila and Agua Fria Rivers. Extensive damage to commercial, industrial, agriculture and public facilities. Allenville severely flooded.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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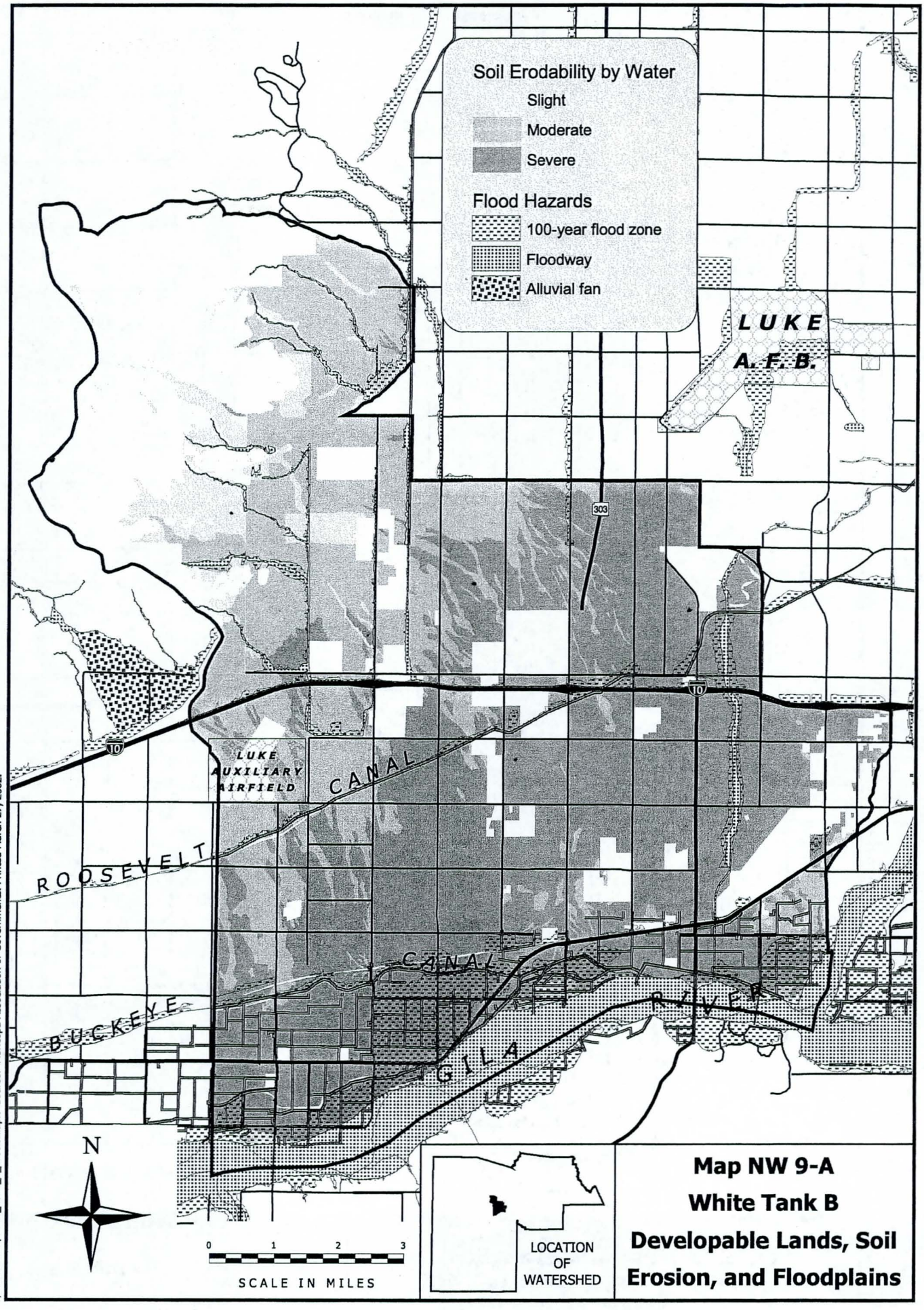
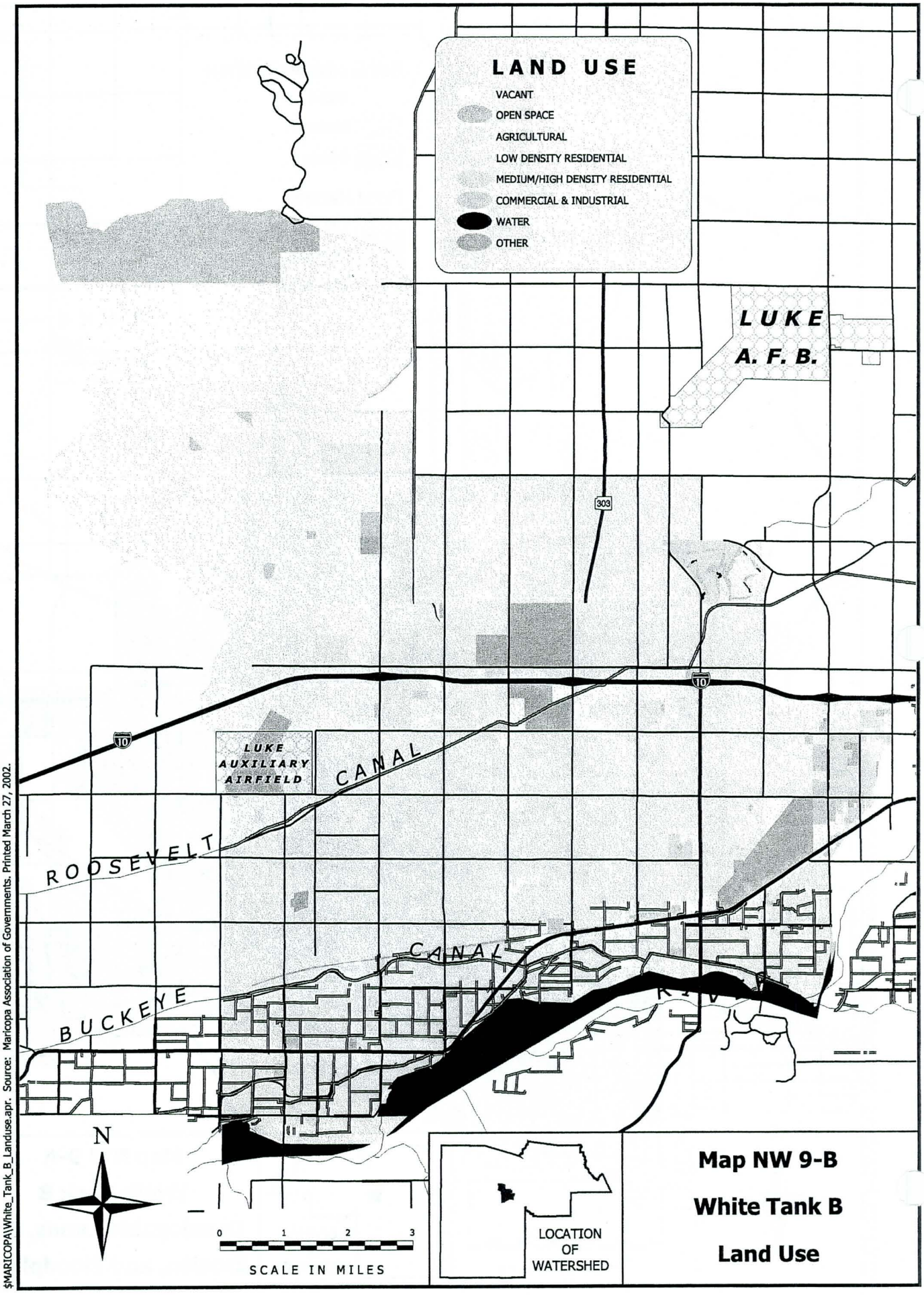
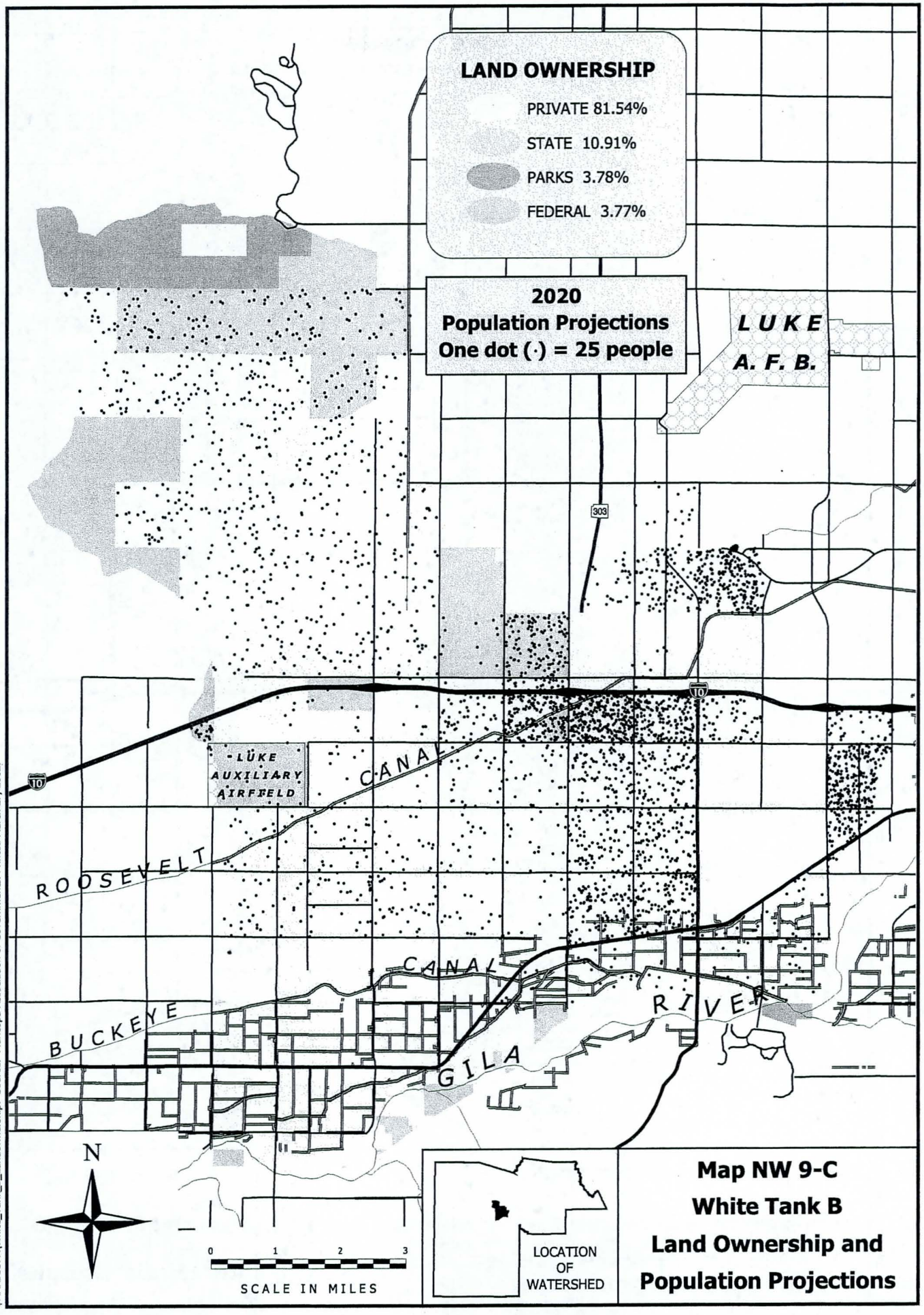


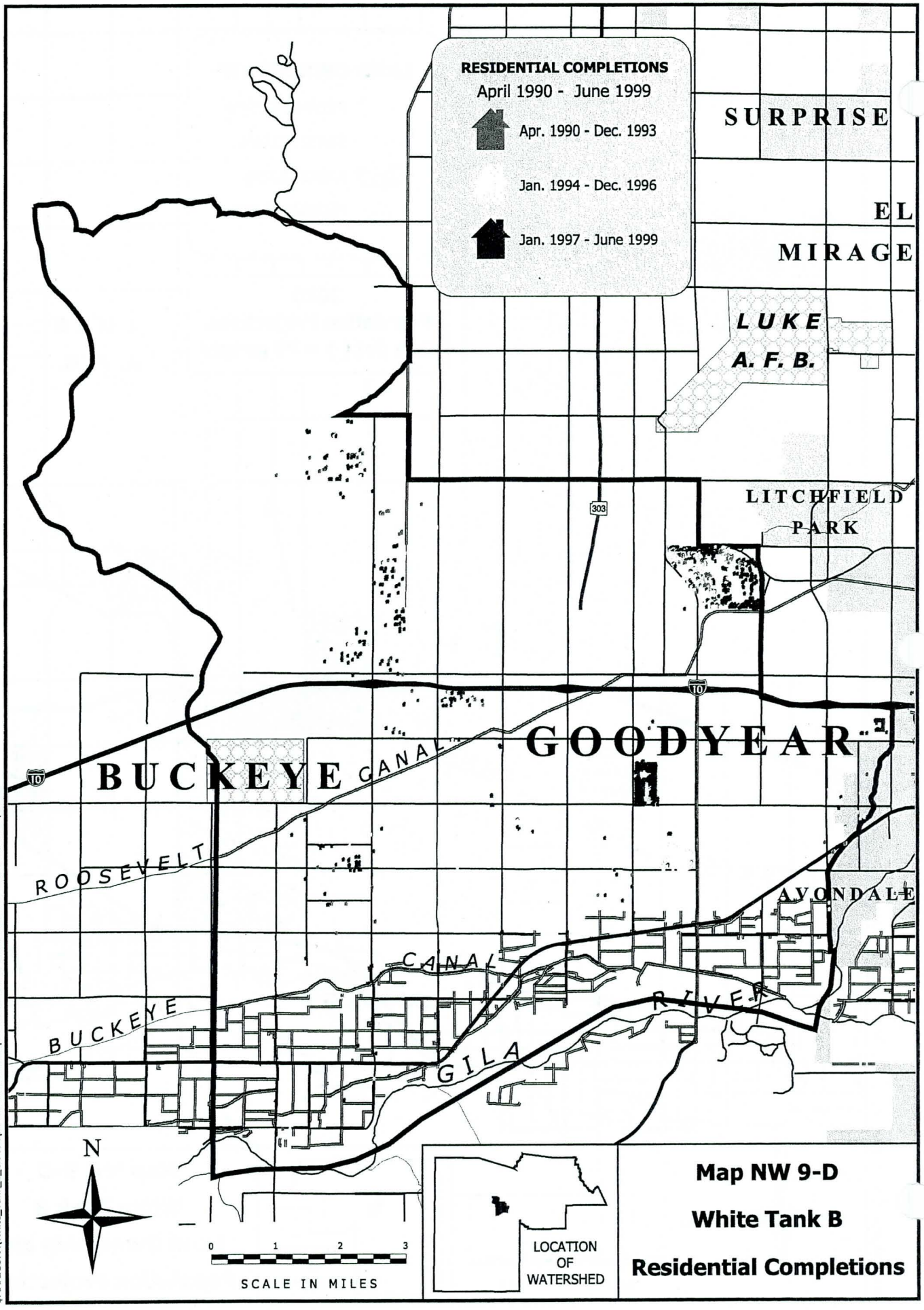
$MARICOPA\White_Tank_B_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\White_Tank_B_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\White_Tank_B_Landownership. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\White_Tank_B_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

UPPER HASSAYAMPA WATERSHED

Description

The Upper Hassayampa Watershed is located entirely within Yavapai County and has not been analyzed for this Report. However, this Watershed includes all of the drainage for the upper Hassayampa River. Runoff from this Watershed enters the Hassayampa River and eventually reaches Maricopa County just north of the Town of Wickenburg. The Hassayampa River passes through Wickenburg and along the western edge of the Town of Buckeye before entering the Gila River near the unincorporated community of Hassayampa. Thus, what happens in this Watershed can have some impact on location of development and on size and type of flood prevention measures instituted in Maricopa County. However, minimal development is projected for this Watershed so conditions are not expected to change during the time period covered by this Report.

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AJO WATERSHED

Table SW 1-1
Land Use in the Ajo Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential			
Low Density Residential			
Commercial & Industrial			
Agricultural	75	0.12	0.03%
Open Space	251,022	392.22	93.70%
Vacant	16,550	25.86	6.18%
Water			
Other	241	0.38	0.09%
Out of County/Not Classified			
Total Area	267,888	418.57	100.00%

Table SW 1-2
Land Ownership in Ajo Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
MILITARY	251,111.00	392.36	0.00%	93.74%
FEDERAL	13,335.30	20.84	4.98%	4.98%
STATE	3,084.30	4.82	1.15%	1.15%
PRIVATE	353.20	0.55	0.13%	0.13%
Total	267,884.70	418.57	100.00%	100.00%

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Table SW 1-3
Flood Damage Report for the Ajo Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan- 8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges.	4 deaths-countywide. $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries, Queen Creek, Hassayampa River and Centennial Wash.	1 death-countywide.Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

DRAFT

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.

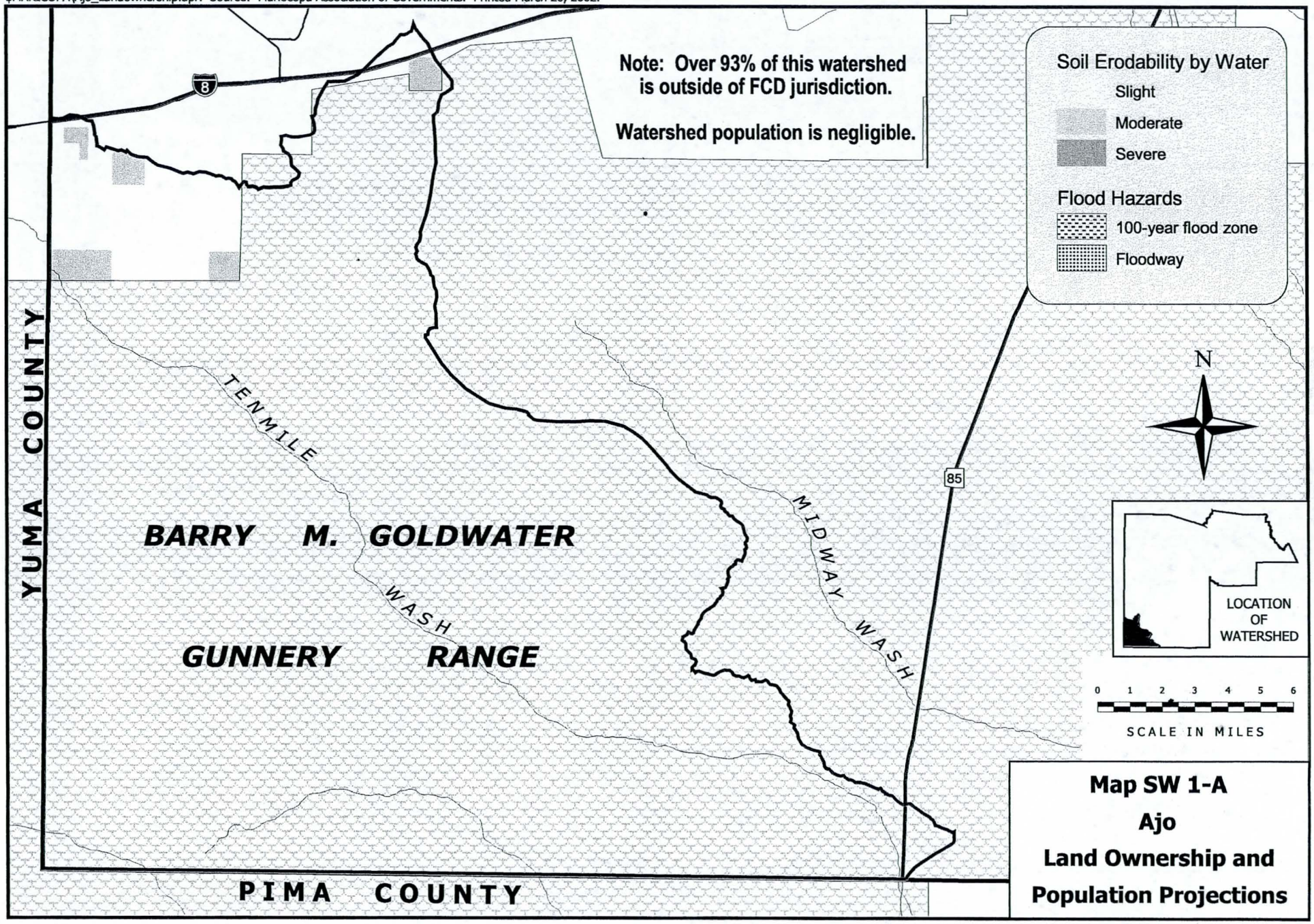
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.

3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.

4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.

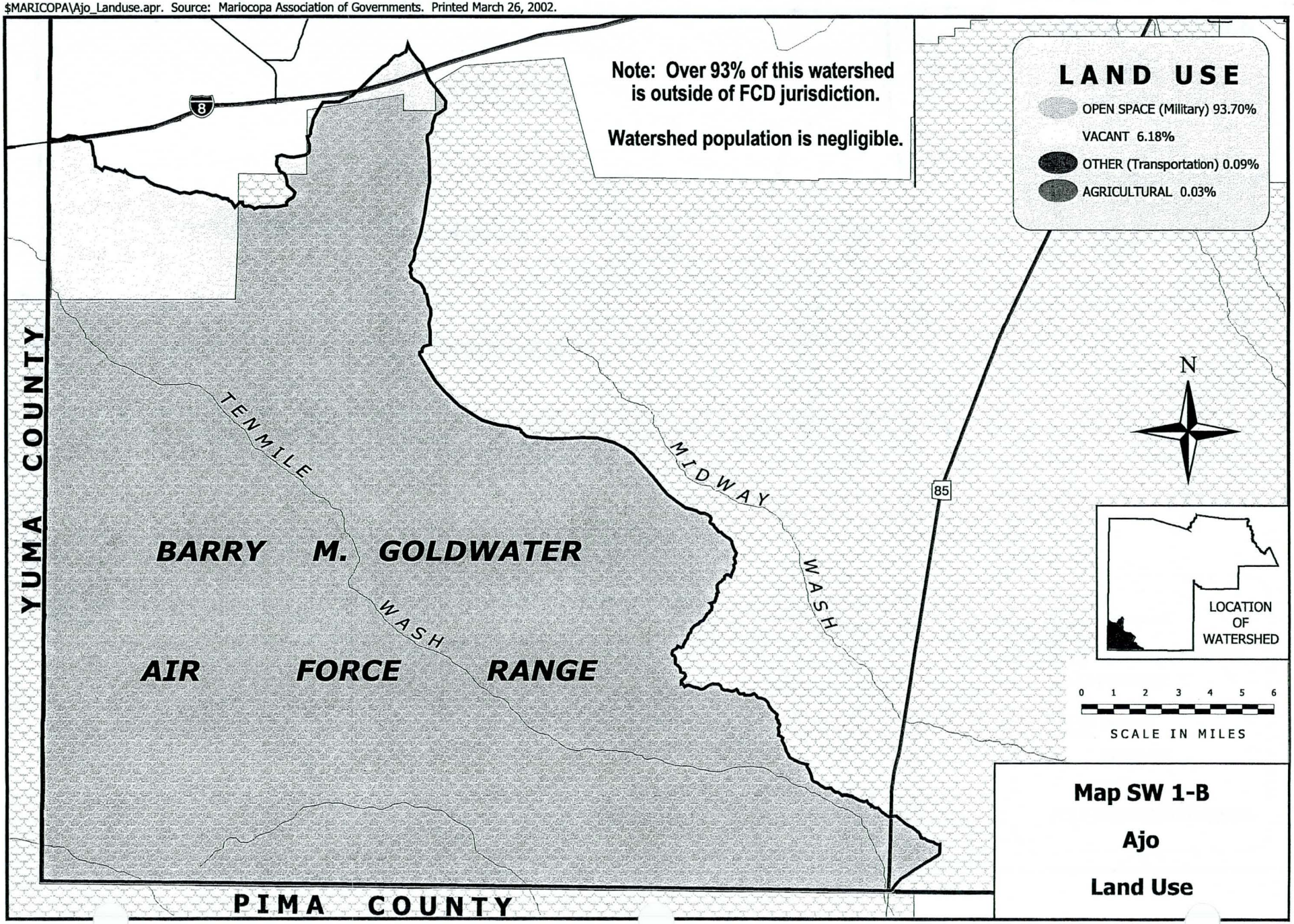
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

$MARICOPA\Ajo_Landownership.apr. Source: Mariocopa Association of Governments. Printed March 26, 2002.

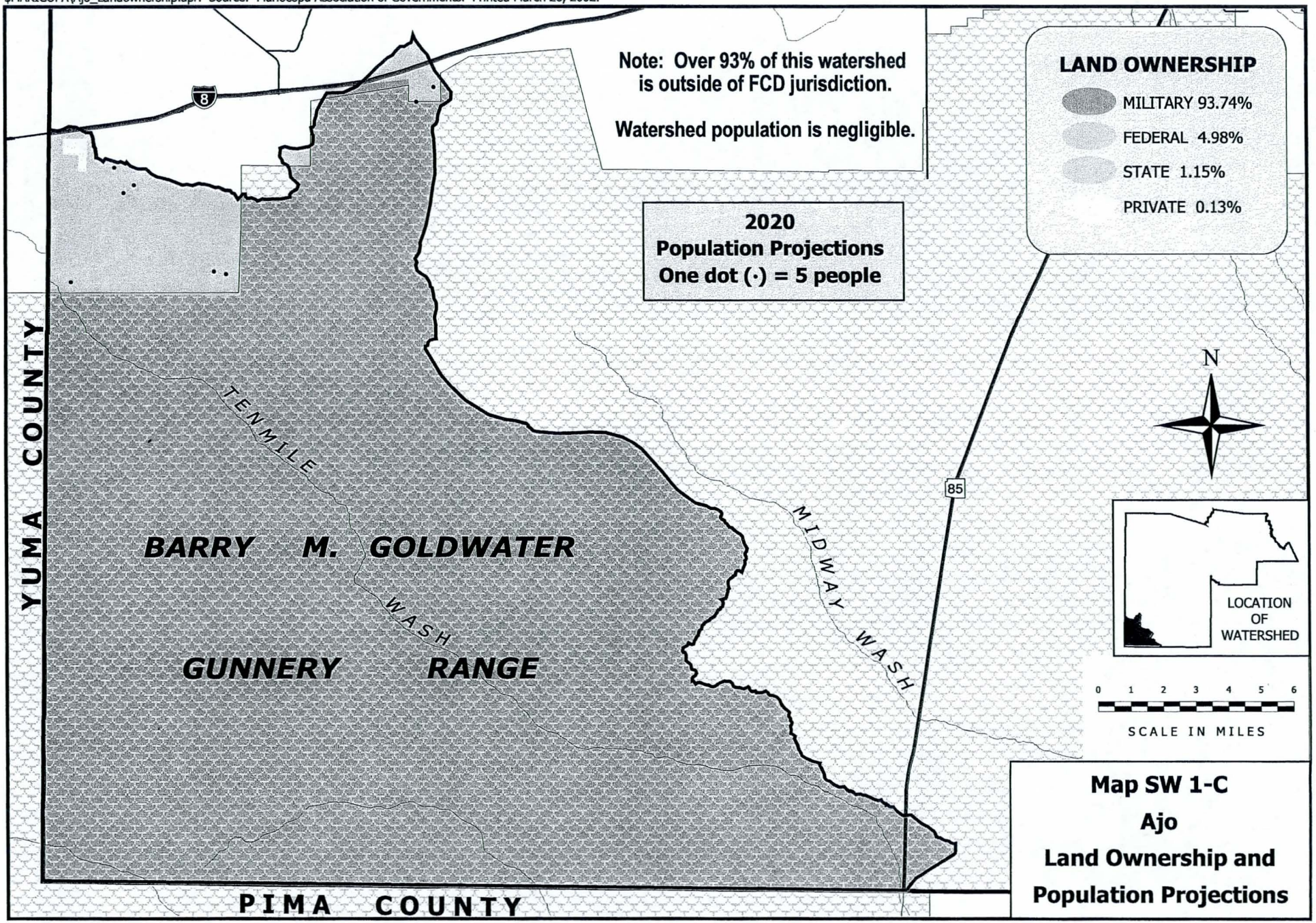


Map SW 1-A
Ajo
Land Ownership and
Population Projections

$MARICOPA\Ajo_Landuse.apr. Source: Mariocopa Association of Governments. Printed March 26, 2002.



$MARICOPA\Ajo_Landownership.apr. Source: Mariocopa Association of Governments. Printed March 26, 2002.



GILA BEND WATERSHED

Table SW 2-1
Land Use in Gila Bend Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential			
Low Density Residential	590	0.92	0.26%
Commercial & Industrial	533	0.83	0.24%
Agricultural	31	0.05	0.01%
Open Space	141,941	221.78	63.36%
Vacant	79,048	123.51	35.28%
Water	120	0.19	0.05%
Other	1,768	2.76	0.79%
Out of County/Not Classified			
Total Area	224,031	350.05	100.00%

Table SW 2-2
Land Ownership in Gila Bend Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
MILITARY	128,250	200.39	57.25%	57.25%
FEDERAL	76,285	119.20	34.05%	34.05%
PRIVATE	15,069	23.55	6.73%	6.73%
STATE	4,428	6.92	1.98%	1.98%
Total	224,031	350.05	100.00%	100.00%

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Table SW 1-3
Flood Damage Report for the Ajo Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan- 8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb- 10:00 AM/ 22 Feb- 12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec- 12:00 PM/ 20 Dec- 12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges.	4 deaths-countywide. $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78- 3 Mar 78	1 Mar- 4:00 PM/ 2 Mar- 4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries, Queen Creek,	1 death-countywide.Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:
1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.

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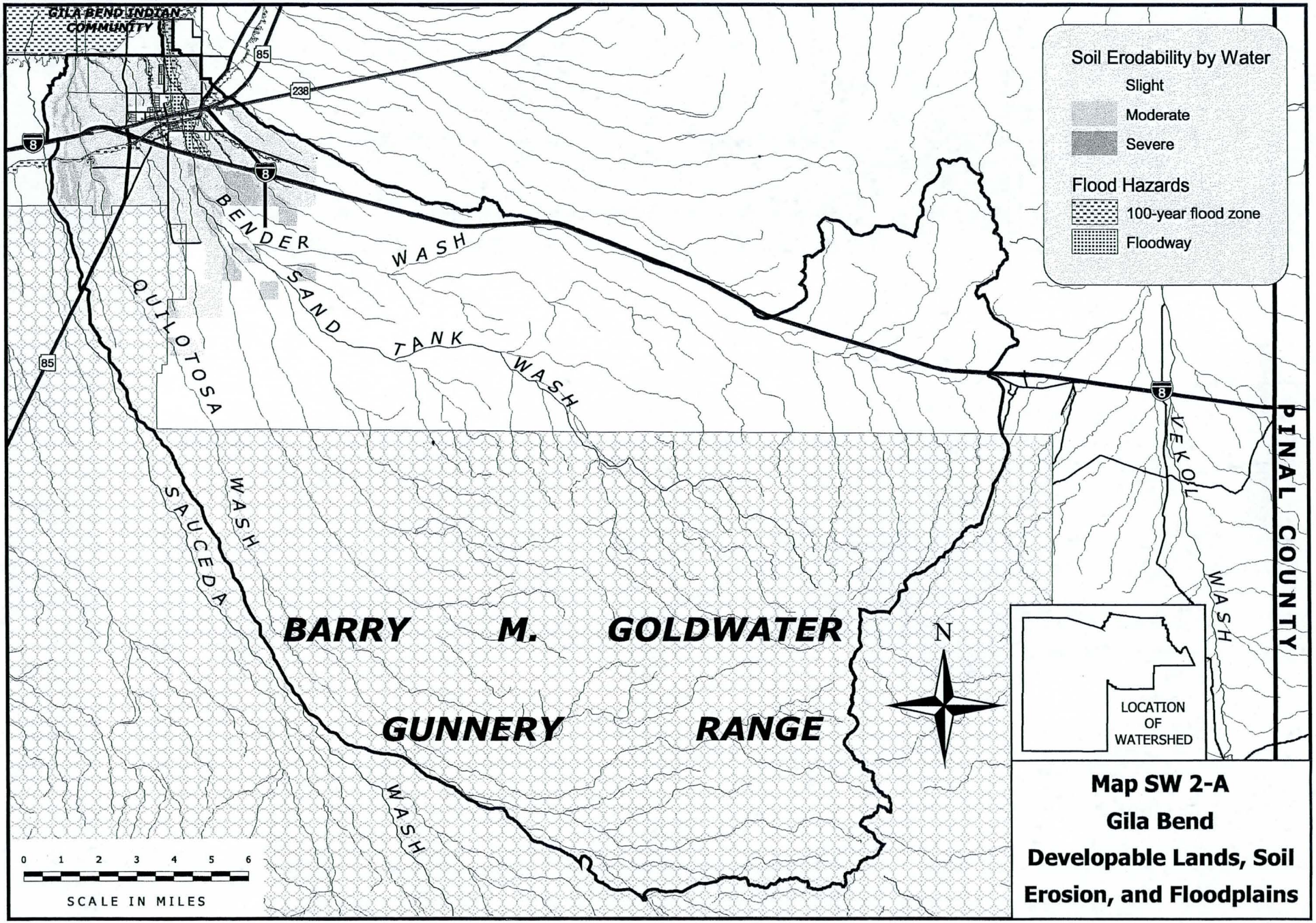
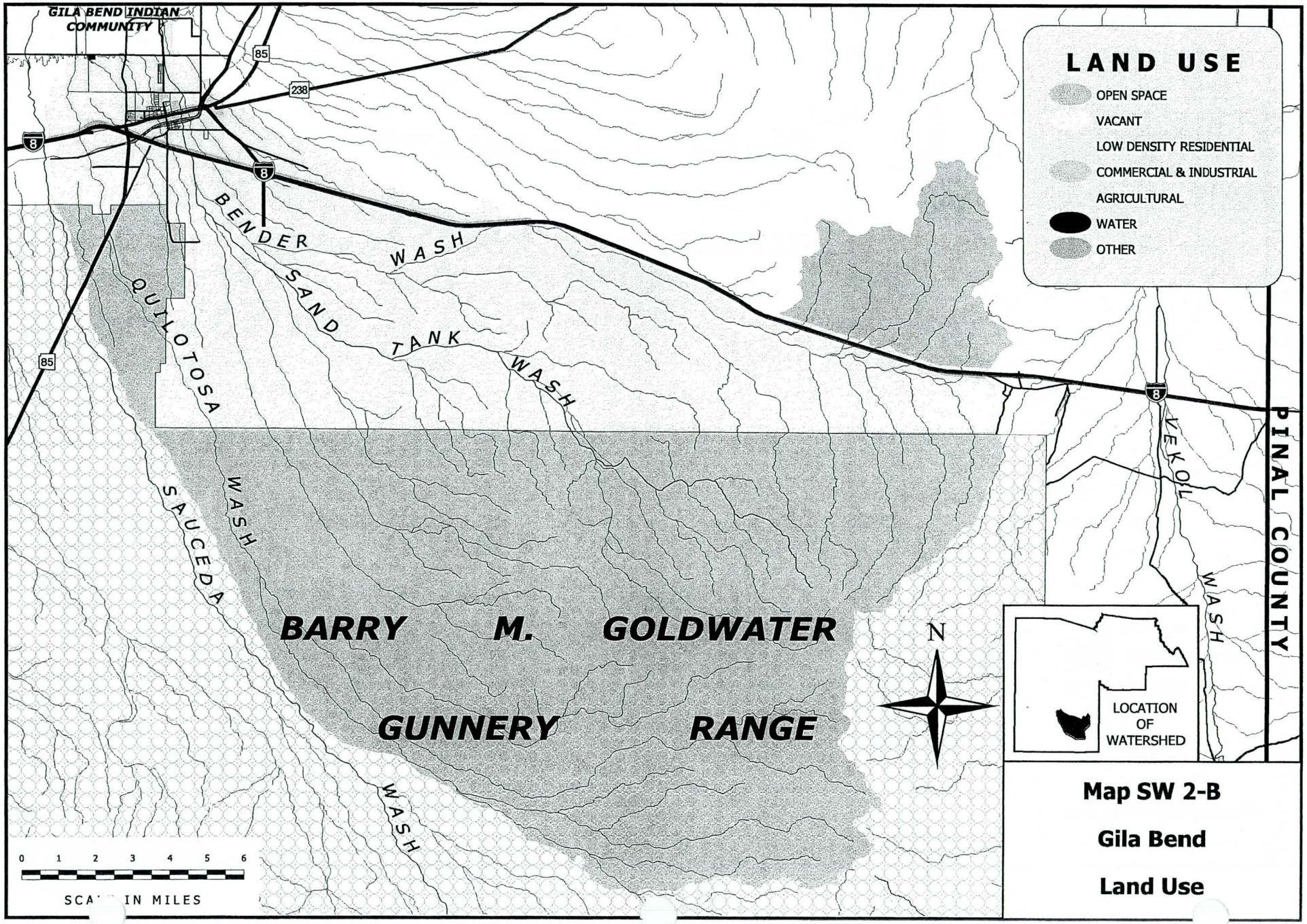
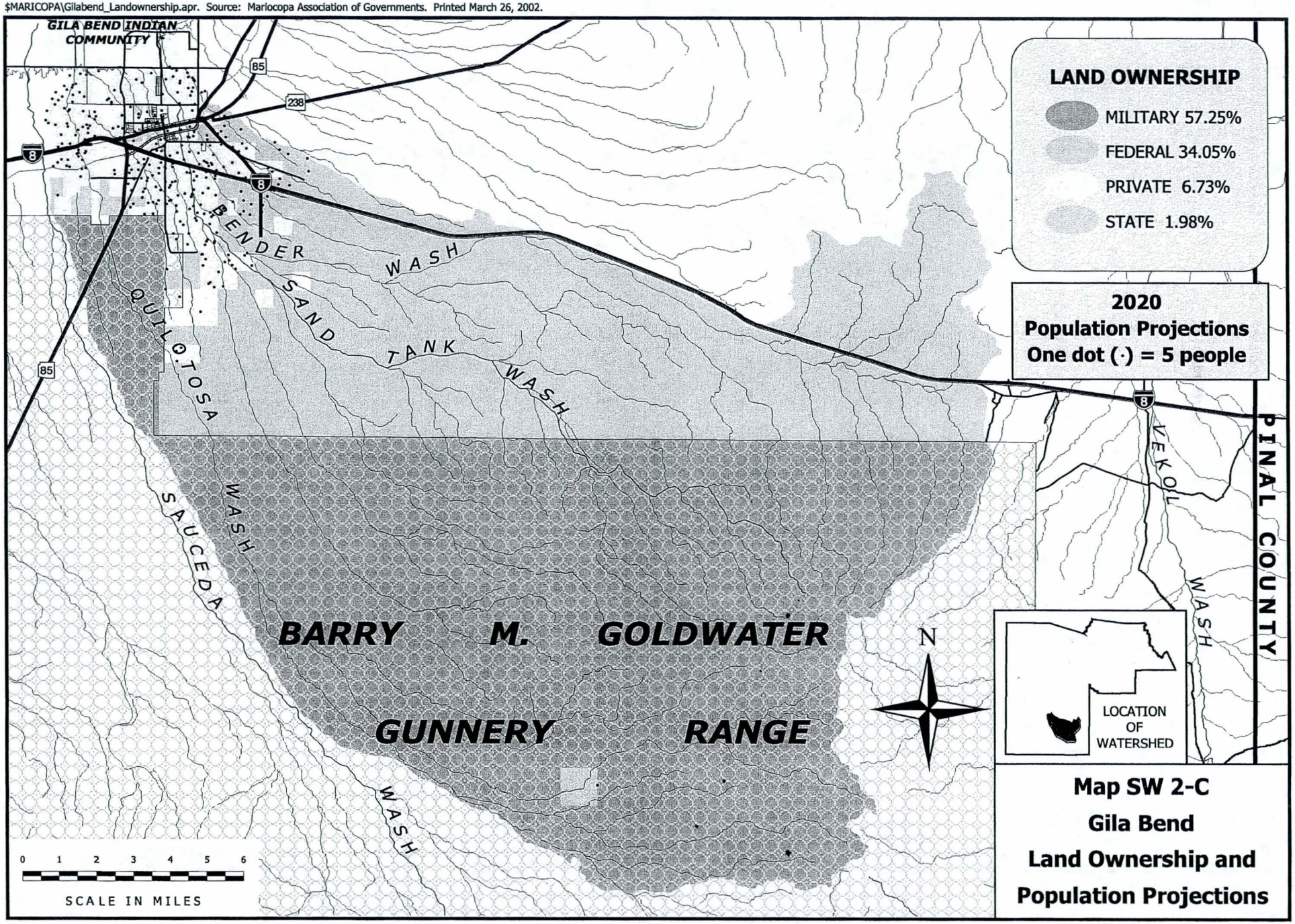
$MARICOPA\GilaBend_Erosion.apr. Source: Mariocopa Association of Governments. Printed March 26, 2002.



Map SW 2-A
Gila Bend
Developable Lands, Soil Erosion, and Floodplains

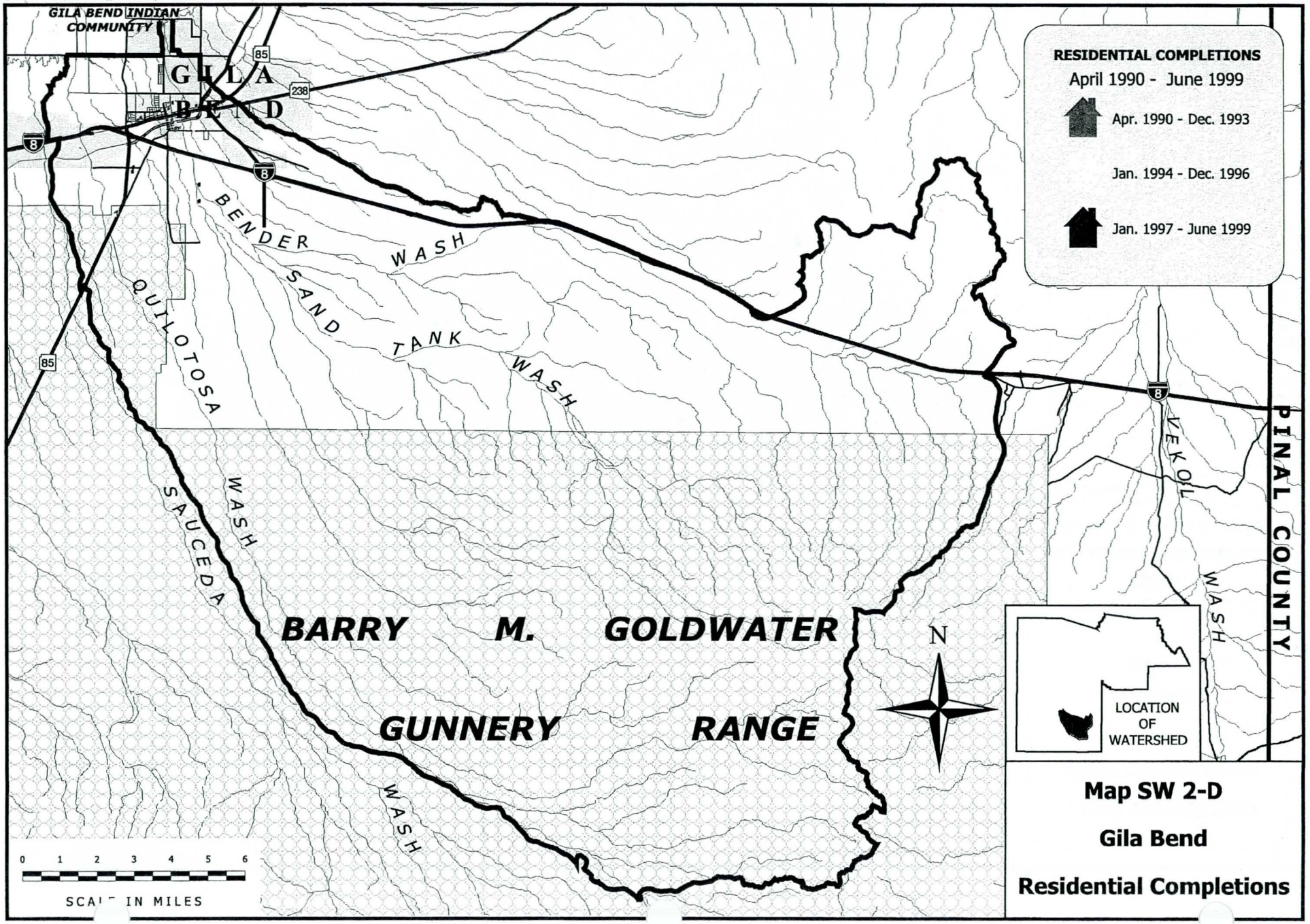

$MARICOPA\GilaBend_Landuse.apr. Source: Mariocopa Association of Governments. Printed March 26, 2002.
GILA BEND INDIAN COMMUNITY
85
238
8
BENDER WASH
SAND TANK WASH
QUITOTOSA
SAUCEDA WASH
BARRY M. GOLDWATER
GUNNERY RANGE
WASH
VEKOL WASH
PINAL COUNTY
LAND USE
OPEN SPACE
VACANT
LOW DENSITY RESIDENTIAL
COMMERCIAL & INDUSTRIAL
AGRICULTURAL
WATER
OTHER
N
LOCATION OF WATERSHED
0 1 2 3 4 5 6
SCALE IN MILES
Map SW 2-B
Gila Bend
Land Use

$MARICOPA\Gilabend_Landownership.apr. Source: Mariocopa Association of Governments. Printed March 26, 2002.



Map SW 2-C
Gila Bend
Land Ownership and
Population Projections

$MARICOPA\GilaBend_Erosion.apr. Source: Mariocopa Association of Governments. Printed March 26, 2002.



GILLESPIE WATERSHED

Table SW 3-1
Land Use in Gillespie Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential			
Low Density Residential	28	0.04	0.01%
Commercial & Industrial			
Agricultural	12,042	18.82	5.87%
Open Space	67,747	105.85	33.02%
Vacant	123,428	192.86	60.16%
Water	1,350	2.11	0.66%
Other	576	0.90	0.28%
Out of County/Not Classified			
Total Area	205,173	320.58	100%

Table SW 3-2
Land Ownership in the Gillespie Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
FEDERAL	148,312	231.74	72.29%	72.29%
PRIVATE	30,358	47.43	14.80%	14.80%
STATE	25,954	40.55	12.65%	12.65%
PARKS	549	0.86	0.27%	0.27%
Total	205,173	320.58	100.00%	100.00%

DRAFT

Table SW 3-3
Flood Damage History

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges.	4 deaths-countywide. $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries, Queen Creek, Hassayampa River and Centennial Wash.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

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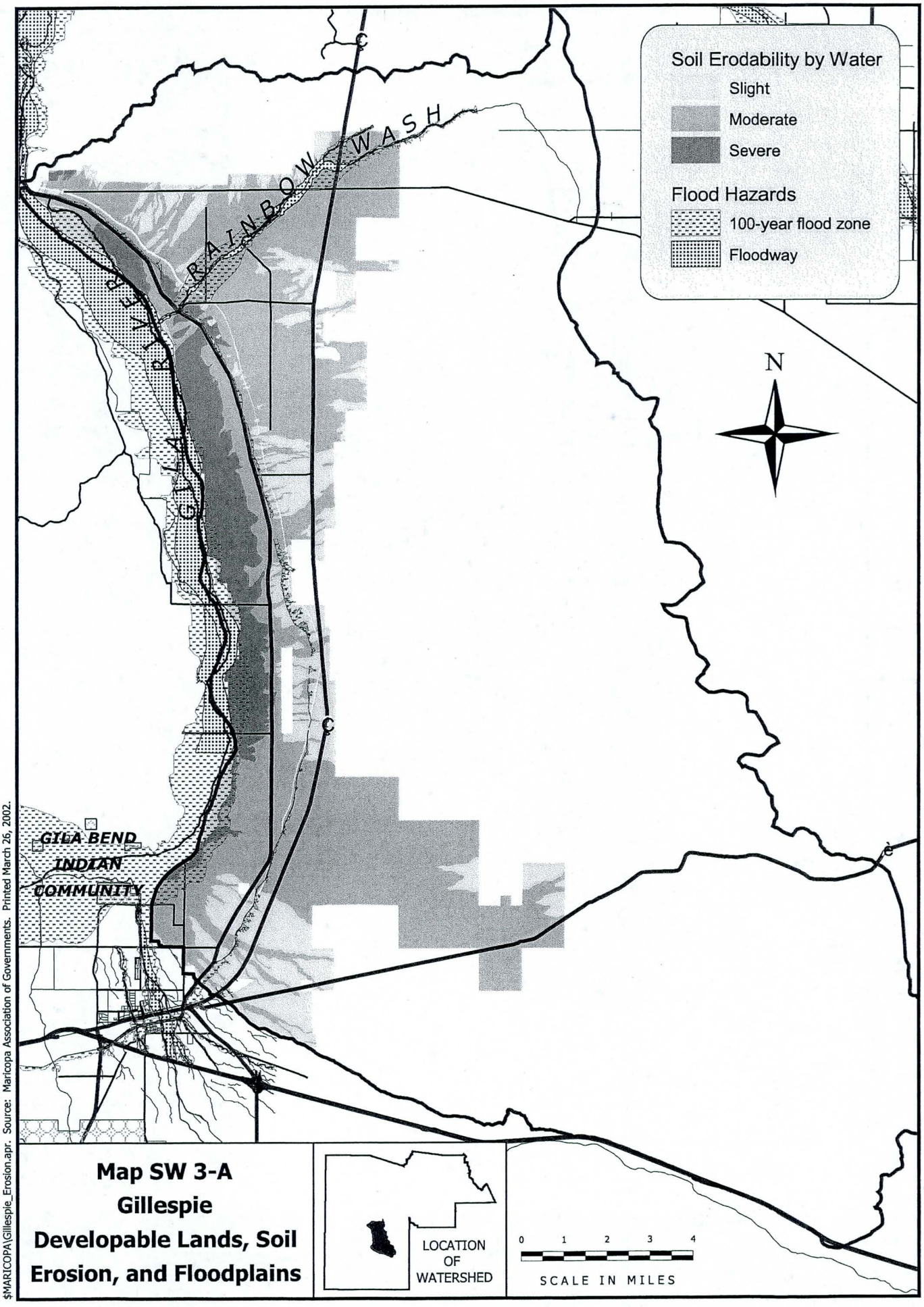
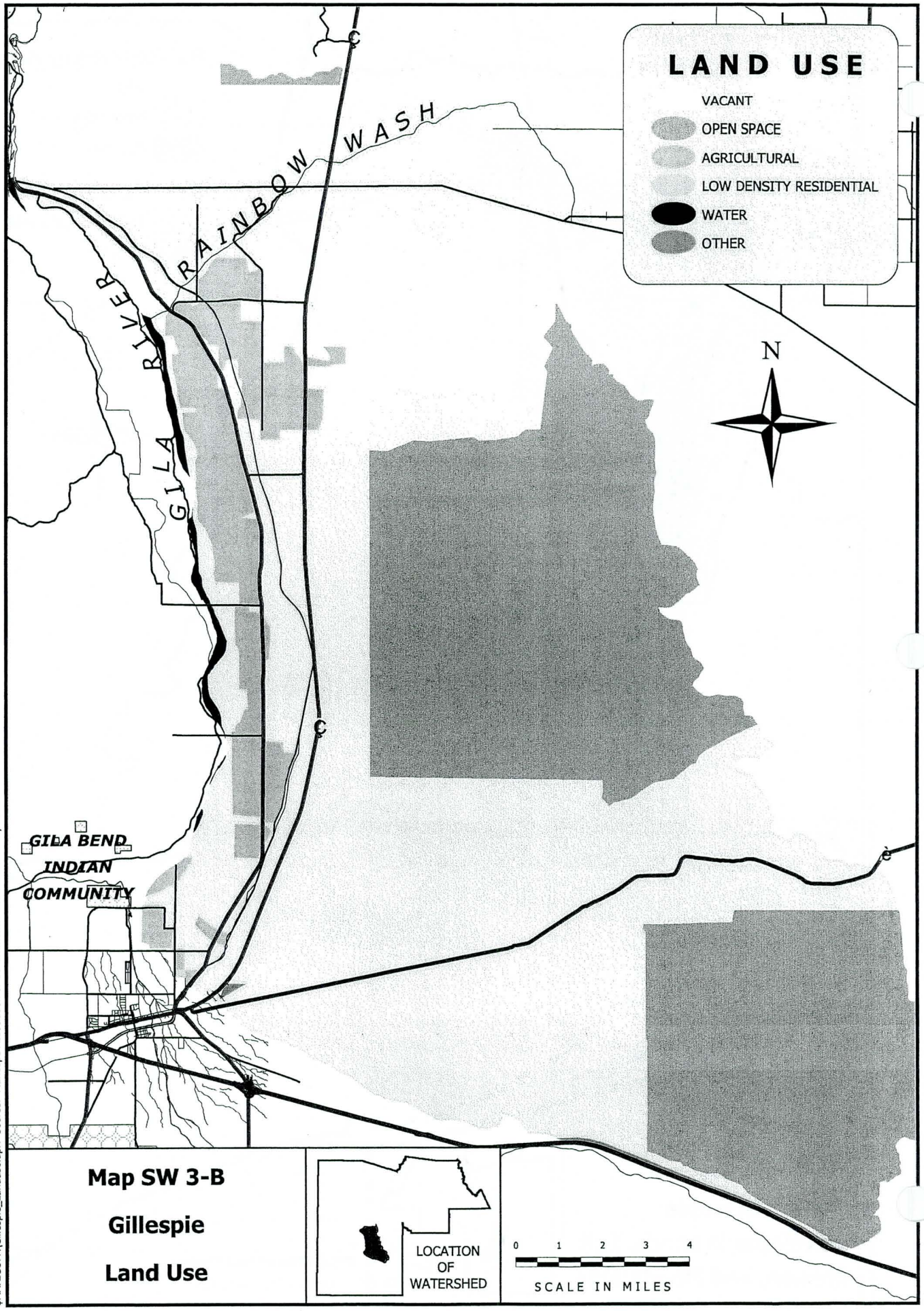
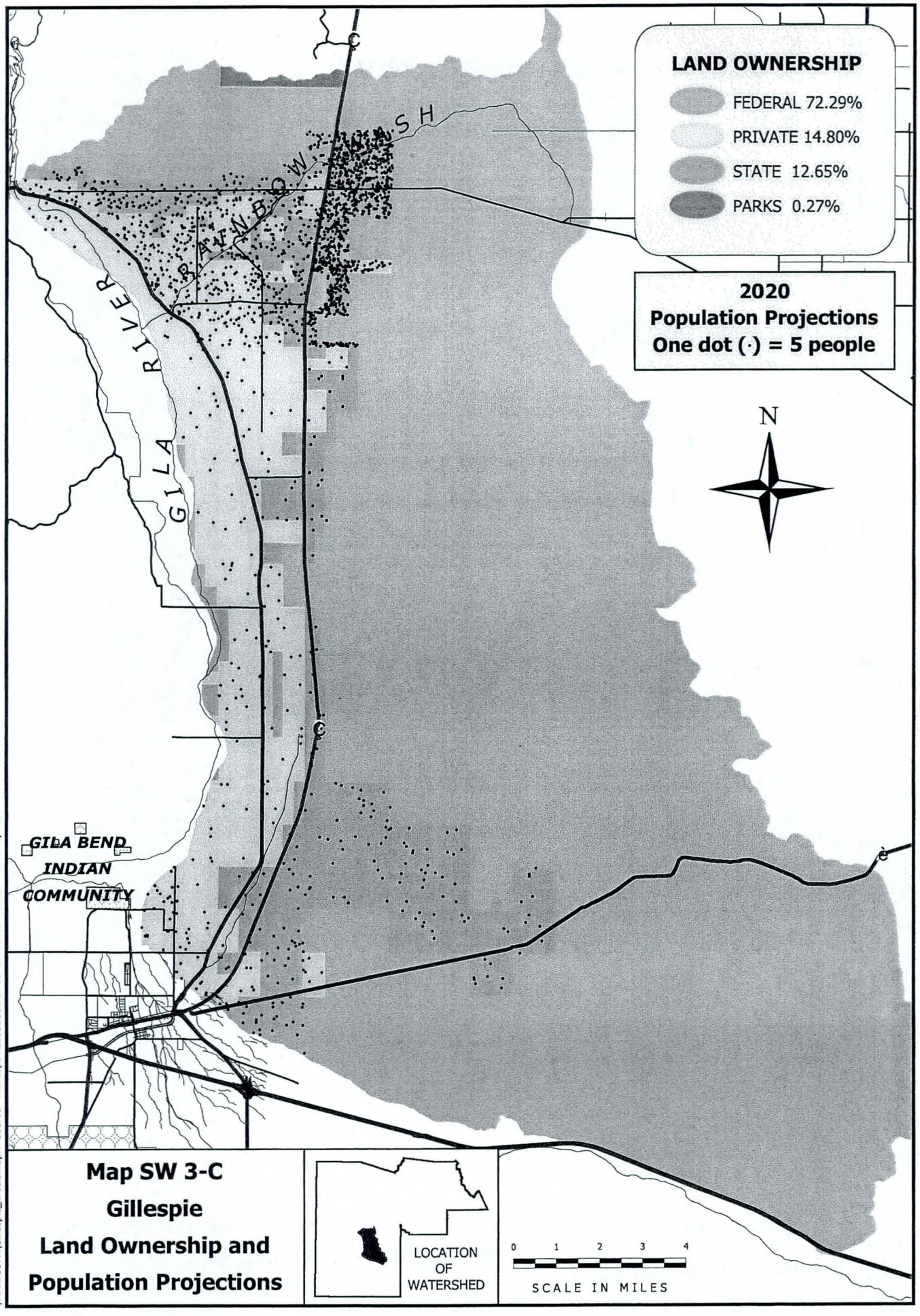
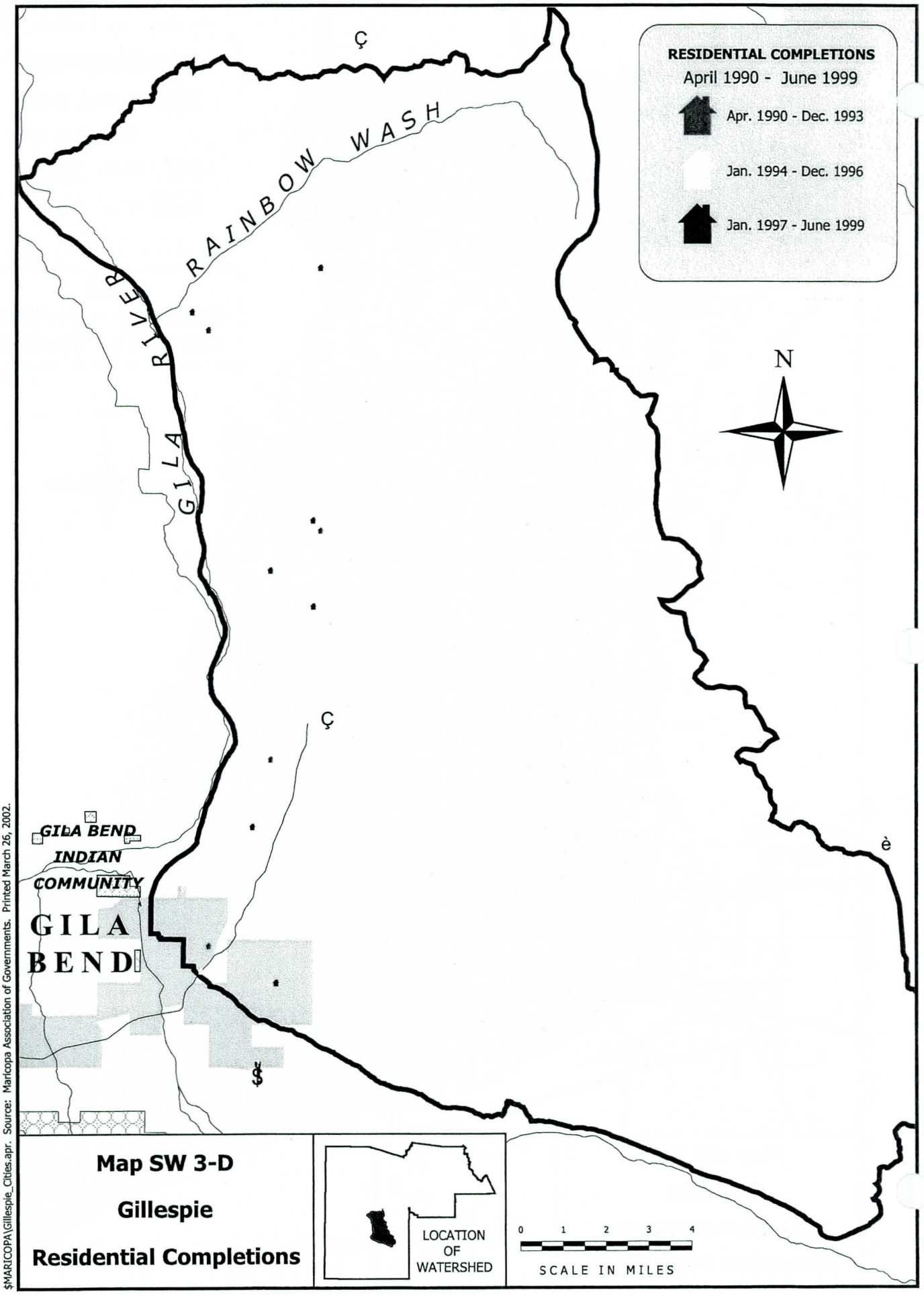


Map SW 3-A
Gillespie
Developable Lands, Soil Erosion, and Floodplains

$MARICOPA\Gillespie_Erosion.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.


LAND USE
VACANT
OPEN SPACE
AGRICULTURAL
LOW DENSITY RESIDENTIAL
WATER
OTHER
N
GILA RIVER
RAINBOW WASH
GILA BEND
INDIAN
COMMUNITY
Map SW 3-B
Gillespie
Land Use
LOCATION
OF
WATERSHED
0 1 2 3 4
SCALE IN MILES
$MARICOPA\Gillespie_Landuse.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.


LAND OWNERSHIP
FEDERAL 72.29%
PRIVATE 14.80%
STATE 12.65%
PARKS 0.27%
2020
Population Projections
One dot (·) = 5 people
N
GILA RIVER
RAINBOW
GILA BEND
INDIAN
COMMUNITY
Map SW 3-C
Gillespie
Land Ownership and
Population Projections
LOCATION
OF
WATERSHED
0 1 2 3 4
SCALE IN MILES
$MARICOPA\Gillespie_Erosion.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.


RESIDENTIAL COMPLETIONS
April 1990 - June 1999
Apr. 1990 - Dec. 1993
Jan. 1994 - Dec. 1996
Jan. 1997 - June 1999
GILA RIVER
RAINBOW WASH
N
GILA BEND
INDIAN
COMMUNITY
GILA
BEND
Map SW 3-D
Gillespie
Residential Completions
LOCATION
OF
WATERSHED
0 1 2 3 4
SCALE IN MILES
$MARICOPA\Gillespie_Cities.apr. Source: Maricopa Association of Governments. Printed March 26, 2002.

LOWER GILA AND PAINTED ROCK WATERSHEDS

Table SW 4-1
Area of Land in Lower Gila/Painted Rock Watershed, by Classification

	Acres	Sq. Mi.	Percent
Medium/High Density Residential			
Low Density Residential	34	0.05	0.01%
Commercial & Industrial			
Agricultural	11,555	18.05	2.83%
Open Space	74,533	116.46	18.25%
Vacant	267,127	417.39	65.40%
Water	9,453	14.77	2.31%
Other	41	0.06	0.01%
Out of County/Not Classified	45,678	71.37	11.18%
Total Area	408,421	638.16	100.00%

SW 4-2
Painted Rock and Lower Gila

Land Ownership Category	AREA	Land Area by Ownership Category		Percent of each watershed		
		Acres	Sq. Mi.	Painted Rock	Lower Gila	Both Combined
FEDERAL: Lower Gila	8,766,653,224	201,254.7	314.460		69.81%	74.83%
FEDERAL: Painted Rock	4,545,360,813	104,347.1	163.042	86.85%		74.83%
PRIVATE: Lower Gila	918,269,370	21,080.6	32.938		7.31%	8.56%
STATE: Lower Gila	890,619,782	20,445.8	31.947		7.09%	5.33%
PRIVATE: Painted Rock	605,073,620	13,890.6	21.704	11.56%		8.56%
STATE: Painted Rock	56,880,646	1,305.8	2.040	1.09%		5.33%
INDIAN: Painted Rock	26,477,902	607.8	0.950	0.51%		0.15%
OUT OF COUNTY: Lower Gila	1,981,478,081	45,488.5	71.076		15.78%	11.14%
Total	17,790,813,437	408,420.9	638.158	100.00%	100.00%	

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Table SW 4-3

Flood Damage Report for Lower Gila/Painted Rock Watersheds

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm	71 roads, streets and bridges reported closed. Sewage disposal pond, north of Gila Bend, was breached, sending raw sewage into Gila River and Painted Rock reservoir backwater.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries, Queen Creek, Hassayampa River and Centennial Wash.	1 death-countywide-Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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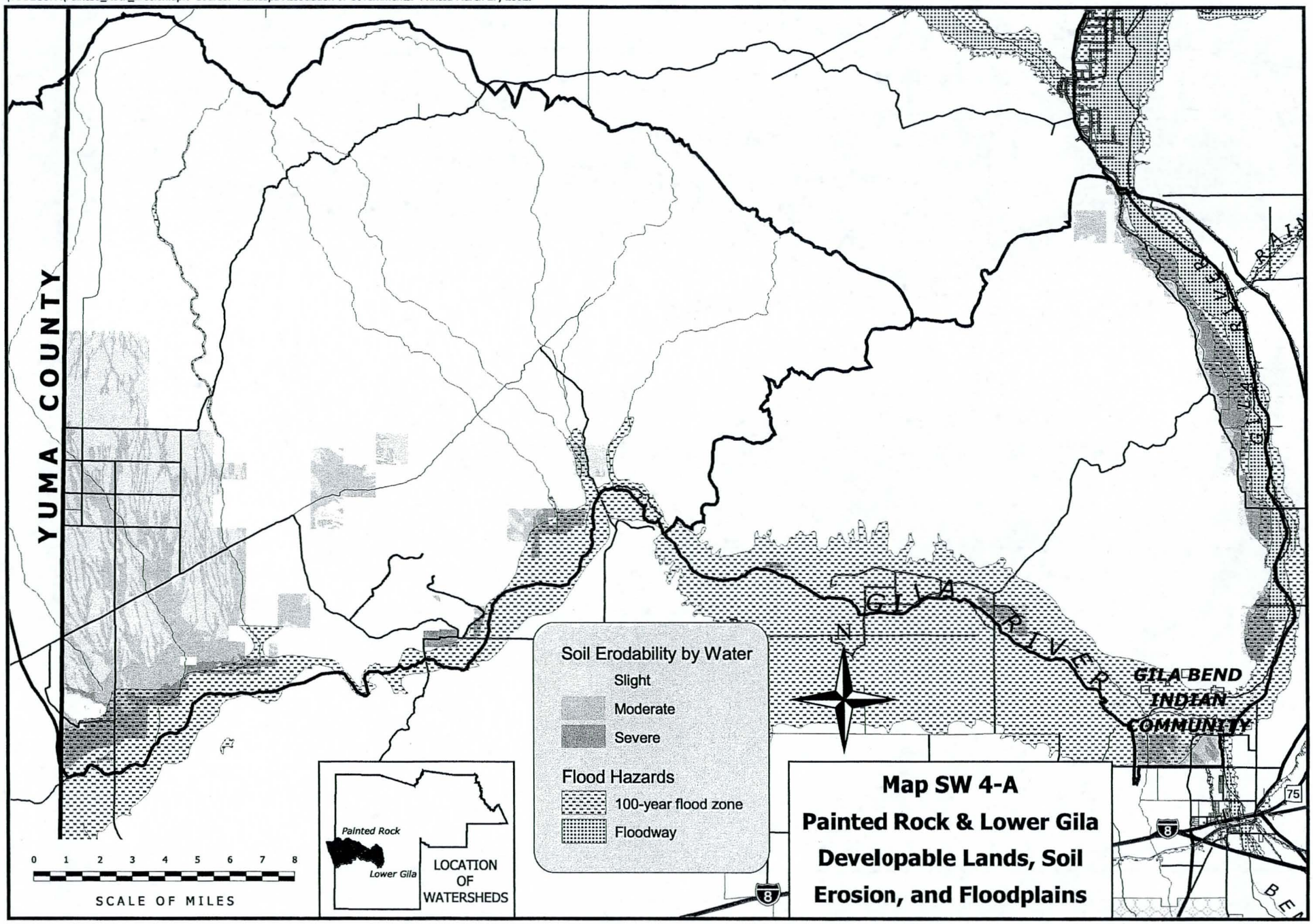
$MARICOPA\Painted_Rock_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



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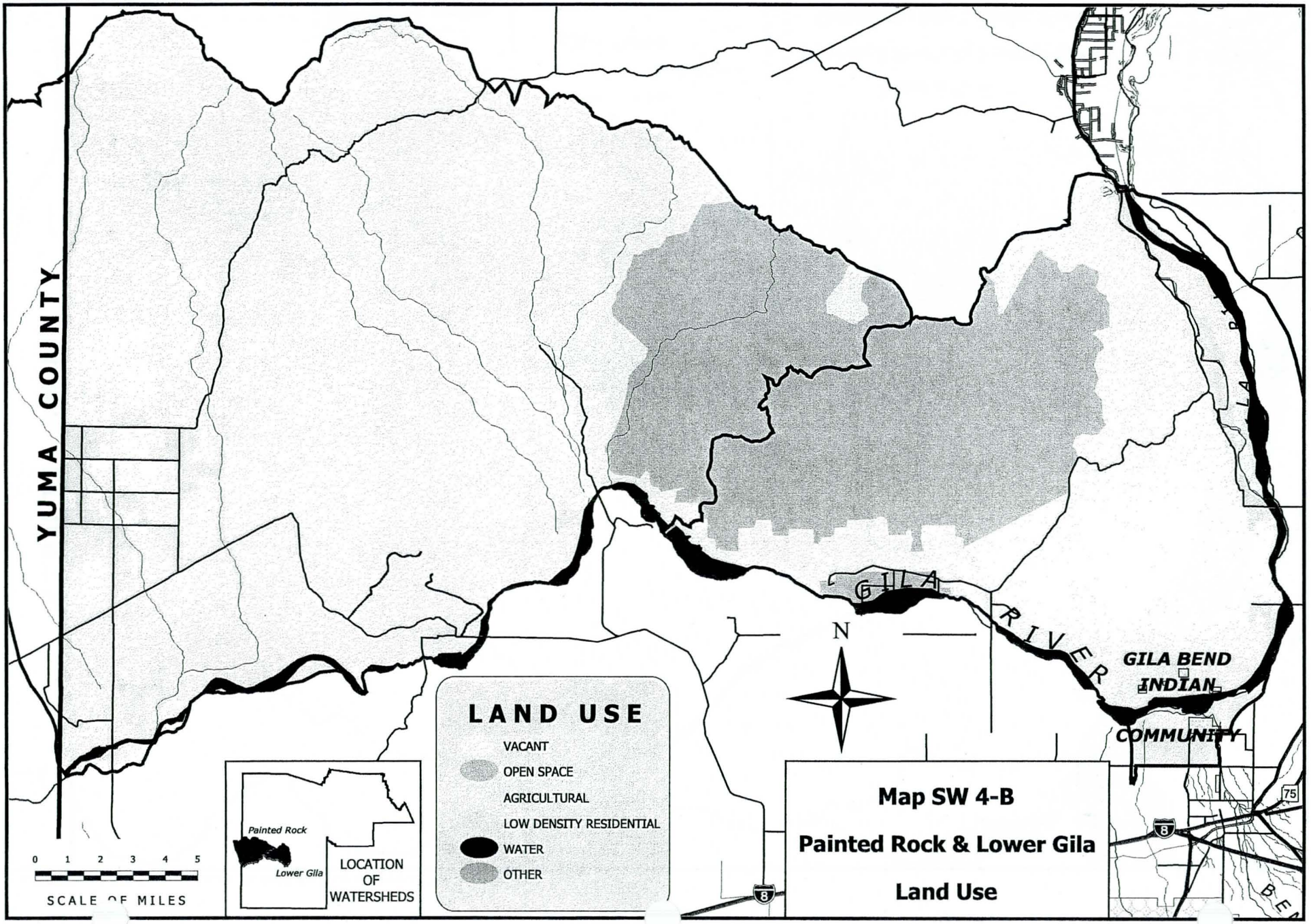
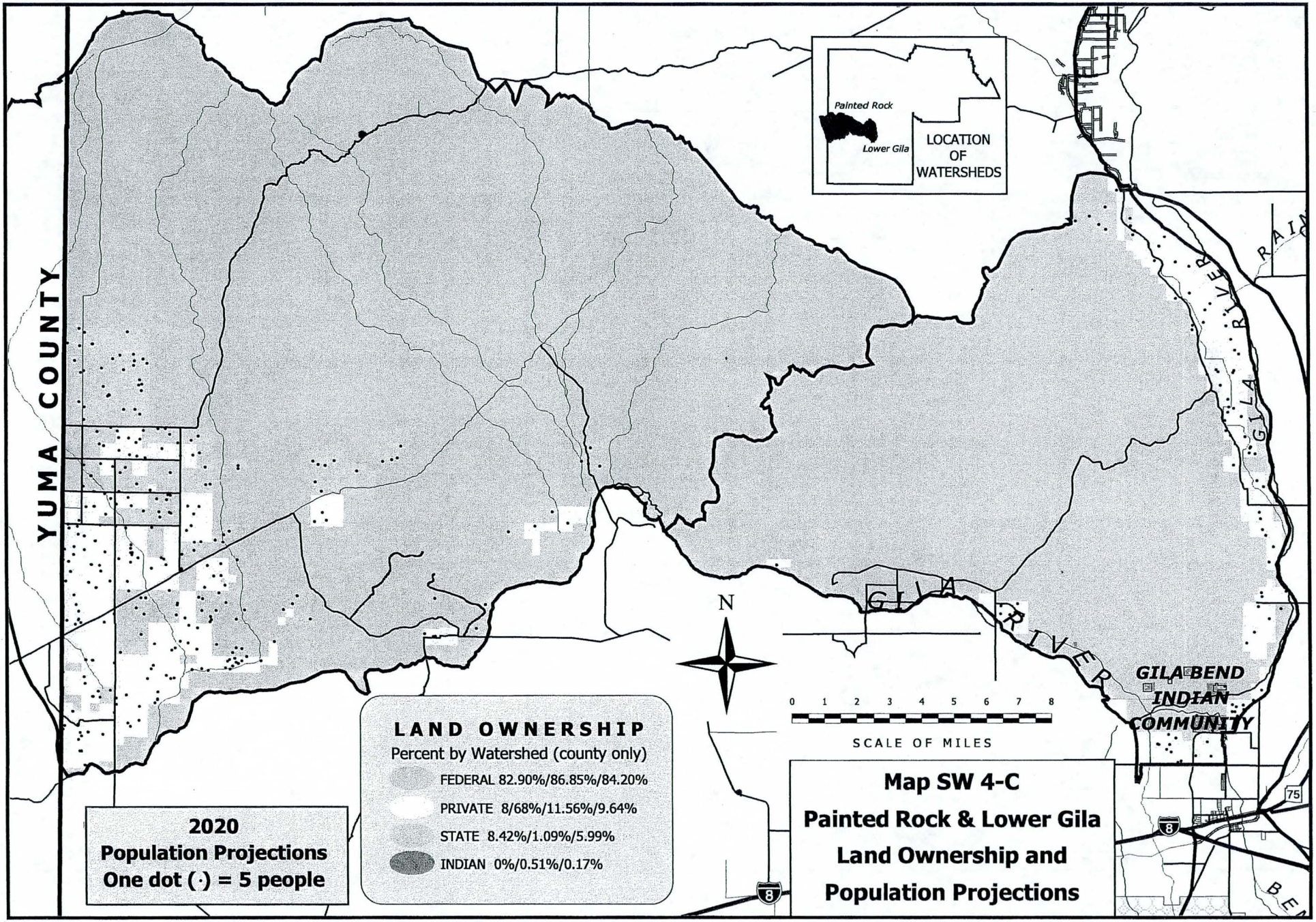


$MARICOPA\Painted_Rock_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



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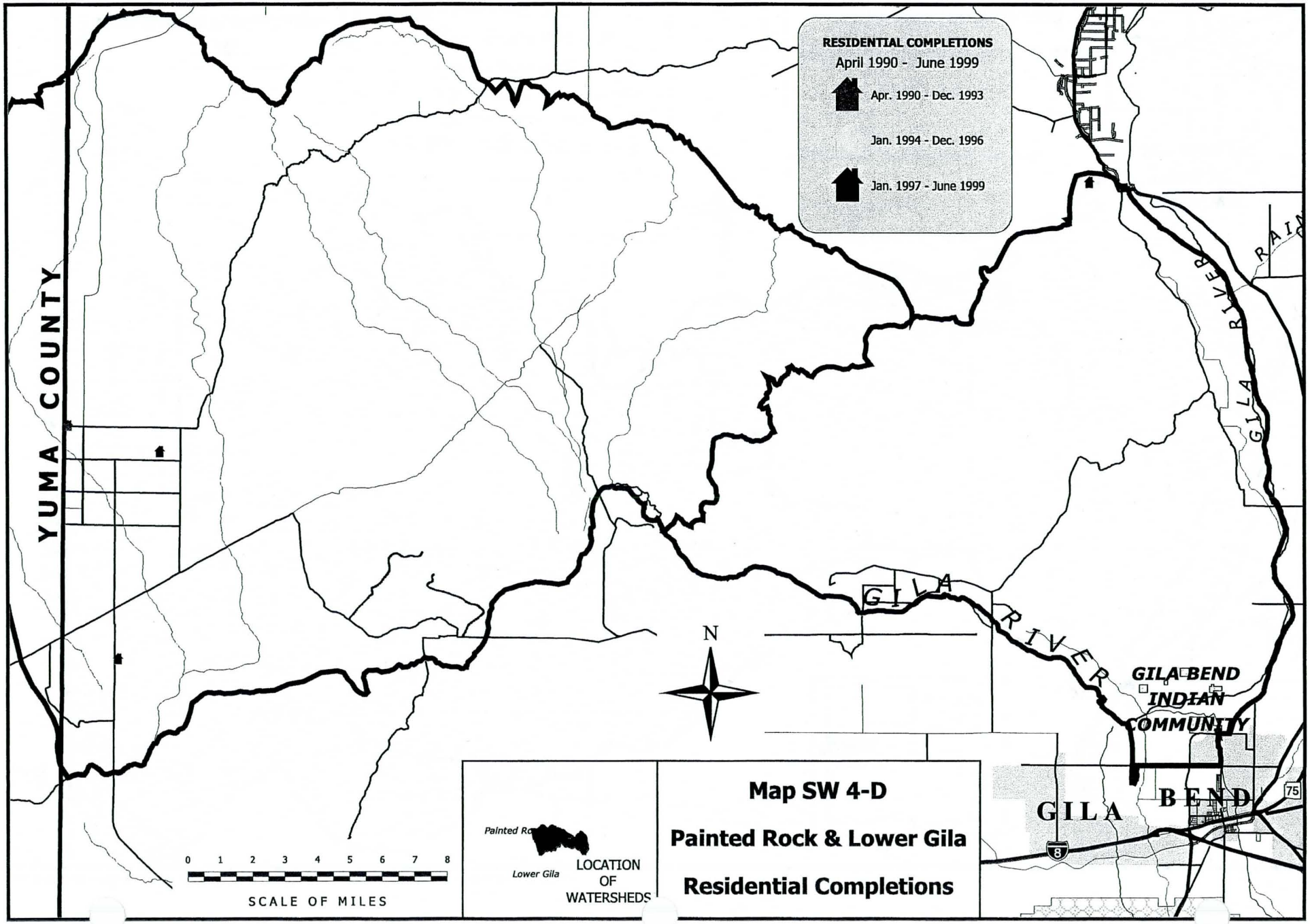

SENTINEL WATERSHED

Table SW 5-1
Land Use in Sentinel Watershed, by Classification

	Acres	Sq. Mi.	Percent
Medium/High Density Residential			
Low Density Residential	39	0.06	0.01%
Commercial & Industrial			
Agricultural	2,631	4.11	0.63%
Open Space	249,848	390.39	59.76%
Vacant	145,297	227.03	34.75%
Water	1,929	3.01	0.46%
Other	1,406	2.20	0.34%
Out of County/Not Classified	16,936	26.46	4.05%
Total Area	418,086	653.26	100.00%

Table SW 5-2
Land Ownership in the Sentinel Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
MILITARY	251,167	392.45	62.60%	60.83%
FEDERAL	113,339	177.09	28.25%	27.11%
STATE	27,552	43.05	6.87%	6.59%
PRIVATE	9,123	14.26	2.27%	2.18%
INDIAN	31	0.05	0.01%	1.00%
OUT OF COUNTY	16,874	26.37		4.04%
Total	418,086	653.26	100.00%	100.00%

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Table SW 5-3
Flood Damage History for Sentinel Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan- 8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed. Sewage disposal pond, north of Gila Bend, was breached, sending raw sewage into Gila River and Painted Rock reservoir backwater.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb- 10:00 AM/ 22 Feb- 12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec- 12:00 PM/ 20 Dec- 12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78- 3 Mar 78	1 Mar- 4:00 PM/ 2 Mar- 4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries, Queen Creek, Hassayampa River and Centennial Wash.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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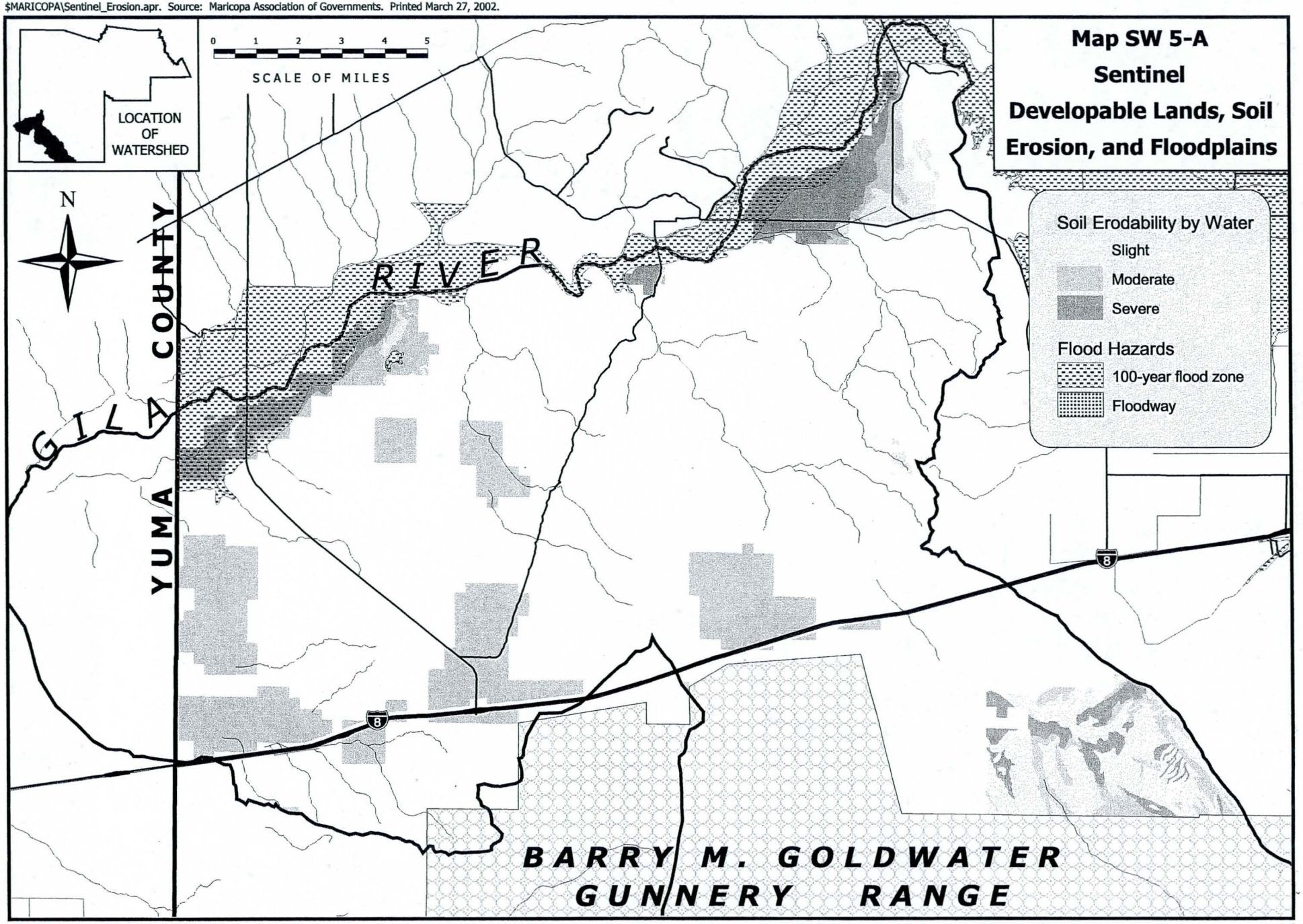
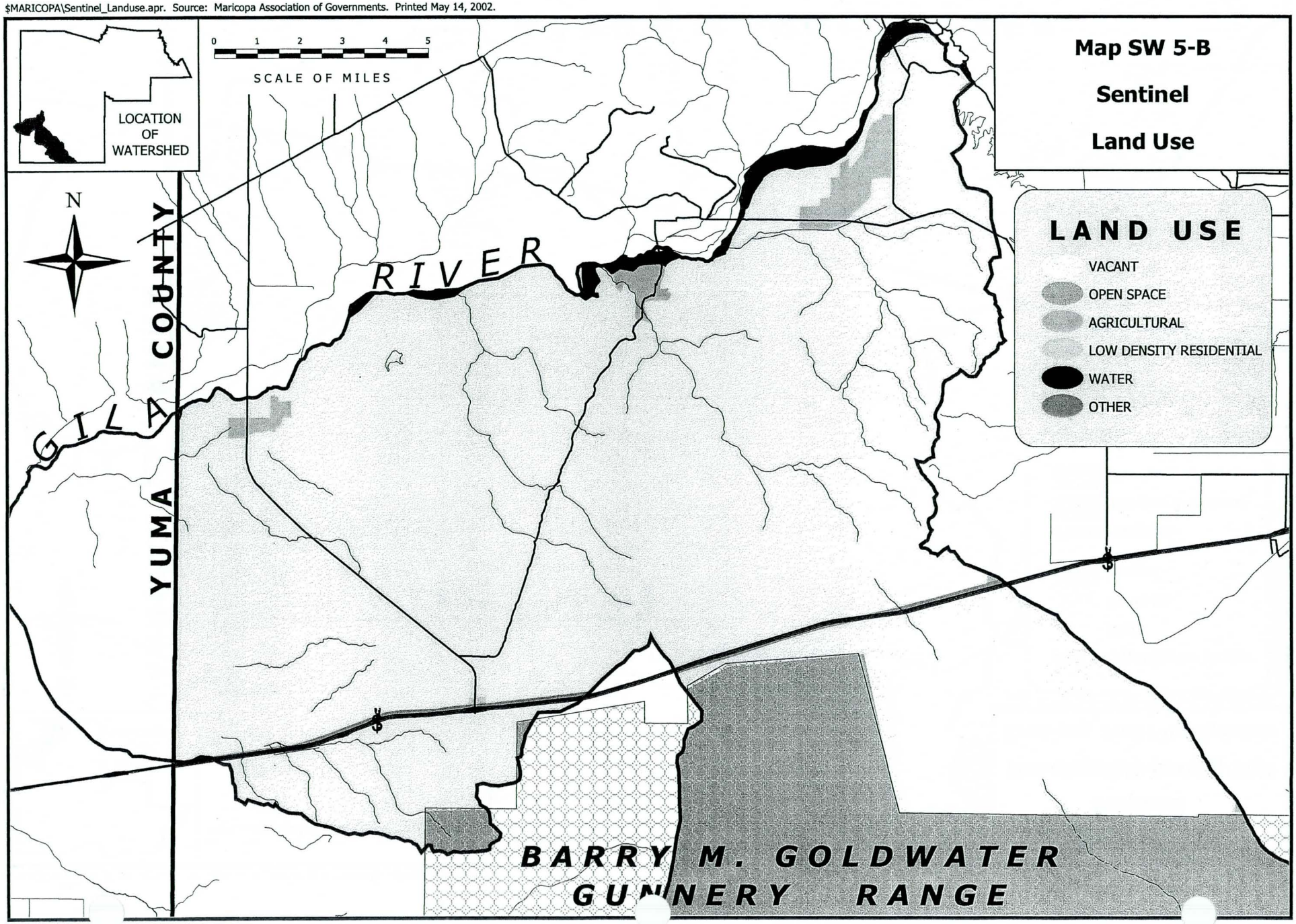
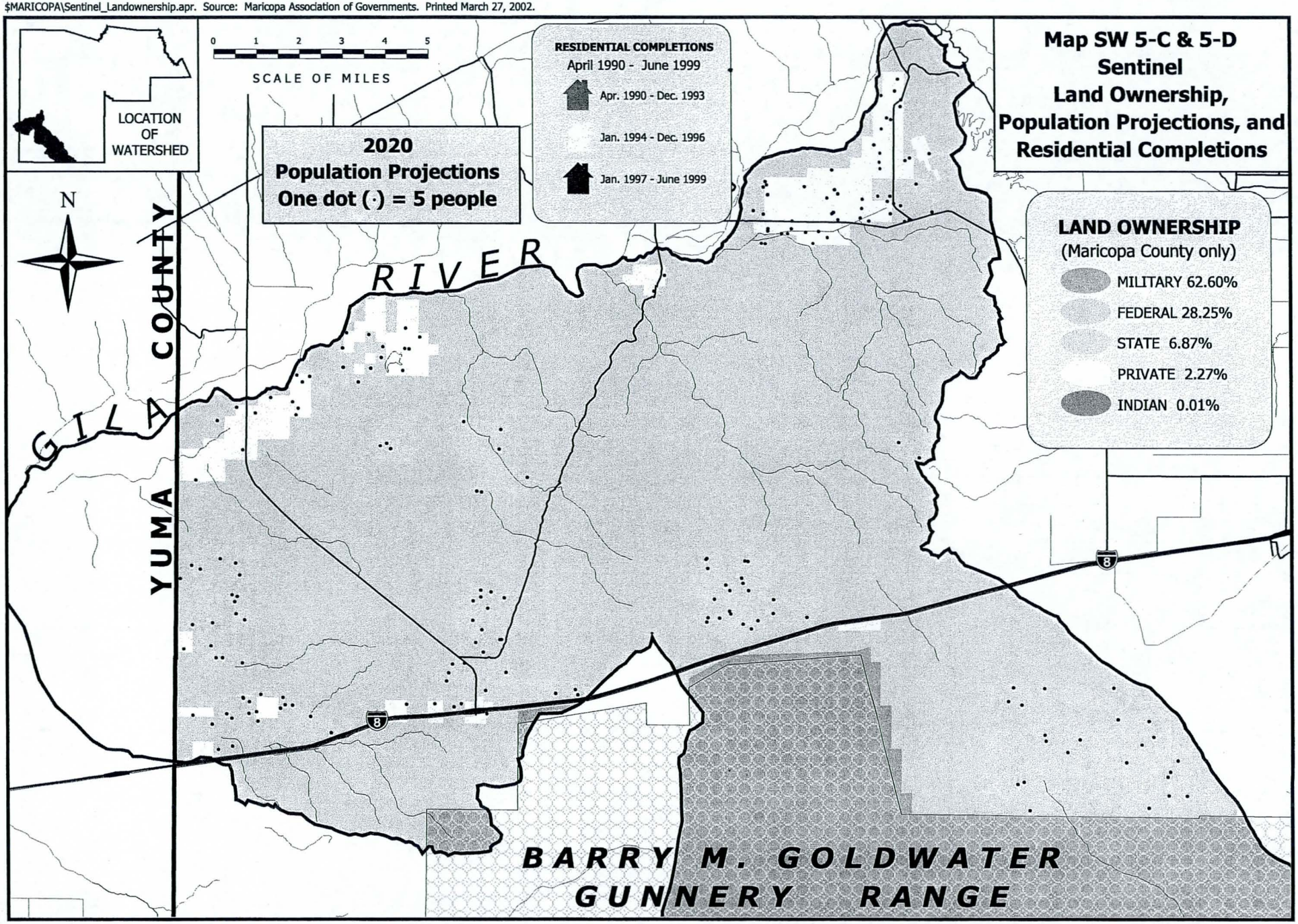
$MARICOPA\Sentinel_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.




$MARICOPA\Sentinel_Landuse.apr. Source: Maricopa Association of Governments. Printed May 14, 2002.
LOCATION OF WATERSHED
0 1 2 3 4 5
SCALE OF MILES
N
Map SW 5-B
Sentinel
Land Use
LAND USE
VACANT
OPEN SPACE
AGRICULTURAL
LOW DENSITY RESIDENTIAL
WATER
OTHER
GILA RIVER
YUMA COUNTY
BARRY M. GOLDWATER
GUNNERY RANGE

$MARICOPA\Sentinel_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



THEBA WATERSHED

Table SW 6-1
Land Use in the Theba Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential			
Low Density Residential	54	0.08	0.02%
Commercial & Industrial	51	0.08	0.02%
Agricultural	21,368	33.39	7.71%
Open Space	147,157	229.93	53.08%
Vacant	102,618	160.34	37.01%
Water	4,795	7.49	1.73%
Other	1,196	1.87	0.43%
Out of County/Not Classified			
Total Area	277,239	433.19	100.00%

Table SW 6-2
Land Ownership in the Theba Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
MILITARY	144,762	226.19	52.22%	52.22%
PRIVATE	67,362	105.25	24.30%	24.30%
INDIAN	31,363	49.01	11.31%	11.31%
FEDERAL	17,924	28.01	6.46%	6.46%
STATE	15,829	24.73	5.71%	5.71%
Total	277,239	433.19	100.00%	100.00%

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Table NW 6-3
Flood Damage History for Trilby Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	71 roads, streets and bridges reported closed. Sewage disposal pond, north of Gila Bend, was breached, sending raw sewage into Gila River and Painted Rock reservoir backwater.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries, Queen Creek, Hassayampa River and Centennial Wash.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

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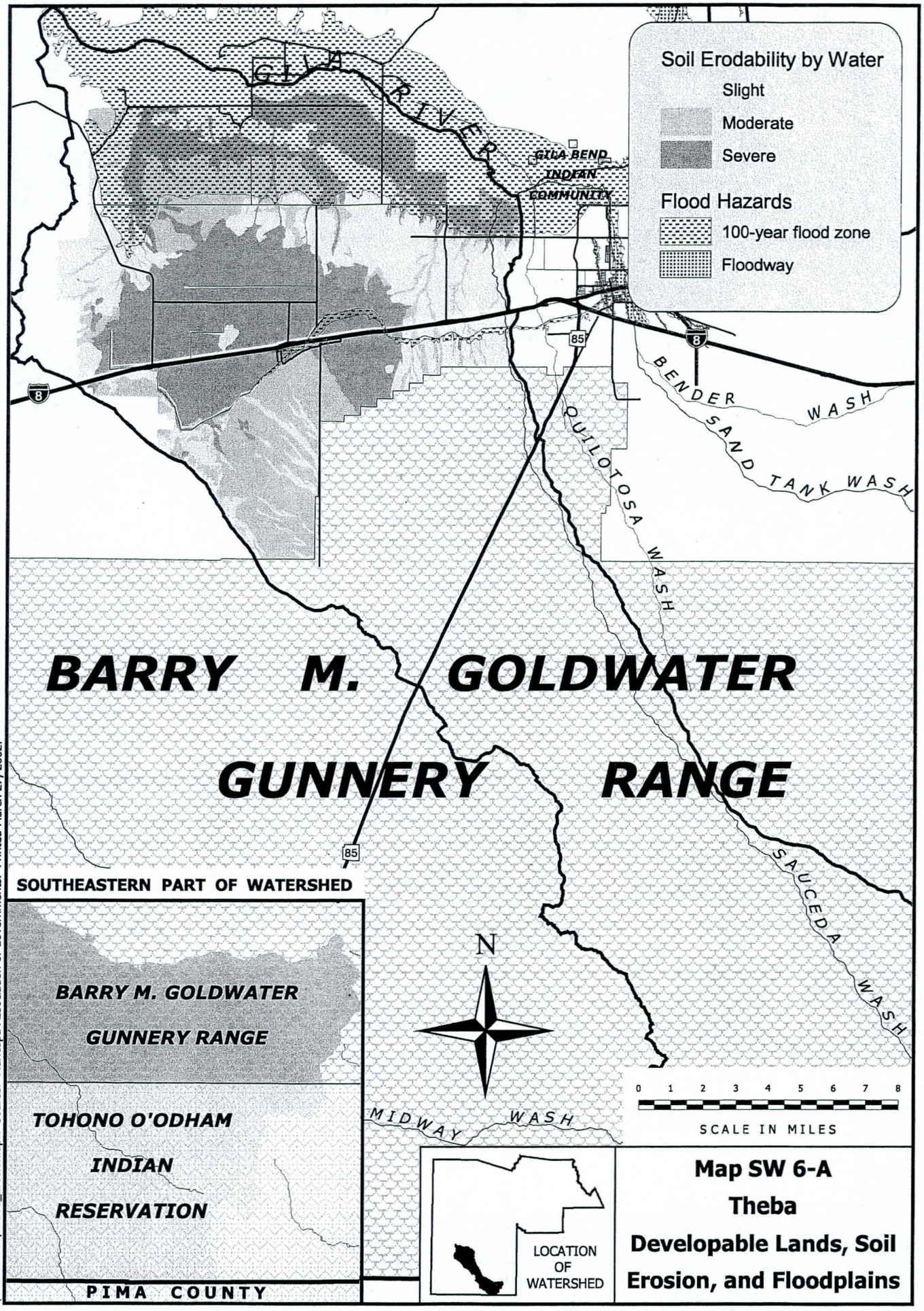
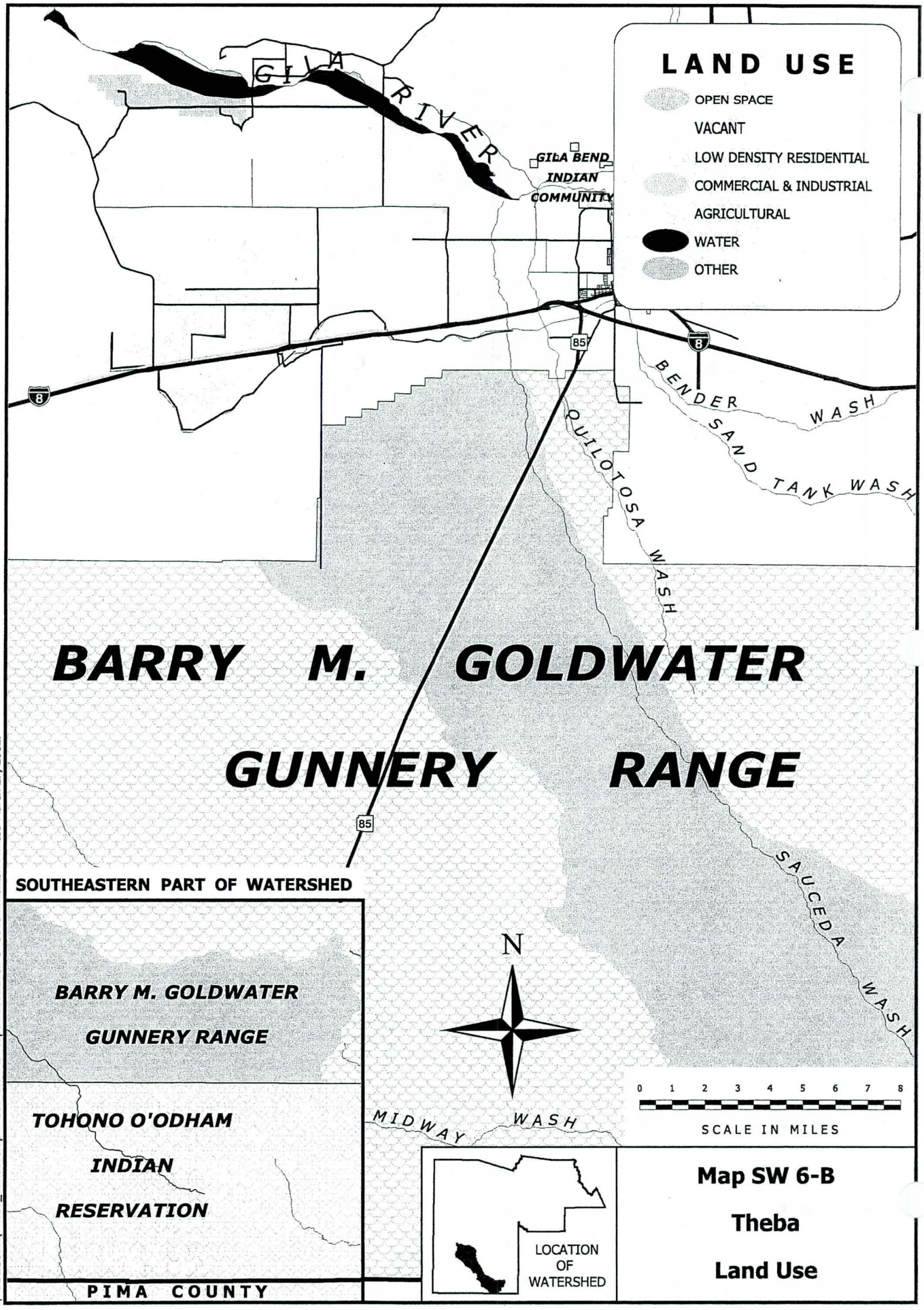
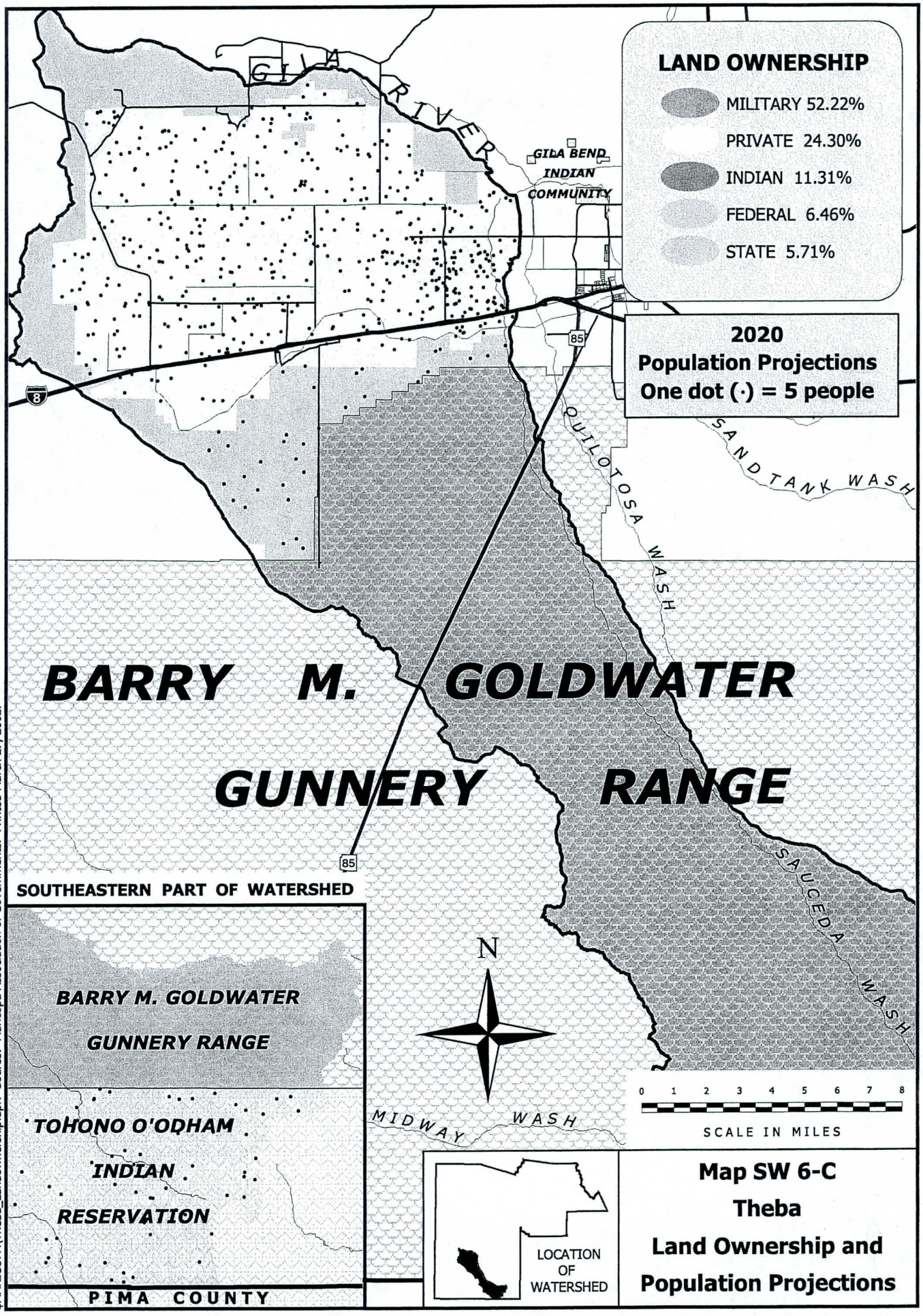


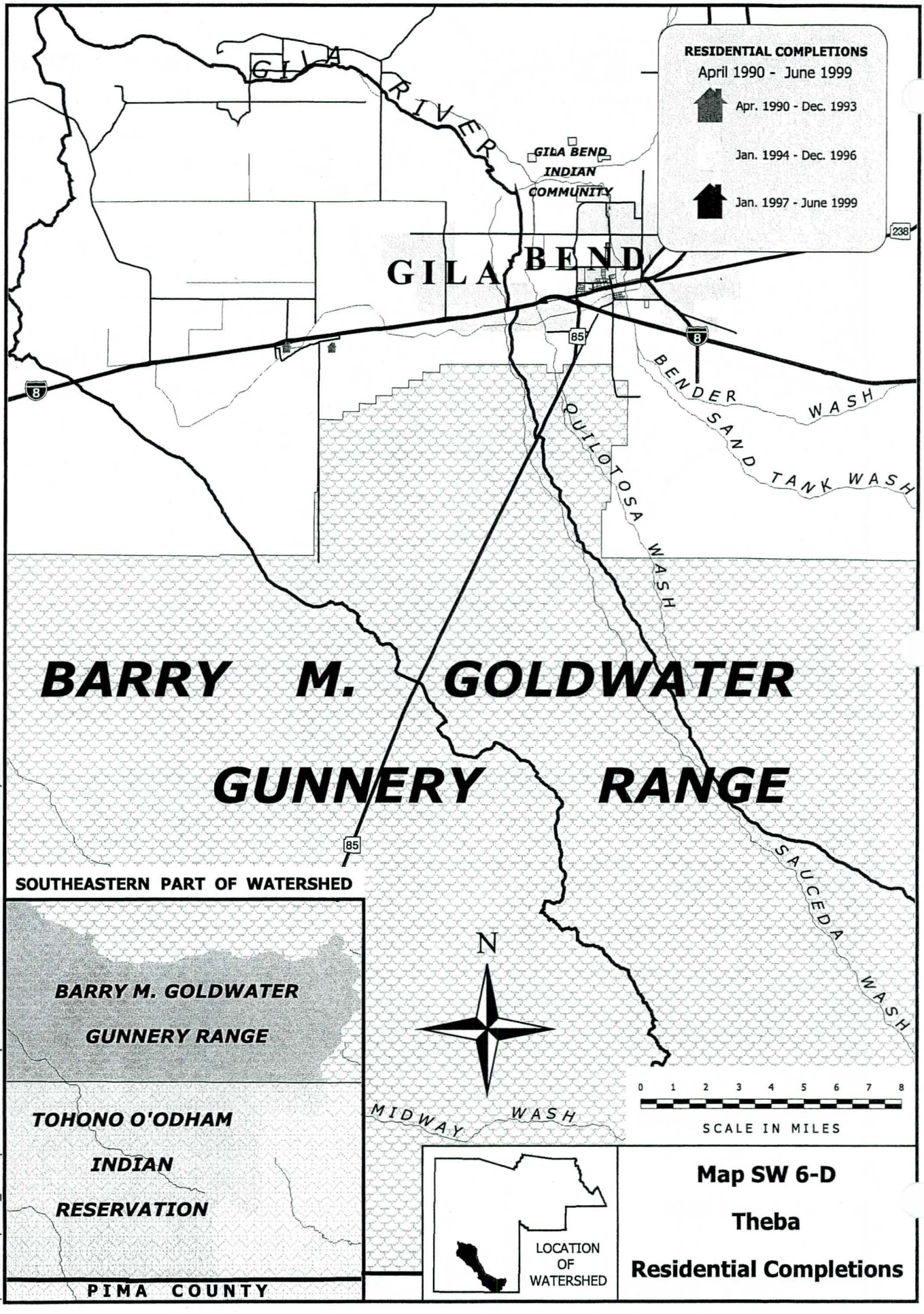
$MARICOPA\Theba_Erosion.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Theba_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Theba_Landownership.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.


RESIDENTIAL COMPLETIONS
April 1990 - June 1999
Apr. 1990 - Dec. 1993
Jan. 1994 - Dec. 1996
Jan. 1997 - June 1999
GILA RIVER
GILA BEND INDIAN COMMUNITY
GILA BEND
238
85
8
BENDER WASH
SAND TANK WASH
QUILOTOSA WASH
BARRY M. GOLDWATER
GUNNERY RANGE
SAUCEDA WASH
MIDWAY WASH
SOUTHEASTERN PART OF WATERSHED
BARRY M. GOLDWATER GUNNERY RANGE
TOHONO O'ODHAM INDIAN RESERVATION
PIMA COUNTY
N
0 1 2 3 4 5 6 7 8
SCALE IN MILES
LOCATION OF WATERSHED
Map SW 6-D
Theba
Residential Completions
$MARICOPA\Theba_Cities.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.

VEKOL WATERSHED

Table SW 7-1
Area of Land in Vekol Watershed, by Classification

	Acres	Sq. Mi.	Percent
Medium/High Density Residential			
Low Density Residential	18	0.03	0.01%
Commercial & Industrial			
Agricultural			
Open Space	39,192	61.24	19.94%
Vacant	81,451	127.27	41.44%
Water			
Other	619	0.97	0.31%
Out of County/Not Classified	75,260	117.59	38.29%
Total Area	196,538	307.09	100.00%

SW 7-2
Land Ownership in Vekol Watershed

Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
FEDERAL	66,553.20	103.99	54.88%	33.86%
MILITARY	36,029.60	56.30	29.71%	18.33%
PRIVATE	13,279.00	20.75	10.95%	6.76%
STATE	2,983.80	4.66	2.46%	1.52%
INDIAN	2,432.90	3.80	2.01%	1.24%
OUT OF COUNTY	75,259.70	117.59		38.29%
Total	196,538.50	307.09	100.00%	100.00%

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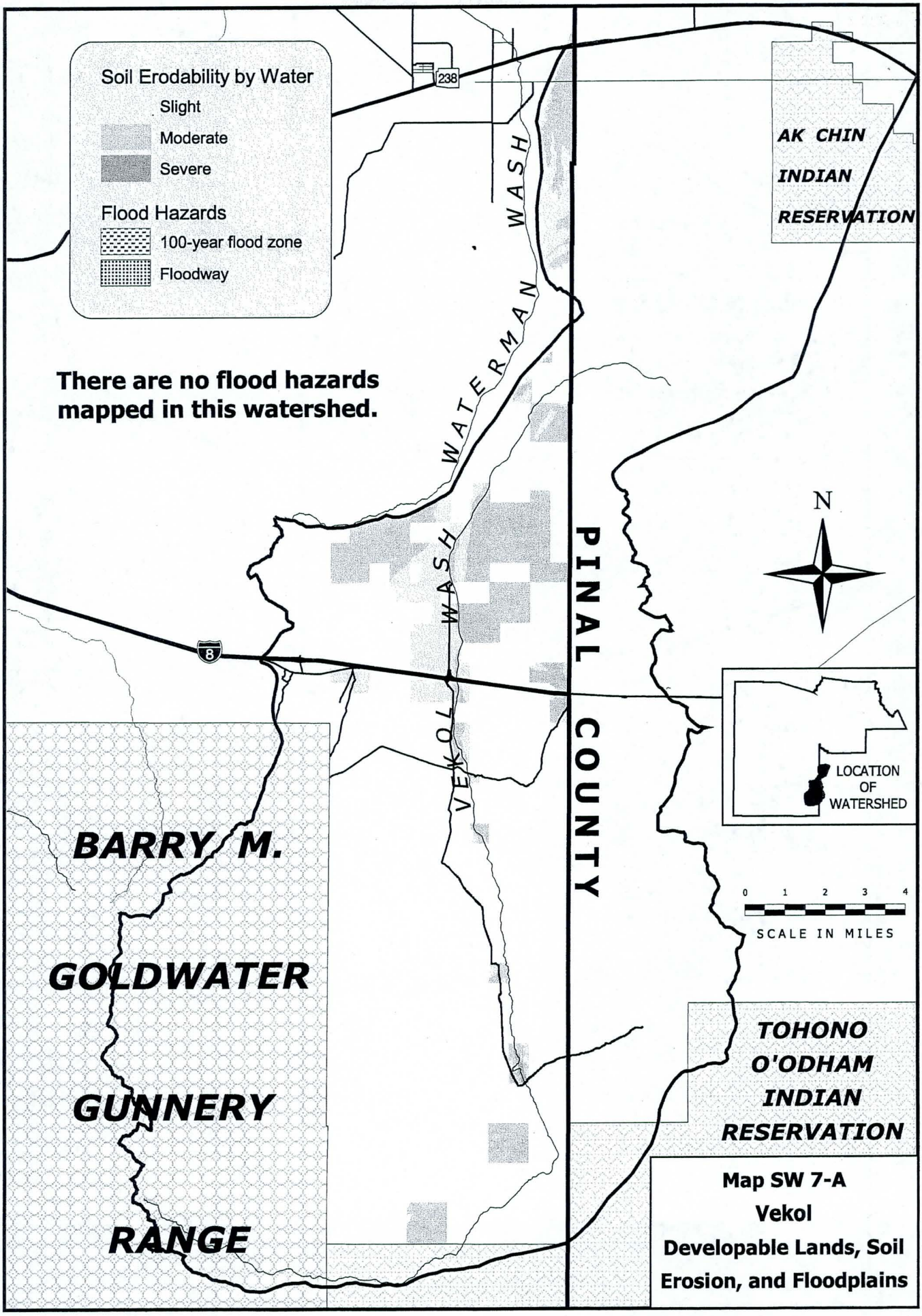
Table SW 7-2
Flood Damage History for Vekol Watershed

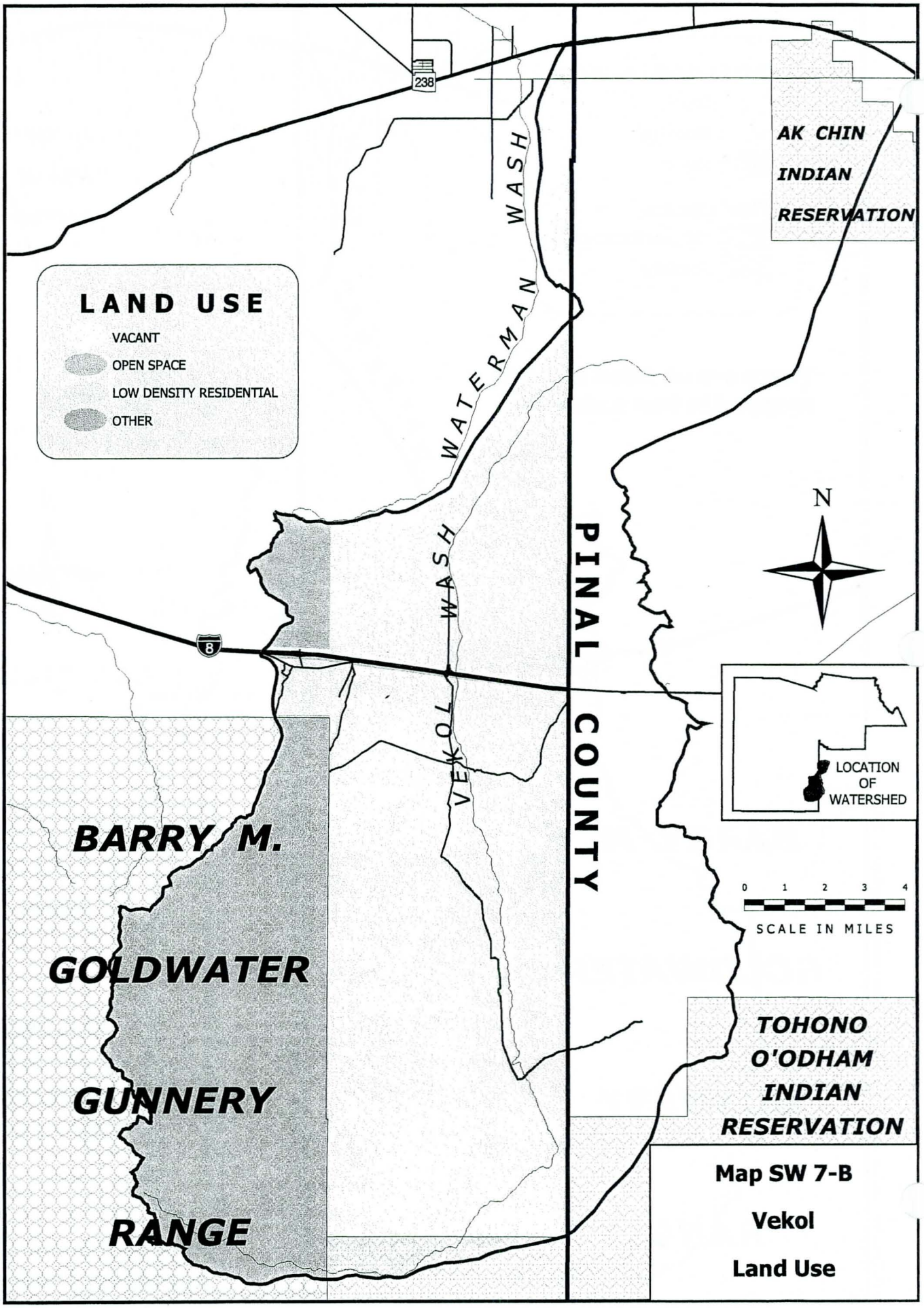
Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm	71 roads, streets and bridges reported closed.	2 deaths-countywide. Public and private damages exceeded $38 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix. 3-4 in. in northern foothills/ Heavy to light rainfall from 13-22 Feb.	Extensive damage to roads and bridges.	$17 million-public
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage capacity above Bartlett Dam. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along irrigation canals on north side of metro area, tributaries of the Gila River, Agua Fria and tributaries, Queen Creek, Hassayampa River and Centennial Wash.	1 death-countywide. Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

Sources of Information:

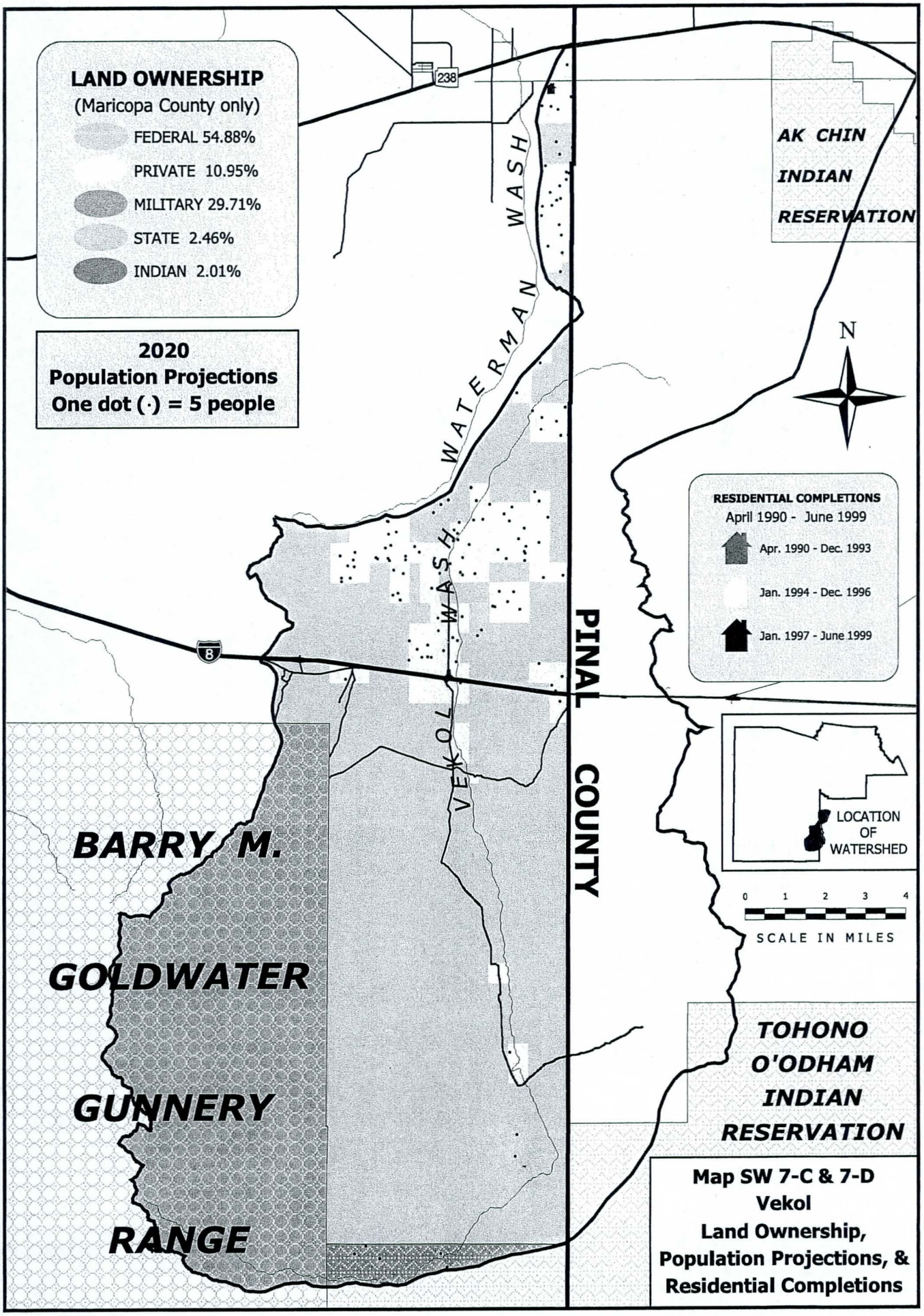
1. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
2. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
3. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
4. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
5. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.



$MARICOPA\Vekol_Erosion.apr. Source: Maricopa Association of Governements. Printed March 27, 2002.



$MARICOPA\Vekol_Landuse.apr. Source: Maricopa Association of Governments. Printed March 27, 2002.



$MARICOPA\Vekol_Landownership.apr. Source: Maricopa Association of Governements. Printed March 27, 2002.

WATERMAN WATERSHED

Table SW 8-1
Land Use in the Waterman Watershed

Classification	Acres	Sq. Mi.	Percent
Medium/High Density Residential	95	0.15	0.03%
Low Density Residential	2,014	3.15	0.68%
Commercial & Industrial	2	0.00	0.00%
Agricultural	18,331	28.64	6.17%
Open Space	65,229	101.92	21.96%
Vacant	207,261	323.85	69.77%
Water	1,655	2.59	0.56%
Other	435	0.68	0.15%
Out of County/Not Classified	2,050	3.20	0.69%
Total Area	297,073	464.18	100.00%

DRAFT

Table SW 8-2
Land Ownership in Waterman Watershed

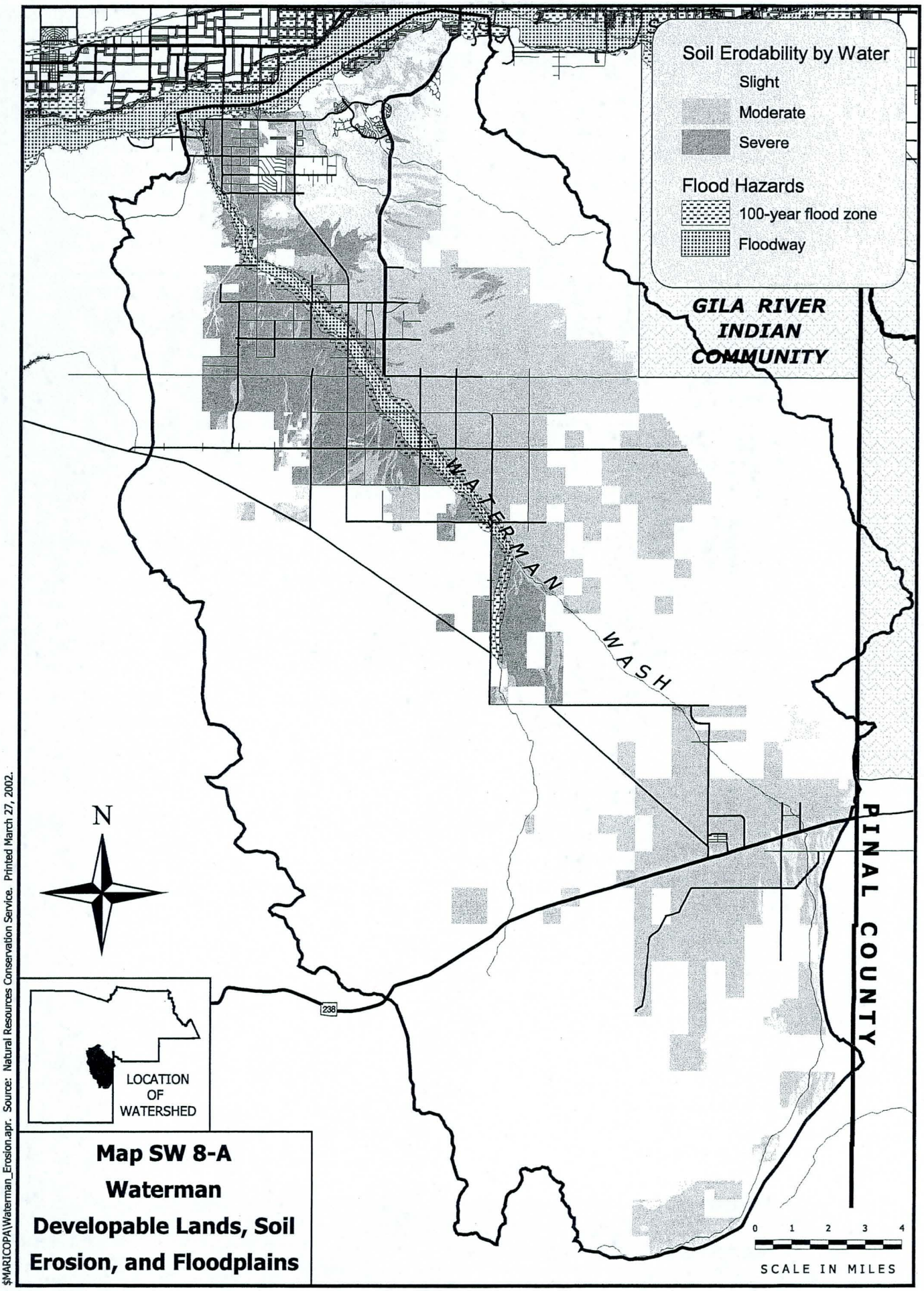
Land Ownership Category	Land Area by Ownership Category		Percent of Total Area	
	Acres	Sq. Mi.	County Land Only	Entire Watershed
FEDERAL	180,954	282.74	61.34%	60.91%
PRIVATE	76,879	120.12	26.06%	25.88%
STATE	24,925	38.95	8.45%	8.39%
PARKS	9,794	15.30	3.32%	3.30%
INDIAN	2,471	3.86	0.84%	0.83%
OUT OF COUNTY	2,050	3.20		0.69%
Total	297,073	464.18	100.00%	100.00%

Table SW 8-3
Flood Damage Report for Waterman Watershed

Flood Event Date	Storm Start/End Time	Area/Extent of Storm	Rainfall / Duration / Frequency	Area/Extent of Damage	Damage Cost
27-Oct-00	10:00 AM/ 2:00 PM	West and Northwest Maricopa County. Main band of rain moved slowly east across county. Ground saturated from storm of Oct. 19 and Oct. 21-22.	2.56 in. Centenial Wash/6 hr./30 yr. storm.	Centennial Wash (flow into Wenden), Wickenburg (Sols Wash) and Skunk Creek.	Data not available.
8-Jan-93	6 Jan-8 Jan	Closely spaced storms occurred during Jan. covering northern mountains and central Arizona. Rain and snowmelt contributed to high degree of runoff in Verde, Salt, Gila and Agua Fria Rivers.	3 in. average in the Verde and Salt River drainages. 1.94 in. at Sky Harbor Airport./ 24 hr./25 yr. storm.	Several farms, feedlots, and dairies in the western county were damaged by high water, loss and drowning of livestock. Erosion of Tri-City landfill sent about 55,000 cu. yds. of debris washed down river. 71 roads, streets and bridges reported closed.	2 deaths-countywide, Public and private damages exceeded $38 million. Downstream cleanup costs $4 million.
High runoff from 13-22 Feb 80	13 Feb-10:00 AM/ 22 Feb-12:00 PM	6 major storms from 13-22 Feb, heavy to light rainfall, covering large portions of Central & Western Arizona.	1.5-2.0 in. in south Metro Phoenix	Area extending from Watson Rd. to 115th Ave.: extensive damage to roads, bridges and utilities, some residential damage. Agricultural damage included land erosion, damage to irrigation structures and more than 700 acres of crop losses.	Gila River: $1.3 million-agriculture, $0.63 million-roads/ bridges, $0.38 million-utilities, $0.46 million-residential.
High runoff from 18-20 Dec 78	18 Dec-12:00 PM/ 20 Dec-12:00 PM	Heavy storms occurred from 16-20 Dec. covering most of Arizona, from northeast to southwest and into New Mexico. Runoff from these storms was heavy in the Gila, Salt, Verde and Agua Fria Rivers.	10 in. northeast of Phoenix- Mazatzal Mountains. 5 in. Central Mountains.	Light residential damage, moderate damage to agriculture, commercial and industrial; severe damage to roads and bridges.	4 deaths-countywide, $16.3 million-public, $3.1million-residential, $5 million-agriculture.
High runoff from 28 Feb 78-3 Mar 78	1 Mar-4:00 PM/ 2 Mar-4:00 PM	Storm centered over the mountains north and east of Phoenix, 35 miles north at Rock Springs.	Extrapolation of intensity-probability data: 5.73 in./ 24 hr. 400 yr. storm.	Main source of flooding due to Verde River, runoff volume exceeded reservoir storage. Combined with release from the Salt River reservoir system and tributaries. Flooding also occured along tributaries of the Gila River, Agua Fria and tributaries, Hassayampa River and Centennial Wash. Extensive damage to commercial, industrial, agriculture and public facilities.	1 death-countywide, Total damage costs: $37 million: $3.1 million-residential, $16 million-public, $4 million-agriculture, $7.8 million-industrial, $0.75 million-commercial.

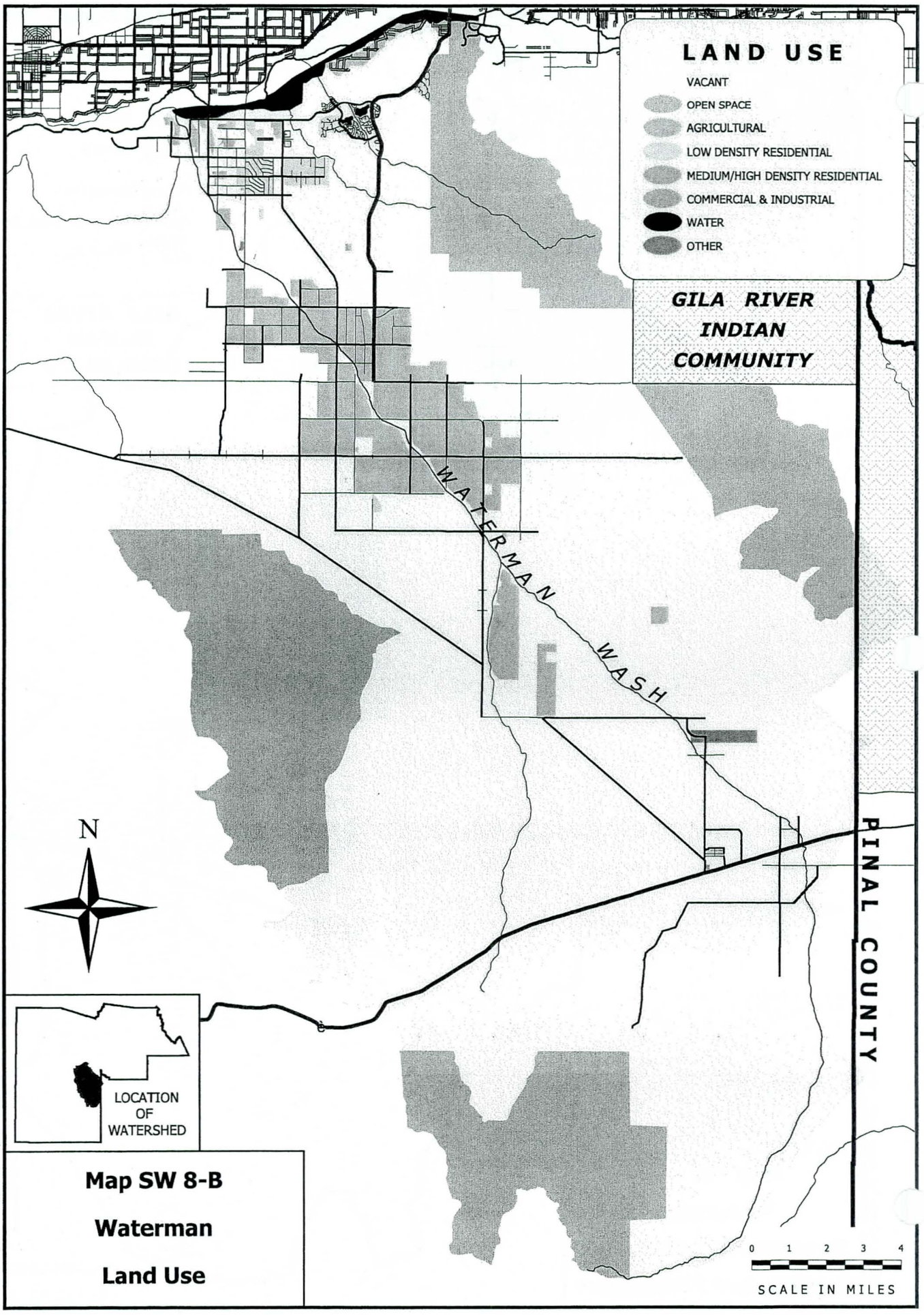
Sources of Information:

1. "Storm Report, Summer/Autumn Storms of 2000", Flood Control District of Maricopa County.
2. "Flood Damage Report, State of Arizona, Floods of 1993", U.S. Army Corps of Engineers, Los Angeles District.
3. "After Action Report, The Floods of 1993", Flood Control District of Maricopa County.
4. "Phoenix Flood Damage Survey, February 1980", U.S. Army Corps of Engineers, Los Angeles District.
5. "Flood Damage Report, Phoenix Metropolitan Area, December 1978 Flood", November 1979, U.S. Army Corps of Engineers.
6. "Flood Damage Report, 28 February-6 March 1978 on the storm and floods in Maricopa County, Arizona", U.S. Army Corps of Engineers, Los Angeles District.

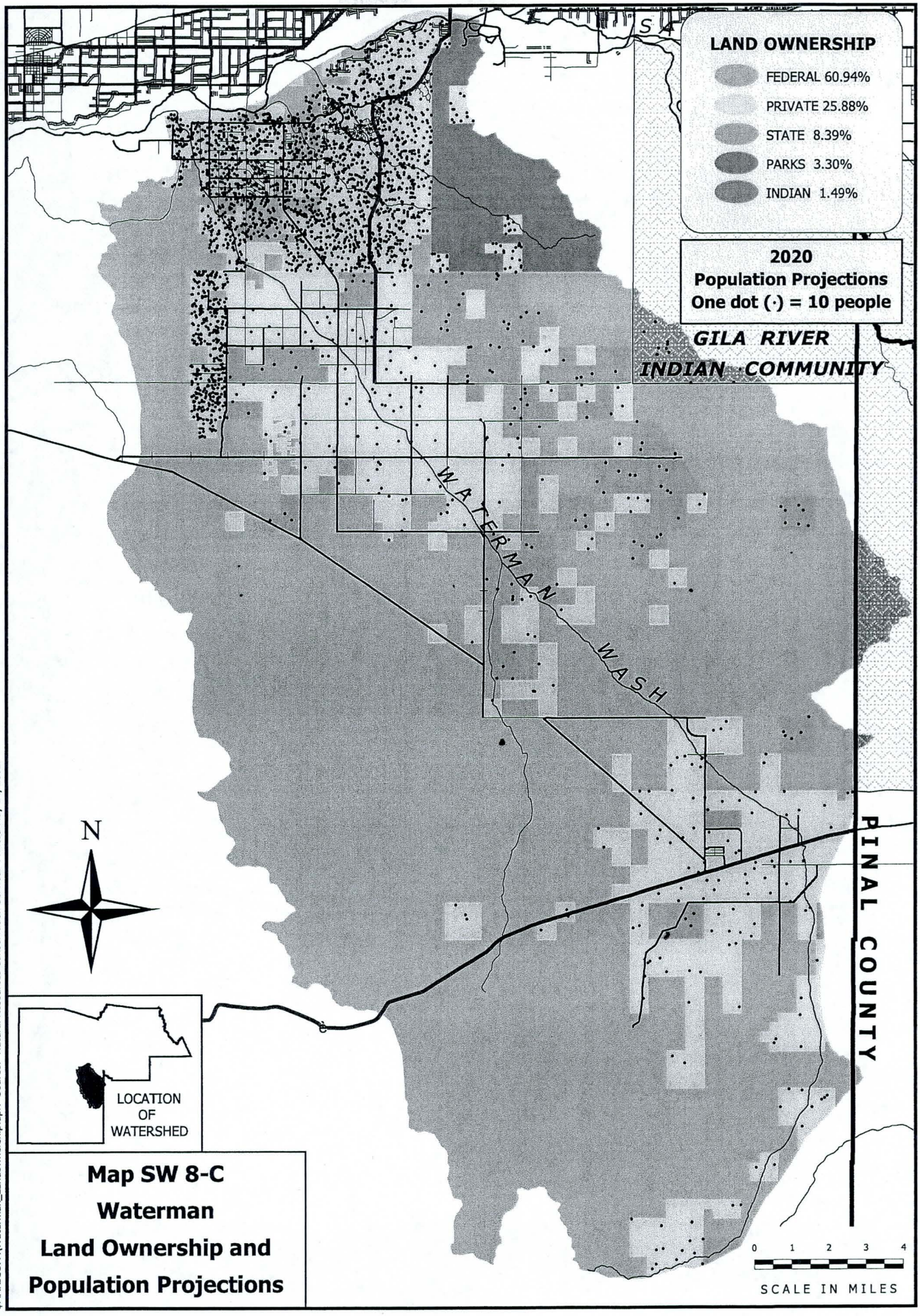


Map SW 8-A
Waterman
Developable Lands, Soil Erosion, and Floodplains

$MARICOPA\Waterman_Erosion.apr. Source: Natural Resources Conservation Service. Printed March 27, 2002.

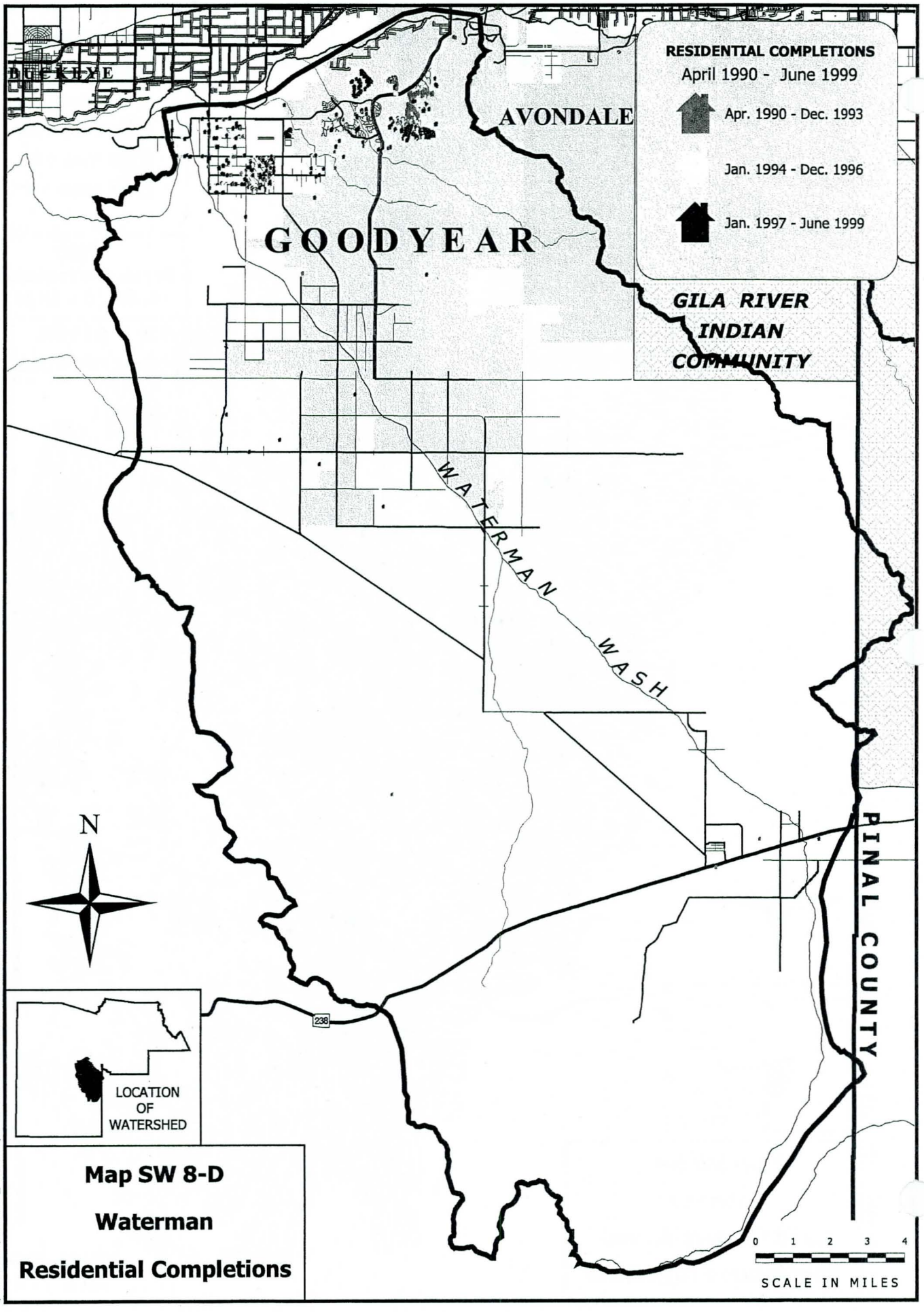


$MARICOPA\Waterman_Landuse.apr. Source: Natural Resources Conservation Service. Printed May 14, 2002.



Map SW 8-C
Waterman
Land Ownership and
Population Projections

$MARICOPA\Waterman_Landownership.apr. Source: Natural Resources Conservation Service. Printed May 14, 2002.



Map SW 8-D

Waterman

Residential Completions

$MARICOPA\Waterman_Landuse.apr. Source: Natural Resources Conservation Service. Printed March 27, 2002.

SANTA ROSA WATERSHED

The Ajo Watershed is an area that contributes flows to ..... This Watershed is located in Townships 9-10 South and Ranges 1 West and 1 East.

The Maricopa County portion is located entirely within the Tohono O'Odham Native American Community and Barry M. Goldwater Gunnery Range. Therefore, none of the land in the Maricopa County portion is developable. No development is expected for this Watershed.

The Santa Rosa Watershed includes _____ acres or about _____ square miles in southwestern Maricopa County. The majority of this Watershed is in Pima and Pinal Counties.

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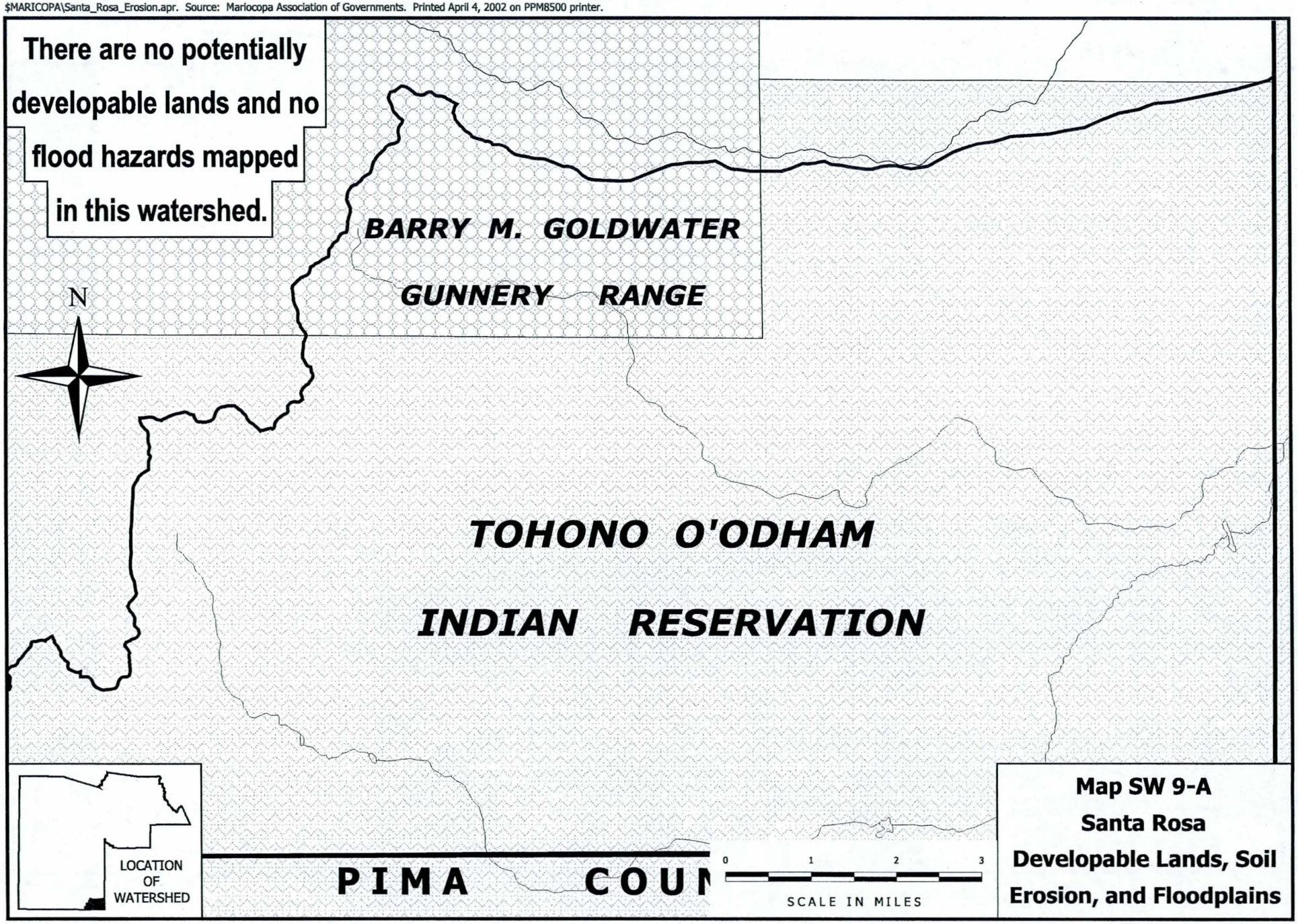
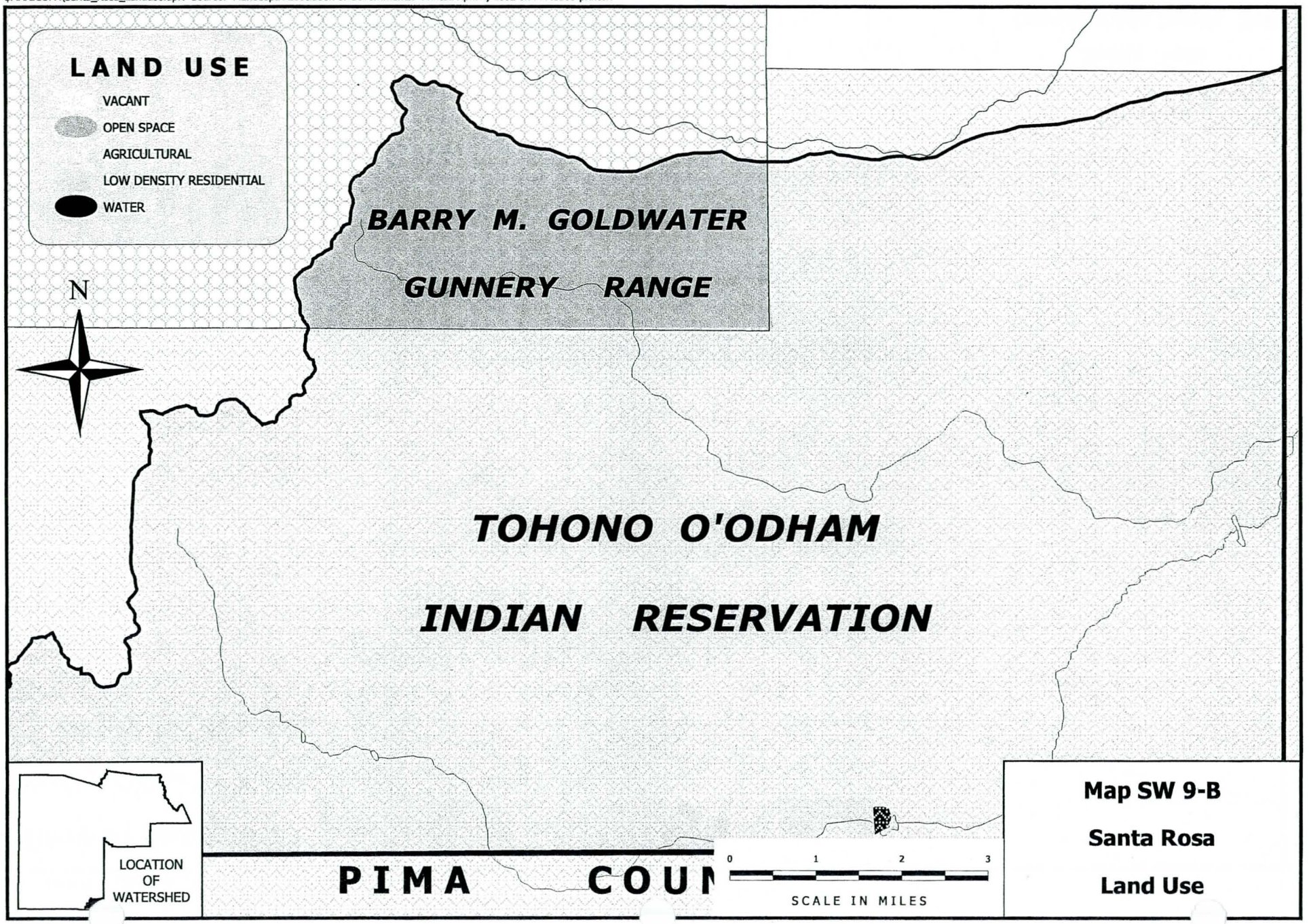
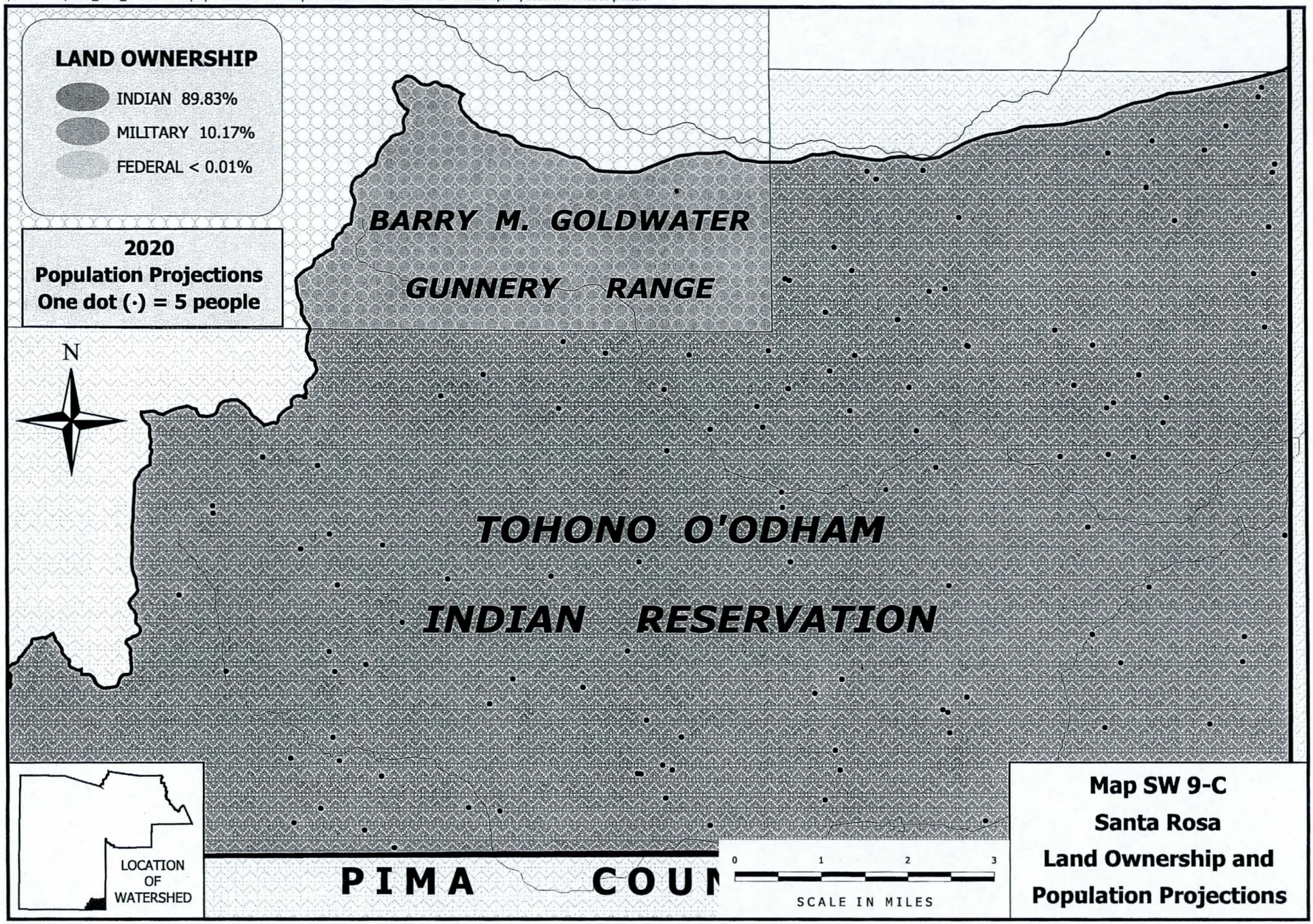
$MARICOPA\Santa_Rosa_Erosion.apr. Source: Mariocopa Association of Governments. Printed April 4, 2002 on PPM8500 printer.



$MARICOPA\Santa_Rosa_Landuse.apr. Source: Mariocopa Association of Governments. Printed April 4, 2002 on PPM8500 printer.



$MARICOPA\Santa_Rosa_Landownership.apr. Source: Mariocopa Association of Governments. Printed April 4, 2002 on PPM8500 printer.



APPENDIX C

Affidavits of Publishing, Sign-in Sheets, Questionnaires

APPENDIX D

Miscellaneous Background Information

Total Resident Population by Municipal Planning Area
1995 - 2020

Municipal Planning Area	Total Resident Population: July1, 1995	July1, 2000	July1, 2005	July1, 2010	July1, 2015	July1, 2020
Avondale	23,580	29,080	32,543	37,499	51,809	84,788
Buckeye	11,094	18,052	22,353	28,144	51,414	82,384
Carefree	2,265	2,930	3,431	4,611	5,019	5,384
Cave Creek	3,065	4,181	6,259	8,981	11,163	12,579
Chandler	135,382	169,395	198,252	221,664	240,787	258,915
County Areas	78,685	90,806	101,414	110,057	124,977	154,685
El Mirage	5,690	5,846	5,914	5,927	6,078	7,273
Fountain Hills	14,015	18,661	25,764	34,585	52,499	54,632
Gila Bend	1,985	2,118	2,243	2,387	2,542	2,695
Gila River Indian Community	2,624	2,680	2,736	2,804	2,891	3,073
Gilbert	65,460	108,534	132,812	174,690	201,393	244,842
Glendale	188,610	216,843	237,178	260,561	288,225	305,164
Goodyear	11,527	19,640	28,204	38,082	58,031	92,579
Guadalupe	5,319	5,502	5,661	5,720	5,727	5,732
Litchfield Park	3,705	4,876	6,517	8,452	12,561	14,688
Mesa	372,378	425,238	480,164	540,608	567,741	593,962
Paradise Valley	12,638	13,309	13,344	13,375	13,397	13,418
Peoria	76,058	93,675	126,408	141,185	167,355	183,815
Phoenix	1,154,139	1,298,121	1,415,330	1,544,093	1,671,489	1,795,539
Queen Creek	5,108	7,376	10,659	13,965	17,205	20,505
Salt River Indian Community	5,855	5,957	6,075	6,112	6,231	6,519
Scottsdale	168,615	204,892	242,179	270,763	294,181	306,713
Surprise	13,462	26,506	37,245	41,278	47,338	60,955
Tempe	152,738	164,256	170,399	174,769	181,177	183,466
Tolleson	4,220	4,467	4,725	6,897	7,544	8,207
Wickenburg	7,812	8,470	8,942	9,491	10,044	10,556
Youngtown	2,671	2,739	2,799	2,875	2,957	3,032
Maricopa County Total	2,528,700	2,954,150	3,329,550	3,709,575	4,101,775	4,516,100

2025

+ 300000

Notes: 1) The resident population projections are consistent with the October 27, 1995 Special Census.
2) The resident population projections have been prepared by MAG to be consistent with the county population control totals developed by developed by the Department of Economic Security (DES) and approved by the director of DES in January, 1997 as required by Executive Order 95-2.
3) These projections were based on planned and proposed development and adopted land use plans.
4) These projections should be used with caution. They are subject to fluctuation as a result of changes in economic and development conditions.

Prepared by the Maricopa Associtaion of Governments (MAG) using projections approved by the MAG Regional Council, June 25, 1997.

JULY 1, 2001 MUNICIPALITY POPULATION AND HOUSING UNIT UPDATE

MARICOPA ASSOCIATION OF GOVERNMENTS

Jurisdiction	Year 2000 Census (April 1, 2000)							Net Units 4/01/2000 - 6/30/2001	Population from new Units	Annexations		July 1, 2001 Update			
	Population			Housing Units		Pop. Per Occupied Unit	Occupancy Rate			Population	Housing Units	Population			Total Housing Units
	Total	Household	Group Quarter	Total	Occupied							Household	Group Quarter	Total (Round to 5)	
Avondale	35,883	35,737	146	11,419	10,640	3.35874	0.93178	1,458	4,563	0	0	40,300	146	**40,445**	**12,877**
Buckeye	6,537	6,528	9	2,344	2,158	3.02502	0.92065	141	393	14	5	6,935	3,716	**10,650**	**2,490**
Carefree	2,927	2,927	0	1,769	1,389	2.10727	0.78519	103	170	0	0	3,097	0	**3,095**	**1,872**
Cave Creek	3,728	3,728	0	1,753	1,571	2.37301	0.89618	81	172	0	0	3,900	0	**3,900**	**1,834**
Chandler	176,581	175,799	782	66,592	62,377	2.81833	0.93670	3,852	10,169	50	19	186,018	856	**186,875**	**70,463**
El Mirage	7,609	7,608	1	3,162	2,121	3.58699	0.67078	1,789	4,304	0	0	11,912	1	**11,915**	**4,951**
Fountain Hills	20,235	20,228	7	10,491	8,653	2.33769	0.82480	475	916	0	0	21,144	44	**21,190**	**10,966**
Gila Bend	1,980	1,980	0	766	659	3.00455	0.86031	7	18	0	0	1,998	0	**2,000**	**773**
Gila River	2,699	2,654	45	685	629	4.21940	0.91825	0	0	0	0	2,654	45	**2,700**	**685**
Gilbert	109,697	109,631	66	37,007	35,405	3.09648	0.95671	4,273	12,659	6	2	122,295	66	**122,360**	**41,282**
Glendale	218,812	215,955	2,857	79,667	75,700	2.85277	0.95021	2,272	6,159	0	0	222,114	2,857	**224,970**	**81,939**
Goodyear	18,911	16,541	2,370	6,771	6,179	2.67697	0.91257	1,601	3,911	0	0	20,452	2,370	**22,820**	**8,372**
Guadalupe	5,228	5,220	8	1,184	1,110	4.70270	0.93750	0	0	0	0	5,220	8	**5,230**	**1,184**
Litchfield Park	3,810	3,780	30	1,633	1,508	2.50663	0.92345	16	37	0	0	3,817	30	**3,845**	**1,649**
Mesa	396,375	392,426	3,949	175,701	146,643	2.67606	0.83462	7,494	16,738	963	431	410,126	3,949	**414,075**	**183,626**
Paradise Valley	13,664	13,652	12	5,499	5,034	2.71196	0.91544	101	251	0	0	13,903	12	**13,915**	**5,600**
Peoria *	108,363	106,849	1,514	42,570	39,183	2.72692	0.92044	3,520	8,835	0	0	115,684	1,514	**117,200**	**46,090**
Phoenix	1,321,045	1,298,577	22,468	495,832	465,834	2.78764	0.93950	9,164	24,005	24	9	1,322,606	22,169	**1,344,775**	**505,005**
Queen Creek *	4,197	4,197	0	1,229	1,172	3.58106	0.95362	183	625	0	0	4,822	0	**4,820**	**1,412**
Salt River	6,405	6,355	50	2,526	1,959	3.24400	0.77553	33	83	0	0	6,438	50	**6,490**	**2,559**
Scottsdale	202,705	201,028	1,677	104,974	90,669	2.21716	0.86373	3,787	7,252	4	2	208,284	1,677	**209,960**	**108,763**
Surprise	30,848	30,724	124	16,260	12,484	2.46107	0.76777	3,997	7,553	0	0	38,277	124	**38,400**	**20,257**
Tempe	158,625	153,383	5,242	67,068	63,602	2.41161	0.94832	338	773	0	0	154,156	5,280	**159,435**	**67,406**
Tolleson	4,974	4,974	0	1,485	1,432	3.47346	0.96431	20	67	0	0	5,041	0	**5,040**	**1,505**
Wickenburg	5,082	5,039	43	2,691	2,341	2.15250	0.86994	40	75	6	3	5,120	147	**5,265**	**2,734**
Youngtown	3,010	2,857	153	1,783	1,641	1.74101	0.92036	90	144	0	0	3,001	153	**3,155**	**1,873**
Unin-New River	10,740	10,695	45	4,514	3,921	2.72762	0.86863	40	95	0	0	10,790	45	**10,835**	**4,554**
Unin-Rio Verde	1,419	1,419	0	1,168	761	1.86465	0.65154	37	45	0	0	1,464	0	**1,465**	**1,205**
Unin-Sun City	38,309	37,641	668	27,731	23,490	1.60243	0.84707	172	233	0	0	37,874	668	**38,540**	**27,903**
Unin-Sun City West	26,344	26,083	261	17,359	14,997	1.73921	0.86393	42	63	0	0	26,146	261	**26,405**	**17,401**
Unin-Sun Lakes	11,936	11,936	0	7,746	6,683	1.78602	0.86277	326	502	0	0	12,438	0	**12,440**	**8,072**
Unin-Other	113,471	111,215	2,256	48,852	40,941	2.71647	0.83806	3,282	7,472	-1,066	-471	117,621	296	**117,915**	**51,663**
Total	**3,072,149**	**3,027,366**	**44,783**	**1,250,231**	**1,132,886**	**2.67226**	**0.90614**	**48,734**	**118,282**	**0**	**0**	**3,145,648**	**46,484**	**3,192,125**	**1,298,965**

Note: Totals may not add due to rounding.

* Maricopa County portion only. Total Year 2000 Census population: Peoria = 108,364 Queen Creek = 4,316.
Total July 1, 2001 population: Peoria = 117,200, Queen Creek = 4,940.

Sources: U.S. Bureau of the Census Year 2000 Census, Maricopa Association of Governments Residential Completion database.
Prepared by the Maricopa Association of Governments, August 2001.
Approved by the MAG Regional Council on October 3, 2001.

July 1, 2001	
Occupied Housing Units	**1,175,925**
Pop. per Occupied Housing Unit	**2.67504**
Occupancy Rate	**0.90528**

1995 Special Census

Avondale	22771
Buckeye	4,857
Carefree	2,286
Cave Creek	3,076
Chandler	132,360
El Mirage	5,741
Fountain Hills	14,146
Gila Bend	1,724
Gila River	2,648
Gilbert	59,338
Glendale	182,615
Goodyear	9,250
Guadalupe	5,369
Litchfield Park	3,739
Mesa	338,117
Paradise Valley	12,448
Peoria	74,565
Phoenix	1,149,417
Queen Creek	3,072
Salt River	5,910
Scottsdale	168,176
Surprise	10,737
Tempe	153,821
Tolleson	4,261
Wickenburg	4,765
Youngtown	2,694
Apache Junction	150
Ft McDowell	660
Sun City	38,037
Sun City West	21,281
Sun Lakes	9,908
Balance of County	103,826
	2,551,765

ADDENDUM

LISTED BELOW ARE THE DATES OF THE ORIGINAL FIRMS, FBFM AND FIS STUDIES FOR THE COMMUNITIES FOR WHICH THE FLOOD CONTROL DISTRICT OF MARICOPA COUNTY PERFORMS FLOODPLAIN MANAGEMENT:

COMMUNITY	ORIGINAL FIS & MAP DATES
TOWN OF BUCKEYE	FEBRUARY 15, 1980
TOWN OF CAREFREE	JULY 2, 1979
TOWN OF CAVE CREEK	SEPTEMBER 29, 1989
CITY OF CHANDLER	JULY 16, 1980
CITY OF EL MIRAGE	DECEMBER 1, 1978
TOWN OF GILA BEND	DECEMBER 4, 1979
TOWN OF GUADALUPE	APRIL 15, 1988
CITY OF LITCHFIELD PARK	SEPTEMBER 29, 1989
CITY OF MESA	MAY 15, 1980
TOWN OF QUEEN CREEK	SEPTEMBER 4, 1991
CITY OF SURPRISE	JANUARY 15, 1978
CITY OF TOLLESON	JANUARY 16, 1980
TOWN OF YOUNGTOWN	NOVEMBER 15, 1978

Table 15-2. Suggested Standards for Siting Schools

	Nursery School	Elementary School	Junior High School	High School
Assumed Population Characteristics	60 children of nursery school age per 1,000 persons or 275–300 families	175 children of elementary school age per 1,000 persons or 275–300 families	75 children of junior high school age per 1,000 persons or 275–300 families	75 children of high school age per 1,000 persons or 275–300 families
Size of School				
Minimum	4 classes (60 children)	250 pupils	800 pupils	1,000 pupils
Average	6 classes (90 children)	800 pupils	1,200 pupils	1,800 pupils
Maximum	8 classes (120 children)	1,200 pupils	1,600 pupils	2,600 pupils
Population Served				
Minimum	4 classes: 1,000 persons (275–300 families)	1,500 persons	10,000 persons (2,750–3,000 families)	14,000 persons (3,800–4,000 families)
Average	6 classes: 1,500 persons (425–450 families)	5,000 persons	16,000 persons (4,500–5,000 families)	24,000 persons (6,800–7,000 families)
Maximum	8 classes: 2,000 persons (550–600 families)	7,000 persons	20,000 persons (5,800–6,000 families)	34,000 persons (9,800–10,000 families)
Area Required				
Minimum	4 classes: 4,000 ft.²	7–8 acres	18-20 acres	32–34 acres
Average	6 classes: 6,000 ft.²	12–14 acres	24–26 acres	40–42 acres
Maximum	8 classes: 8,000 ft.²	16–18 acres	30–32 acres	48–50 acres
Radius of Area Served				
Desirable	1–2 blocks	1/4 mile	1/2 mile	3/4 mile
Maximum	1/3 mile	1/2 mile	3/4 mile	1 mile
General Location	Near an elementary school or community center	Near center of residential area; near or adjacent to other community facilities	Near concentration of dwelling units or near center of residential area; away from major arterial streets	Centrally located for easy access; proximity to other community facilities advantageous; adjacent to park area

Note: Such standards are good starting points for local standard-setting but should be adjusted to reflect local education policy, proposed residential densities in the land use plan, and the average number of school-age children per household locally.

Source: De Chiara and Koppelman 1982, 374–75.

Methodology

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Table 15-3. Recreation and Open Space Standards Suggested by the National Recreation and Park Association

Component	Use	Service Area	Desirable Size	Acres per 1000 population	Desirable Site Characteristics
Local or close-to-home space					
Minipark	Specialized facilities that serve a concentrated or limited population or specific group such as tots or senior citizens	Less than 1/4 mile radius	1 acre or less	0.25 to 0.5	Within neighborhoods and close to apartment complexes, townhouse development, or housing for the elderly
Neighborhood park/playground	Area for intense recreational activities such as field games, court games, crafts, skating, and picnicking; also for wading pool and playground apparatus areas	1/4 to 1/2 mile radius to serve a population up to 5000 (a neighborhood)	15+ acres	1.0 to 2.0	Suited for intense development; easily accessible to neighborhood population; geographically centered with safe walking and bike access; may be developed as a school-park facility
Community park	Area of diverse environmental quality; may include areas suited for intense recreational facilities, such as athletic complexes, large swimming pools; may be an area of natural quality for outdoor recreation, such as walking, viewing, sitting, picnicking; may be any combination of the above, depending upon site suitability and community need	Several neighborhoods, 1 to 2 mile radius	25+ acres	5.0 to 8.0	May include natural features, such as water bodies, and areas suited for intense development; easily accessible to neighborhood served
Total close-to-home space = 6.25 to 10.5 acres per 1000 population					
Regional space					
Regional/metropolitan park	Area of natural or ornamental quality for outdoor recreation, such as picnicking, boating, fishing, swimming, camping, and trial uses; may include play areas	Several communities, 1 hour driving time	200+ acres	5.0 to 10.0	Contiguous to or encompassing natural resources
Regional park reserve	Areas of natural quality for nature-oriented outdoor recreation, such as viewing and studying nature, wildlife habitats, conservation, swimming, picnicking, hiking, fishing, boating, camping, and trail uses; may include active play areas; generally 80% of the land is reserved for conservation and natural resource management, with less than 20% used for recreation	Several communities, 1 hour driving time	1,000+ acres, sufficient area to encompass the resource to be preserved and managed	Variable	Diverse or unique natural resources, such as lakes, streams, marshes, flora, fauna, and topography
Total regional space = 15.20 acres per 1000 population					
Space that may be local or regional and is unique to each community					
Linear park	Area developed for one or more varying modes of recreational travel, such as hiking, biking, snowmobiling, horseback riding, cross-country skiing, canoeing, and pleasure driving; may include active play areas. (Note: Any activities included for the preceding components may occur in the linear park.)	No applicable standard	Sufficient width to protect the resources and provide maximum use	Variable	Built on natural corridors, such as utility rights-of-way, bluff lines, vegetation patterns, and roads, that link other components of the recreation system or community facilities, such as schools, libraries, commercial areas, and other park areas
Special use	Areas for specialized or single-purpose recreational activities, such as golf courses, nature centers, marinas, zoos, conservatories, aboreta, display gardens, arenas, outdoor theaters, gun ranges, or downhill ski areas, or areas that preserve, maintain, and interpret buildings, sites, and objects of archaeological significance; also plazas or squares in or near commercial centers, boulevards, and parkways	No applicable standard	Variable depending on desired size	Variable	Within communities
Conservancy	Protection and management of the natural or cultural environment with recreational use as a secondary objective	No applicable standard	Sufficient to protect the resource	Variable	Variable, depending on the resource being protected

Note: Although called "standards," the NRPA stresses that they should be viewed as "guides" for a community to use in developing its own standards.

Source: NRPA-suggested classification system (Lancaster 1983, 56–57).

Calculations for Growth Assumptions
using data from Urban Land Use Planning 4th Edition (Kaiser/Godschalk?Chapin Jr., 1995)

2,419,700	additional people		
0.06%	Nursery School	60/1000	145,182 / 2,419,700
0.175%	Elementary School	175/1000	423,448 / 2,419,700
0.075%	Junior High	75/1000	181,478 / 2,419,700
0.075%	High School	75/1000	181,478 / 2,419,700

Area needed for schools

	no. in schools over 30 years	no. in schools per year	average number of children per school	schools per year	area required in acres	maximum acres needed
nursery	145,182	4,839	90	54	0.138	7.45
elementary	423,448	423,448	800	529	14	7,410
junior high	181,478	181,478	1,200	151	26	3,932
high school	181,478	181,478	1,800	100	40	4,000
						15,349.45

(~500 acres per year)

area needed for open space / parks

type of park		acres
Local	0.5 acre per 1,000 people	1,200
Neighborhood	15 acres or 2 per 1,000	4,839
Community (Regional)	25 acres or 8 per 1,000	19,358
		25,397