

# *Flood Control District of Maricopa County*



## *Comprehensive Plan 2005*

### *Flood Control Program Report*

Flood Control District of Maricopa County



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*Flood Control Program Report*

Maricopa County, Arizona

Flood Control District of Maricopa County

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## *Flood Control Program Report*

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*Adopted on November 2, 2005*



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## EXECUTIVE SUMMARY

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 This statute was repealed in 1985 and replaced by Title 48, Chapter 21, Article 1, ARS.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 2002. The *Comprehensive Plan 2005 – Flood Control Program Report* (Plan) is an update to the 2002 Plan. For the 2005 Plan, District staff has continued 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 2005 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 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 through tools such as the District Strategic Plan, Business and Financial Plans, Planning Branch studies, Delineation Branch studies, Capital Improvement Program, and adopted regulations and policy documents.



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.
- 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. 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, completed structural projects and studies, 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.

*The **mission** of the Flood Control District of Maricopa County is to provide flood hazard identification, regulation, remediation, and education to the people in Maricopa County so that they can reduce their risks of injury, death, and property damage due to flooding while enjoying the natural and beneficial values served by floodplains.*

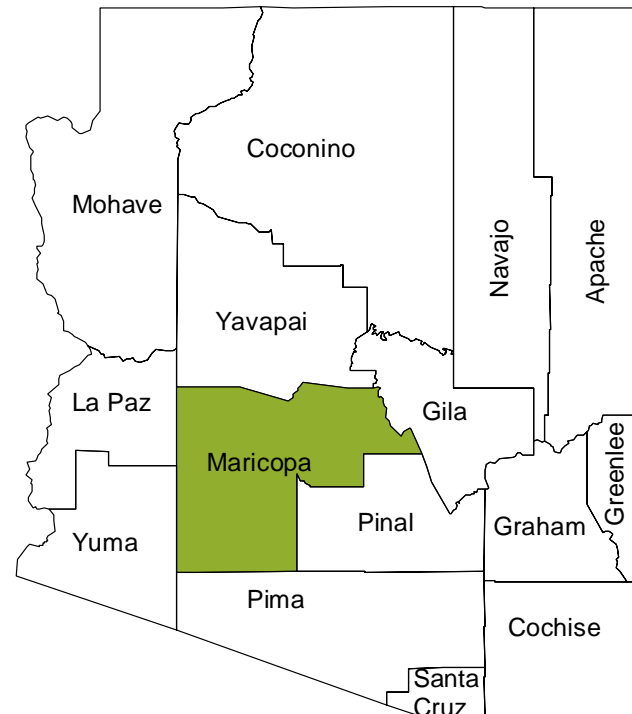


## CHAPTER 1. INTRODUCTION

### 1.1. County Overview

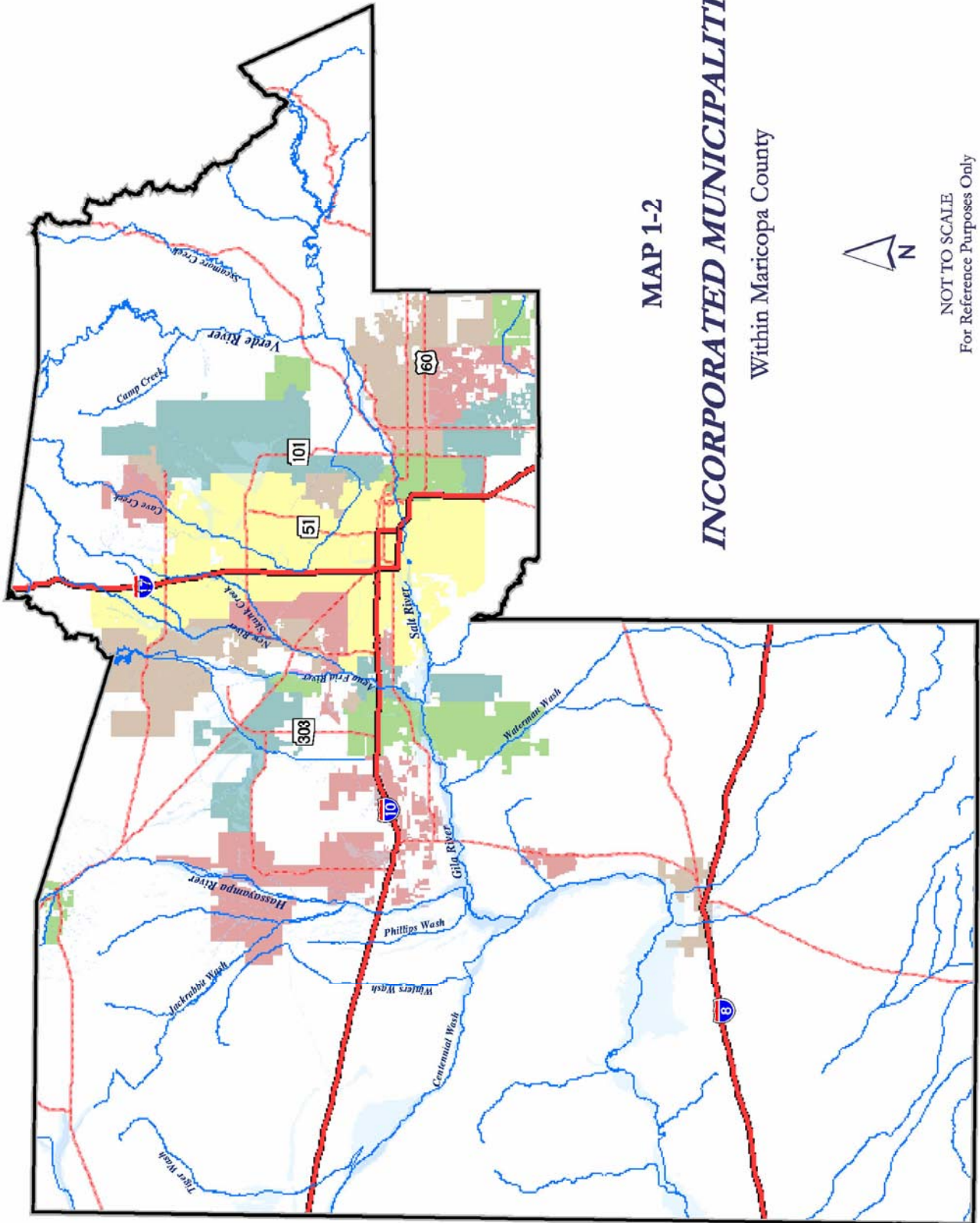
Maricopa County is located in south central Arizona and is one of 15 counties in the state (Map 1-1). In 2002, Maricopa County had a population of approximately 3.3 million people living within the 24 incorporated municipalities and the remaining unincorporated areas (Map 1-2). The population concentration in the urban area (Phoenix Metropolitan Area) of the county is located within a valley with four major rivers. The Salt River enters the county from the east and flows through the southern third of the Metropolitan Area moving in an east to west direction. The Verde River, located to the east of the Metropolitan Area, flows from the north and combines with the Salt River just east of the City of Mesa. The Agua Fria River also flows from the north and is located on the western edge of the metropolitan urban area. It combines with the Gila River which enters the County from the southeast and then flows in a westerly direction. The Gila River is the main watercourse for all tributary 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 flows from north to south through the towns of Wickenburg and Buckeye before entering the Gila River. In addition, 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 in 1863 was the beginning period of more intense development. Early settler developments were prone to flooding because they did not recognize the hazards within the natural environment. Farmers wanting to prevent fields from flooding had to create their own dams or diversion channels. In later years assistance was provided through federal programs. Some of these flood control facilities are described later in this chapter. Even today, new residents are not always aware of flood and erosion hazards until they are impacted or studies are completed that identify the flood hazards and floodplains. In the past, problems were handled individually and solutions possibly jeopardized other's remedies if they were not coordinated. The damage these early floods caused provided the impetus to plan and coordinate projects regionally to keep residents and property safe from flood and erosion hazards, resulting in the passage of State Legislation. Development in Maricopa County is still occurring at a rapid pace, prompting the need for continued regional flood hazard and floodplain management.



Source: Maricopa County Planning & Development



## 1.2. Need for a Comprehensive Plan

The Flood Control District of Maricopa County (District) developed the latest Comprehensive Plan in 2002. Regular updates to the plan are necessary to reflect the changes that have taken place physically and through completed projects. For the overall 2005 Plan, District staff has continued to include aspects of the Growing Smarter Plus legislation and Community Rating System – National Flood Insurance Program (NFIP) requirements. These additions will work to make the District's Flood Control Program Report more compatible with other comprehensive planning documents and be useful in guiding future development. This Plan looks at all of the District's programs 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 2005 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 Managing for Results Strategic Plan, Business and Financial Plans, Planning Branch Studies, Capital Improvement Program, and adopted regulations and policy documents.

The Managing for Results 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 initially 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 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).

From a regulatory standpoint the District has jurisdiction over incorporated areas, unless the incorporated areas assume the responsibility, and unincorporated areas within the boundaries of Maricopa County. Municipalities may declare by resolution that they will assume the powers and duties of floodplain management, 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. From a structural and planning process perspective, the District may assess flooding problems within an incorporated area and in those areas outside the County that contribute to flooding problems within the County boundary. 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 Resolutions 88-08 and 88-08A are in Appendix A.

The 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 §11-821 states that a “comprehensive plan shall be developed so as to conserve the natural resources of the county, to ensure 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 *Managing for Results 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 Flood Control District of Maricopa County is to provide flood hazard identification, regulation, remediation, and education to the people in Maricopa County so that they can reduce their risks of injury, death, and property damage due to flooding while enjoying the natural and beneficial values served by floodplains.*

The District accomplishes its mission through a number of activities under various programs, which include the construction of dams and channels, the implementation of regulatory tools, and promoting 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 are 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.
- Disaster Mitigation Act of 2000 (DMA2K). Public Law 106-390 – Oct. 30, 2000. Code of Federal Register Amendments, effective date February 26, 2002. Federal Emergency Management Agency (FEMA), 44 CFR Parts 201 and 206. The purpose of this Public Law is to amend the Robert T. Stafford Disaster Relief and Emergency Assistance Act of 1974



authorize a program for pre-disaster mitigation, streamline the administration of disaster relief, control the Federal costs of disaster assistance, and for other purposes. This law is part of FEMA's tools for proactive response to disaster management.

### **1.5.2. State**

- A.R.S. §33-1324. Requires the District to maintain residential 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 its responsibilities...."

### **1.5.3. County**

- Floodplain Regulations for Maricopa County, adopted August 4, 1986 (subsequently amended) provides for the review and regulation of development in the floodplain.
- The Revised Drainage Regulation for the Unincorporated Area of Maricopa County, adopted September 2004, 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**

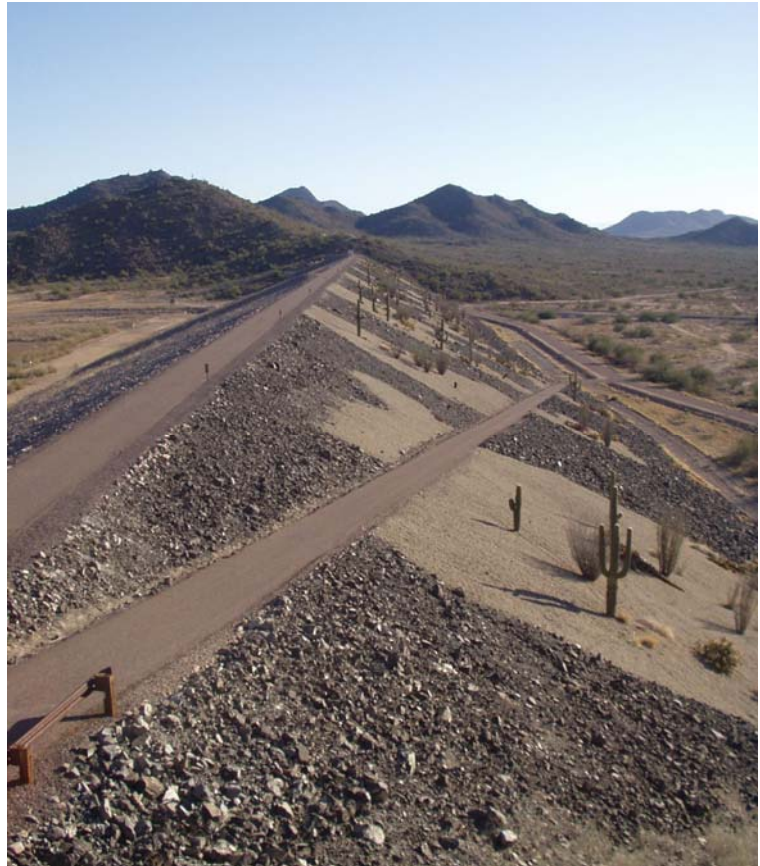
Comprehensive Flood Control Program Reports have played a major role in the District's operations since 1963 when the first survey of flood control problems and report was published. The 1963 report served as a blueprint for District activities for the next 25 years.



There have been additional draft reports prepared over the years. The 1963, 1991, and 2002 Comprehensive Flood Control Program reports were presented and received approval from the FCAB and the Flood Control District BOD. This report, the 1997 and 2002 reports, and all future comprehensive plans are based on the 1963 report.

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.



**New River Dam at Lake Pleasant Road**

### **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 that were since added.



**Table 1-1 Projects by Group from the 1963 Program Report – Groups I, II, III, IV**

**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	<b>Total Deer Valley</b>	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	

**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

**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.

**1.6.3. Comprehensive Plan 2002**

The *Comprehensive Plan 2002 – Flood Control Program Report (Plan)* was an update to the 1997 Plan. For the 2002 Plan, District staff 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 made the Plan more compatible with other comprehensive planning documents for guiding future development. The Plan looked at all of the District’s activities for providing flood control and floodplain management – from structural to non-structural solutions, education, and regulation.

## 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.<sup>1</sup> “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.

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.<sup>2</sup>



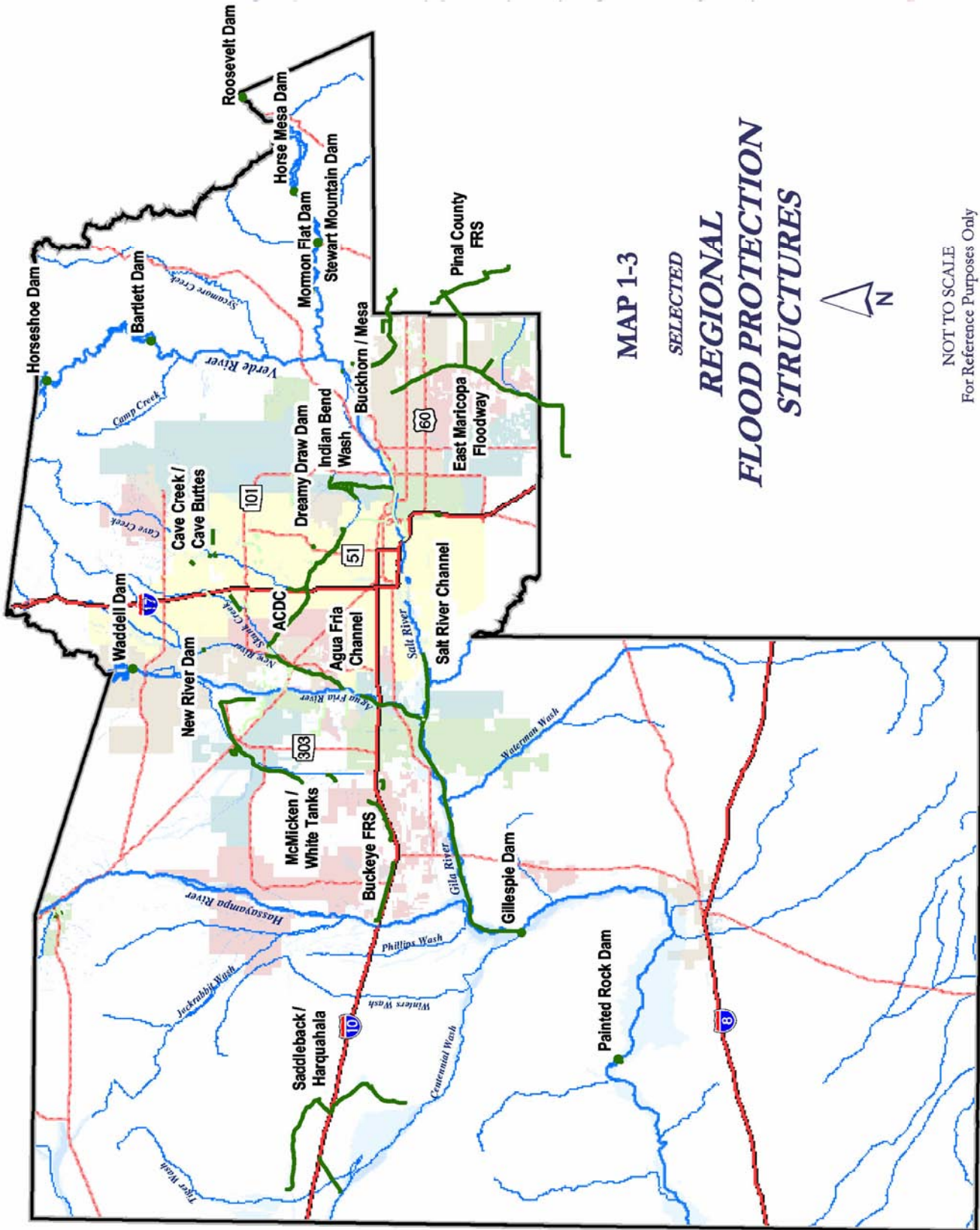
Tropical Storm Nora. September 26, 1997. Flooding, Eagle Eye Road (Rd) and US 60.



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

<b>Date</b>	<b>Remarks</b>
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 19-20, 1954	Flooding from heavy rains in the Superstition Mountains caused \$446,000 in property damage and \$1.4 million in crop damage in what is now Queen Creek, Gilbert and Chandler.
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.
August 26 <sup>th</sup> -27 <sup>th</sup> and September 6 <sup>th</sup> , 2003	Late monsoon storms of 2003 in the Upper Trilby Wash Watershed.
February, 2005	Following several months of above-average rainfall, a series of storms in February caused many of the major rivers in Maricopa County to carry significant flows. Several houses and a bridge were damaged due to bank erosion - total damages were estimated at \$6.5 million.

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 together tend to make for greater flood damage. However, summer storms should not be excluded when considering overall flood damage. 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 1-3](#) 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.<sup>3</sup> 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.<sup>4</sup>

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.

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.

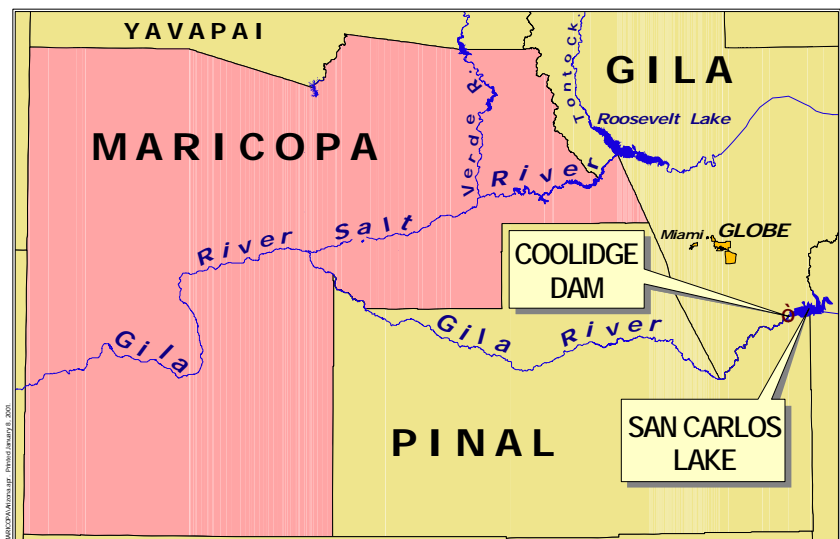
The previously noted volumes for all six of the reservoirs are for water conservation. Only the modified Roosevelt Dam has flood storage as an identified purpose. How much can be stored at any given time is a function of several factors, such as: amount of available capacity in the reservoir at the time 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<sup>5</sup> 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<sup>6</sup> 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.<sup>7</sup> The San



Map 1-4 Coolidge Dam in relation to Maricopa County



Carlos Reservoir has had excess 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. U.S. 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 operated and maintained 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 was adequate for existing development, but it has also allowed many historic floodplains to be developed for a variety of intensive uses. However, these intensive uses, in many cases, now require protection levels in excess of what many of these structures were designed to provide, which has created added risk and liability. In addition, 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**

<b>Table 1-3 Flood Control District Structures</b>							
<b>STRUCTURE</b>				<b>DAM BREAK</b>		<b>SPILLWAY</b>	
	<b>Name</b>	<b>Built By</b>	<b>Year Completed</b>	<b>Report Done By</b>	<b>Year</b>	<b>Report Done By</b>	<b>Year</b>
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**

In addition to Casandro Dam, the District 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, which protect portions of Maricopa County. The District is also responsible for the safety of the dams and FRSs (structures) as currently performed under elements of the District's Dam Safety Program. The twenty-two structures 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 watersheds 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's history since man came to inhabit this area. Records of flooding and problems have been kept for well over 100 years, which helps the District plan for the future. The District was organized over 45 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 provided 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 flood events presents an indication of some of the flooding problems the District must respond to in addition to the more problematic localized flooding problems.

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 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. Localized flood mitigation problems and solutions are also covered in Chapter 4. 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

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- <sup>1</sup> Jim Patton, Sun Valley, Nov 2, 1966. "County Flood Control Plan Based on Historic Deluge of '91.
- <sup>2</sup> 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
- <sup>3</sup> 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".
- <sup>4</sup> 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.
- <sup>5</sup> 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
- <sup>6</sup> 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.
- <sup>7</sup> This figure from a telephone conversation with San Carlos Project Office, Bureau of Indian Affairs, U.S. Department of Interior.



## CHAPTER 2. CHARACTERISTICS

### 2.1. Overview

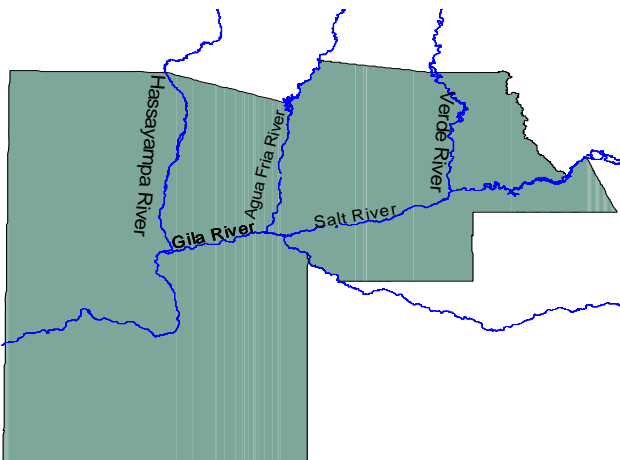
According to research cited by the Population Institute the majority of humanity will soon, for the first time, become urban dwellers. This demographic shift from predominantly agrarian to urban human settlement patterns -- a process termed *urbanization* -- marks a new era with ramifications that have yet to be fully understood.<sup>1</sup>

Maricopa County has experienced urbanization for a number of years, but recent expansion into previously remote unincorporated areas has accelerated the process. Like many other southwestern cities, the County is rapidly evolving into a sprawling collection of urban communities. With each passing year, development reaches further out from the former hub of the County and Phoenix, and is replacing agricultural communities with residential. Maricopa County's sprawled, spatial development (versus compact and dense) generates a number of challenges to agencies tasked with providing infrastructure and public service.



Arizona State University's College Farm sat on 326 acres from 1956-83. The land has since been developed as the ASU Research Park.

The District's strategy to manage the demands that new communities bring is to plan ahead, "get ahead of the development". The District accomplishes this task by analyzing the primary drivers of change, socio-economic forces. Socioeconomic forces are those that identify the human variables that influence physical space. This category includes population figures, land ownership and development trends. Also carefully studied, because these tend to constrain or encourage growth, are the physical characteristics of the County. Physical characteristics include topography, soils, climate, hydrology, geomorphology, vegetation, and riparian habitat.



Map 2-1 Major River Systems in Maricopa County

The physical characteristics describe pre-development conditions of the region. Some areas of the County are more suitable for development than others. This knowledge is invaluable because it can assist the District in determining where it should invest its time, money and energy towards protecting the public from flood risk.

This chapter separates these characteristics for Maricopa County into the two broad categories entitled physical and socioeconomic characteristics. Human interaction with these conditions can contribute to flooding problems.



## 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 the 5<sup>th</sup> largest, in land area, in Arizona, and the 14<sup>th</sup> largest in the United States.<sup>2</sup> It measures 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.

Bisecting the County, the Salt River flows east to southwest, joins the Gila River which flows from the southeast near the center of the County, continuing in a southwesterly direction to the County line (See Map 2-1).

Elevations range from a high of 7,657 feet on Brown's Peak in the eastern 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.<sup>3</sup>

### 2.2.2. Soils

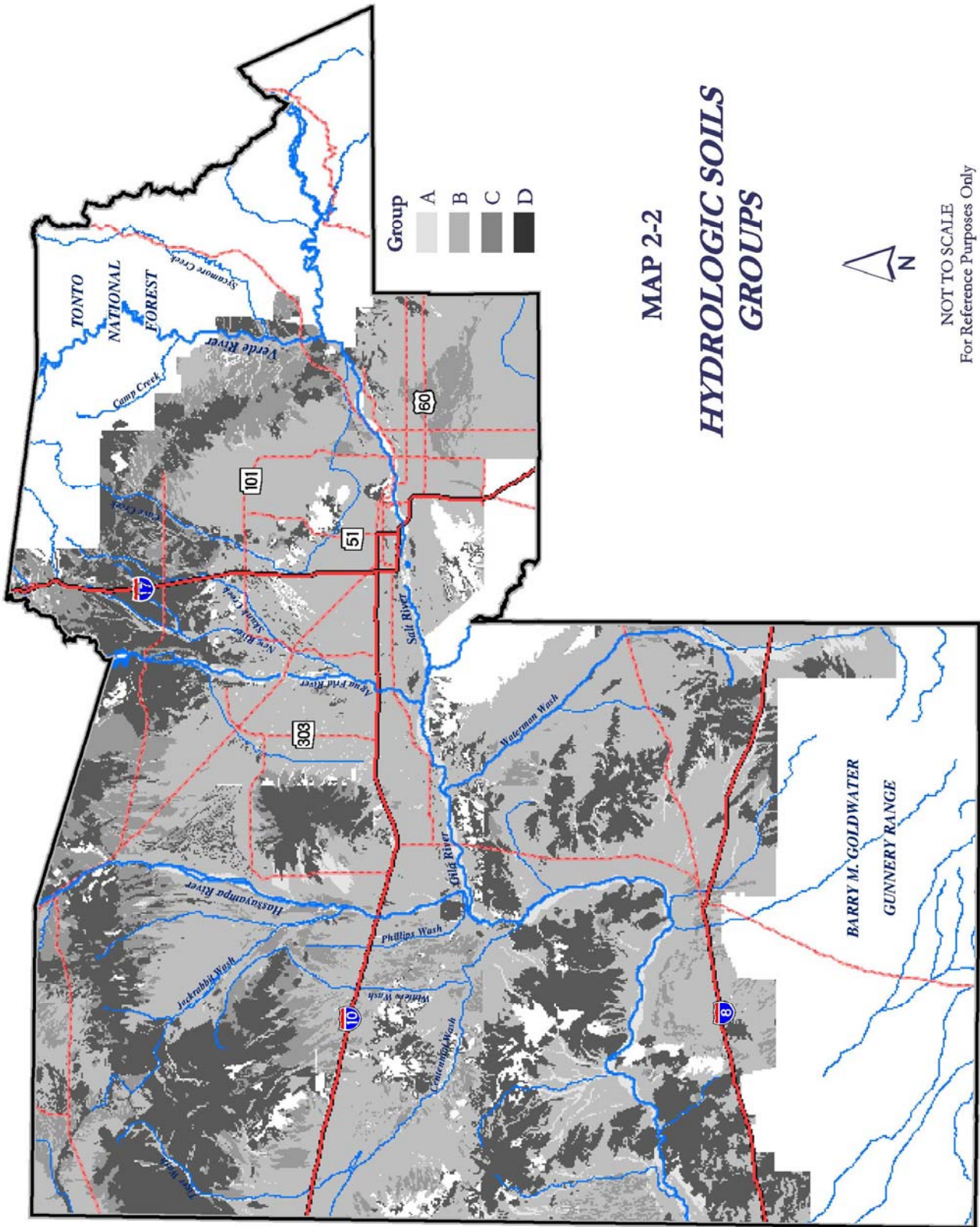
Maricopa County has nearly 60 different soil types that have been surveyed and mapped to show the geographic distribution of dynamic and inherent soil qualities, some of which contribute to erosion and sedimentation problems. These potential hazards are of particular importance to the District. In order to understand the extent of Maricopa County's soil related risk, a brief discussion about soil taxonomy is necessary.

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 include: 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. (The Natural Resources Conservation Service (NRCS) in Maricopa County does not recognize dual classes.) 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.<sup>4</sup>

- 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.







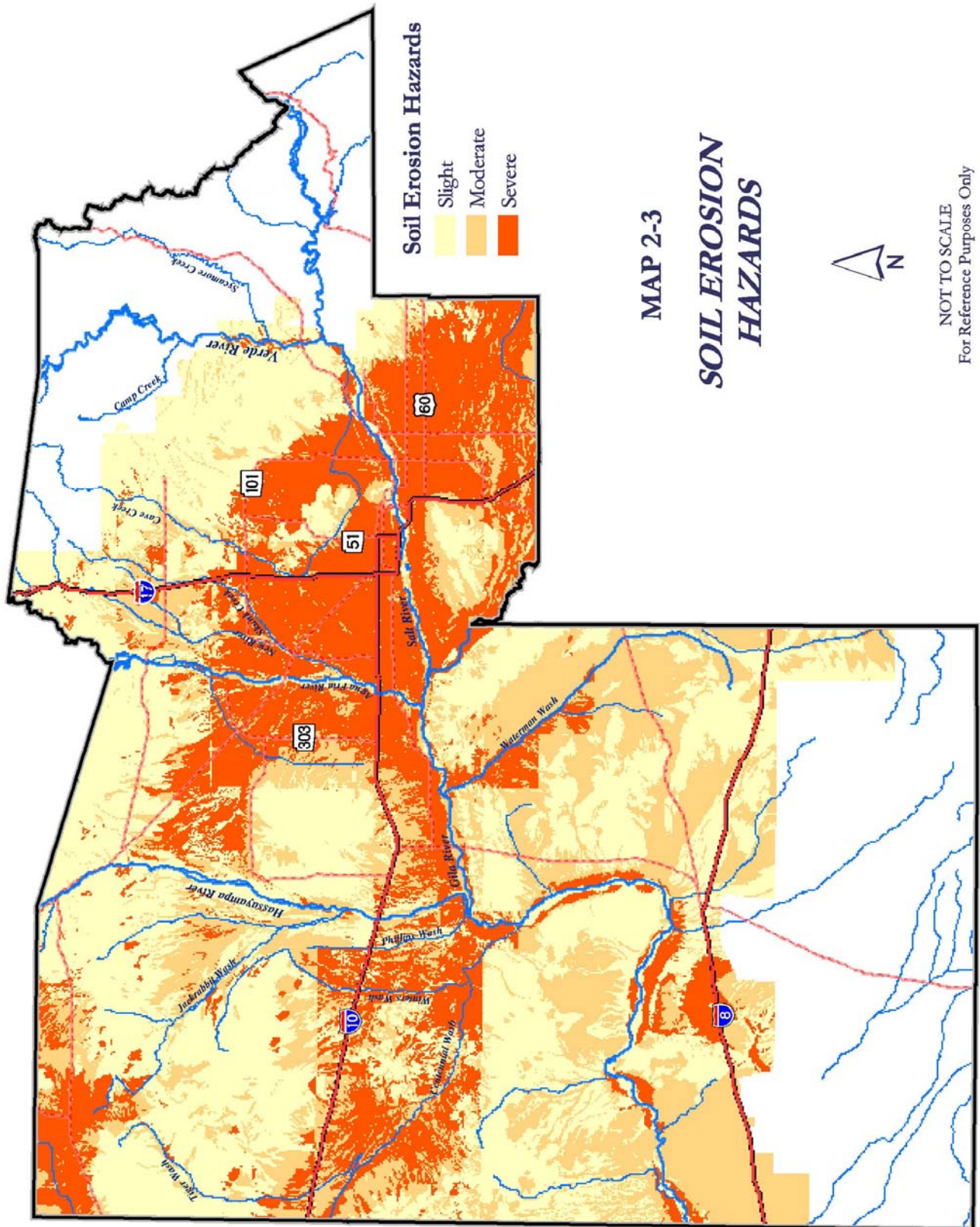
- Hydrologic Soil Groups C and D have a high runoff potential. These soils are primarily silt and clays or have an impervious under layer, such as bedrock that impedes the downward movement of water.

Approximately 35 percent of the 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). These groups are in the mountains and low hills of the County, which are sparsely populated, and therefore the threat of direct flood damage is relatively minor. However, runoff from these areas can impact lower lying, more densely populated land 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. This soils information presents a very general overview to use for preliminary assessment of risk. A more detailed assessment is conducted during area drainage master studies. Soils along most of the washes and rivers tend to be very erodable.

#### **2.2.2.1 Erosion Hazards**

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 drainage ways can erode 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 mobilization or 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 nationwide. Sediment, deposited by floodwaters within homes and businesses, will normally contribute as much to total damages as from the high water itself. Both of these processes can cause problems with culverts disrupting traffic movement and putting persons at risk if roads become flooded.

The NRCS, through their Digital Soil Survey program, has developed a Soil Erosion By Water map for Maricopa County from which the Soil Erosion Hazards Map (See Map 2-3) was generated. This 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.





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 the erosion process as well as being impacted by it.

**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 indicates that, on the average over 80 days per year, the maximum temperature exceeds 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.

	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
<b>Annual</b>	<b>86.3</b>	<b>60.3</b>	<b>73.3</b>	<b>76.3</b>	<b>81</b>	<b>70.2</b>	<b>64</b>
<b>Winter</b>	<b>68.4</b>	<b>44.0</b>	<b>56.2</b>	<b>61.8</b>	<b>81</b>	<b>49.8</b>	<b>49</b>
<b>Spring</b>	<b>84.7</b>	<b>57.7</b>	<b>71.2</b>	<b>77.5</b>	<b>89</b>	<b>66.6</b>	<b>65</b>
<b>Summer</b>	<b>103.9</b>	<b>78.0</b>	<b>90.9</b>	<b>94.8</b>	<b>94</b>	<b>86.5</b>	<b>55</b>
<b>Fall</b>	<b>88.2</b>	<b>61.7</b>	<b>75.0</b>	<b>77.9</b>	<b>77</b>	<b>70.4</b>	<b>57</b>

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. This 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.



<b>Table 2-2</b>					
Period of Record Climate Summary For Phoenix from 1948 to 2003 - Precipitation (in.)					
	Mean	High	Year	Low	Year
January	0.8	5.2	1993	0.0	1970
February	0.7	3.2	2003	0.0	1967
March	0.9	3.2	1983	0.0	1955
April	0.3	1.9	1952	0.0	1950
May	0.1	1.1	1976	0.0	1950
June	0.1	1.7	1972	0.0	1951
July	0.9	5.2	1984	0.0	1993
August	1.0	5.6	1951	0.0	1973
September	0.7	3.4	1984	0.0	1948
October	0.7	4.4	1972	0.0	1950
November	0.6	3.0	1952	0.0	1948
December	0.9	4.0	1967	0.0	1958
<b>Annual</b>	7.6	15.2	1978	2.8	1956
<b>Winter</b>	2.4	10.0	1993	0.0	2000
<b>Spring</b>	1.3	4.1	1952	0.0	1972
<b>Summer</b>	2.0	6.9	1955	0.3	1991
<b>Fall</b>	1.9	5.7	1972	0.1	1953

#### 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. 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 occur 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 in relationship to the floodwaters. 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.<sup>5</sup>

Rainfall records have been kept for the Phoenix area on a consistent basis for over 100 years and has been analyzed. At Sky Harbor Airport the 24-hour duration rainfall that would occur in a 100-year event<sup>6</sup> would be 3.30 inches; a 50-year event would generate 2.93 inches; and a 10-year event 2.57 inches.<sup>7</sup> These values vary throughout Maricopa County.

The District currently has over 280 precipitation measuring gages located in Maricopa County and surrounding counties with the first of these gages being installed in 1981. This system is



still being expanded as information is needed in other locations. Data from 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. 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.

In a six year period, the ten percent chance rainfall was equaled or exceeded somewhere in Maricopa County 138 times. This does not mean that damageable floods occurred 138 times during this period. It does mean that the potential existed 138 times, or an average of 23 times per year 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.

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

<u>Year</u>	<u>10% or &gt;</u>	<u>50% or &gt;</u>	<u>100% or &gt;</u>
1998	4	0	0
1999	10	1	0
2000	29	9	4
2001	4	0	0
2002	8	1	0
2003	56	7	5
Totals	111	18	9

**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. In the northern and western portions, volcanics are more dominant, while basalts are more common in the West.<sup>8</sup>

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.<sup>9</sup>

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 and along the floodplains of the major washes and their tributaries 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.

#### **2.2.6.1. Desert Landforms - Arroyos and Alluvial Fans**

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.

An 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.<sup>10</sup>

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.

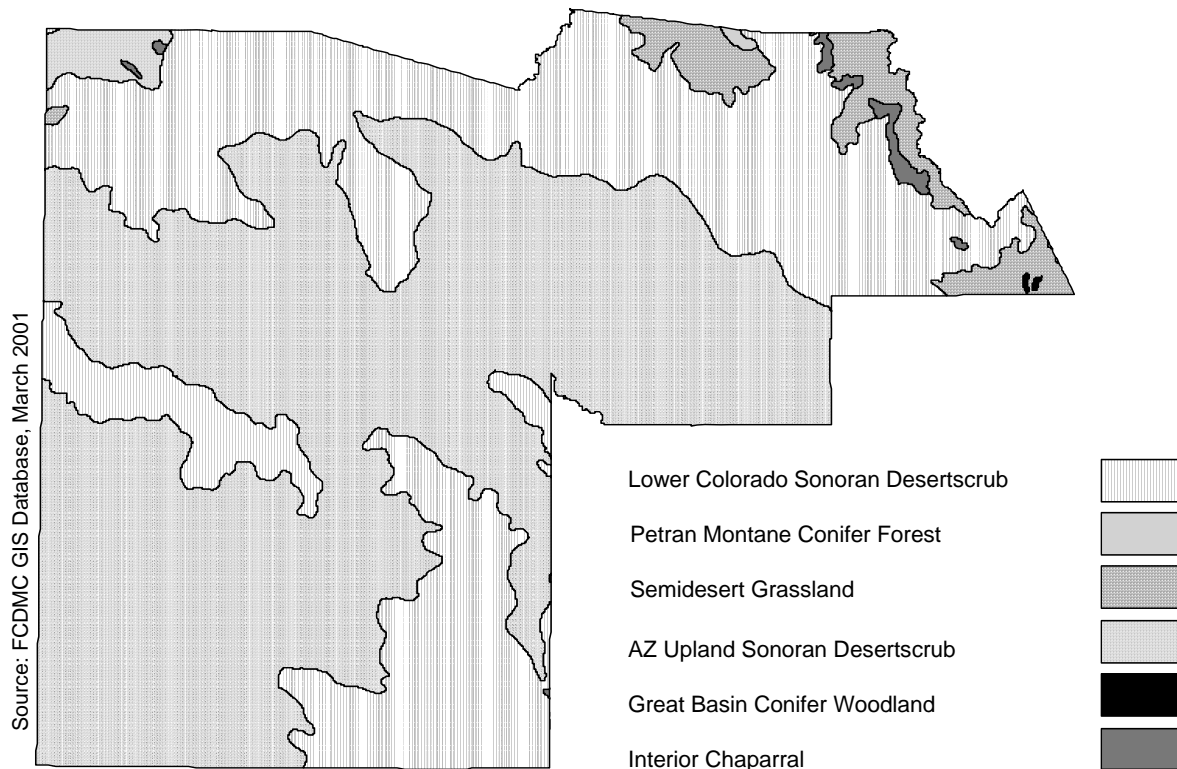
In a report entitled “Alluvial Fan Hazards in the United States” the Federal Emergency Management Agency (FEMA, 1989) lists the following as hazards that may occur on alluvial fans: high velocity flows; erosion/scour; deposition of sediment and debris; debris flows/impact forces; mudflows; inundation;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

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.<sup>11</sup> 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.<sup>12</sup>

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. Non-native species have been introduced into some of the river areas. Tamarisk is one that has become abundant.





Tamarisk is an aggressive, woody invasive plant species that has become established over as much as a million acres of floodplains, riparian areas, wetlands and lake margins in the western United States. There are several species of salt cedar or tamarisk in Maricopa County, but the problem species is *Ramosissima*.



*Tamarisk trees grow in thick stands along the Little Colorado River near Cameron, AZ  
Photo by John Grahame*

Suggested undesirable attributes that tamarisk possess relative to floodplain management are the following: crowds out native stands of riparian and wetland vegetation; increases the salinity of surface soil rendering the soil inhospitable to native plant species; provides generally lower wildlife habitat value than native vegetation; dries up springs, wetlands, riparian areas and small streams by lowering surface water tables; widens floodplains by clogging stream channels; increases sediment deposition due to the abundance of tamarisk

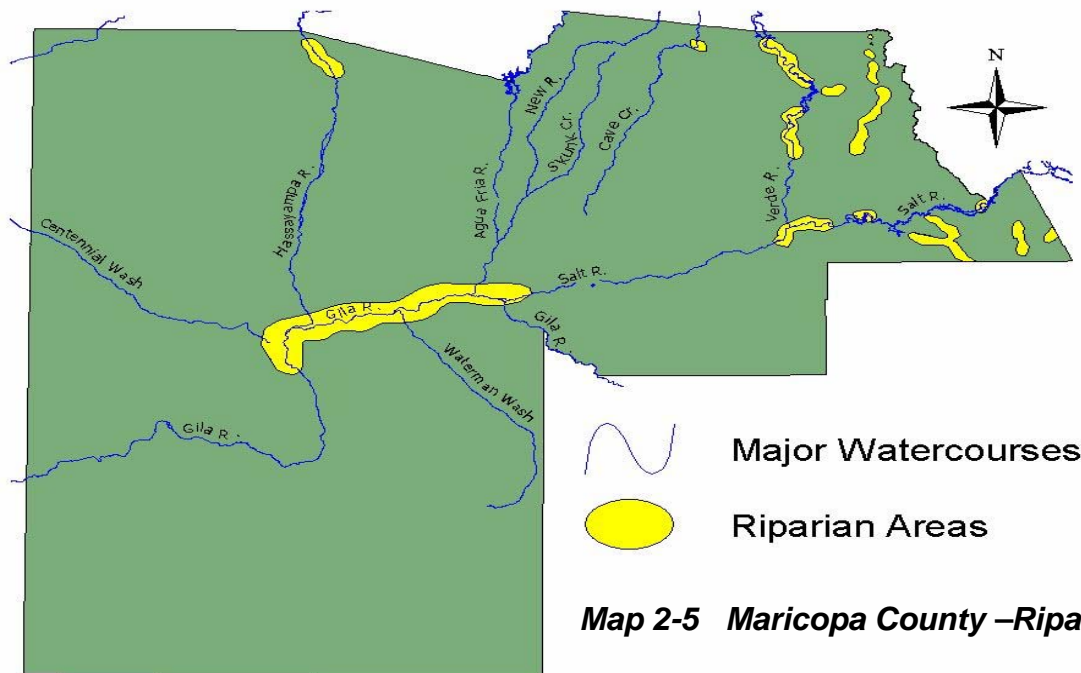
stems in dense stands; and may use more water than comparable native plant communities. Invasive species are being evaluated for issues related to floodplain management.

#### **2.2.8. Riparian Habitat**

Riparian areas are ecotones, or transition zones, between watercourses and the surrounding upland. In Maricopa County the majority of the watercourses are ephemeral; flowing in direct response to rainfall. Yet, due to the presence of 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 significant riparian areas in the County.

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, the channel banks, and decrease erosion impacts near streams. Vegetation along channel banks help 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 biodegradation. 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,



**Map 2-5 Maricopa County –Riparian Areas**

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.<sup>13</sup>

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 impact 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.<sup>14</sup> 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.

In 1995 the Maricopa Association of Regional Governments (MAG) Regional Council adopted the *Desert Spaces Plan*. The concept for this plan was to provide a non-regulatory framework toward establishing a regional open space network. The Plan<sup>15</sup> defined regionally significant mountains, rivers, washes, and upland desert in terms of open space preservation value. Both natural and cultural settings were identified and evaluated.

In January of 1998, the City of Phoenix Parks, Recreation and Library Department (PRLD) completed the *Sonoran Preserve Master Plan*. This Plan calls for the practice of development to be evaluated, specifically the grading and drainage ordinances. Currently, the practice is that developers submit a subdivision plan that eliminates natural washes in favor of structural channels and detention basins. This method of handling storm water runoff from developments has left little natural desert except within dedicated public open space. The District is working with the City of Phoenix to develop nonstructural flood plain management guidelines based on an understanding of the complete hydrologic systems rather than on a site-by-site basis. Accommodating the natural migration of washes (a commonly observed occurrence in the southwest where soils associated with washes tend to be highly erodible) will greatly expand the notion of preservation beyond dedicated parcels of Sonoran Desert.

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.<sup>16</sup> Landscape Character Types and Subtypes were identified and delineated for the entire state of Arizona by the USDA Forest Service.<sup>17</sup> 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.

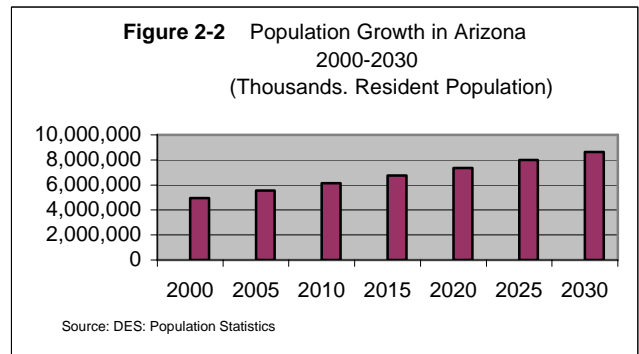
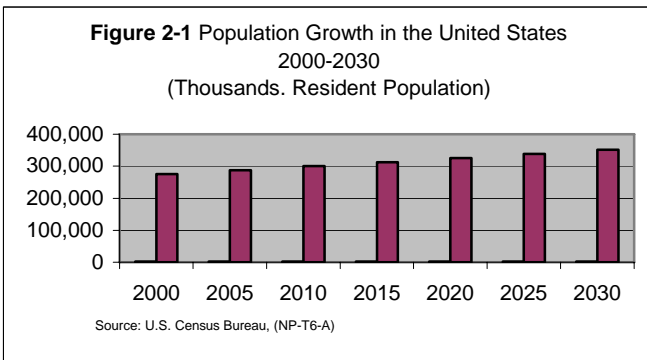


Flood control facilities, including, dams, dikes, basins and channels, have the potential to beneficially or negatively affect the scenic character and aesthetic values of adjacent communities, pastoral and natural landscapes within Maricopa County. The identification and mapping of existing landscape 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

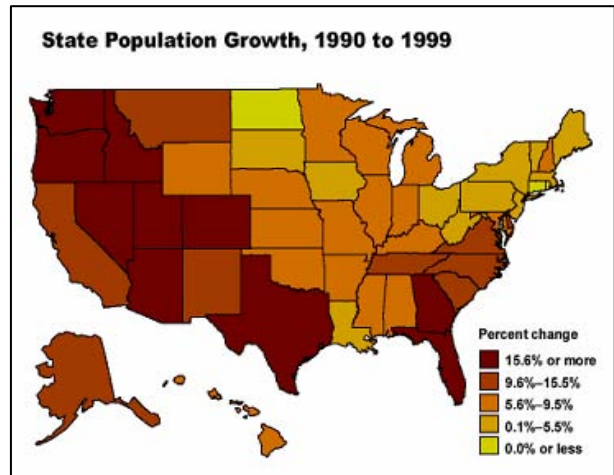
The population of the United States in Census 2000 stood at 281.4 million, a 13.2 percent increase from the 1990 population of 248.7 million. The 32.7 million increase, added to the U.S. population during the ten-year period from 1990 to 2000, represents the largest census-to-census increase in American history.<sup>18</sup> This trend is expected to continue as the population of the U.S. is projected to reach 351.1 million by 2030 (see Figure 2-1).<sup>19</sup>



Arizona had a population of approximately 5 million people in 2000 and is projected to increase to over 8.6 million in 2030 (see Figure 2-2).<sup>20</sup> This growth is a continuing trend in the movement of U.S. populations to the west. Western states Nevada, Arizona, Colorado, Utah, and Idaho, were the fastest growing states over the past decade,<sup>21</sup> each growing by more than 20% from 1990 to 2000<sup>22</sup> (see Figure 2-3). Nevada, which had 1.2 million people in 1990, surged 66 percent over the decade to reach nearly 2 million. Arizona grew 40 percent to 5.1 million, for a much larger numerical gain. Hawaii, Montana and Wyoming were the only Western states with relatively slow growth.<sup>23</sup>

The majority of Arizona's population growth will occur in Maricopa County, the fifth largest county in land area in Arizona. Municipalities within the county are growing at varying rates. Currently there are four municipally planned areas (MPA's) in Maricopa County with populations of over 200,000 persons; these include: Phoenix, Mesa Glendale, and Scottsdale. By 2010, Chandler and Gilbert will surpass 200,000 in population, and will be followed by Peoria prior to the

Figure 2-3 Top Ten States Ranked by Population Size in 1,000's





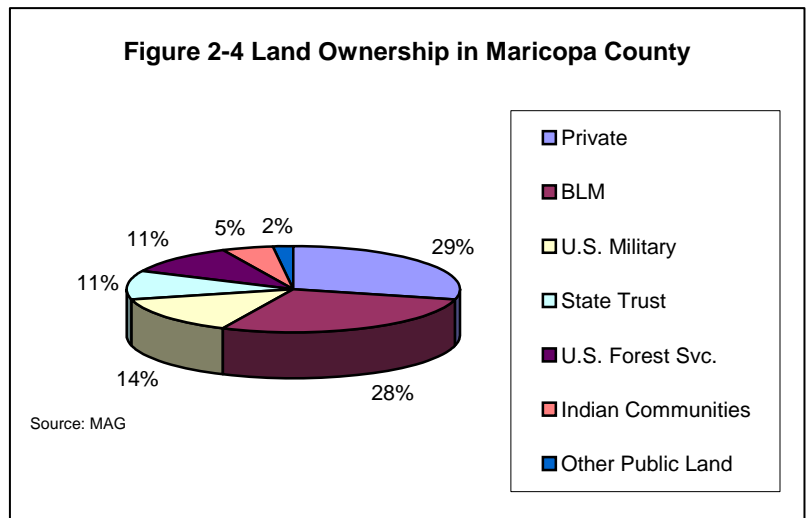
beginning of 2020. By 2025, the largest MPA, Phoenix, will contain 2.1 million persons, followed by Mesa at 630,000 and Surprise at 312,000.<sup>24</sup>

There will be implications for the District if Maricopa County’s forecasted growth rates are realized. The population data is reported in this chapter so that a series of assumptions can be made to identify where people may impact flooding, erosion, and sedimentation. Continued rapid growth could put more people in harm’s way from flooding hazards. The District uses the assumptions detailed in Section 2.3.7. 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 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

Nearly two-thirds of the land in Maricopa County is publicly owned and under some form of federal control. The breakdown of land ownership in the county is shown in Figure 2-4. Map 2-6 shows the location and breakdown of land ownership groupings for the county. The largest expanses of public land are the Tonto National Forest, in the northeastern part of the county, and various tracts (primarily) in the western portion of the county, owned by the U.S. Bureau of Land Management (BLM). The BLM controls nearly four times as much land as the Forest Service. As with Forest Service Lands, BLM lands largely are used for cattle grazing leases, though they are managed under the doctrine of “multiple use.” Some BLM land is administered as wilderness areas managed for wildlife habitat and limited recreation.<sup>25</sup>

The Arizona State Trust also controls a considerable amount of land in the county, especially to the north of the urban fringe. Like the BLM, state trust lands are primarily used for grazing. Statewide, grazing leases are held on 93 percent of the state trust lands. These trust lands temporarily act as growth boundaries, limiting sprawl and leapfrog development. The goal of the trust, however, is to raise funds for public uses, especially the education system. Thus, trust lands are sold or leased when the value of the land increases because of encroaching urbanization. State trust lands historically have been developed under the concept of “highest and best use,” with sales for less than the appraised fair market value prohibited. Some of the developed land in the urbanized areas once was state trust land.<sup>26</sup> Other public lands include federal, state, county, and city parks, preserves and open spaces.<sup>27</sup>



Five Indian communities control about five percent of land in Maricopa County. Three of them border urbanized areas, including the Gila River Reservation to the south and the Salt River



Pima-Maricopa and Fort McDowell Mohave-Apache communities in the northeast. Modest amounts of development have occurred on the three Indian reservations, with the exception of the Salt River-Pima Maricopa Indian Community (SRPMIC). This community is the most urban of all the Indian communities in Arizona. Located between Scottsdale and Mesa, commercial development is expected to occur along the Interstate 101, designated a business corridor by the Community.

Privately owned land is mainly concentrated in the urbanized area, the farmlands southeast of the urbanized area, and lands west of the urbanized area, extending for some distance near the major transportation routes of I-10 and State Route 85 and I-8. Despite much of the land in the county being publicly held or undevelopable, the remaining amount of land available for development would allow the population of the Phoenix metro area to expand by at least several million.<sup>28</sup> Table 2-4 lists a broad breakdown for land area available for development or already dedicated to specific long-term uses.

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%
<b>TOTAL</b>	<b>5,904,640</b>	<b>9,226</b>	<b>100.00%</b>

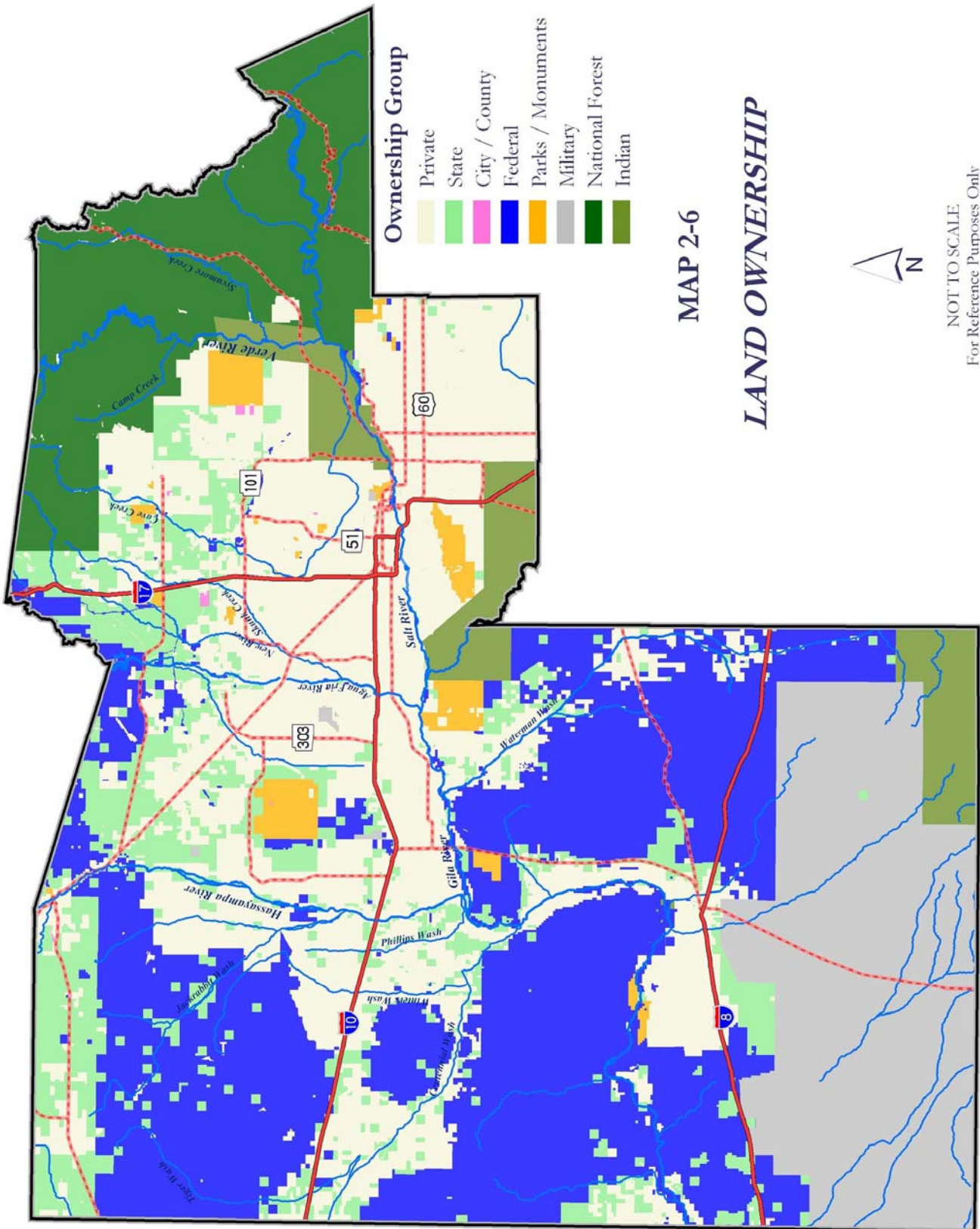
\* Land in private and state trust ownership with less than 15% slope and not in a floodway.

### 2.3.3. Land Use

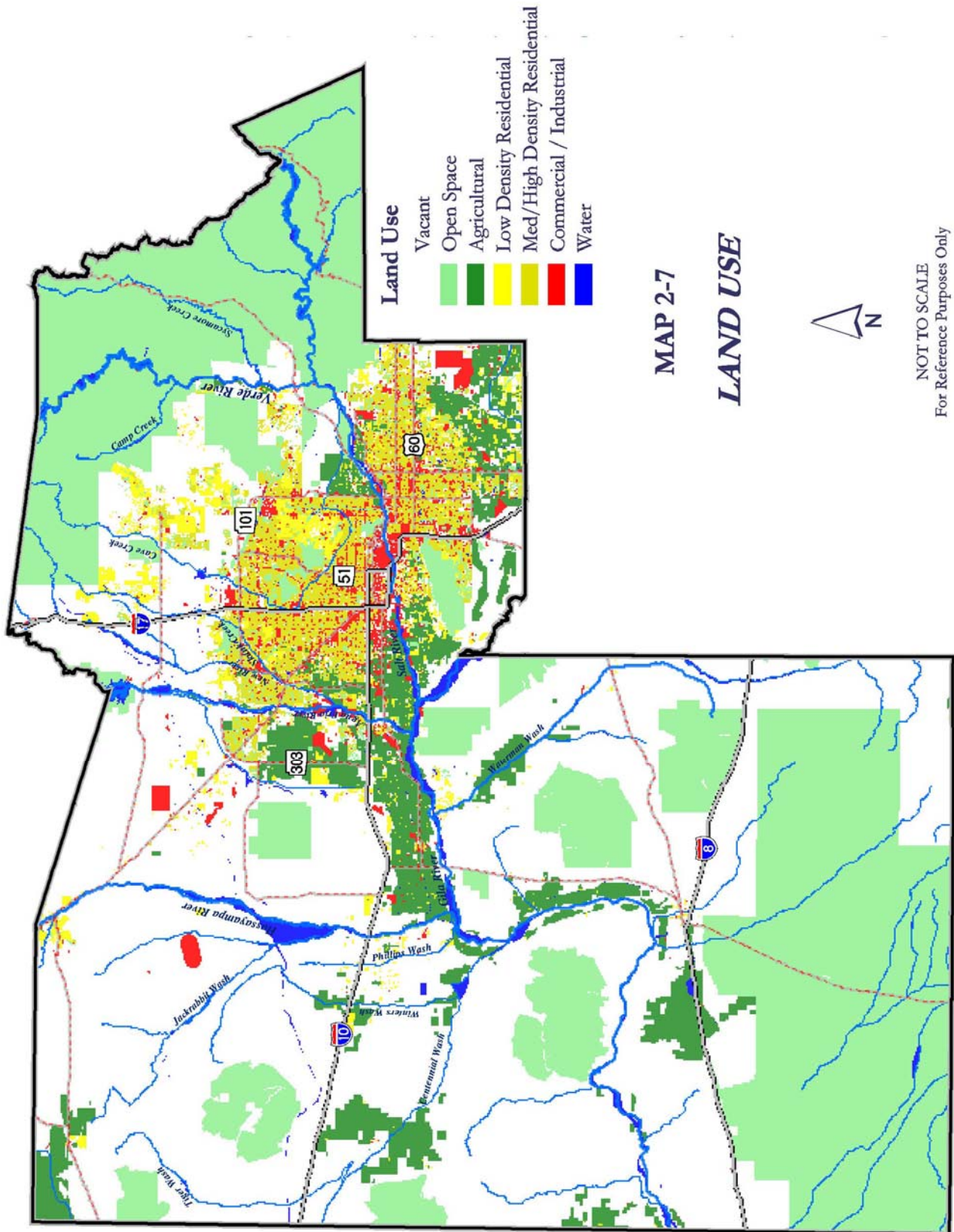
In an arid region, land use is primarily determined by the availability of water. In the Phoenix area, for example, the development of irrigation systems for agriculture in the late 19th and early 20th centuries initiated the rural settlement and expansive development of the Salt River Valley. In the past 80-100 years, large numbers of new residents moving to the area increased commercial and industrial uses, and extensive urban and suburban residential development have significantly replaced agricultural activities. The Phoenix area has experienced exceptionally high urban growth, which it has been able to accommodate, because it is able to use water from large dams and lakes that impound water on the Salt and Verde rivers as well as Central Arizona Project water from the Colorado River.

Despite this urbanization, Maricopa County still remains important to the agricultural industry, but this is significantly attributed to more intensive use rather than extensive use of the available land for agricultural production. Population growth, urbanization, and sufficient water to accommodate urban expansion may continue to reduce land available for agriculture.

While similar in overall size to Pima County to the south, Maricopa County uses only 12 percent of its land base for agricultural purposes compared to 50 percent in Pima County. About 6,000 acres of agricultural land - an area the size of the town of Paradise Valley - permanently goes out of production each year. Today, about half of the Phoenix area urbanization is on land previously used for farming. Conversion of farmland to development creates a different type of flood hazard compared to the development in the natural desert.



Source: Maricopa Association of Governments



Source: Maricopa Association of Governments





Map 2-7 shows current land use categorized by the Maricopa Association of Governments. Besides agricultural use, categories include: vacant, open space, residential, commercial/industrial and water.

Development boundaries will have moved about 13.5 miles further out by 2025 from 1998, setting a criteria for expansion of a “half-mile each year”. 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.<sup>29</sup> 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.

#### **2.3.4. Land Use Restrictions**

Controlling development on environmentally sensitive lands through ordinance to prevent inappropriate development is becoming an accepted practice in a number of municipalities in the County. Zoning regulations and Environmentally Sensitive Lands Ordinances (ESLO's) are now in place in many municipalities. The intent and purpose of the ESLO is to identify and protect environmentally sensitive lands and to promote public health and safety by controlling development on these lands in the particular city that adopts the ordinance. The ordinance requires that a percentage of these properties be permanently preserved as natural area open space and that specific environmental features, including vegetation, washes, mountain ridges and peaks, be protected from inappropriate development. ESLO's also prohibit development of land with severe limitations of any of the hazards identified earlier in the chapter. In the past, however, a number of areas with one or more of these limitations have been developed.

#### **2.3.5. Potential Developable Land**

Anticipating future development areas to determine flood hazard issues requires an analysis of trends and land ownership. Understanding the direction of the County's population growth is essential to getting ahead of development and mitigating hazards before they cause damage. To do this the District needs to know how much of the presently developed land is subject to flood, and/or erosion and sediment damages, and how much of future development will be located in areas susceptible to flood and/or erosion and sediment problems. Several trends the District looks at are new residential completions, land ownership, and population projections.

New residential completions have been the drivers of development over the past decade in Maricopa County, following the transportation infrastructure with businesses clustering near these new residences. Future development seems likely to continue to be most heavily concentrated in the west and north sections of the Metropolitan area (see Map 2-8). This appears likely for two reasons. First, the southeast and the east sections of the County are nearly built-out with master planned communities stretching 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, 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.

By the year 2025, development boundaries will have moved about 13.5 miles further out from where they were in 1998. This expansion accounts for approximately 625 square miles of the County's 9,226 square miles being developed for residential or commercial use as of 1995. Approximately 236,000 acres will likely be developed over the next 30 years and there is about 1.7 million acres of potentially developable land in the County.

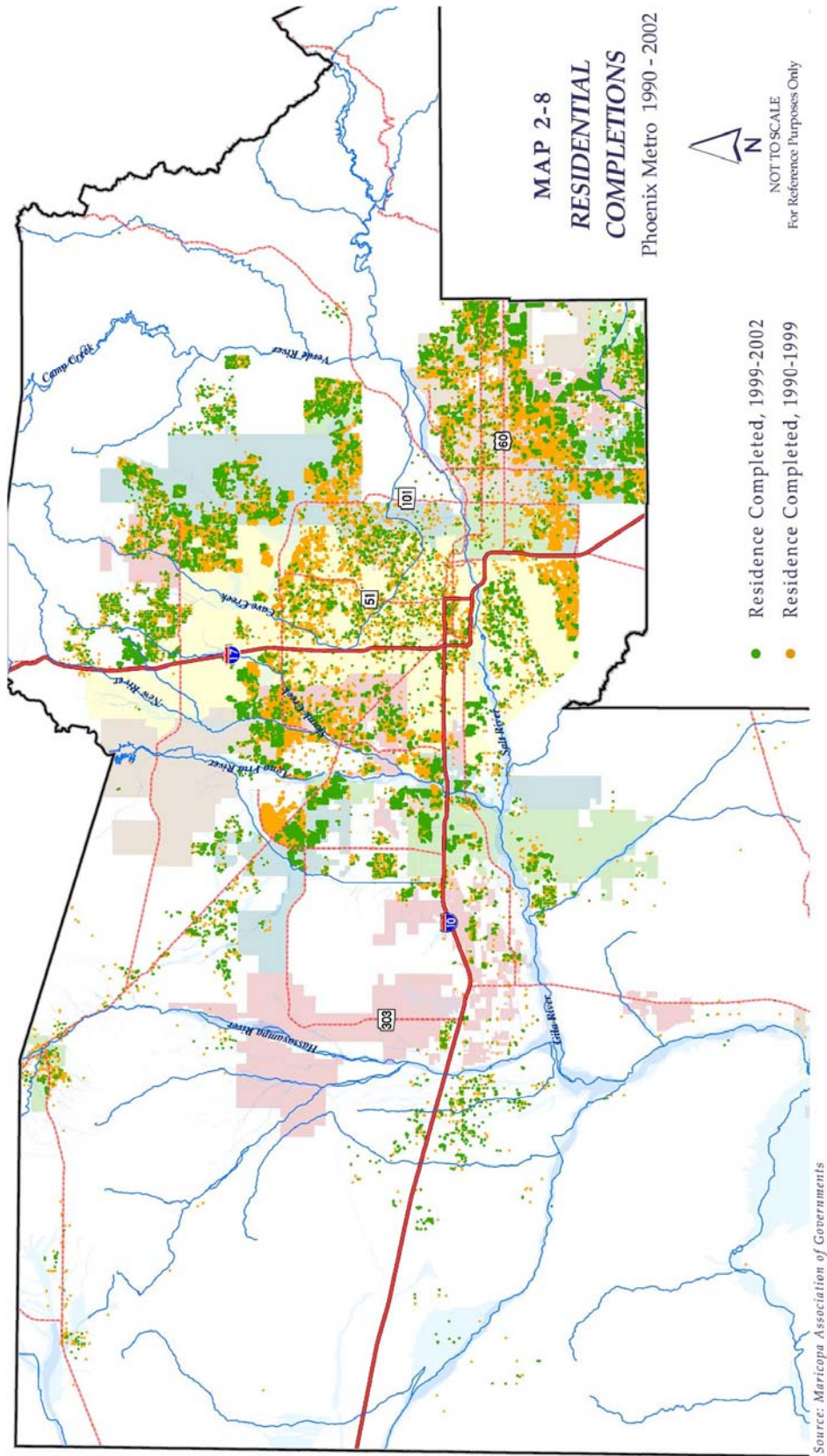
With control of 9.3 million acres of land, the Arizona State Trust Land Department exerts significant influence over the future development in Maricopa County. Managed to generate revenue for trust beneficiaries, the State Trust leases or sells land (along with the natural products: forage, timber, minerals, etc.) to the "highest and best bidder". The mandate to maximize the revenue that can be derived from the land implies that the state, more than any other player, has the ability to drive the future pattern of development and open space in Maricopa County. As the State Land Department administers its mission, we can expect state lands to increasingly be converted to private ownership for commercial and residential development.<sup>30</sup> Out of the 9.3 million acres held in trust, 8.4 million acres is leased for grazing. The remainder of the land is held for commercial leases, oil and gas leases, use permits (e.g. gravel pits and antenna sites), rights-of-way, and agricultural leases. Approximately 3,000 to 5,000 acres of state trust lands are sold per year, primarily for commercial and residential development.<sup>31</sup>

The Maricopa Association of Governments (MAG) is the Council of Governments (COG) that serves as the designated regional metropolitan planning organization (MPO) for transportation planning in the metropolitan Phoenix area. MAG provides regional planning and policy decisions in areas of transportation, air quality, environment analysis, regional development, and social services. MAG also develops population estimates and projections for the region, along with a database that provides information on active, planned and proposed development projects in Maricopa County. These potential development areas, as of July 1, 2001, are shown on [Map 2-9](#). The total area in all of these developments is about 331,000 acres, more than enough land to take care of the projected population needs through the year 2020. Of this total, approximately 49,000 acres are actively being developed, and 282,000 acres are proposed. Over half of the proposed development is expected to occur in the northwestern region of the County. Section 2.36 of this Chapter presents assumptions and data in order to estimate acres needed for development throughout the next twenty-five years. Development will also occur on non-master planned areas or infill.

### **2.3.6. Development in the Floodplain and Floodway**

Managing development in the floodplain and floodway is quite different today from what it was 30 years ago. Prior to 1978 floodplain mapping wasn't available for most areas of the county, resulting in structures being constructed in floodplains and/or floodways. Today the District relies on floodplain delineations studies to stay ahead of development and keep structures out of flood prone areas.

Terms used throughout this report are defined<sup>32</sup> below using the *Floodplain Regulations for Maricopa County*:





Delineation - the identification of floodplains, defining the physical boundaries of a stream, floodplain, jurisdictional wash, and other others where flooding or ponding occur.

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

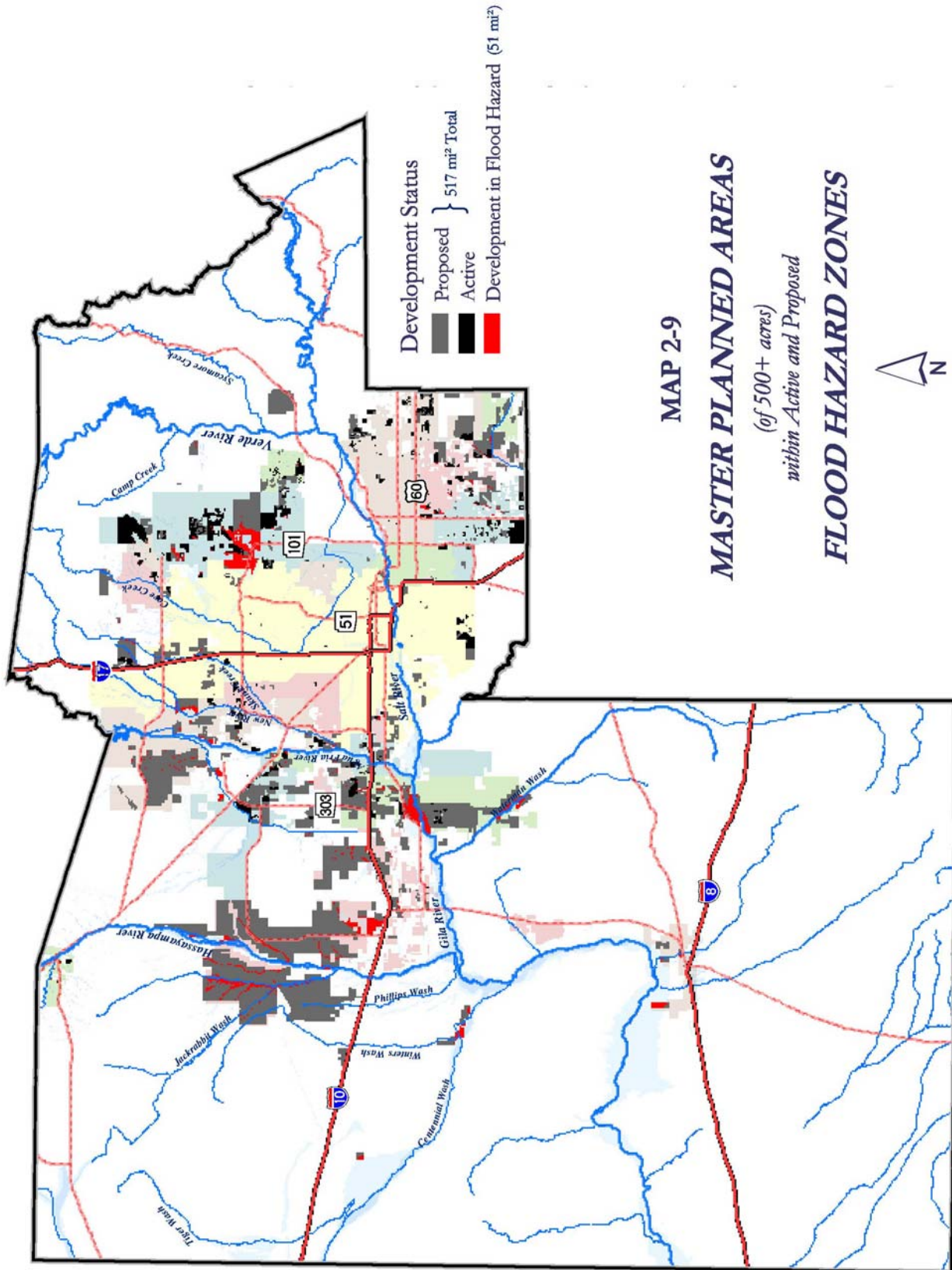
Floodplain - the area susceptible to inundation by a base flood including areas where drainage is or may be restricted by man-made structures that have been or may be covered partially or wholly by floodwater from the 100-year flood.

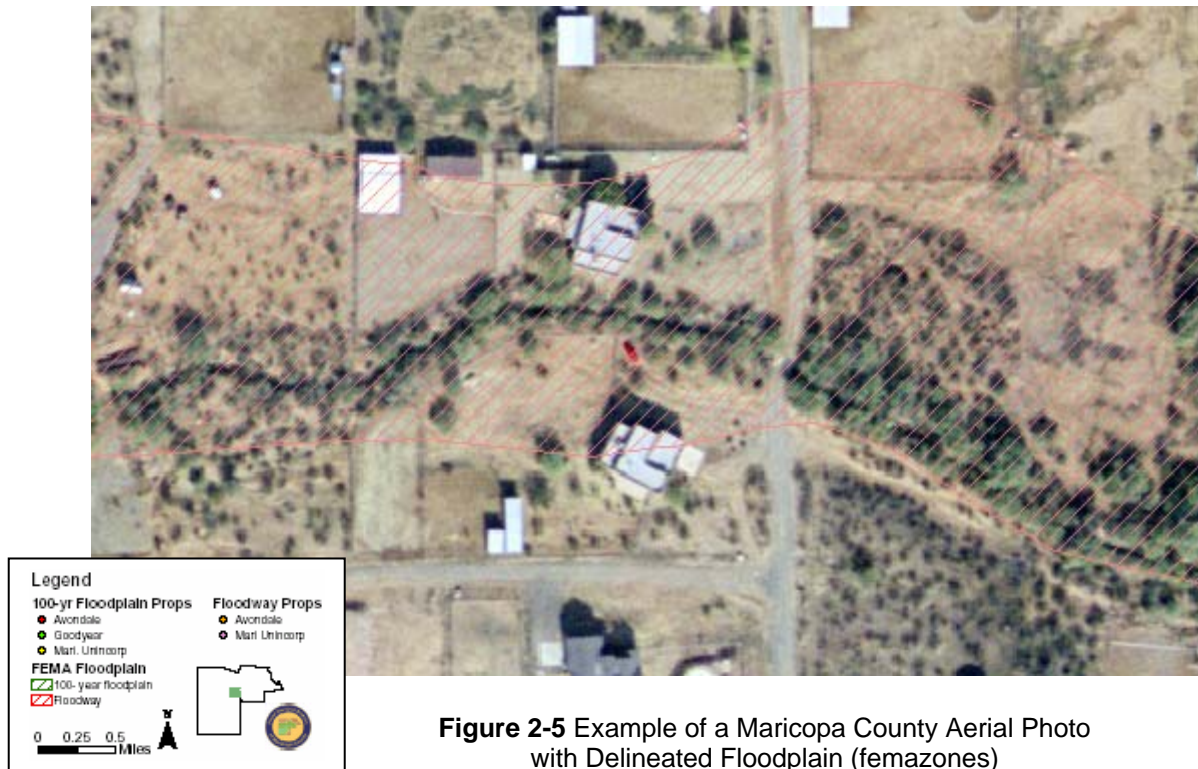
Floodway - the channel of a river or other watercourse and the adjacent land areas necessary in order to discharge the 100-year flood without cumulatively increasing the water surface elevation more than one foot.

There are approximately 8,700 linear miles of stream courses with drainage areas of greater than one square mile in Maricopa County (per the 100,000 scale USGS Hydrography). 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.

The delineated floodways and floodplains, and floodplains defined using approximate methods, were placed on current 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 2004. This same procedure has identified about 250 of the 22,000 structures as being in a defined floodway. These structures could be susceptible to varying degrees of damage from water and sediment. 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. The District reviews development permits to keep this from happening. [Figure 2-5](#) 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 2-9](#)). 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 if delineation studies are not done beforehand.





**Figure 2-5** Example of a Maricopa County Aerial Photo with Delineated Floodplain (femazones)

Potential erosion hazard areas are even more pronounced. Soil erosion hazard areas are also overlain on the future development areas when determining risk assessment for watersheds. 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 estimated 300 structures identified within the floodways would have been constructed prior to completing studies documenting the floodway. Therefore, new construction within currently designated floodways should not be 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 4-4](#) in Chapter 4 shows, by watershed, the watercourse lengths for which floodplain delineations have not yet been completed.

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.

### **2.3.7. 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 2-5.<sup>33</sup> 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 2000 Census, in 2030 is 6,139,971.<sup>34</sup> [6,139,971 (2030) – 3,096,613 (2000) = 3,043,358 additional people]
2. The U.S. Census Bureau shows an average of 2.67 persons per household in Maricopa County in 2000<sup>35</sup> (3,043,358 ÷ 2.67 = 1,139,834 new households ÷30 = 37,994 average per year)
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.<sup>36</sup> Streets and roads will take up additional area - 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.<sup>37</sup> 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.<sup>38</sup> 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),<sup>39</sup> 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.

<b>Housing Units Authorized for Installation in Maricopa County – 2002</b>		
<b>Type</b>	<b>Number</b>	<b>% of Total</b>
1 Unit	40,002	82%
2 Units	188	0%
3 & 4 Units	366	1%
5 Units & More	7,343	15%
Manufactured Housing	974	2%
<b>TOTAL</b>	<b>48,873</b>	<b>100.00%</b>

Sources: Housing Unit, U.S. Census; Manufacturing Housing, Arizona Department of Building, Fire & Safety



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.<sup>40</sup> This is 1,138 square feet per household. Detailed calculations to arrive at the numbers for assumptions 7, 8, and 9 for Table 2-5 are in Appendix C.

In Table 2-6, 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.

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
<b>Subtotal</b>	<b>N/A</b>	<b>100%</b>	<b>934,247</b>	<b>6,154,630,427</b>	<b>141,291</b>	<b>220.77</b>
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
<b>Subtotal</b>	Subtotal 4,407	N/A	N/A	<b>10,270,350,649</b>	<b>235,781</b>	<b>368.42</b>

\* 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 as well as the 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-risk areas for flood hazards. Encouraging higher population densities in areas of low flood risk would be an alternative solution to accommodate the fast growth expected to continue in Maricopa County.

## 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 331,000 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's studies should provide assistance to the development community by helping to 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

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- <sup>1</sup> Dabers, William. 2003. Bright Lights, Bigger cities: The Consortium for the Study of Rapidly Urbanizing Regions. ASU Vision Online. Summer 2003, Volume 6, number 3. <http://www.asu.edu/alumni/vision/03v06n03/feature20.html>
- <sup>2</sup> Information in this paragraph came from the Maricopa County website. <http://www.maricopa.gov> 2002
- <sup>3</sup> Information in the preceding two paragraphs is taken from the Maricopa County Comprehensive Plan 2020 Eye to the Future, adopted October 20, 1997.
- <sup>4</sup> General Soil Map with Soil Interpretations for Land Use Planning, Maricopa County, United States Department of Agriculture, Soil Conservation Service, March 1973.
- <sup>5</sup> Assumption is based on evaluating and reviewing PL83-566 Small Watershed Projects for the Soil Conservation Service (Natural Resource Conservation Service over a 30-year period.
- <sup>6</sup> 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.
- <sup>7</sup> Figures taken from NOAA Technical Memorandum NWS WR-177, Climate of Phoenix, Arizona, December 1986 (Revised) p. 92.
- <sup>8</sup> Reynolds, 1988 in Maricopa County, 1995.
- <sup>9</sup> Ibid.
- <sup>10</sup> Vogt, Brandon J., *The Arroyo Problem in the Southwestern United States*.
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- <sup>12</sup> Ibid.
- <sup>13</sup> Arizona Department of Water Resources (ADWR). 1994. *Arizona Riparian Protection Program Legislative Report*.
- <sup>14</sup> 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.
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- <sup>17</sup> Updated, Landscape Character Types of the National Forests in Arizona and New Mexico, USDA FS, Southwest Region.
- <sup>18</sup> U.S. Census Bureau, Population Change and Distribution: 1990 to 2000, Census 2000 Brief issued April 2001, C2KBR/01-2.
- <sup>19</sup> U.S. Census Bureau: Components of Change for the Total Resident Population: Middle Series, 1999 to 2100 accessed on 12/22/03
- <sup>20</sup> Arizona Department of Economic Security. Population Statistics, July 1, 1997 to July 1, 2050. Arizona County Population Projections.



- <sup>21</sup> AmeriStat, Population Reference Bureau: U.S. Population on the Move, accessed on 1/5/04 from <http://www.prb.org/Ameristat>
- <sup>22</sup> Ibid.
- <sup>23</sup> Ibid.
- <sup>24</sup> Ibid.
- <sup>25</sup> Rex, T.R. 2000. Development of Metropolitan Phoenix: Historical, Current and Future Trends, as part of the Brookings Growth Case Study. Prepared for the Morrison Institute of Public Policy. Center for Business Research, L. William Seidman Research Institute, College of Business, Arizona State University.
- <sup>26</sup> Ibid.
- <sup>27</sup> Ibid.
- <sup>28</sup> Ibid.
- <sup>29</sup> Less than 12 miles to the east, west and south but much greater than 12 miles to the north.
- <sup>30</sup> Grand Canyon Trust. 2003. State Trust Land Reform in Arizona. Accessed on July 16, 2004 from <http://www.grandcanyontrust.org/ggc/urban/landref.html>
- <sup>31</sup> Sonoran Institute. 2003. State Trust Lands Program. Accessed on July 16, 2004 from [http://www.sonoran.org/programs/si\\_stl\\_faqs.html](http://www.sonoran.org/programs/si_stl_faqs.html)
- <sup>32</sup> Floodplain Regulations for Maricopa County (Adopted August 4, 1986). 2000. Accessed on April 4, 2004 from the Flood Control District website at [http://www.fcd.maricopa.gov/Services/FCDMC\\_Fldpln\\_Regs\\_00.pdf](http://www.fcd.maricopa.gov/Services/FCDMC_Fldpln_Regs_00.pdf)
- <sup>33</sup> Maricopa Association of Governments. 2003. Interim Projections of Population, Housing and Employment by Municipal Planning Area and Regional Analysis.
- <sup>34</sup> Maricopa County MapStats from Fedstats. Maricopa County, Arizona accessed on 11/24/03 from <http://www.fedstats.gov/qf/states/04/0413.html>
- <sup>35</sup> Metroscan for Windows 2.64
- <sup>36</sup> Morrison Institute for Public Policy, Arizona State University
- <sup>37</sup> 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.
- <sup>38</sup> 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.



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## CHAPTER 3. DISTRICT ORGANIZATION & PROGRAMS

### 3.1. District Organization

#### 3.1.1. Overview

The District is a municipal corporation, and political subdivision of the State of Arizona, governed by a Board of Directors, which double as the County Board of Supervisors, with advice of a Citizens' Flood Control Advisory Board. 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.

Created in 1959, 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 constructed 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

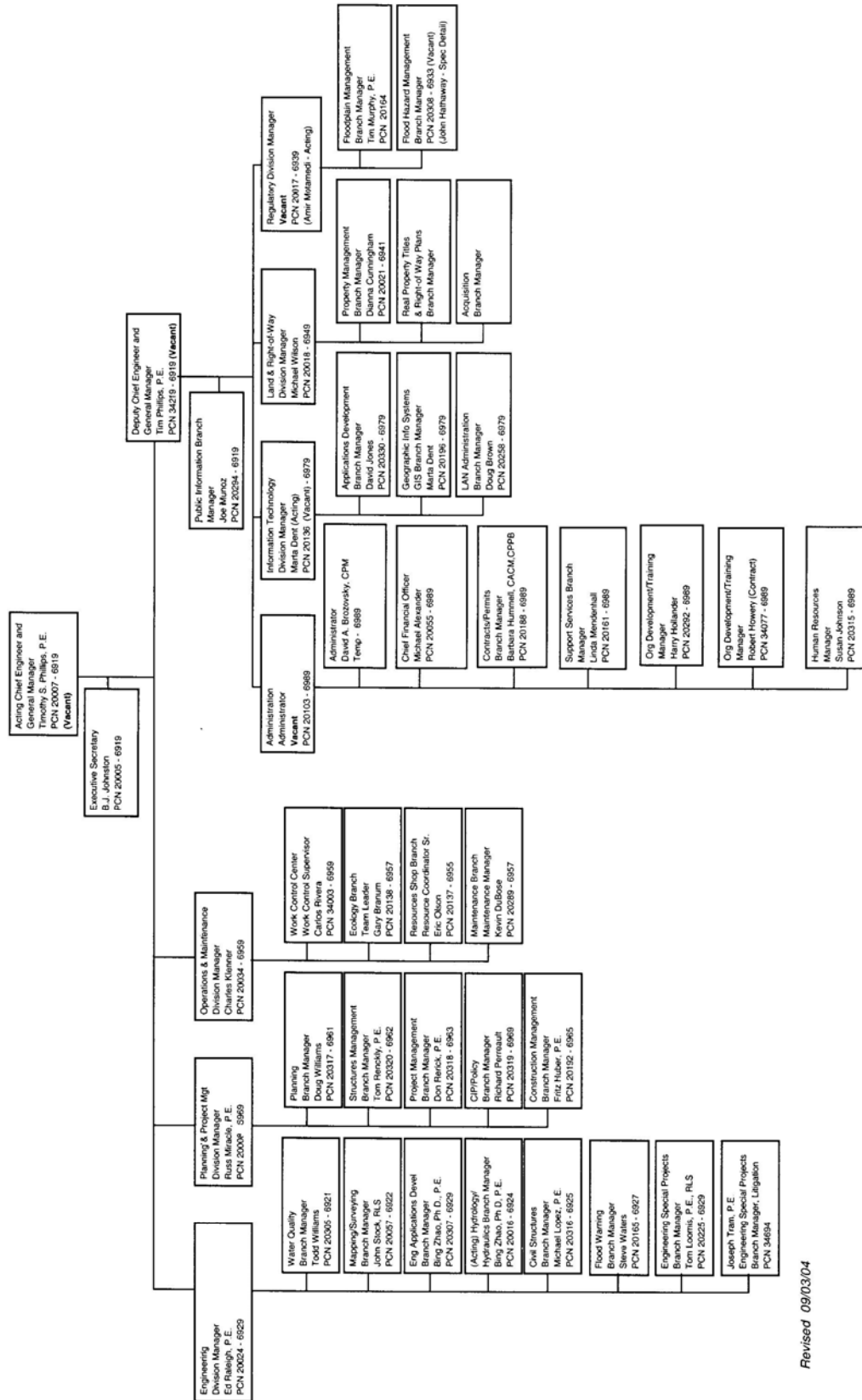
The Flood Control District of Maricopa County is a political taxing subdivision of the State of Arizona. By statute, the District is managed by the Flood Control District Chief Engineer and General Manager. The District is organized into an executive branch and seven divisions. The executive branch includes 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. These core functions include flood hazard remediation, regulation, education, and identification. The Flood Control District's *Managing for Results Strategic Plan* further defines the programs, services, and activities in these core functions. Programs supporting the core functions include employee, customer service and financial management.

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: the treasurer and the attorney for the District. 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 Public Works Director and the County Administrative Officer. In addition, the District and the County have an intergovernmental agreement by which each provides specific services for the other. The services are either reimbursed in accordance with Title 11 and/or Title 48 authority or fees are debited to offset the expenses.



Flood Control District of Maricopa County  
 Organizational Chart



Revised 09/03/04



### 3.1.3. Strategic Planning Process

To assess and adjust the District's direction in response to an ever changing 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 Managing for Results strategic planning process 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 Managing for Results Strategic Planning process groups the District's functions into specified and implied tasks, as detailed below.

#### 3.1.3.1. Specified Tasks

Specified tasks are those duties 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 (PPM) and the Operations and Maintenance (O & M) Divisions, with support from the Lands, Engineering, and Geographic Information Systems Divisions.
- **Flood Hazard Regulation** offers direction, and enforcement to the public so that they can avoid causing adverse impacts to floodplains, and use their property safely and in compliance with applicable state and federal laws. This program includes: floodplain, 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 area 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 Management Branch of the Regulatory Division and the Planning Branch of the Planning and Project Management Division.

### 3.1.3.2. Implied Tasks

Implied tasks are those obligations that, although not directly related to the District's core mandates, are necessary to be able to conduct the day to day business of the District. The Managing for Results Strategic Planning Process 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 the taxpayer with 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 responding to individuals, groups, and public/private party requests. The Office of the Chief Engineer manages this program with support from all the Flood Control District Divisions and staff.
- **Financial Management Program** provides financial services including financial resources, program budgeting, and the financial management of revenues and expenditures necessary 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

Under State of Arizona enabling legislation (Arizona Revised Statute (ARS) §48-3603), the Flood Control District is designated as a special taxing district and is given the authority to levy a secondary property tax on parcels within Maricopa County. Flood control projects are also funded by a variety of State, District, County, and city cost sharing arrangements. The revenue from the property tax generally covers the Capital Improvement Program projects. Revenue from other sources, which include: the sale or lease of rights-of-way, fees that developers and individuals are required to pay to obtain building permits within Maricopa County, and cost-sharing with other entities, make up the rest of the District's budget.

### 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





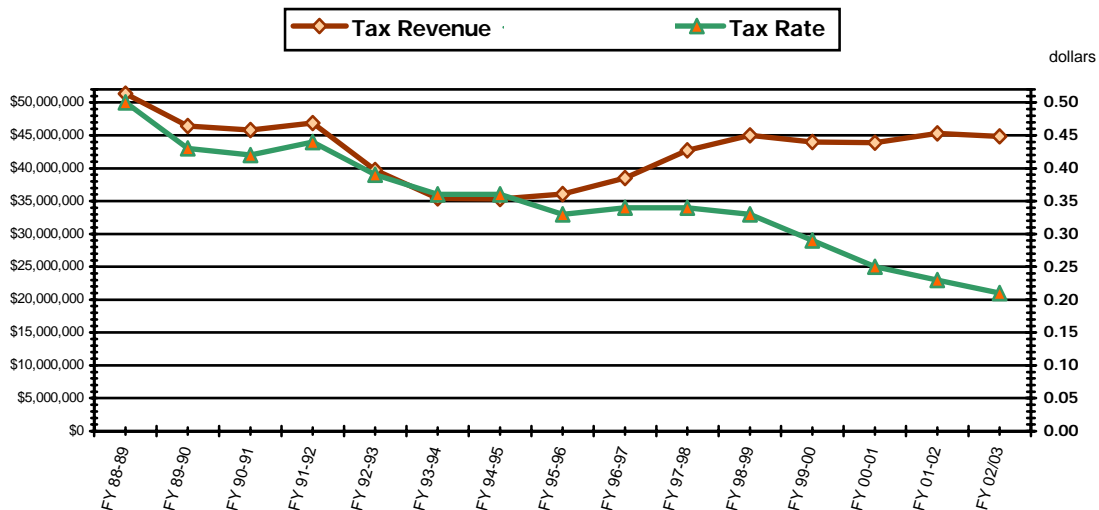
rate of this tax and the assessed real property valuation to which the tax is applied on an annual basis. More than 15 years ago the tax rate was 50 cents for every \$100 of valuation (see Table 3-1). This rate has been steadily declining and was set at 21.2 cents per \$100 valuation for Fiscal Year 2002-2003, remaining unchanged for Fiscal Years 03-04 and 04-05.

Tax revenues have held fairly constant over the past ten years due to the large amount of construction occurring 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). District’s property tax revenues were capped at a maximum of about \$45 million on an annual basis for about six years. The need for the cap has been lifted and the tax rate is now the set value.

**Table 3-1**  
**Flood Control Tax Rates and Revenue by Fiscal Year<sup>1</sup>**

Fiscal Year	Tax Rate	Tax Revenue
04/05	0.2119	\$54,427,000 est.
03/04	0.2119	50,050,367
02/03	0.2119	44,302,534
01/02	0.2319	44,622,753
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	0.3632	36,085,500
94/95	0.3332	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

**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 Branch if a structure is located within a delineated 100-year floodplain and reviewed by the County's Planning Department 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 2002-2003 this income source totaled \$1.8 million, and is estimated to increase to around \$2.1 million for Fiscal Year 2004-2005.

Currently, a Floodplain Use Permit for a Sand and Gravel Operation is issued for a fee of \$2,800. This fee is levied on a one-time basis, payable upon application. The permit is valid for 5 years, and there is no inspection fee or extraction fee. There are currently fifty active sand and gravel extraction permits. Fines for operating without a Floodplain Use Permit are limited to doubling of the permit fee, and those monetary penalties as defined within the Floodplain Regulations of up to \$10,000 per violation.

### **3.2.1.3. Intergovernmental Participation**

A third revenue source is cost sharing with other entities for project development and construction. Most of the structural projects in the early years of the District's operation were constructed through cost sharing arrangements with Federal agencies, such as the U.S. Army Corps of Engineers, the U.S. Department of Agriculture, and the Soil Conservation Service (now the Natural Resources Conservation Service). In most instances the federal cost share partner would pay for project construction and the District would furnish the land on which the structure would be built. Once the project was completed the District would take over operation and maintenance responsibilities. However this practice is steadily declining, as federal cost sharing monies have been decreasing in the last ten years as federal budgets have been reduced. Today, most recent cost sharing has been with local municipalities and county agencies, with some monies coming from various state agencies.

Revenue generated from intergovernmental agreements is substantial, generating \$17.1 million for Fiscal Year 2001-2002. Budgeted participation revenue for Fiscal Year 2002-2003 was \$14.5 million<sup>2</sup>, and is estimated to be \$17.6 million in Fiscal Year 2004-2005.

Almost \$556 million has been spent on flood control structures in Maricopa County since the District's inception. The majority of money has been spent constructing structures in the 60's and 70's, with nearly 60 percent of this total coming from federal sources<sup>3</sup>. There are approximately \$196 million of structures at 2000 prices that were primarily built by the District and partners<sup>4</sup>. However, now that much of Maricopa County's dam infrastructure is in place, the District's role is shifting from designing and installing flood control structures to a maintenance and protection emphasis. This process begins with a structural assessment program. The District is currently looking for Federal/District partnerships to continue the rehabilitation and dam safety process. Unfortunately, the District is not alone in seeking Federal partnership funding. The National Resource Conservation Service, having built over 10,000 structures within the past 50 years, is competing for federal dollars as well.



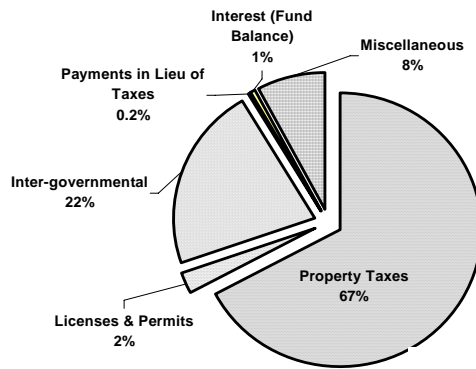
**3.2.1.4. Miscellaneous**

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 \$25,215 for Fiscal Year 2000-2001. Revenue from excess land sales during this same time frame was \$2.6 million. Excess land sales for Fiscal Year 2001-2002 were \$8.86 million, \$15.44 million for Fiscal Year 2002-2003, and \$6.35 million for Fiscal Year 2003-2004. Estimated revenue is \$2.45 million for Fiscal 2004-2005. 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.

**3.2.2. Budget**

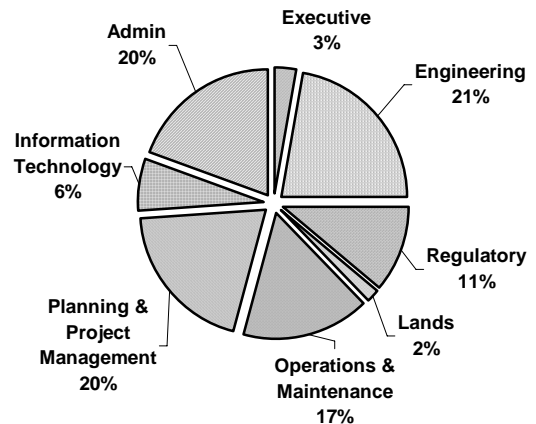
The District’s budget is separated into two main categories: The Operating Budget, and the Capital Improvement Program (CIP). There are subcategories under each of these. The revenue derived from the property tax and the other sources is used for the CIP and operations expenditures. The District’s Total Budget for Fiscal Year 2004 was approximately \$76 million. About \$51 million of this was dedicated to the Capital Improvement Program, and \$24 million to Operations. The District maintains an end of year fund balance of approximately \$15 million. These breakdowns remain fairly constant each fiscal year.

The following Figures show the District revenues and expenditures by percent:

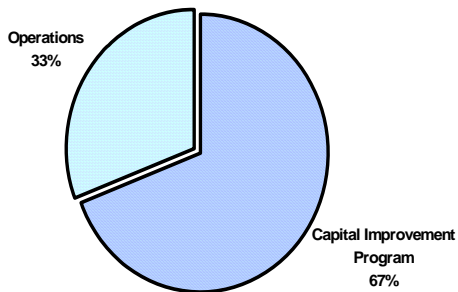


**Figure 3-4**  
 FY 2005 District Revenues

**Figure 3-5**  
 Operating Expenditures  
 FY 2005 – Full District



**Figure 3-3**  
 FY 2005 Budgeted Expenses





### 3.2.2.1. Expenditures – Operating and Capital Improvement Program

Operating Expenditures of around \$20 million annually are shown by percent for each of the District’s Divisions in Figure 3-5. The CIP, for FY 03/04 - 07/08, has identified \$269.5 million for capital improvements for the five-year period. An estimated \$95 million will most likely be obtained from partners on various projects to cover the difference between expected revenue and capital projects to 2006.

### 3.2.2.2. Comparison With Other Districts

Although flood control districts are unique unto their own local circumstance, most districts rely on taxes as their primary revenues sources. 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	
<b>Riverside, CA</b>	1.4 million	2,700	64	28	92	property tax
<b>Orange, CA</b>	2.98 million	798	31	56	87*	property tax
<b>Clark, NV</b>	1.6 million	7,927	35	31	66	sales tax (0.25 cent)
<b>Maricopa, AZ</b>	3.1 million	9,226	49	22	71	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 evolved considerably over the years. There are a number of reasons that new programs are developed, updated, or expanded. First, no one program can solve all the flooding problems in a diverse landscape like Maricopa County. Proactive programs that prevent new development in flood prone areas, and eliminate the need for future reactive programs, make sense in some locations, but can be impractical in others. Likewise, reactive programs can be very efficient in mitigating flooding problems in areas where development has already taken place, but not with newly converted raw land. Secondly, the District must keep up with new compliance standards, as well as technical and business practices. 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 make it necessary for the District to seek alternative funding options.

New programs have been developed within each core function 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 2003 Strategic Planning Process.



### **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 construction 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. The District’s Regulatory Division reviews these measures.

In the last ten years, there has been a decided shift in the structural measures remediation 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. A committee of senior District staff members evaluates first, all newly proposed projects according to predetermined and weighted criteria. The selected projects that require additional information is 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. Dam Safety Program**

The District operates and maintains 22 flood control dams, which provide highly beneficial flood protection for significant portions of Maricopa County. Most of these dams are the main flood control features of federal flood control projects of which the District was the local



sponsor. The District's Dam Safety Program is made up of three major components, which go beyond normal operation and maintenance activities. These major components are: Recurrent Dam Safety Activities, Structures Assessment and Dam Rehabilitation.

#### **3.3.1.3.a. Recurrent Dam Safety Activities**

Recurrent Dam Safety Activities primarily include: dam safety inspections, outlet pipe inspections, field surveys and development and updating of Emergency Action Plans. Dam Safety inspections are performed on an annual basis by District staff. Inspections of outlet pipes by video camera are performed every 5-years. Field surveys of the dams are required to monitor physical changes to the dams due primarily to embankment and foundation settlement and land subsidence. Most dam surveys are performed under consultant contracts. Emergency Action Plans are required for all dams and are developed and updated under consultant contracts.

#### **3.3.1.3.b. Structures Assessment**

The Structures Assessment component of the Dam Safety Program is being implemented to assess and evaluate the physical condition of the District's 22 dams in order to assure continued compliance with current regulations and to implement short term and interim term measures for the safe operation and proper functioning of the dams required beyond normal O&M requirements. Phase I Assessments provide an overall evaluation of the dams pertaining to dam safety and flood protection. In addition, preliminary alternatives are developed in Phase I to address long-term issues of aging infrastructure and urbanization. Multi-use opportunities are generally compatible with the function of the dams since significant flood impoundments are infrequent. Under Phase II of Structures Assessment, site-specific dam safety issues and potential dam safety issues are investigated and repaired or corrected as needed. In addition, Phase II technical studies (Phase II Special Studies) are being performed to identify and address issues common to most of the dams. Interim dam safety repairs are performed as required under CIP construction contracts such as the White Tanks FRS#3 Interim Dam Safety Repair.

#### **3.3.1.3.c. Dam Rehabilitation**

Fourteen District dams have currently been identified for overall rehabilitation or replacement due to issues of: dam safety, urbanization and flood protection. The Dam Rehabilitation component of the Dam Safety Program is anticipated to have a total cost of \$225 million over a 25-year period. The District intends to seek federal funding assistance for all of the 14 dams to be rehabilitated or replaced under existing federal programs that provide a 65% federal, 35% local cost share split. Proposed District Dam Rehabilitation efforts in FY 2004-05 include work on White Tanks FRS#3, White Tanks FRS#4, Buckeye FRS#1 and McMicken Dam.

#### **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.).

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. As of 2005, the District maintains 26,000 acres in fee and 35,000 acres in easements.

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, and 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. 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 initiate acquisitions. District acquisition staff then 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.

##### **3.3.1.6.a. Floodprone Properties Acquisition Program (FPAP)**

Less than 18 percent of the estimated 9,800 miles of stream corridor in Maricopa County have been mapped with regulatory floodplains and floodways. In many areas, development took place prior to floodplain mapping. As floodplains are delineated, some residents are



learning that their homes are within a regulatory floodplain or floodway. These homes are at a higher risk for flooding than those outside the floodplain. The presence of these structures can also create adverse impacts to adjacent homeowners. To address these issues, the Flood Control District Board of Directors approved the *Floodprone Properties Acquisition Program* on July 30, 2003 as a method to acquire properties in floodprone areas to protect the public from flooding.

Property owners who believe their home is eligible and are interested in applying for the program begin by submitting an application to the District. Upon each annual application deadline, all of the residences that qualify for the program will be evaluated in order to prioritize the requests. If the proposed properties meet the initial eligibility criteria, District staff will determine whether the property is located within an area benefited by a possible future CIP project. The evaluation committee applies the FPAP's prioritization factors to the eligible properties, which are then assigned a numerical value of risk. Factors utilized to measure eligibility are predetermined by District staff and include: severity of hazard, location of the residence in relation to the floodway/floodplain, economic benefit, and potential impacts to adjacent properties. The funding for the FPAP is included in the CIP budget for the upcoming fiscal year. Number of properties purchased are dependent upon the approved CIP budget.

The Floodprone Properties Acquisition Program is a voluntary program. To qualify for the Program a property must meet one or more of the following criteria to be evaluated for inclusion into the program:

1. Property with an inhabited residential structure located in a delineated 100-year floodway, or floodplain if no floodway designation exists, and built prior to such designation.
2. Property with an inhabited residential structure located in a delineated 100-year floodplain that has experienced documented flood damage.

The acquisition process begins with title searches and appraisals of the selected properties, followed by acquisition offers, opening of escrow accounts, relocation of residents, closing of escrow accounts, demolition of property improvements, and ongoing maintenance or disposition of the property. This step will generally take six to 12 months to complete. Eligible properties not selected during a budget cycle, and therefore not acquired during a given fiscal year can be reconsidered during the subsequent budget cycles. District staff, the resident, or the appropriate jurisdiction will have to confirm continued interest in the program by re-submitting the request to the evaluation committee.

### **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:

<b>AGENCY</b>	<b>REGULATORY PROGRAM</b>
Environmental Protection Agency	Clean Water Act (water quality standards)
Arizona Department of Environmental Quality	Clean Water Act (water quality standards)
Environmental Protection Agency	Clean Air Act (Asbestos NESHP)
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 floodprone 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 Arizona Department of Water Resources (ADWR) 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. The Floodplain Regulations that were adopted in 1972 still applied and have been subsequently amended.



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<sup>5</sup>. 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 a 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 twenty-five percent (25 %) 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 County provides for the benefit of the residents of Maricopa County by reducing the potential risk for property damage and for death or injury due to stormwater runoff. Regulating land development by enforcing the Drainage Regulations reduces the cost of future flood losses and the cost of remedial flood control measures needed to protect development constructed in an unsound manner.

County Planning and Development 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 clearances, plan review, and inspections. Adoption of the Regulation resulted in more efficient administration of the activity. Previously drainage compliance was covered in Subdivision Regulations, Zoning Ordinance, or State Statutes. The Drainage Regulations were revised and then adopted December 14, 1994, with



updated drainage and floodplain review fee schedules to reflect actual costs of the inspection, permitting, and plan review efforts, thus clarifying and strengthening the Regulation. The Drainage Regulation were again revised and adopted by the Board in September 2004.

The County's Planning and Development Department Drainage Review encompasses four primary services, which are the following:

- 1) Development Plan Review – The development plan review service regulates development so that projects are designed in accordance with the Drainage Regulations and sound engineering principles. The intent is maintain conveyance of stormwater in a manner that does not adversely impact the proposed development or neighboring properties.
- 2) Drainage Permitting – The permitting service tracks development so that all development is reviewed and receives a drainage clearance through the County function of issuing building activity permits.
- 3) Drainage Inspection – The inspection service involves field inspections to determine site conditions and the level of engineering detail required for a particular project and to verify that construction is performed in accordance with the approved plans.
- 4) Investigation and Correction of Drainage Violations – The drainage enforcement service investigates reported or observed violations of the Drainage Regulations. Violators are pursued to the extent necessary to achieve compliance. Typically, this requires formal notification and monitoring of corrective actions.

Drainage Administration, by the County, 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 program in the early 1990's to assist Maricopa County municipalities and agencies designated as Phase I permittees (Phoenix, Mesa, Tempe, Glendale, Scottsdale and Arizona Department of Transportation (ADOT)) in complying with National Pollutant Discharge Elimination System (NPDES) stormwater permitting requirements. In December of 1999, EPA established the Phase II stormwater permitting program and municipalities under this program had until March 10, 2003 to apply for permit coverage. Maricopa County was listed as a permittee under the Phase II program.

Due to the District's involvement on stormwater management issues, the District assumed a leadership role for Maricopa County. On March 10, 2003, with Board of Supervisors approval, the District applied for an individual Phase II Arizona Pollutant Discharge Elimination System Permit (AZPDES – Arizona's equivalent to the NPDES program) on behalf of Maricopa County. In addition to the municipal permit, the District applied for 12 industrial permits and one (1) non-exposure certification for County facilities that were previously exempted under the



industrial permitting program that was part of the Phase I stormwater program. The County is currently taking on the responsibilities for the stormwater permitting program.

The District became involved in the Phase I stormwater program because it was believed that by establishing a regional network of stormwater monitoring stations it would be a cost-effective cooperative solution to stormwater management issues. Additionally, since runoff from various municipalities within the urbanized areas potentially enter District structures prior to entering the Salt or Gila River systems it was appropriate for the District to participate in the program. Due to runoff into District structures, 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 the following Phase I entities, (Phoenix, 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 18 different stormwater sampling stations throughout Maricopa County. The USGS conduct the stormwater sampling for the City of Phoenix and Glendale on our behalf and District staff sample for the City of Scottsdale and ADOT.

The second component to the stormwater program at the District involves managing the Phase II stormwater permitting effort on behalf of Maricopa County. Although, the District is not currently listed as a targeted permittee under the Phase II stormwater program, the Environmental Protection Agency (EPA) and Arizona Department of Environmental Quality (ADEQ) have the option of enlisting flood control districts 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 permit cycles of five 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 control measures including: 1) public education, 2) public involvement, 3) illicit discharge detection and elimination, 4) construction activities, 5) post-construction activities, and 6) good housekeeping at municipal operations. The District and other County departments will be responsible for ensuring all six of these components are met. This effort will involve a great deal of interdepartmental interaction.

The third component to the water quality program involves working with the County on being a regional leader on stormwater management issues. The District supports the County in taking 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 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 may be viewed as a resource to other



municipalities within or outside of Maricopa County. Additional County resources include a regional public education effort, a stormwater webpage, and the Volume III – Erosion Control Manual utilized by contractors and stakeholders within the County. This manual includes a series of BMP's for construction site activity. This manual is currently being rewritten and will include post-construction management issues as well.

#### **3.3.2.4 Sand and Gravel Operations in the Floodplain**

The Flood Control District of Maricopa County has regulated sand and gravel mining within watercourses since February 25, 1974, when the County's first floodplain regulations were established. Like all other floodplain activities, sand and gravel mining regulations are based on federal and state requirements for floodplain management. ARS 48-3613 states *"...a person shall not construct any structure which will divert, retard or obstruct the flow of water in any watercourse without securing written authorization from the board of the district in which the watercourse is located... 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....."*

The Floodplain Regulations for Maricopa County define development standards and permit requirements for sand and gravel excavation within flood and erosion hazard zones (Article IX, Section 902.7; Article X, Section 1002.12). The stated purpose of these regulations is to have applicants *"show that excavations will not have 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 allocated and they will comply with any applicable Watercourse Master Plan adopted by the Board of Directors."*

Arizona Revised Statutes (ARS §48-3609) and the Code of Federal Regulations (44 CFR Ch.1) direct Maricopa County to promote and protect the health, peace, safety, comfort, convenience, and general welfare of its residents, to minimize public and private losses due to flood conditions in specific areas, and to enable Maricopa County and its residents to participate in the National Flood Insurance Program, receive Federal Disaster Assistance, obtain flood insurance and reduce the cost of flood insurance.

State regulations also require that local communities enforce development standard in erosion hazard areas. Under the authority of Arizona Revised Statutes 48-3605(a), the Arizona Department of Water Resources (ADWR) developed standards for development near streams subject to lateral erosion.

Federal regulations for the National Flood Insurance Program (NFIP) require local communities to manage development in "flood-related erosion prone areas" in order to participate in the NFIP. 44 CFR Chapter 1, Part 60.5(a) establish minimum standards for floodplain management of erosion-prone areas and requires that participating local communities do the following:

- (1) Require the issuance of a permit for all proposed construction, or other development in the area of flood-related erosion hazard, as it is known to the community.





- (2) Require review of each permit application to determine whether the proposed site alterations and improvements will be reasonably safe from flood-related erosion and will not cause flood-related erosion hazards or otherwise aggravate the existing flood-related erosion hazard.
- (3) If a proposed improvement is found to be in the path of flood-related erosion or to increase the erosion hazard, require the improvement to be relocated or adequate protective measures to be taken which will not aggravate the existing erosion hazard.

44 CFR Chapter 1, Part 60.24 further states that communities with flood-related erosion prone areas should recognize the importance of directing future developments to areas not exposed to flood-related erosion; and the possibility of reserving flood-related erosion-prone areas for open space purposes.

There are a total of 83 sand and gravel operations that have been permitted within FCD jurisdiction since 1974. There have been 51 Floodplain Use permits issued for sand and gravel operations since 1983, almost half of these in the last four years. The current rate of permitting is about five per year, with an average of 46 operations with permits. A detailed review of the Floodplain Use Permit database for Sand and Gravel Activities revealed a total of 152 records of permit applications, not all of which were approved.

### **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. As part of this effort, 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.

Public involvement responsibilities were often performed by technical staff (project managers and engineers) prior to the development of a Public Involvement Program. 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.

Currently, the District's in-house communications staff has three major responsibilities: public education, public involvement and public information. The three functions have distinct elements.

1. Public Education – Educating the public about flooding and related hazards and about the District, its decision-making processes, regulations and projects;
2. Public Involvement – Encouraging the public to contribute input about a project or activity before decisions are made and when choices among alternatives are still available, and assimilating that input into the District's decision-making process; and



3. Public Information – Informing the public about District flood control projects, studies and activities that will impact them and about the District and decisions that have been made.

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

For many years, the public was not 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 proactive 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 operates and maintains.

The Board of Directors, realizing the importance of real-time hydrometeorologic 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 require a land use planning program that emphasizes 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 toward 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 (ADMS's) and Master Plans (ADMP's); Watercourse Master Plans (WCMP's); 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 proactive 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. Recently, the District has been studying about 400 linear miles of floodplains per year with approximately 1,390 linear miles completed as of 2003 and about 5,353 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.

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.

Project start-ups for the floodplain delineation program have included: 213 linear miles and \$1,350,000 for Fiscal Year 2002-2003; 325 linear miles and \$1,175,000 for Fiscal Year 2003-2004; and 27 linear miles and \$715,000 for Fiscal Year 2004-2005. There will be additional delineations completed in FY 2004-05 as part of the four ADMP's that are underway. On the average each year, approximately 300 linear miles of floodplain delineation will be completed over the next 6-7 years.

In 1997, 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 has submitted a listing of mapping needs for a number of watercourses to FEMA for assistance.

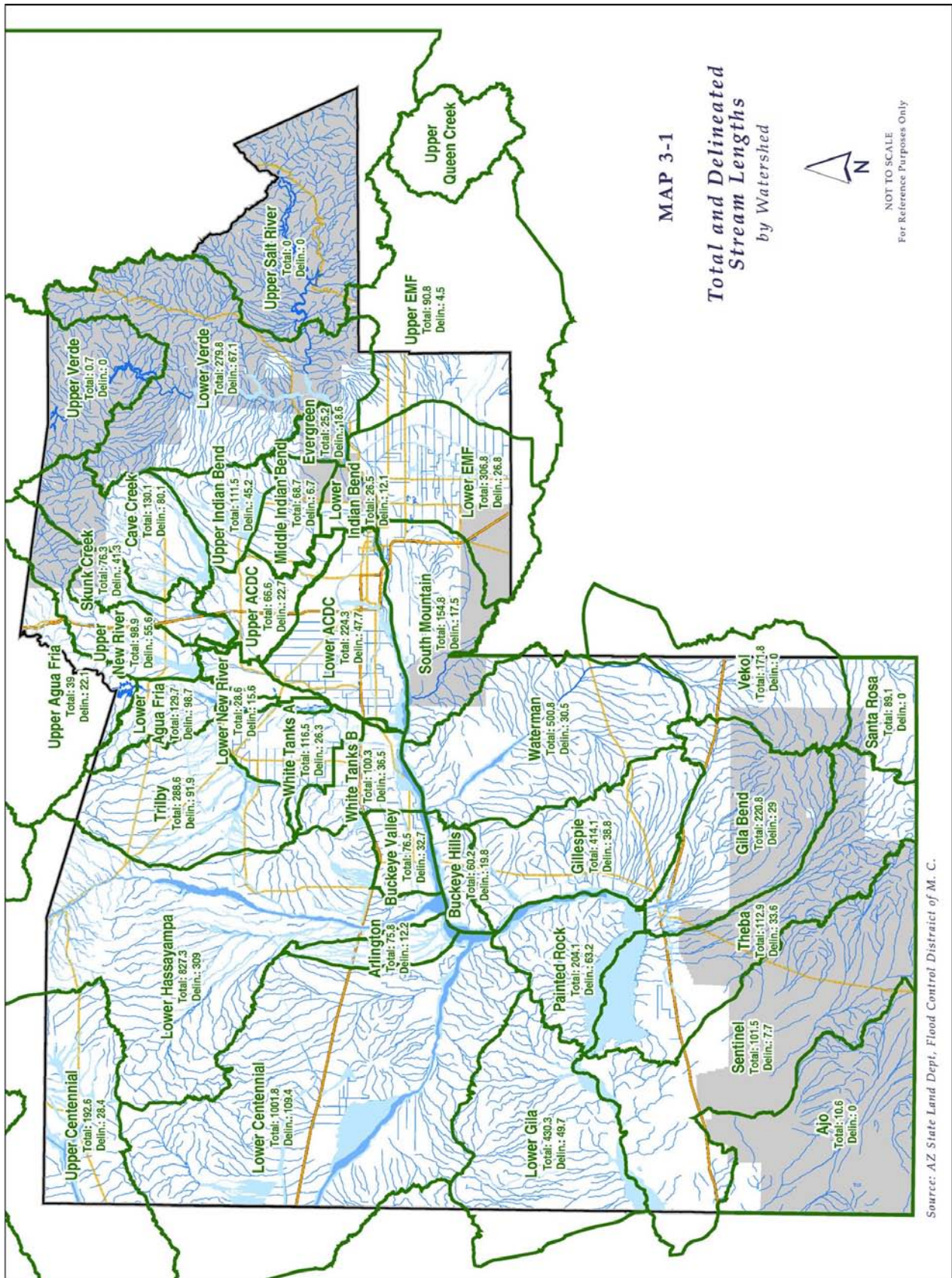
#### **3.3.4.3. Area Drainage Master Studies/Plans**

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 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 is to develop plans to mitigate the flood hazards identified in the preceding ADMS. The major components of the ADMP 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 analyses 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 ADMPs 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/ADMPs and Watercourse Master Plans.



Source: AZ State Land Dept., Flood Control District of M. C.



#### **3.3.4.4. Watercourse Master Plans (WCMP's)**

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, and 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.

WCMPs 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.



#### **3.3.4.6. District Landscaping and Aesthetic Treatment Policy**

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.

#### **3.3.4.7. 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 ESA 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 functions 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 1,087,200 in 1972 to 3,294,911 in 2002, a growth rate of 203 percent<sup>6</sup>. 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

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<sup>1</sup> Flood Control District of Maricopa County. 2003. 2002-2003 Annual Report.

<sup>2</sup> Ibid.

<sup>3</sup> Figures taken from the District Financial Analysis dated 6/7/02.

<sup>4</sup> Updated to 2000 values by Mike Alexander, 06/27/00.

<sup>5</sup> FEMA. Community Rating System. (2000). <http://www.fema.gov/nfip/crs.htm>. (September 14, 2000)

<sup>6</sup> The Real Estate Center. 2005. Maricopa County. AZ Population and Components of Change. <Http://recenter.tamu.edu/data/popc/pc04013.htm>. (January 26, 2005)



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## CHAPTER 4. FLOOD CONTROL PROGRAM REPORT

### 4.1. Overview

This Chapter discusses District reporting requirements mandated by Arizona Revised Statute (§ 48-3616). The first section discusses District reporting specifications and identifies where, in the report, they are located. The remaining portion of the chapter serves to directly meet the outlined reporting requirements. Elements that fulfill the balance of the reporting requirements include: status of all structural projects (since the District's inception), proposed projects, and an analysis of flood problems by watershed.

#### 4.1.1. Report Requirements

As required by the Arizona Revised Statutes, an initial survey of the flood control problems was done in the 1963 Report, as 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. 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 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.

### 4.2. Present Status of all Projects Since 1963

In the 44 years that the District has been in operation, significant changes and growth have taken place in the County. 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. Four decades of growth have occurred since the District's inception. In 1963 the County's population was approximately 800,000 with nearly 120 square miles of land covered with urban development. By the year 2000, the population increased more than 3.86 times, to over 3 million. The amount of land utilized for urban development increased as well, covering approximately 625 square miles of the 9,226 square miles of land in the County. This phenomenal growth has necessitated that



additional projects and studies to be identified and completed to keep up with this ever expanding population.

Summaries 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. A number of projects have been identified over the years but were never built due to funding constraints, changes in site conditions, or other compelling reasons.



Bethany Home Outfall Channel (BHOC), 2005

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 FY2003/04 to FY 2007/08 CIP for the District, and Map 4-2 shows the location of each project.

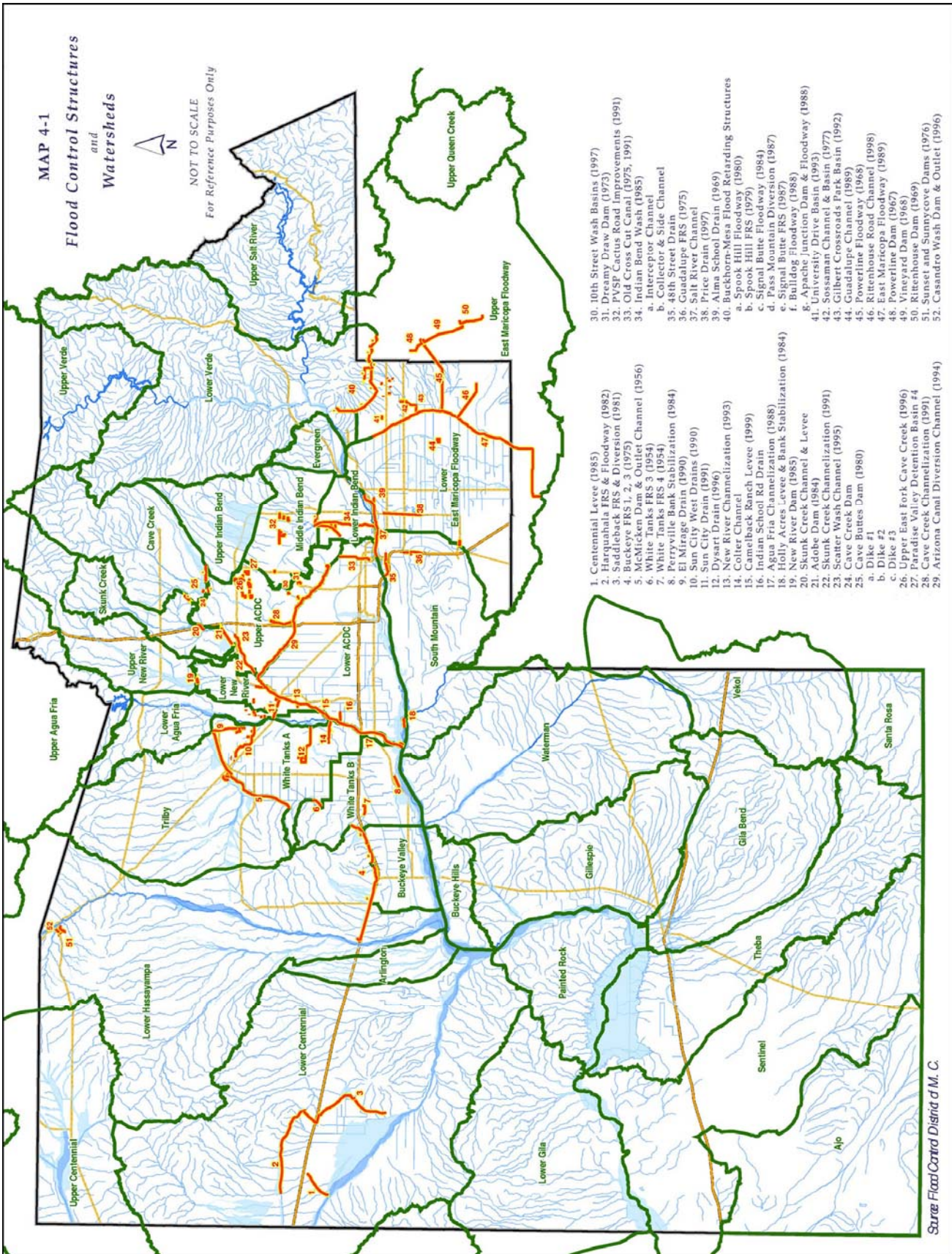
**Table 4-1 Update of Completed structures by Region thru June 2004**

Additional Projects since 1963 Report			
REGION	PROJECT	DESCRIPTION	STATUS
Southeast	Alma School Drain		Completed 1969
	Sossaman Channel and Basin	Earth lined channel with soil cement drop structures	Completed 1977
	Guadalupe Channel	Concrete trapezoidal channel	Completed 1989
	Gilbert Crossroads Park Basin	Earth lined basin with stabilized drop inlets	Completed 1992
	University Drive Basin		Completed 1993
	Price Drain		Completed 1997
	Rittenhouse Road Channel	Earthen channel with rip rap sides	Completed 1998
	Salt River Channel	Earth bottom with soil cement sides and soil cement drop structures	
	Holly Acres Levee and Bank Stabilization	Rip rap and grouted rip rap levee on north bank of river	Completed 1984
	Agua Fria Channelization	Earth channel with soil cement levees and drop structures designed to convey the SPF flood	Completed 1988
	Old Cross Cut Canal	Box culvert for low flow with recreational grass lined channel on top to convey more extreme events	Completed 1991
	New River Channelization	Earth channel with gabion baskets on banks with drop structures, with soil cement bank protection and drop structures in lower reaches	Completed 1993
	Arizona Canal Diversion Channel (ACDC)	Comprised of reaches, the upper most being a buried rectangular box, transitioning into a trapezoidal cement channel, transitioning into an earth lined channel with drop structures, finally transitioning into New River	Completed 1994



**Table 4-1 Update of Completed structures by Region thru June 2004- cont.**

Southwest	Camelback Ranch Levee	Earth channel with soil cement levee on south side of New River and west side of Aqua Free River	Completed 1999
	Indian School Road Drain	This structure carries local street runoff & irrigation tail water into the river	?
	48 <sup>th</sup> Street Drain	Concrete lined trapezoidal channel	Completed 1984
	Ivanhoe and Erie Storm Drains		Completed 2001
	San Tan Collector Channel Phase III	Concrete lined channel and box culvert	Completed 2002
	Sossaman Channel	Drainage Improvements	Completed 2002
	Warner/Greenfield Park Basin	Basin	Completed 2002
	Baseline Road Storm Drain	Storm drain system & basins	Completed 2002
	S.E. Phoenix Regional Drainage System	Large retention basin	Completed 2002
	Alma School Drain	Bring the drain up to appropriate maintenance levels	Completed 2003
	Southern Avenue Channel	Replaced channel with a box culvert & storm drain system	Completed 2003
	Hawes Road Channel	Channel & culvert improvements	Completed 2004
	Elliot Road Detention Basin & Outfall	Basin & outfall channel	Completed 2004
Northeast	Sun City Drain	Cement lined drainage channels	Completed 1991
	Skunk Creek Channel and Levee		
	Adobe Dam	Zoned earth-filled dam	Completed 1982
	Paradise Valley Detention Basin #4		
	PVSP Cactus Road Improvements		Completed 1991
	Cave Creek Channelization	Concrete lined channel	Completed 1991
	Skunk Creek Channelization		Completed 1991
	Scatter Wash Channel	Concrete lined channel	Completed 1995
	Upper East Fork Cave Creek		Completed 1996
	Osborn Road Storm Drain	Storm drain	Completed 2001
	83 <sup>rd</sup> Avenue GCS/Bell Park	Conveyance capacity improvements & bank protection	Completed 2002
	Carefree Town Center Drainage	Drainage facility improvements	Completed 2002
	Greenway Parkway Channel	Channel	Completed 2002
	Doubletree Ranch Rd. System	Storm drain	Completed 2004
	10th Street Wash Basins	Basins	Completed 1997
Northwest	Centennial Levee	Compacted earth embankment with channel along the upstream side	Completed 1985
	Saddleback FRS and Diversion	Compacted earth-fill with core drain	Completed 1981
	Casandro Wash Dam and Outlet	Homogeneous dam	Completed 1996
	El Mirage Drain	Unlined channel	Completed 1990
	Sun City West Drains	Drainage channels carry Sun City street runoff into the Agua Fria River	Completed 1990
	Dysart Drain	Concrete lined channel, shotcreted on top edge	Completed 1996
	Colter Channel	Unlined channel of compacted earth	?
	Bullard Wash		Completed 2001
Southwest	---	NO PROJECTS FOR THIS AREA	---





**Table 4-2 Summary of Capital Improvement Projects by Watershed  
1963-2004**

<b>Region</b>	<b>Watershed</b>	<b>Projects</b>
Southeast	Lower ACDC	8 past structural projects constructed, 5 planned in CIP FY03/04 - 07/08
	Lower East Maricopa Floodway ***	3 past structural project constructed, 4 planned in CIP FY03/04 - 07/08
	South Mountain	4 past structural projects constructed, 3 planned in CIP FY03/04 - 07/08
	Upper East Maricopa Floodway **	17 past structural projects constructed, 6 planned in CIP FY03/04 - 07/08
	Upper Queen Creek *	Watershed outside of County boundary
Northeast	Cave Creek ***	3 past structural projects constructed
	Evergreen	
	Lower Indian Bend	1 past structural projects constructed
	Lower New River	3 past structural projects constructed, 2 planned in CIP FY03/04 - 07/08
	Lower Verde	7 past structural projects constructed, 1 planned in CIP FY03/04 - 07/08
	Middle Indian Bend	3 past structural projects constructed, 1 planned in CIP FY03/04 - 07/08
	Skunk Creek	2 past structural projects constructed
	Upper ACDC	7 past structural projects constructed
	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
	White Tank A	5 past structural projects constructed, 6 planned in CIP FY03/04 - 07/08
White Tank B	3 past structural projects constructed, 2 planned in CIP FY03/04 - 07/08	
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 2003/2004 TO 2007/2008**

City	Summary			Description	Five-Year CIP x \$1,000					5-Yr Total
	Dist.	Reg	Act#		FY 03/04	FY 04/05	FY 05/06	FY 06/07	FY 07/08	
Chandler	1	SE	C022	City of Chandler	1,424	980	0	0	0	2,404
Scottsdale/SRPMIC	1,2	NE	C027	City of Scottsdale	0	575	565	1,100	1,900	4,140
Guadalupe	5	SE	C035	Town of Guadalupe	0	0	0	0	375	375
Multiple	All		C050	Dam Safety Program	758	1,010	350	3,100	2,925	8,143
Phoenix	5	SE	C117	South Phoenix Drainage Improvement	11,045	3,847	1,265	2,475	2,425	21,057
Paradise Valley/Scottsdale	2	NE	C120	PVSP (P.V., Scottsdale, Phoenix)	225	3,050	0	0	0	3,275
Gilbert/Queen Creek/Mesa	1	SE	C121	East Maricopa Floodway	578	3,610	5,300	5,075	5,050	19,613
CORPS/Phoenix	5	SE	C126	Salt/Gila River	0	40	0	0	0	40
Arlington School District	5	NW	C129	Arlington Valley	1,215	0	0	0	0	1,215
Surprise	4	NW	C202	McMicken Dam	1,420	1,225	1,600	0	0	4,245
Phoenix	3	NE	C350	Cave Buttes Dam	0	0	0	0	0	0
Peoria	4	NE	C362	Skunk Creek	890	0	0	0	0	890
Peoria	4	NE	C370	New River Dam	80	0	0	0	0	80
Peoria	4	NE	C400	Skunk Creek/New River	925	6,450	0	0	0	7,375
Mesa	2	SE	C420	Spook Hill ADMP	0	400	1,475	4,050	4,100	10,025
Mesa	1,2	SE	C442	East Mesa ADMP	6,461	6,138	2,640	4,200	6,125	25,564
Glendale/Peoria	4	NE	C450	Glendale/Peoria ADMP	0	565	3,400	3,310	8,100	15,375
Buckeye/El Mirage /Goodyear/Surprise	4,5	NW	C470	White Tanks ADMP	2,707	5,130	15,800	11,600	7,020	42,257
Gilbert/Queen Creek	1	SE	C480	Queen Creek ADMP	1,840	630	70	4,025	4,375	10,940
Chandler/Gilbert/Mesa	1,2	SE	C491	Higley ADMP	100	125	4,050	4,945	2,975	12,195
UMC	3	NE	C520	Skunk Creek Floodprone Properties Acquisition	30	0	0	0	0	30
Avondale/Phoenix/Tolleson	5	SE	C565	Durango ADMP	3,050	2,485	3,035	2,400	4,100	15,070
Paradise Valley/Phoenix	2	NE	C580	ACDC ADMP	4,532	0	0	0	0	4,532
Glendale/Phoenix	4,5	SE	C620	Maryvale ADMP	10,423	2,450	6,400	6,200	5,025	30,498
Phoenix	3	SE	C625	Metro ADMP	400	3,300	0	0	0	3,700
<b>SUBTOTAL PROJECTS</b>					<b>\$48,103</b>	<b>\$42,010</b>	<b>\$45,950</b>	<b>\$52,480</b>	<b>\$54,495</b>	<b>\$243,038</b>
PROJECT RESERVE					\$3,297	\$5,390	\$2,450	\$1,920	\$405	\$13,462
<b>PROJECTS TOTAL</b>					<b>\$51,400</b>	<b>\$47,400</b>	<b>\$48,400</b>	<b>\$54,400</b>	<b>\$54,900</b>	<b>\$256,500</b>
FORCE					\$2,600	\$2,600	\$2,600	\$2,600	\$2,600	\$13,000
<b>CIP PROJECTS TOTAL</b>					<b>\$54,000</b>	<b>\$50,000</b>	<b>\$51,000</b>	<b>\$57,000</b>	<b>\$57,500</b>	<b>\$269,500</b>



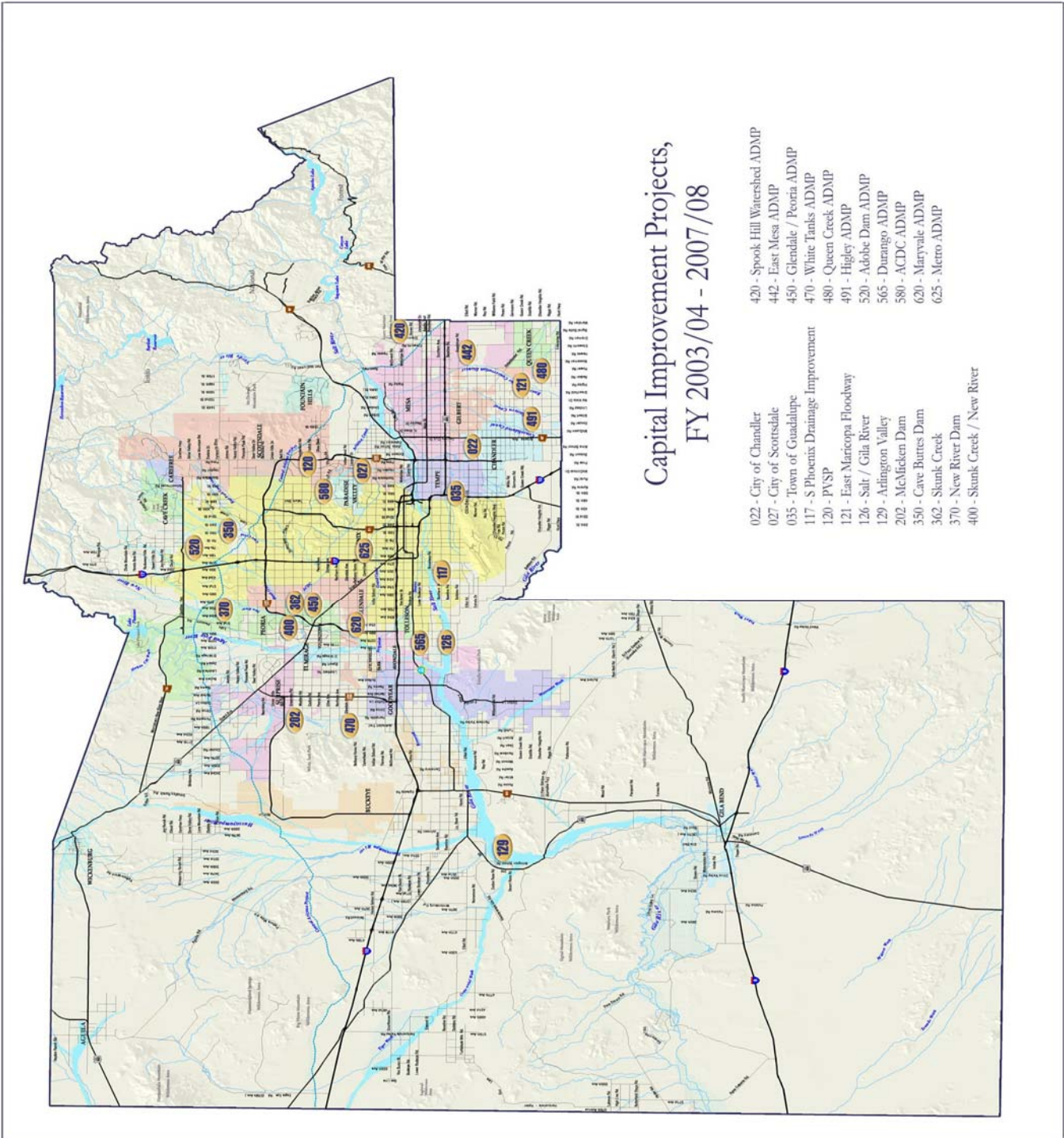


MAP 4-2

Capital Improvement Program



NOT TO SCALE  
 For Reference Purposes Only







### 4.3. Analyzing the Remaining Problems by Watersheds

As noted in Chapter 2, Maricopa County has a varied landscape made up of rugged mountains, hills, flat valleys, and a wide assortment of soil and vegetation types. Development trends and patterns are also varied across the County. To address these vast differences, watersheds are studied individually. Analyzing the District as a whole does not provide for arriving at viable solutions appropriate to each watershed. In addition to geographic differences, the watersheds are at varying stages of urbanization, which requires different levels of activity on the District's part.

Watershed boundaries are generally determined by major drainage areas and are usually named for watercourses or other significant features within the watershed boundary. 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 (see Map 4-3). Significant portions of a number of the 37 watersheds are partially outside the County boundary. This Plan concentrates on the land area that is within Maricopa County. For report purposes, and ease of mapping and discussion, Maricopa's watersheds are divided into four regions. These are geographic boundaries not political boundaries. The regions are labeled as follows:

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

This section presents a broad summary of each region, details the region's physical and socioeconomic characteristics, lists District projects that have been completed or are planned, and assesses the hazards and problems within each region. District projects are detailed for each watershed and organized by project type including capital improvement projects; non-structural projects; studies; structural assessment and retrofit projects; and landscape aesthetics and recreational multi-use projects.

There are several levels of review needed to fully address the issues across the County and identify appropriate projects. A preliminary assessment of watersheds, utilizing the criteria presented below, includes a review of population growth and the development trends within each watershed. Watersheds that appear to be most at risk receive a more detailed risk assessment that includes soil types, slopes, type of future development, projects underway, and the District's flood management responsibilities within each watershed.



*East Bank of the Hassayampa River, February 12, 2005*

Table 4-4 is a representation of key information the District tracks to identify future need. This table lists by watershed a summary of information including area size, expected population



growth, linear miles of delineations, remaining land to be developed, structures in the floodplain and erosion hazard zones, and floodplain use and drainage clearance permits issued, as well as residential completions. 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.

The District takes into consideration a variety of information from external and internal sources to prioritize area need. This information is summarized in [Table 4-4](#). The primary source of external socio-economic data comes from the Maricopa Association of Governments (MAG). One of the most important products MAG provides to governmental agencies, for the purpose of trend analysis, is population growth estimates. MAG updates these numbers annually using data from the Department of Economic Security (DES), U.S. Census, and other sources.

The District also generates a number of datasets, which are also noted in [Table 4-4](#). The District's Floodplain Management Branch is responsible for the delineation of floodplains, and tracks the number of linear miles completed by watershed. Linear miles of delineations were calculated by District staff and are explained in footnotes on [Table 4-4](#). Data for the remaining land to potentially be developed were calculated utilizing techniques noted in Chapter 2. Numbers for floodplain permits issued are based on the information from the District's database for these permits and include both incorporated and unincorporated areas. The numbers for drainage clearance permits are a reflection of total building permits issued in the watersheds by the County and municipalities.

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 District's 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.



*District O & M crews working on structure*



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

Watershed	Area (square miles) Inside County Boundary	Population (2000)	Projected Population (2020)	Population Change (2000-2020)	100,000 Scale Hydrography (Linear Stream Miles)	Approximate & Detailed Delineated (Linear Miles) <sup>2</sup>	Delimitations remaining to be done	Potential Developable Land (Square Miles)	Structures in Floodway	Structures in 100 year Floodplain	Floodplain Use Permits Issued 1993-2003	Drainage Clearance Permits 1993-2003	Residential Completions 1993-2003
<b>SOUTHEAST REGION</b>													
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
Upper East Maricopa Floodway**	132	134,097	269,438	135,341	99	5	86	63.00	0	212	59	7,004	33,226
Soulin Mountain	245	263,341	381,670	118,329	272	18	137	46.90	0	464	29	929	19,441
Lower ACDC	235	893,014	1,065,688	172,674	224	27	177	77.31	41	6,414	225	4,113	33,797
Lower East Maricopa Floodway***	265	676,724	919,497	242,773	315	48	280	87.00	0	3,017	235	6,889	76,145
<b>TOTAL</b>	<b>877</b>	<b>1,967,176</b>	<b>2,636,293</b>	<b>669,117</b>	<b>910</b>	<b>97</b>	<b>680</b>	<b>279.21</b>	<b>41</b>	<b>10,107</b>	<b>548</b>	<b>15,235</b>	<b>162,609</b>
<b>NORTHEAST REGION</b>													
Cave Creek**	194	33,751	91,967	58,216	259	80	50	63.00	18	2,275	527	5,793	13,282
Evergreen	40	2,965	13,805	10,819	83	19	7	2.15	0	0	5	0	1,537
Lower Indian Bend	43	93,473	104,535	11,062	48	12	14	0.50	0	485	3	26	757
Lower New River	42	93,479	134,366	40,887	29	16	13	16.93	0	21	4	1,266	19,651
Lower Verde	560	39,919	100,294	60,375	1,022	67	213	55.20	2	32	73	4,868	10,319
Middle Indian Bend	95	205,104	231,847	26,743	85	7	62	11.17	0	50	0	0	12,951
Skunk Creek	89	17,084	64,821	47,737	94	41	35	41.10	37	127	0	3,849	5,624
Upper ACDC	120	390,707	420,382	29,675	70	23	44	25.00	36	1,190	5	375	22,483
Upper Agua Fria***	62	79	1,116	1,037	61	22	17	7.23	0	0	1	0	7
Upper Indian Bend	99	40,803	145,274	104,471	121	45	66	63.99	0	6,013	76	192	15,229
Upper New River***	143	5,041	49,066	44,025	161	56	43	68.58	13	31	30	9,479	4,887
Upper Verde**	168	41	1,263	1,222	252	0	1	0.20	0	0	0	0	0
Upper Salt River**	388	55	127	72	549	0	0	0.00	0	0	0	0	7
<b>TOTAL</b>	<b>2,013</b>	<b>922,522</b>	<b>1,359,863</b>	<b>436,341</b>	<b>2,442</b>	<b>276</b>	<b>565</b>	<b>355.05</b>	<b>106</b>	<b>10,224</b>	<b>724</b>	<b>25,886</b>	<b>106,724</b>
<b>NORTHWEST REGION</b>													
Arlington	66	1,644	3,767	2,123	76	12	64	59.40	4	3	42	475	408
Buckeye Hills	58	124	6,555	6,431	63	20	40	3.78	0	0	26	22	20
Buckeye Valley	70	11,211	21,646	10,435	77	33	44	57.91	0	61	32	470	1,060
Lower Agua Fria	106	28,835	57,100	28,265	140	99	31	47.70	0	36	76	1,362	5,932
Lower Centennial***	990	11,657	13,185	1,528	1,070	109	892	347.03	2	42	58	1,217	446
Lower Hassayampa***	800	9,733	19,742	10,009	864	309	518	390.82	39	367	55	1,454	986
Triby (Wittman)***	200	5,484	19,612	14,128	314	92	197	210.36	17	98	124	2,876	1,339
Upper Centennial***	231	1,225	3,015	1,790	201	28	164	172.20	2	131	37	283	137
White Tank A	132	93,026	169,792	76,766	120	26	90	92.25	0	627	98	10,786	40,750
White Tank B	110	23,425	62,756	39,331	109	37	64	76.81	4	61	69	1,676	6,848
Upper Hassayampa*	[600]	0	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	0	0
<b>TOTAL</b>	<b>2,853</b>	<b>186,364</b>	<b>377,170</b>	<b>190,806</b>	<b>3,034</b>	<b>765</b>	<b>2,104</b>	<b>1459.26</b>	<b>68</b>	<b>1,426</b>	<b>617</b>	<b>20,621</b>	<b>57,926</b>
<b>SOUTHWEST REGION</b>													
Alto***	418	0	388	388	321	0	11	5.14	0	0	0	0	0
Gila Bend	350	2,229	2,000	-229	472	29	192	24.93	10	92	31	25	50
Gilispie	322	261	9,334	9,073	431	39	375	84.70	0	2	2	40	30
Lower Gila***	380	107	2,754	2,647	462	50	381	62.90	0	4	1	7	2
Painted Rock	188	70	1,400	1,330	229	63	141	16.20	0	0	5	8	4
Santa Rosa***	107	143	97	-46	108	8	89	0.00	0	0	0	0	0
Sentinel***	627	96	1,765	1,669	425	8	94	55.23	0	3	0	7	6
Theba***	433	5,485	19,612	14,127	410	34	79	125.65	0	12	0	8	0
Verde***	190	31	401	370	226	0	172	25.06	0	0	0	2	4
Waterman**	462	5,211	16,752	11,541	528	31	470	144.17	0	6	4	1,118	2,431
<b>TOTAL</b>	<b>3,477</b>	<b>13,633</b>	<b>54,503</b>	<b>40,870</b>	<b>3,613</b>	<b>253</b>	<b>2,004</b>	<b>543.98</b>	<b>10</b>	<b>119</b>	<b>1,932</b>	<b>12,151</b>	<b>2,527</b>
<b>COUNTY TOTAL</b>	<b>9,220</b>	<b>3,089,695</b>	<b>4,426,829</b>	<b>1,337,134</b>	<b>9,999</b>	<b>1,390</b>	<b>5,353</b>	<b>2636.50</b>	<b>225</b>	<b>21,876</b>	<b>1,932</b>	<b>62,957</b>	<b>329,785</b>

\* Watershed completely outside of Maricopa County boundary  
 \*\* 90% of watershed outside of Maricopa County boundary  
 \*\*\* A portion of the Watershed lies outside the Maricopa County boundary  
 1 Linear Stream Mile data derived from 15 Quadrangle USGS maps. Linear stream miles include canals and laterals. Braided streams were "thinned" so that watercourse length wasn't exaggerated unduly.  
 2 Estimate of Delineated Miles includes floodplains already delineated utilizing GIS. Miles are the intersection of delineated (FEMA approved) floodplains within the hydrography layer. This includes streams that haven't necessarily been explicitly delineated in detail, but happen to cross through a Zone A area. The actual number of detailed delineations would be somewhat less. In cases where there were delineations performed in an otherwise excluded area, these were included in the total delineations figure.



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

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 to be mitigated over time as solutions are identified. 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, potentially restoring riparian areas along corridors.

#### 4.3.1.3. Land Status

The existing land use pattern for the Southeast Region is vastly different from the total county averages. Residential and commercial development is 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 compared to overall county figures. Map 4-5 shows the land use patterns over this Region.

Also, land ownership patterns in the Southeast Region are decidedly different from the county averages. Private ownership accounts for 73 percent of the total land in this region versus 29 percent<sup>1</sup> for the county. Native American lands account for 17 percent of ownership versus just under five percent for the county as a whole. State, federal, military, and national forest ownership average around ten percent, which is well below the total for the entire county.

Approximately 597 square miles of the total 877 square miles of the 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 1,967,176 in 2000. Over three-fifths (63 percent) of the total residents of Maricopa County lived in this Region as of 2000, but this total will drop from 63 percent to 59 percent by 2020 as other regions gain in population. The projected population for the Region is expected to be 2,636,293 by 2020 or an increase of 669,117 over the 20-year time frame. This additional population represents an increase of approximately 34 percent over the 20 years or about 33,456 people per year. This 3.30 percent growth rate on an annual basis is well above the state average of 1.91 percent and ahead of the overall Maricopa County rate of 2.85 percent per year. The Lower ACDC and Lower East Maricopa Floodway Watersheds are expected to have the largest population gains over this 20-year period. Map 4-6 shows the land ownership and population projections over this region.



View from South Mountain Park looking north to the East

#### 4.3.1.5. Hazard and Problem Assessment

The Southeast Region is more heavily populated than the other three regions. Population projections show the largest 20-year increase in total numbers of people among the four regions. Although growth is rapid, available developable land should be adequate for projected population without impacting flood hazard areas. Most new development is master planned communities and associated businesses.

However, the 680 linear miles of delineations out of 910 identified by the USGS 100,000 scale hydrography need to be re-evaluated to determine how urbanization has affected these originally identified streams. There are 41 structures in the delineated floodway and 10,107 structures in the floodplain as identified in a review of 2004 aerial photos with floodplain overlays. The majority (10,107 buildings) are also in a moderate or severe erosion hazard zone. 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. About 15,235 drainage clearance permits and 548 floodplain use permits were issued from 1993 to 2003. Map 4-7 shows the number of residential completions during this same year. With over 162,609 new builds over a ten-year period this region far exceeds any other region in growth.

The District will continue its public education and regulatory programs to prevent loss from flood hazards. In addition, specific problems that need to be addressed through the District's other programs in the Southeast Region Watersheds (that are inside the County's boundary) include the following:

- Analysis through the ADMPs of urban watershed issues needs to be done in detail for some watersheds in this region.
- WMS or other appropriate programs need to be used for each watershed to determine if there are still streams to be delineated as identified in the USGS 100,000 scale hydrography.
- 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 section 4.3.1.7.b.
- All 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 Floodprone Acquisition Program needs to be considered for the properties in the Tres Rios/Holly Acres (repetitive loss) area for homes in the highest hazard category.
- A more detailed look at homes that have been constructed in delineated floodplains and severe erosion hazard areas needs to be done.

**4.3.1.6. District Activities Completed**

**4.3.1.6.a. Flood Hazard Identification Program**

A number of Area Drainage Master Studies and Area Drainage Master Plans have been completed or are in process for the Southeast Region and are listed below. Watercourse delineations, totaling 228 linear miles, have been completed in the five watersheds out of an estimated 910 linear miles from the 100,000 scale USGS Hydrography. The South Mountain Watershed has 137 lineal miles of these detailed delineations. These studies are also listed.

<b>Program</b>	<b>Watershed</b>	<b>Project Name / Description</b>	<b>Completed</b>
<b>Planning Studies</b>	Lower ACDC	Maryvale ADMS	1997
		Durango ADMP	2002
		Tres Rios Study - Corps of Engineers	2002
	Lower East Maricopa Floodway	Mesa/Gilbert/Chandler ADMS	1988, 1994
		Lower East Maricopa Floodway Study	1980's
		East Mesa ADMP	1998
		Higley ADMP	2000
		EMF Capacity Mitigation Study	2000
		Queen Creek/Sanokai Wash Hydraulic Master Plan (includes Upper EMF)	2000





Program	Watershed	Project Name / Description	Completed
<b>Planning Studies</b>	South Mountain	Hohokam	1980's
		Foothills ADMS	1980's
		Laveen ADMS	1990, 1994
		South Phoenix/Laveen ADMP	1997
		Laveen ADMP	2001
Upper East Maricopa Floodway	East Maricopa County ADMS	Queen Creek ADMS	1987
		East Mesa ADMP	1991
		East Mesa ADMP	1998
Upper Queen Creek		No ADMS/ADMP's done for this watershed	

Program	Floodplain Delineation Studies	River Miles	Year
<b>Delineations</b>	Queen Creek Topo/FIS	22	1986
	Salt River Topo/FIS	11	1986
	Gilbert-Chandler Topo/FIS	45	1987
	Southern Pacific Railroad/Queen Creek	8	1989
	Laveen (ADMS)	21	1989
	Cross Roads Park LOMR	n/a	1990
	Salt & Gila River	32	1992
	Tolleson Area Study (SPRR, Roosevelt Canal)	15	1995
	Queen Creek (near the Town)	4	1995
	EMF – all 6 reaches, 3 discharges (non-FEMA)	21	1997
	Sanokai Wash (not submitted to FEMA)	7	1997
	Rittenhouse Channel	4	1998
	Laveen	6	1999
	Camelback Ranch Levee North	2	1999
	Phoenix Rio Salado (Salt River above 19 <sup>th</sup> Ave)	n/a	1999
	Eastern Canal North FDS	7	2000
	Consolidated Canal	7	2000
	Highline/Western Canal FDS	10	2002
Tempe Canal FDS	6	2003	
	Total Linear Miles	228	

Program	Project Name / Description	Completed
<b>Structures Retrofit</b>	Phase 3 – East Valley Structures Assessment of opportunities to retrofit existing flood control facilities to provide landscaping and aesthetic treatments, multi-use opportunities	2002
	Design Concept Reports – District flood control facilities and floodplains as components of the Maricopa County Regional Trail System completed for the following: Agua Fria River (1999), East Maricopa Floodway (2000)	2000



Program	Project Name / Description	Completed
<b>Structures Retrofit</b>	Native vegetation salvage as part of project implementation for 4-5 Basins Project is complete and has been initiated for the East Mesa Detention Basin Project.	-
	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, 43 <sup>rd</sup> Avenue Detention Basin Tempe Town Lake, Old Cross Cut Cannel Project	various

**4.3.1.6.b. Flood Hazard Remediation Program**

A variety of different structural projects have been constructed in the southeastern watersheds over the years. These projects are as follows:

Program	Watershed	Project Name / Description	Completed
<b>Structural/ CIP</b>	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
	Lower East Maricopa Floodway	Salt River Channel	
		San Tan Collector Channel Phase III	2002
		Alma School Drain	2003
		Gilbert Crossroads Park Basin	1992
		Price Drain	1997
		Roosevelt Water Conservation District (RWCD) Tailwater Analysis	2003
		Ivanhoe and Erie Storm Drains	2003
		EMF Capacity Mitigation detention basins and channel improvements	2003
	South Mountain	Guadalupe FRS	1975
		48 <sup>th</sup> Street Drain	
		Baseline Road Storm Drain	2002
		S.E. Phoenix Regional Drain System	2002
		Phoenix Rio Salado Project Environmental Restoration	2002



Program	Watershed	Project Name / Description	Completed
Structural / CIP	Upper East Maricopa Floodway	Powerline Dam	1967
		Powerline Floodway	1968
		Vineyard Dam	1968
		Rittenhouse Dam	1969
		Alma School Drain	1969
		Sossaman Channel & Basin	1977, 1988
		Guadalupe Channel	1989
		East Maricopa Floodway	1989
		University Drive Basin	1993
		Rittenhouse Road Channel	1998
		Sossaman Channel	2002
		Warner/Greenfield Park Basin	2002
		Southern Avenue Channel	2003
		Hawes Road Channel	2004
Elliot Road Detention Basin & Outfall	2004		
	Upper Queen Creek	No District Structures	-

#### 4.3.1.7. Future Activities (Presently Identified)

##### 4.3.1.7.a. Flood Hazard Identification Program

**Planning** – Planning studies, delineations and other non-structural projects that are to be started in the watersheds for the Southeastern Region are noted below:

- Metro Area Drainage Master Study and Plan for the Lower ACDC Watershed to be started Fiscal Year 2005-2006.

**Structures Assessment /Dam Safety Program** – Currently all of the dams and FRSs 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.

**Other Non-Structural** – The District will utilize existing floodplain and drainage regulations to minimize and prevent damages from flooding problems. Operation and maintenance of existing structures will be ongoing to preserve the life of facilities and prevent flooding from occurring due to maintenance issues.

**Landscape Aesthetics and Recreational Multi-Use Projects** – Implementation of the District’s Landscaping and Aesthetic Treatment Policy includes tasks in the scope of work for WCMPs and ADMPs 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. An analysis of recreation multi-use opportunities in conjunction with the District’s Structures Assessment Program is ongoing.



#### **4.3.1.7.b. Flood Hazard Remediation Program**

**Structures/CIP** – The CIP for Fiscal Years 2003/2004 to 2007/2008 (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

- *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.
- *Ellsworth Channel* – This project includes construction of a flood control channel to mitigate existing and future flooding along Ellsworth Road. Flooding occurs frequently at five 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.
- *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.
- *Siphon Draw Drainage Improvements* – This project would intercept flows entering Maricopa County from the east and convey the flow in a channel along Meridian Road from Guadalupe Road south to Elliot Road. A storm drain pipe or channel system will convey the flow to the existing storm drain along Elliot Road. A detention basin located on the northeast corner of Elliot Road and Meridian Road will decrease the flows that are conveyed to the Elliot Road pipe system.

##### Lower East Maricopa Floodway Watershed

- *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. The project will be completed in Fiscal Year 2004/2005.

Phase 1 – (complete)

Phase 2 – Arrowhead Pump Station and Force Main (under construction)

Phase 3 – Galveston Basin and Erie Drains (design in process)

Phase 4 – Denver Basin Pump Station

Phase 5 – Hartford Force Main and Pecos Road Drain

- *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.

- *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

- *43<sup>rd</sup> 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 43<sup>rd</sup> Avenue to the Salt River.
- *South Phoenix Detention 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.

#### Lower ACDC Watershed

- *Durango Regional Conveyance Channel* – Begins just south of Van Buren Street near 67<sup>th</sup> 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 67<sup>th</sup> Avenue, one near Buckeye Road and 75<sup>th</sup> Avenue, and one near Lower Buckeye Road and 91<sup>st</sup> Avenue. Total cost of this project is estimated at \$55,000,000.
- *Durango Regional Outfall Project* – Includes a primary outlet channel, three basins and two auxiliary channels. These auxiliary channels, located on 91<sup>st</sup> and 99<sup>th</sup> 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.
- *67<sup>th</sup> Avenue Storm Drain* – ten-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.
- *Bethany Home Road Outfall Channel* – Includes a linear basin and channel along the north side of the Grand Canal extending westerly from 64<sup>th</sup> 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 73<sup>rd</sup> Avenue and an earthen, linear, on-line detention basin from 67<sup>th</sup> Avenue to 73<sup>rd</sup> Avenue.

- *24<sup>th</sup> Avenue / Camelback Basin* – This project is proposed to reduce flooding for the area.
- *Tres Rios Basins Project* – Consists of for four detention basins, two adjacent to the Salt River and two adjacent to the Gila River. The basins would be located between 107<sup>th</sup> 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. A levee is being constructed as part of a USACE/City of Phoenix project.

**Recommended Projects** – Additional projects, for the Southeast area, which were recommended through the FY 04/05 Capital Improvement Project process, but not yet included in the CIP are the following:

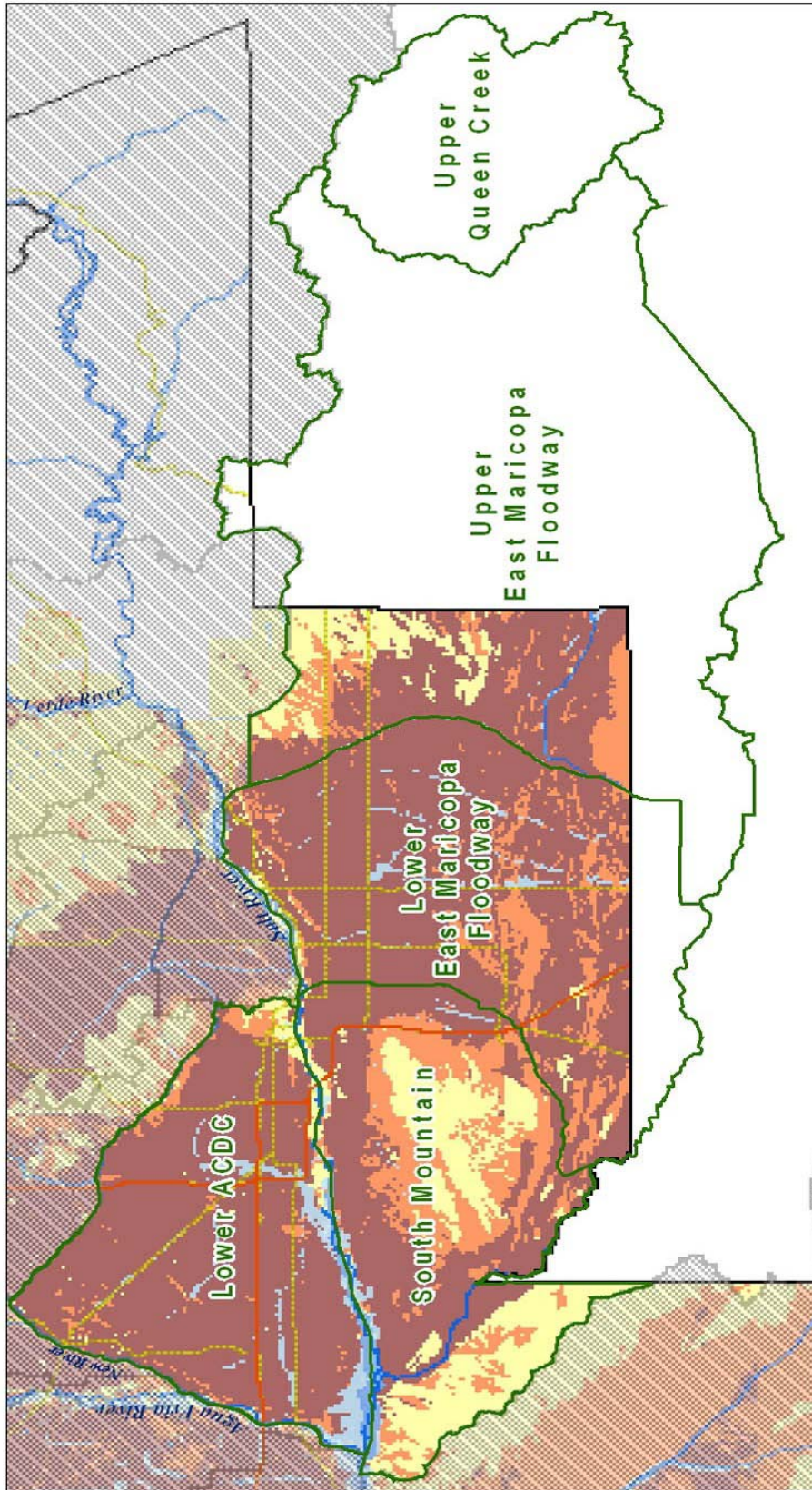
<i>Project Title</i>	<i>Project Description</i>	<i>Proposal Date</i>	<i>Project Developed From</i>	<i>Structures/Utilities/Population Protected</i>	<i>Total Initial Cost Estimate</i>	<i>Proposed Cost Share</i>
Higley Outfall Basin Channel/Basins Project	Outfall channels and/or basin	2001	Higley ADMP	3 municipal jurisdictions and the Gila River Indian Community (GRIC)	\$12 to \$15M	50% District 10% Mesa 15% Chandler 15% Gilbert 5% MCDOT 5% ADOT
Land Acquisition for the Consolidated Canal Diversion Channel	Land Acquisition	2004	Higley ADMP	Roadways, schools and churches. There is no population that is directly impacted by the project at this time.	\$2.6M	100% District
Pecos Road Channel	Earthen Channel	2004	East Mesa ADMP	Four large industrial sites – GM Proving Grounds, TRW, Olin Mitsubishi and Baker Recycling.	\$13.62M	25% Mesa 75% District
Pecos North & Pecos South Detention Basins	Detention Basins	2000	East Mesa ADMP	Four large industrial sites – GM Proving Grounds, TRW, Olin Mitsubishi and Baker Recycling and approximately 2000 acres.	\$15.5M	25% Mesa 75% District
Southern Avenue Storm Drain – Phase II	Storm Drain	1995	Durango Regional Outfall Project	Protection will also be provided to 0.5 square miles of frequently flooded vacant land that currently has little economic utility.	\$1.5M	50% Mesa 50% District
Bethany Home Storm Drain	Storm Drain	2 000	Maryvale ADMP	Grand Avenue, ADOT by providing a drainage outlet for the proposed intersections on improvements at 51 <sup>st</sup> and Grand Avenues.	\$3.15M	50% Glendale 50% District
Meridian North/South Channels	Two Earthen Channels	1999	East Mesa ADMP	Four large industrial sites – GM Proving Grounds, TRW, Olin Mitsubishi and Baker Recycling	\$2.4M	25% Mesa 75% District

**4.3.1.8. Summary**

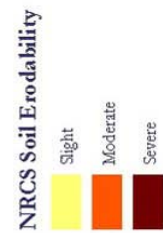
Considerable effort by the District over the years has resulted in mitigation of many of the flood hazards in the Southeast Region, which is the most populated area. The Salt River, major washes, and irrigation canal systems still pose some hazards and the District does floodplain management for five of the twelve municipalities and unincorporated areas of this region. The District will continue to have involvement in studies and projects throughout this area.



**SOUTHEAST REGION**



Source: NRCS



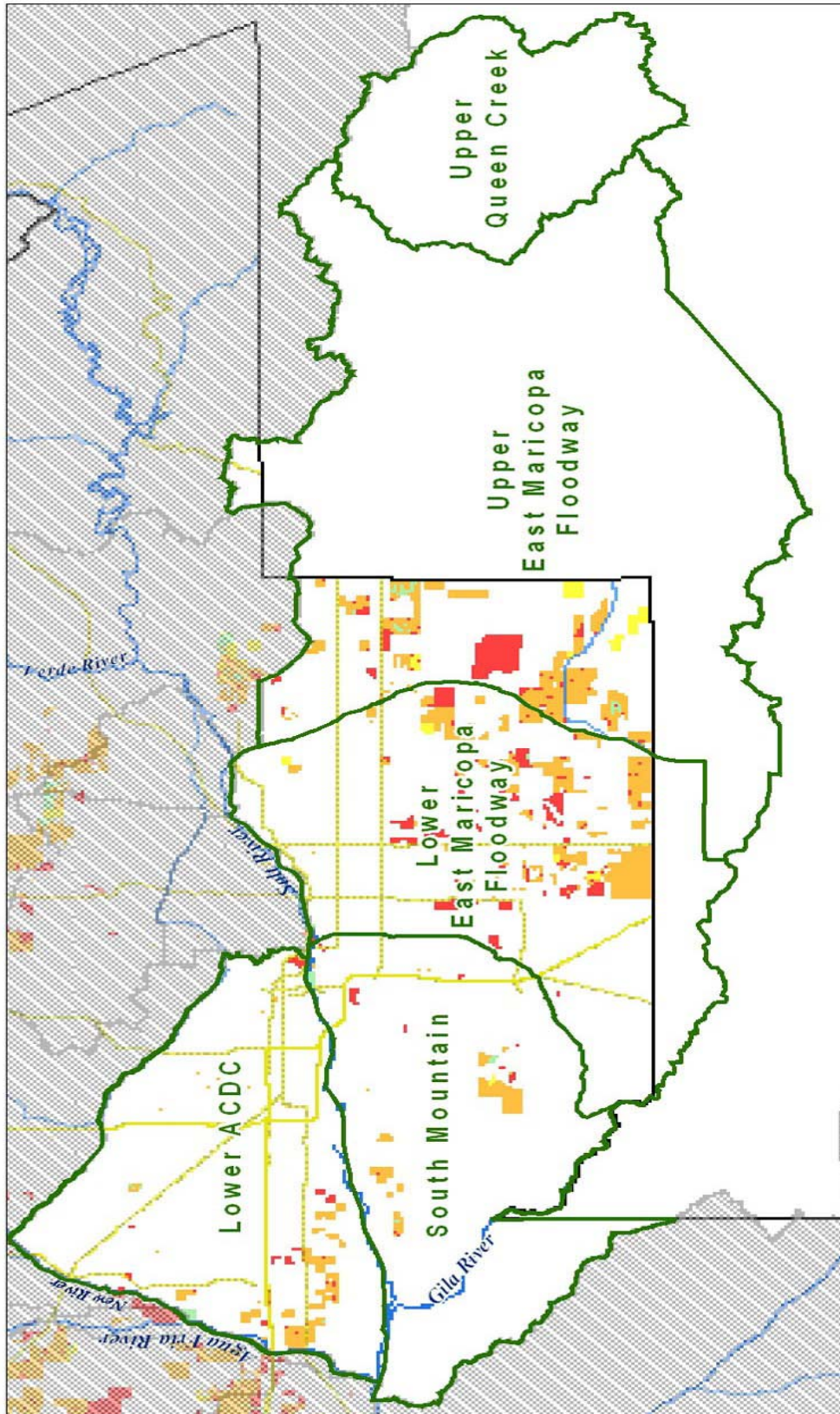
**MAP 4-4**  
**SOIL EROSION**  
*and*  
**FLOODPLAINS**



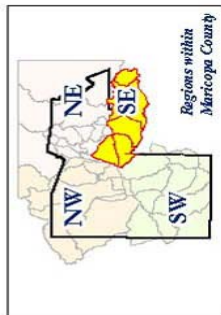
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SOUTHEAST REGION



Source: Maricopa Association of Governments



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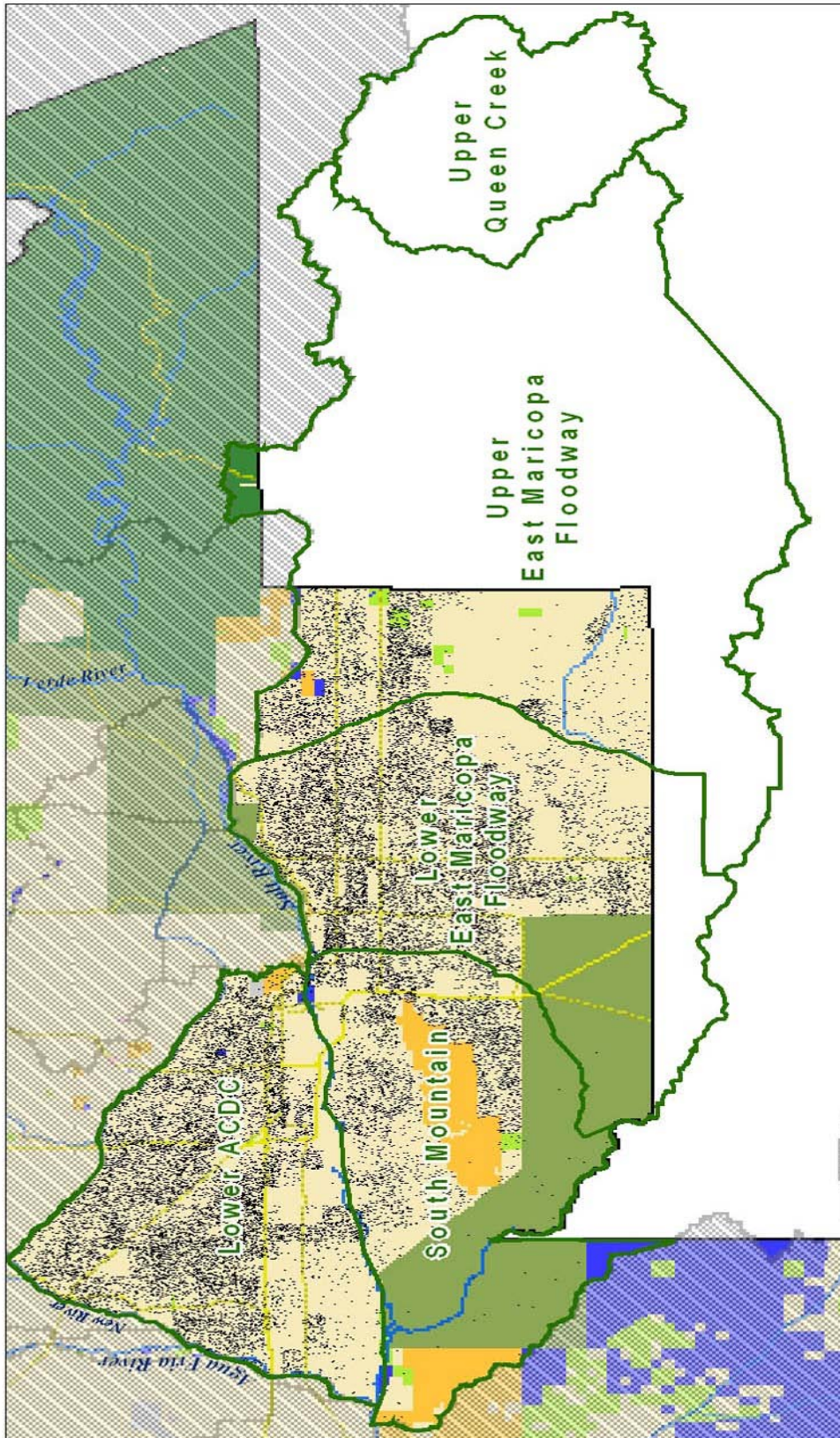
MAP 4-5

LAND USE

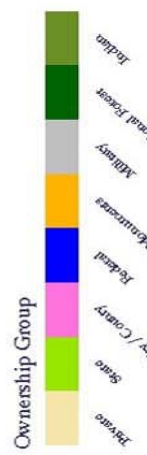




SOUTHEAST REGION



Source: NRCGS, US Census Bureau



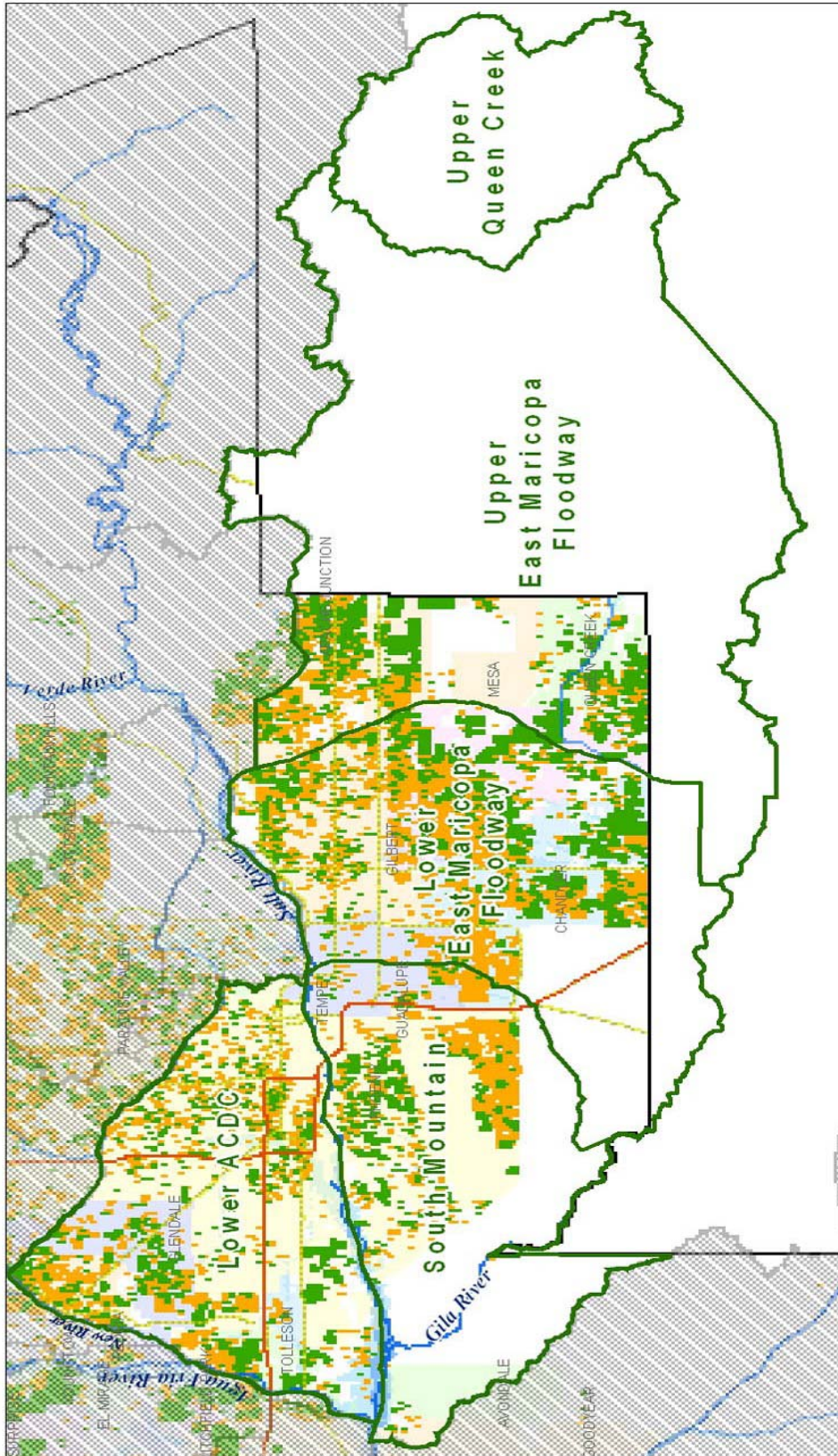
MAP 4-6  
LAND OWNERSHIP  
and  
POPULATION PROJECTIONS

NOT TO SCALE  
For Reference Purposes Only

2020 Population Projection, 1 dot = 100 people



**SOUTHEAST REGION**



Source: Maricopa Association of Governments



**MAP 4-7  
RESIDENTIAL  
COMPLETIONS**



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For Reference Purposes Only

- Residence Completed, 1990-1999
- Residence Completed, 1999-2002



## 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 4-8](#) shows the location of these watersheds. The watershed areas within Maricopa County in this region contain 2,013 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. Physical Characteristics

The region in general is mountainous with slopes over 15 percent for more than 50 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**

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 within the region. Additional open space areas of significance outside of the Forest Service boundary are Lake Pleasant and BLM 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.

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 29 percent for the county as a whole. Native American lands account for six percent of the region versus just under five percent for the county. An extreme is national forest which accounts for 51 percent of the region versus 11 percent when averaging over Maricopa County.

Approximately 1,658 square miles of the 2,013 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 922,522 in 2000. 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 2020 is 1,358,863 or an increase of 436,341 people over the 20-year time frame or about 21,817 per year. This 2.95 percent growth rate on an annual basis is slightly greater than the Maricopa County rate of 2.85 percent per year. The Upper Indian Bend and Lower Verde Watersheds are expected to see the largest increases. [Map 4-10](#) displays the land ownership and population projections for the northeast area.

#### **4.3.2.5. 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. Areas that could be developed are not as extensive in this region as private land is less than the County average. Single-lot development is more predominant than master planned communities. Natural drainage patterns are still in place, versus the developed farmland, creating challenges for development.

Approximately 565 linear miles of delineations out of 2,442 still remain to be done so that these new residences will not develop in flood and erosion hazard areas. Possible re-evaluation of the USGS 100,000 scale Hydrography of previously identified undelineated streams needs to



be done to determine if they have been affected by urbanization. Studies and delineation work has been directed to more urbanized areas due to the lower population at risk and high percentage of government-held land. This has resulted in 106 structures in the floodway and 10,224 structures in the floodplain.

About 25,886 drainage clearance and 724 floodplain use permits were issued from 1993 to 2003. [Map 4-11](#) shows the number of residential completions during this same year. With over 106,724 new builds over a ten-year period, this region ranks second in projected growth.

The District will continue its public education and regulatory programs to prevent loss from flood hazards. Specific 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:

- ADMPs need to be completed for those areas not yet studied and those studies completed over ten years ago need to be revisited.
- About 89 percent of the watercourses are not yet delineated. Evaluation of the remaining 565 linear miles of watercourses needs to be done to determine if additional delineations are warranted.
- 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.
- The Floodprone Properties Acquisition Program needs to be considered for the 106 property owners with buildings that were constructed in delineated floodways, with priority given to residential homes in the highest hazard category.
- A more detailed look at the approximate 10,224 buildings at risk that were constructed in the delineated floodplain and severe erosion hazard areas needs to be done.
- Coordination with Maricopa County Department of Transportation on the various road crossings that have been closed due to flooding should be done to determine if joint projects can be done.



*Photos from Scottsdale Road Corridor DMP, 2002*

#### **4.3.2.6. District Activities Completed**

##### **4.3.2.6.a. Flood Hazard Identification Program**

A number of Area Drainage Master Studies and Area Drainage Master Plans have been completed or are in process for the Northeast Region and are listed below. Watercourse delineations, totaling 542 linear miles, have been completed in the Northeast Region out of an estimated 2,442 linear miles from the 100,000 scale USGS Hydrography. Delineations have been done in all of the watersheds, with the most in the Lower Verde Watershed. These studies are also listed.



Program	Watershed	Project Name / Description	Completed
Planning	Cave Creek	Apache Wash Drainage/Storm Drain Master Plan	1990
		Cave Creek/Carefree ADMS	1993
		Upper Cave Creek/Apache Wash Watercourse Master Plan	2001
		Town of Carefree ADMP	2002
		Adobe Dam / Desert Hills	2005
Evergreen	Desert Greenbelt		1980's
		Fountain Hills	1997
Lower Indian Bend	Salt River Tempe/Mesa Habitat Mitigation		-
Lower New River	ACDC ADMS		1986, 1993
		Glendale/Peoria ADMP	1987, 2001
Lower Verde	Spook Hill ADMP		1987, 2002
		Rio Verde ADMP	2005
Middle Indian Bend	Scottsdale/Paradise Valley ADMS		1980's
Skunk Creek	Adobe Dam		1980's
		Skunk Creek Water Course Master Plan	2001
Upper ACDC	Upper East Fork Cave Creek ADMS		1987
		ACDC ADMS	1986, 1992
Upper Agua Fria	No Studies done		
Upper Indian Bend	Pinnacle Peak ADMS		1980's
Upper New River	New River ADMS		1995
Upper Verde	No Studies done		
Upper Salt River	No Studies done		

Program	Floodplain Delineation Studies	River Miles	Year
Delineations	Buchanan Wash Topo/FIS	1	1986
	Cave Creek – ACDC to Cave Buttes	13	1988
	Cave Creek FEMA Topo/FIS	15	1988
	Cave Creek/Carefree FIS	35	1988
	Cemetery Wash FEMA Topo/FIS	2	1988
	Galloway Wash FEMA Topo/FIS	3	1988
	Apache Wash FIS	25	1989
	Cline & Roger Creek	25	1989
	East Fork of Cave Creek	4	1989
	Morgan City (SAME AS CLINE & ROGER)	25	1989
	New River/Skunk Creek FIS	6	1989
	Skunk Creek FIS	15	1989
	Deadman Wash	14	1991
	New River (Grand Ave to Bell Rd – spf only)	3	1991



Program	Floodplain Delineation Studies	River Miles	Year
Delineations	Fountain Hills	35	1992
	Indian Bend Wash	17	1993
	New River (Grand to Bell – 10 & 100 yr spf)	3	1993
	Rio Verde - North (several washes)	10	1993
	Rio Verde - South (several washes)	6	1993
	Echo Canyon Wash	2	1994
	Cave Creek (above Carefree Highway)	12	1995
	Cave Creek (below Carefree Highway)	6	1995
	Granite Reef Wash	2	1995
	Skunk Creek (above the CAP)	11	1995
	Tatum Wash Sediment Study (non-FEMA)	-	1995
	10th Street Wash	2	1996
	Desert Hills	30	1996
	Skunk Tank Wash (tributary to Skunk Creek)	5	1996
	Skyline Wash (alluvial fan, washes above Buckeye FRS # 3)	10	1996
	Rio Verde South Extension (several washes)	13	1997
	Sweat Canyon Wash and Doe Peak	12	1997
	Rock Springs Creek FDS	3	1998
	Skunk Creek Channel Improvements (51st to 75th Ave)	-	1998
	Skunk Creek Tributaries	6	1998
	Morgan City Wash Tribs Zone A	16	1999
	Sonoran Wash (FLO-2D)	3	1999
	Rawhide Wash FDS	12	2000
	Andora Hills/Galloway	7	2001
	Gavilan Peak FDS	15	2001
	New River Bridge LOMR	4	2001
	Rio Verde North Extension FIS	71	2001
	Wash B	4	2001
	Skunk Creek above Adobe Dam & Buchanan Wash	5	2002
	Adobe Dam / Desert Hills ADMP	12	2003
	North Scottsdale FDS	22	2003
	Total Linear Miles		2,423

Program	Project Name / Description	Completed
Structures Retrofit	Phase 2 – North Valley Structures Assessment of opportunities to retrofit existing flood control facilities, providing landscaping and aesthetic treatments and recreational multi-use opportunities	2000
	IGA with Maricopa County Parks & Recreation Department for the use & management of the Adobe Dam Reservoir area for recreation & open space.	1990
	Landscape Character Elements applied in the following studies or projects: Tatum Wash Basin, West Valley Rivers Project (New River and Lower Agua Fria)	various



**4.3.2.6.b Flood Hazard Remediation Program**

Program	Watershed	Project Name / Description	Completed
Structural / CIP	Cave Creek	Cave Creek Dam	
		Cave Butte Dam Includes Dykes #1, #2, #3	1980
		Carefree Town Center Drain	2002
	Lower Indian Bend Wash	Osborn Road Storm Drain	2001
	Lower Verde	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	
	Lower New River	New River Dam	1985
		Sun City Drain	1991
		83 <sup>rd</sup> Avenue GCS/Bell Park	2002
	Middle Indian Bend	Paradise Valley Detention Basin #4	
		PVSP Cactus Rd Improvements	1991
		Doubletree Ranch Road System	2004
	Skunk Creek	Skunk Creek Channel and Levee	
		Adobe Dam	1984
	Upper ACDC	Dreamy Draw Dam	1973
		Cave Creek Channelization	1991
		Skunk Creek Channelization	1991
		Scatter Wash Channel	1995
		Upper East Fork Cave Creek	1996
		10 <sup>th</sup> Street Wash Basins	1997
		Greenway Parkway Channel	2002

**4.3.2.7. Future Activities (Presently Identified)**

**4.3.2.7.a. Flood Hazard Identification Program**

**Planning** – Planning Studies, delineations and other non-structural projects that are to be started in the watersheds for the Northeast Region are noted below:

- Cave Creek ADMP for the Cave Creek Watershed to be started in 2005-2006.
- Upper New River Area Drainage Master Study and Plan for the Upper New River Watershed to be started 2005-2006. New mapping will be done in 2005.

**Structures Assessment /Dam Safety Program** – Currently all of the dams and FRSs under the District’s jurisdiction are being assessed as part of the three-phase Structural Assessment Program. There are two FRSs and six dams in this region.





**Other Non-Structural** – In addition, the District will utilize existing floodplain and drainage regulations to minimize and prevent damages from flooding problems. Operation and maintenance of existing structures will be ongoing to preserve the life of facilities and prevent flooding from occurring due to maintenance issues.

**Landscape Aesthetics and Recreational Multi-Use Projects** – The implementation of the District’s Landscaping and Aesthetic Treatment Policy includes tasks in the WCMPs and ADMPs that provide for assessment of the following: landscape character and viewshed, multi-use opportunities, plant community and biological resources, historic character, and cultural resources. Implementation of this policy also includes independent structures assessment for retrofit reports. The following is a list of the projects planned in the near future in support of this program for the Northeast Region:

- Coordination with Maricopa County Trails Commission in the possible utilization of District flood control facilities and floodplain areas as components of the County Regional Trail System.
- 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 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.b. Flood Hazard Remediation Program**

**Structures/CIP** – The CIP for Fiscal Years 2003/2004 to 2007/2008 (see Table 4-4 for cost and year) indicates that the following projects are in process or are planned for the Northeast Region:

##### Middle Indian Bend Watershed

- *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 benefited area contains approximately 300 residences and 70 commercial structures.

##### Lower Verde

- *McDowell Road Drainage System and Hermosa Vista/Hawes Road Drainage System* - The elements of this project utilize and, if necessary, upgrade an existing open channel, and new underground storm drains with offline detention basin.

##### Lower 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.



- *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.

**Recommended Projects** – Additional projects, for the northeast area, that were recommended through the FY 04/05 Capital Improvement Project process, but not yet included in the CIP are the following:

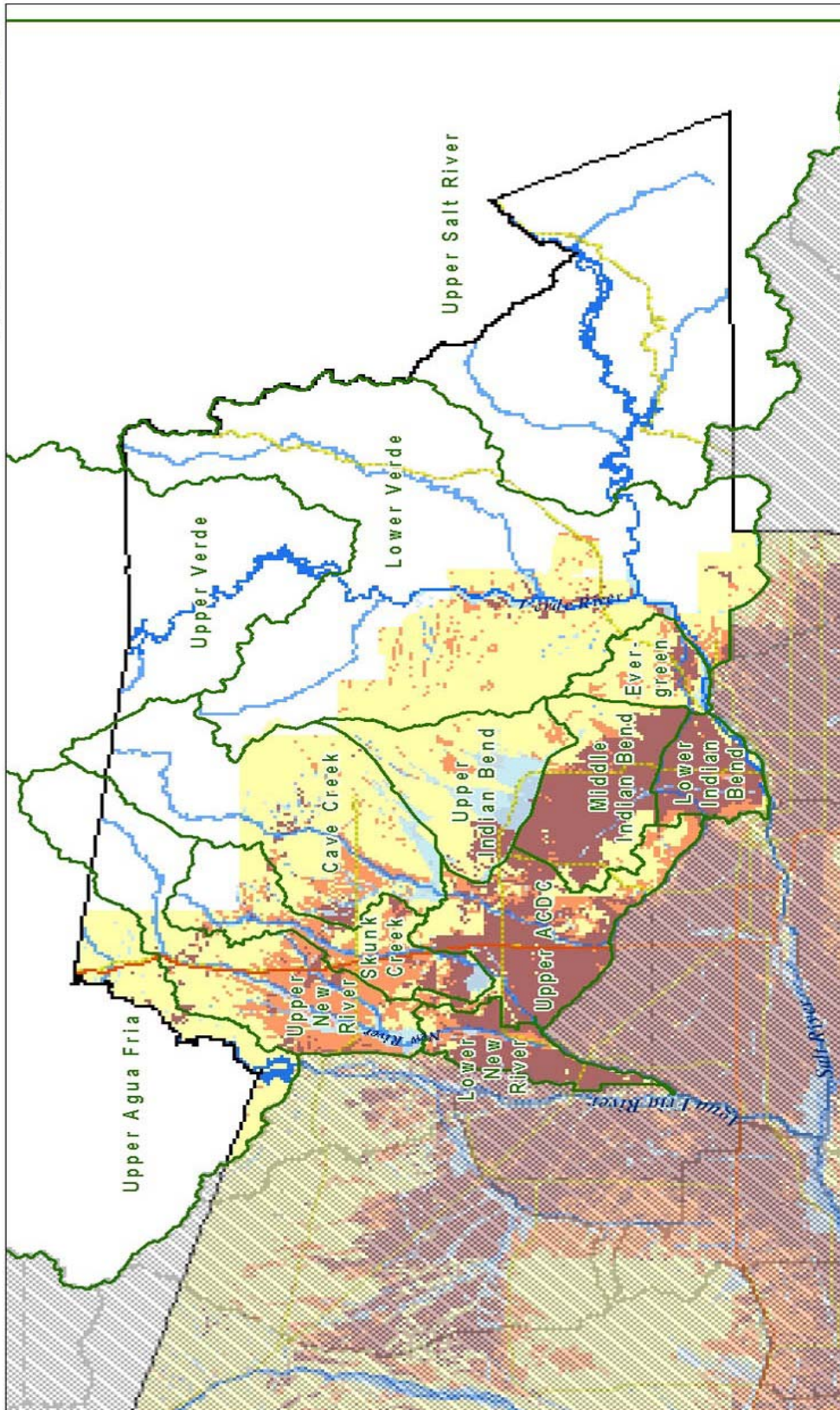
<b>Project Title</b>	<b>Project Description</b>	<b>Proposal Date</b>	<b>Project Developed from</b>	<b>Structures/Utilities/Population Protected</b>	<b>Total Initial Cost Estimate</b>	<b>Proposed Cost Share</b>
Upper Camelback Walk Flood Control Improvements	Channelization Improvements	2001	Scottsdale Storm Water Master Plan	470 residences, a business, one church and a private school	\$7.1M est	40% Scottsdale 60% District
Arcadia Area Drainage Improvements	Storm Drain system	2001	Arcadia ADMS (1997)		\$12M	50% District 50% Phoenix
10 <sup>th</sup> Street Wash Improvement Project	Improvements: channelization, box culverts, and spillway in to the ACDC	2004		Approximately 100 residential properties	\$1M	50% District 50% Phoenix
Oak Street Detention Basin & Storm Drain & 88 <sup>th</sup> Street Detent. Basin & storm drain system	Basins & Outfall Drainage System	2002	Spook Hill ADMP	Roadways of regional significance, 250 single-family homes, 480 future homes	\$7.4M	25% Mesa 75% District
Boulder Mtn. Elem. School Detention Basin, East McKellips Rd. Conveyance System, and Lower Ellsworth Road Storm Drain System	Storm drain, open channel and detention basin	2004	Spook Hill ADMP	Major roadways, a church, approximately 50 existing single-family homes and future development	\$8.3 M	25% MCDOT ? Mesa ?DISTRICT
Ellsworth Road Detention Basin System; Upper Ellsworth Road Storm Drain System	Storm drain and Detention Basin	2004	Spook Hill ADMP	Roadways, a church, and approximately 20 single-family homes.	\$3.85 M	75% McDOT & DISTRICT 25% Mesa
Mohave East Neighborhood Improvements Phases I & II		2001	Scottsdale Stormwater Master Plan and Mngmnt. Program	Four schools, residents, commercial properties, and portions of a number of roadways	\$6.72M	50% Scottsdale 50% District
Indian School Park Watershed Improvements Phases I & II		2001	Scottsdale's Stormwater Master Plan and Mngmnt. Program	Four schools, residents, commercial properties, and portions of a number of roadways	\$2.44M	50% Scottsdale 50% District

#### 4.3.2.8. Summary

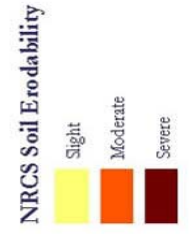
Considerable effort by the District over the years has resulted in mitigation of many of the flood hazards in the Northeast Region, which is the second most populated area in the county. The Salt and Verde Rivers, major washes, and run-off from the forest still pose some hazards. The District does floodplain management for three of the 11 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.



NORTHEAST REGION



Source: NRCS

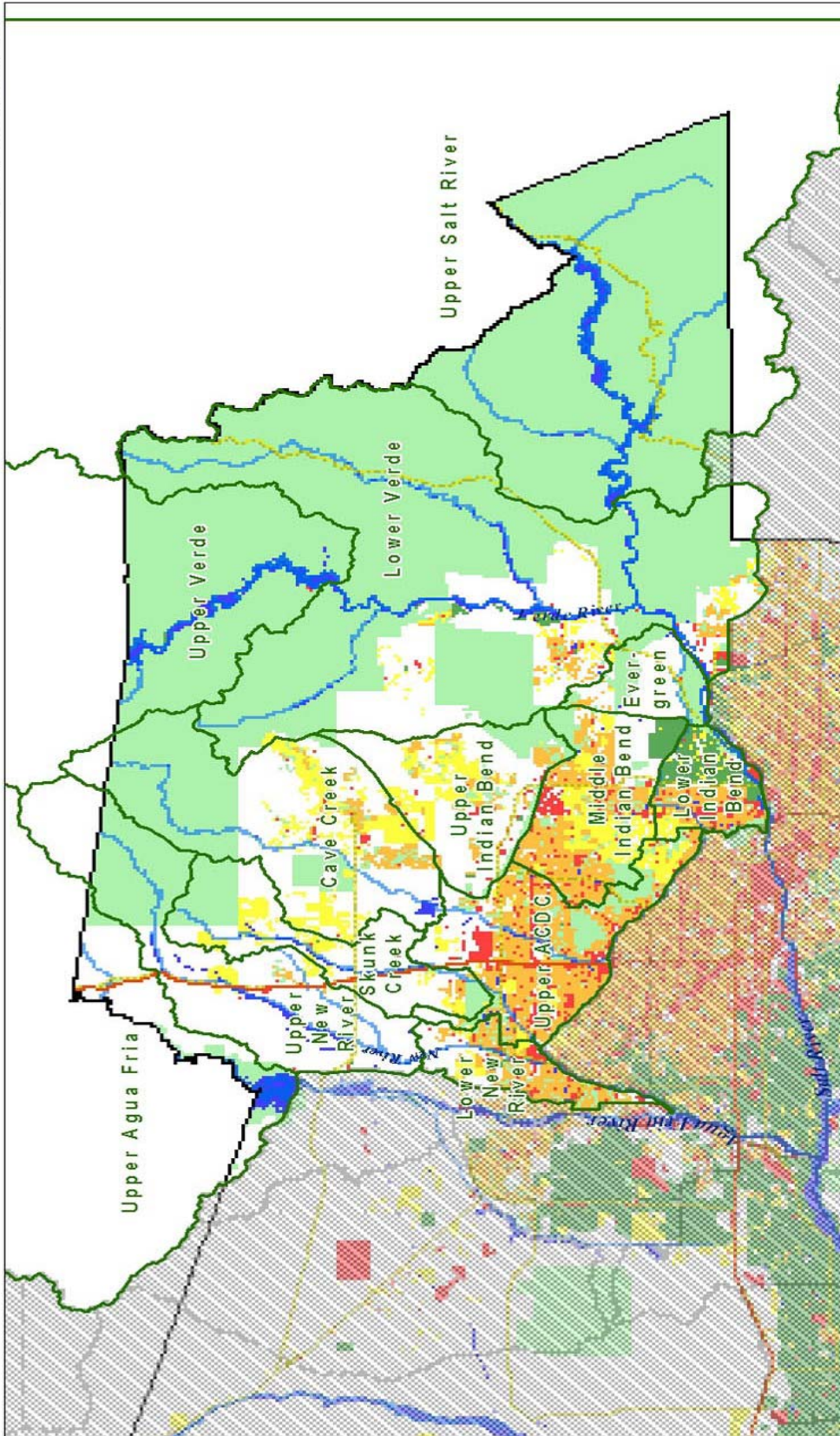


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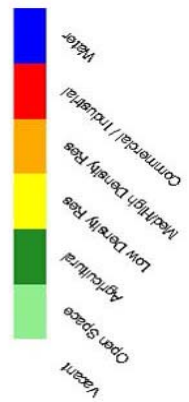
**MAP 4-8**  
**SOIL EROSION**  
*and*  
**FLOODPLAINS**



NORTHEAST REGION



Source: NRCIS

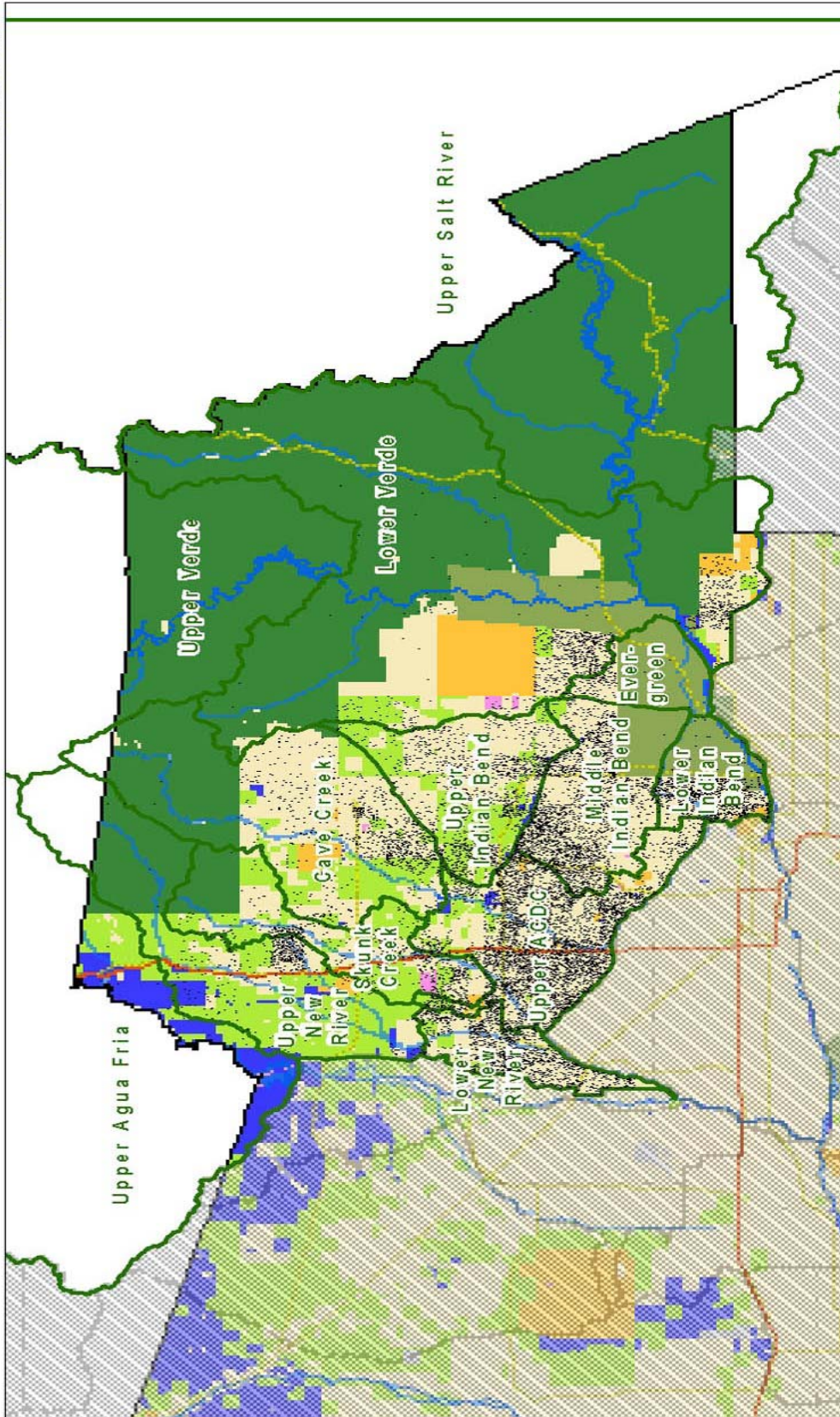


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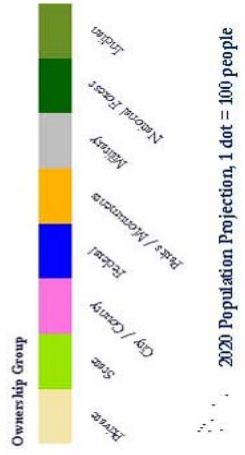
MAP 4-9  
 LAND USE



NORTHEAST REGION



Source: NRCS



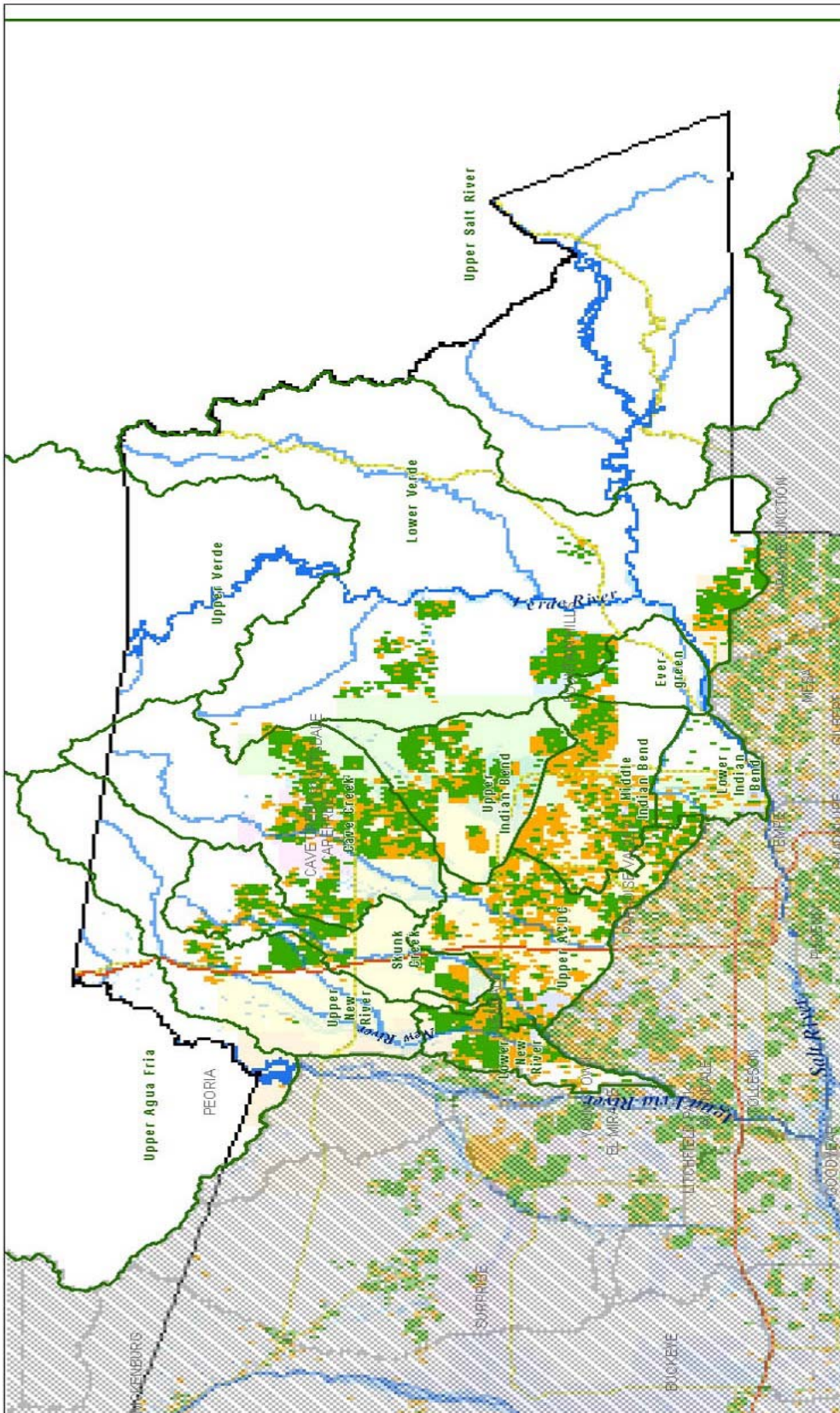
MAP 4-10  
 LAND OWNERSHIP  
 and  
 POPULATION PROJECTIONS

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 For Reference Purposes Only

2020 Population Projection, 1 dot = 100 people



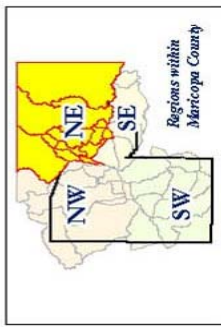
NORTHEAST REGION



MAP 4-11  
 RESIDENTIAL  
 COMPLETIONS

NOT TO SCALE  
 For Reference Purposes Only

- Residence Completed, 1990-1999
- Residence Completed, 1999-2002



Source: Maricopa Association of Governments



### 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 4-11](#) 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 FRSS 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 50 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

The land use patterns vary in certain aspects from the Maricopa County average. Vacant land accounts for nearly 76 percent of the region versus about 49 percent for the county. Agricultural use is just over 10 percent as compared to the county average of seven percent. On the other hand, a number of land use percentages are quite a bit less than the County average. The Northwest Region has only two percent dedicated open space, versus the County's 33 percent, and only three percent residential, versus the county average of six percent. [Map 4-13](#) displays the breakdown of land uses in this region.

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 32 percent of the total land versus about 29 percent for the county as a whole. The percentage of federal and state land ownership in this region is also relatively higher, about 14 percentage points higher than the Maricopa County average. There are no acres of Native American lands in this region, and only a relatively small amount of nationally preserved lands, versus nearly five percent and 11 percent, respectively, for Maricopa County as a whole.



*Lower Hassayampa River*

Approximately 1,395 square miles of the 2,853 square miles of the total area have already been developed or are considered undevelopable. This leaves about 1,458 square miles of land still developable. Using the assumptions from Chapter 2, it is anticipated that about 65 square miles of the 1,458 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 186,364 in 2000. This was approximately six 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 the county. The projected population for the region in 2020 is 377,170 or an increase of 190,806 over the 20-year time frame or about 9,540 per year. This 10 percent growth rate on an annual basis far exceeds the projected growth rate of 2.85 percent for Maricopa County. Development pressure is intense in portions of this region. White Tanks A and B are expected to see the largest increase in population. [Map 4-14](#) shows the land ownership and population projections over this region.





#### 4.3.3.5. Hazard and Problem Assessment

The Northwest Region is presently not 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 20 years. This percentage increase is primarily due to the smaller population base in this region in 2000, and the build-out of other regions. Areas that are developing rapidly are those watersheds that border on the western edge of the Phoenix Metropolitan Area. Development will be a mix of master planned communities and single-lot development.

Approximately 2,104 linear miles of delineations out of 3,034 still remain to be done so that these new residences will not be developed in flood and erosion hazard areas. There are 68 structures in the floodway and 1,426 structures in the floodplain.

About 20,621 drainage clearance permits and 617 floodplain use permits were issued from 1993 to 2003. [Map 4-15](#) shows the number of residential completions during this same year. With over 57,926 new builds over a ten-year period, this region ranks third in projected growth.

The District will continue its public education and regulatory programs to prevent loss from flood hazards. Specific 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:

- ADMPs need to be completed for those areas not yet studied and those studies completed more than ten years ago need to be revisited.
- 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 ADMPs and are listed in the next section.
- About 75 percent of the watercourses are not yet delineated. Evaluation of the remaining 2,104 linear miles of watercourses needs to be done to determine additional delineations to be done and priority.
- The Floodprone Properties Acquisition Program needs to be considered for the 68 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 1,426 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. Remedies identified by the Structures Assessment Branch will need to be implemented.
- Coordination with Maricopa County Department of Transportation on various road crossings that have been closed due to flooding should be done to determine if joint projects can 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 underway to mitigate these flooding hazards for the watersheds in the Northwest Region.



### 4.3.3.6. District Activities Completed

#### 4.3.3.6.a. Flood Hazard Identification Program

A number of Area Drainage Master Studies and Area Drainage Master Plans have been completed or are in process for the Northwest Region and are listed below. Watercourse delineations, totaling 1,765 linear miles, have been completed in the Northwest Region out of an estimated 3,034 linear miles from the 100,000 scale USGS Hydrography. Delineations have been done in all of the watersheds, with the most in the Lower Agua Fria Watershed. These studies are also listed.

Program	Watershed	Project Name / Description	Completed	
Planning	Arlington	No Studies done		
	Buckeye Hills	Buckeye/Sun Valley ADMS	2005	
	Buckeye Valley	Buckeye/Sun Valley ADMS	1989, 2005	
	Lower Agua Fria	Glendale/Peoria ADMS/ADMP (includes Lower New River)		1993, 2001
		The Agua Fria Watercourse Master Plan (includes White Tanks A )		2002
		North Peoria ADMP		2002
	Lower Centennial	Aguila ADMP	2004	
	Lower Hassayampa	Wickenburg ADMS	1992	
		Sols Wash Candidate Assessment Report		2004
	Trilby	Wittmann ADMSU	1989, 2005	
	White Tanks A and B	White Tanks ADMS/ADMP		1989, 1992
		Loop 303 Corridor/White Tanks ADMP Update		2002
	Upper Centennial	No Studies done		
	Upper Hassayampa	No Studies done		

Program	Floodplain Delineation Studies	River Miles	Year
Delineations	Wittmann ADMS	90	1986
	Agua Fria Topo FIS (Gila River to Waddel Dam)	33	1987
	Centennial	40	1988
	Gila River FIS	18	1988
	Hassayampa	53	1988
	Upper Grass/Centennial Washes	27	1988
	White Tanks ADMS	146	1989
	CAP Overchutes	12	1990
	Jackrabbit Wash FIS	22	1990
	Sun Valley Parkway – North	22	1990
	Trilby Wash FIS	7	1990
	Wagner Wash FIS	12	1990



Program	Floodplain Delineation Studies	River Miles	Year
Delineations	Agua Fria Sediment Transport Study (HEC-6)	-	1991
	Buckeye/RID Canals/Railroad	36	1991
	Luke Wash	12	1991
	Salt-Gila Master Study	80	1991
	White Tanks Wash	12	1991
	Daggs Wash	12	1992
	Iona Wash	12	1992
	Mill Wash	12	1992
	Star Wash	11	1992
	Agua Fria River (Gila River to New Waddel Dam)	35	1995
	Padelford Wash	14	1999
	Tiger Wash Alluvial Fan	25	2000
	Luke Wash – Zone A FDS	90	2001
	Upper Agua Fria Watershed Zone A	49	2001
	White Tanks Alluvial Fan, Site 36	15	2001
	Wickenburg Zone A, Watershed G	100	2001
	Agua Fria River (Cactus-Bell Rd.) and Tributaries	6	2002
	Jackrabbit Watershed Zone A	406	2002
	Aguila Area Floodplain	-	2003
	Palo Verde Zone A	350	2003
Total Linear Miles		1,759	

Program	Project Name / Description	Completed
Structures Retrofit	Phase 1 – West Valley Structures Assessment of opportunities to retrofit existing flood control facilities to provide landscaping and aesthetic treatments and recreational multi-use opportunities	2000
	Coordination with Maricopa County Trails Commission in the possible utilization of 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	2003
	IGA's have been completed and approved by the cities of Avondale, Glendale, and Peoria and the District Board of Directors for Recreational Use of District Property for the cities' use and management of along the Agua Fria River and New River. Multi-use trail projects are planned by the cities for these river corridors.	2002-2004
	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	various



**4.3.3.6.b. Flood Hazard Remediation Program**

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

<b>Program</b>	<b>Watershed</b>	<b>Project Name / Description</b>	<b>Completed</b>
<b>Structural / CIP</b>	Buckeye Valley	Buckeye FRS 1, 2, & 3	1975
	Lower Centennial	Centennial Levee	1985
		Saddleback FRS and Diversion	1981
Harquahala FRS and Floodway		1982	
	Lower Hassayampa	Sunset and Sunnycove Dams	1976
		Casandro Wash Dam and Outlet	1996
	Trilby	McMicken Dam and Outlet Channel	1956
	White Tank A	El Mirage Drain	1990
		Sun City West Drains	1990
		Colter Channel	
		Agua Fria Channelization	1988
		RID Overchutte, Channel & Basins	1996
		Dysart Drain	1996
	White Tank B	White Tanks FRS 3	1954
		White Tanks FRS 4	1954
		Perryville Bank Stabilization	1984
		Bullard Wash Channel Phase I	1998

**Remediation - Buy-Out**

*Aguila Hazard Mitigation Grant Program* – Completed 2003. This project purchased and relocated 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.

**4.3.3.7. Future Activities (Presently Identified)**

**4.3.3.7.a. Flood Hazard Identification Program**

**Planning** – Planning Studies, delineations and other non-structural projects that are to be started in the watersheds for the Northeast Region are noted below:

- Sun Valley ADMP for the Lower Hassayampa Watershed started in 2004.
- Wickenburg ADMP for the Lower Hassayampa Watershed to begin in 2005.
- Hassayampa Watercourse Master Plan started in 2004.
- Wittmann ADMP for the Trilby Watershed to begin in Fiscal Year 2005.

**Structures Assessment /Dam Safety Program** – Currently all of the dams and FRSs under the District’s jurisdiction are being assessed as part of the three-phase Structural Assessment Program. There are seven FRS’s and four dams in this Region.



**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 30 linear miles outside of the ADMPs 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.

**Landscape Aesthetics and Recreational Multi-Use Projects** – The implementation of the District’s Landscaping and Aesthetic Treatment Policy includes tasks in the WCMP’s and ADMP’s that provide for assessment of the following: landscape character and viewshed, multi-use opportunities, plant community and biological resources, historic character, and cultural resources. Implementation of this policy also includes independent structures assessment for retrofit reports. The following is a list of the projects planned in the near future in support of the Landscape Aesthetics and Multi-Use Opportunities Program for the Northeast Region:

- Coordination with Maricopa County Trails Commission in the possible utilization 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 for SRP McMicken Dam Power Substation and Palmilla Apartment Complex in the City of Avondale.

#### **4.3.3.7.b. Flood Hazard Remediation Program**

The CIP for Fiscal Years 2003/2004 to 2006/2007 (see Table 4-4 for cost and year) indicates that the following projects are planned for the Northwest Region:

##### White Tank A and B Watersheds

- *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 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.
- *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.

**Recommended Projects** – Additional projects, for the northwest area, that were recommended through the FY 04/05 Capital Improvement Project process, but not yet included in the CIP are the following:

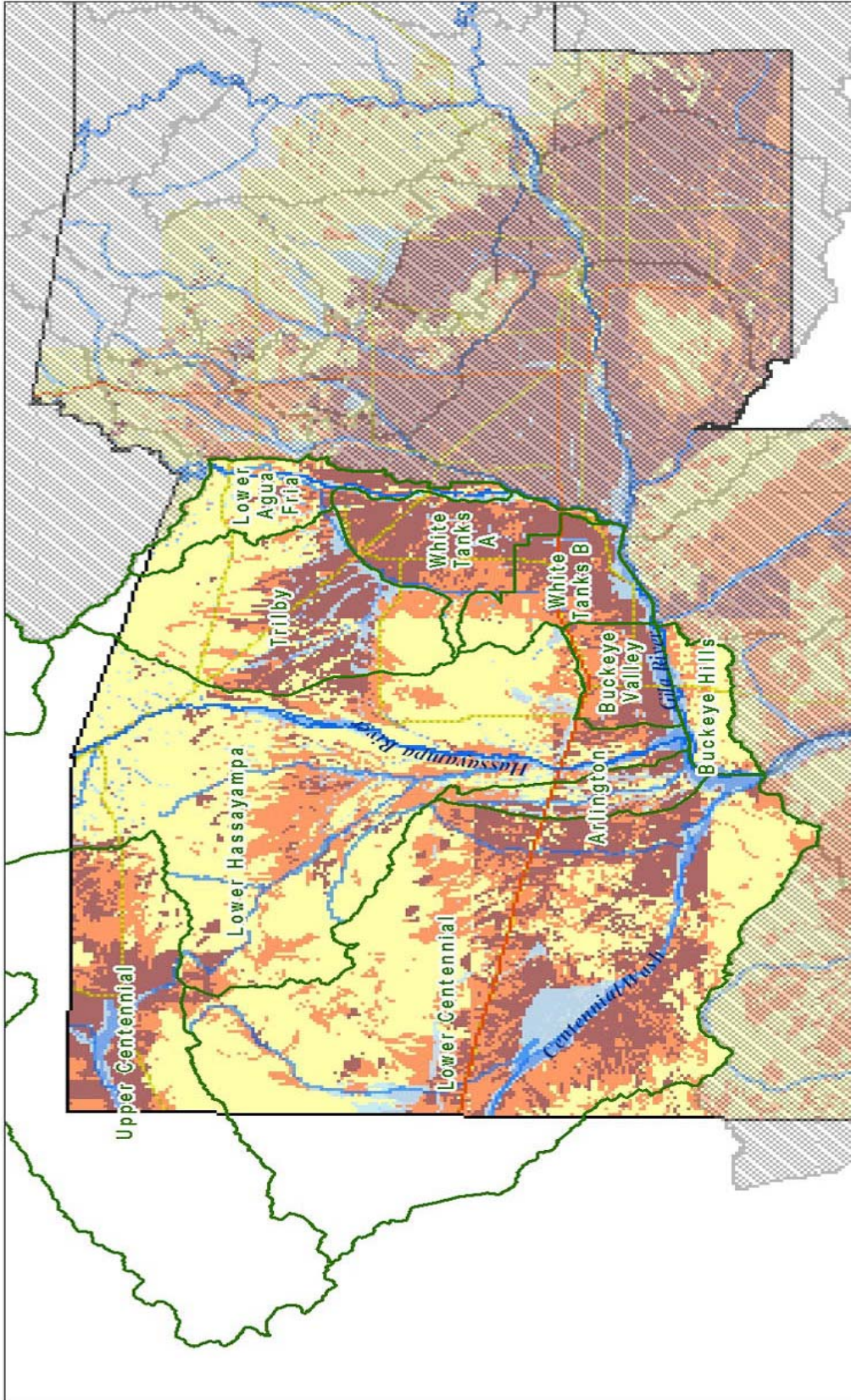
<i>Project Title</i>	<i>Project Description</i>	<i>Proposal Date</i>	<i>Project Developed from</i>	<i>Structures/Utilities/Population Protected</i>	<i>Total Initial Cost Estimate</i>	<i>Proposed Cost Share</i>
Waddell Road/Lower El Mirage Wash Channel	Channel	2001		2300 residential, 3 commercial and 1 public property; 21 arterial roadways, 2 collector roadways, 1 railroad track, 1 public park, Surprise Water Treatment Plan various utilities	\$772,000	67% Surprise 23% District
SR 303 Drainage	Channelization and Detention	2003	Loop 303 Corridor/ White Tanks ADMP	State Route 303, Reems Road Channel Project, Luke AFB, schools, governmental offices	\$105M	76.5% MCDOT ?
Hassayampa River/Sols Wash Flood Protection		2003		Residential, commercial, municipal, agricultural landuse, and a WQARF Consolidation Site. Protect the Barnett Well from invasive floodwaters.	\$4.5M	95% District 5% Wickenburg
Sand Tank Wash Flood Control Improvements	Levee reconstruction, overshoot and basin construction	2000	Gila Bend ADMP	This project will remove approximately 100 homes, 11 businesses and 2 historic buildings from the floodplain, and provide flood relief for a number of road, as well as the Southern Pacific, and Tucson Cornelia and Gila Bend Railroads.	\$12M	10% Gila Bend 90% District
South Gila Bend Drainage Improvements	Channel basin &	2000		This project will protect 12 residential homes, one commercial establishment, and protect a number of roads. The population of the residential structures protected is approximately 50 people.	\$283,116	100% District

**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 10 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.



NORTHWEST REGION



MAP 4-12  
SOIL EROSION  
and  
FLOODPLAINS



NOT TO SCALE  
For Reference Purposes Only

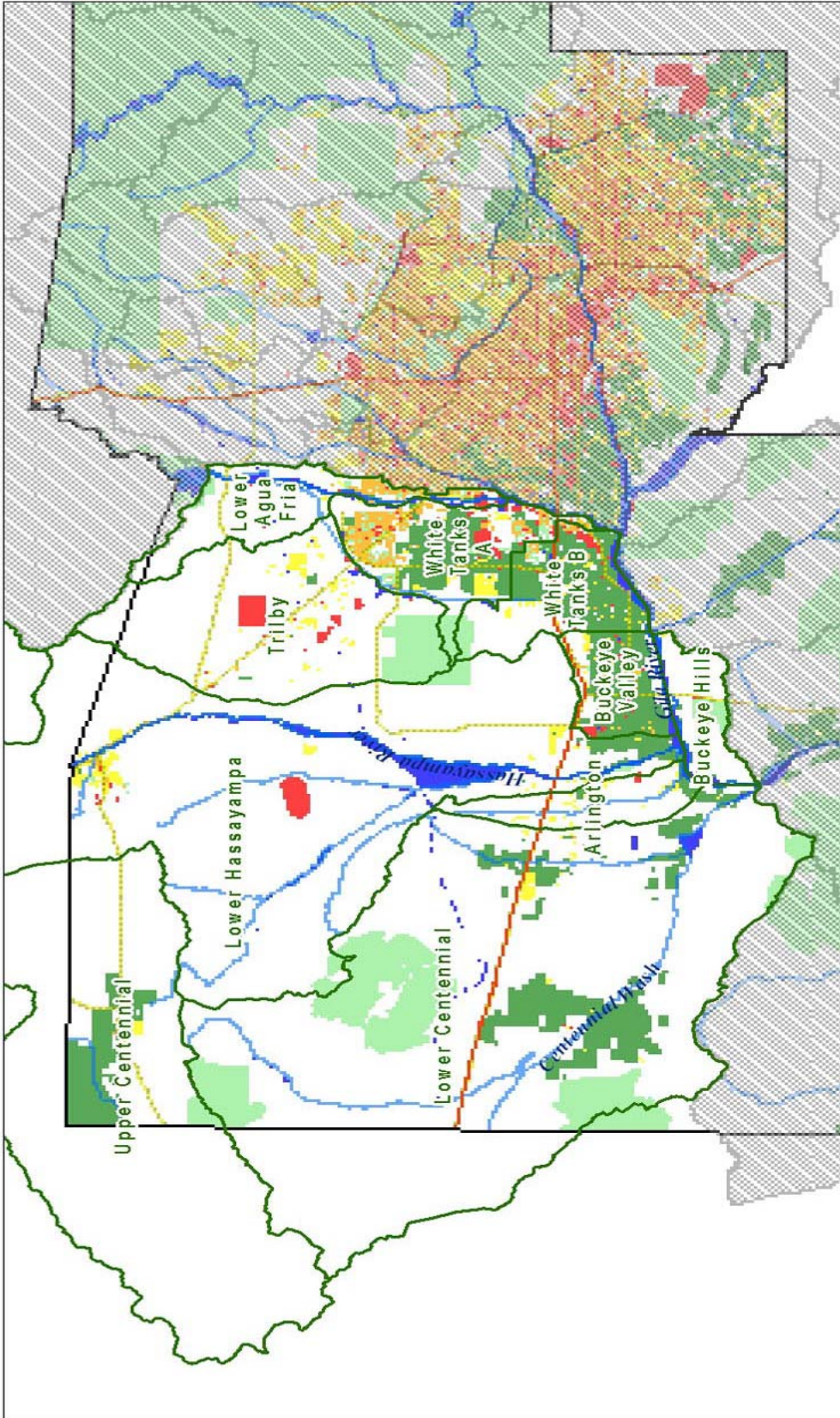
NRCS Soil Erodability



Source: NRCS

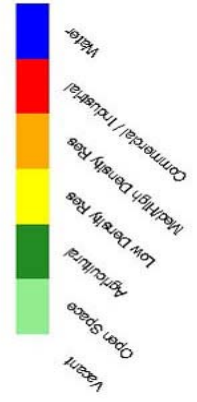


NORTHWEST REGION



MAP 4-13

LAND USE



NOT TO SCALE  
 For Reference Purposes Only

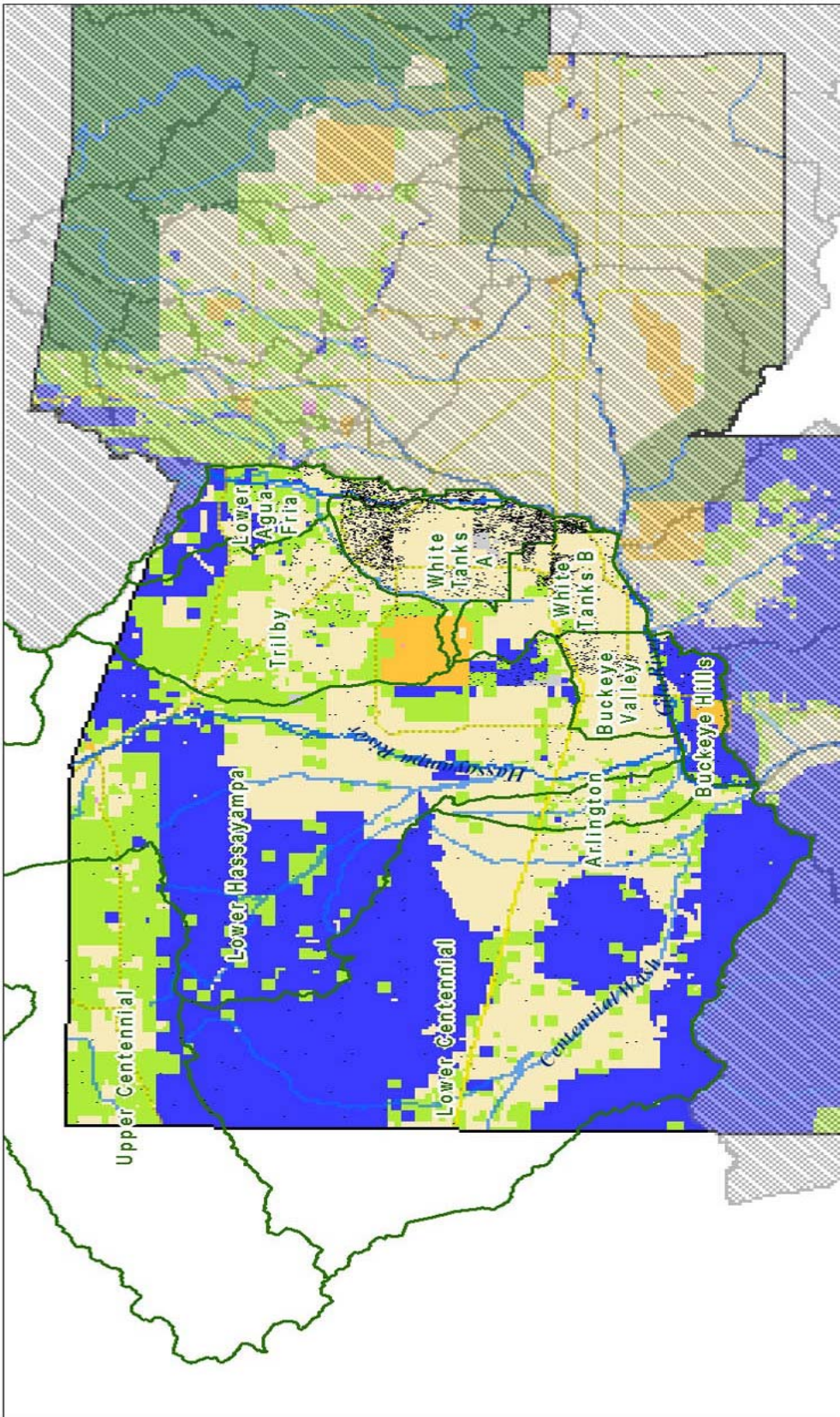


Source: NRCGS





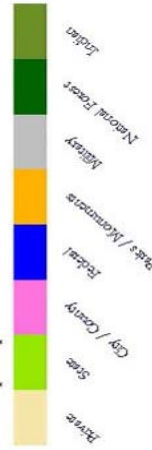
NORTHWEST REGION



Source: NRCG, US Census Bureau



Ownership Group



2020 Population Projection, 1 dot = 100 people

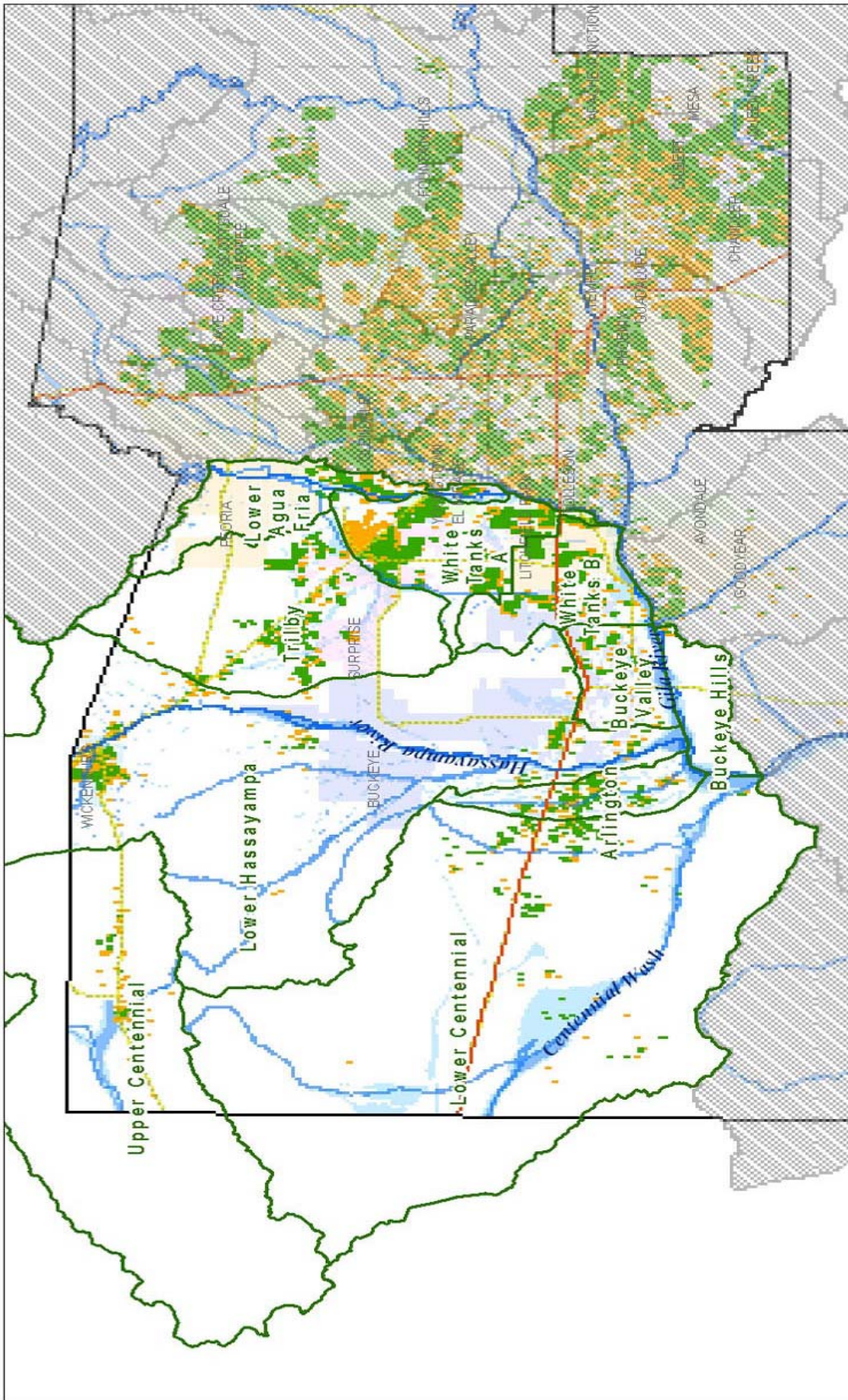


NOT TO SCALE  
For Reference Purposes Only

MAP 4-14  
LAND OWNERSHIP  
and  
POPULATION PROJECTIONS



**NORTHWEST REGION**

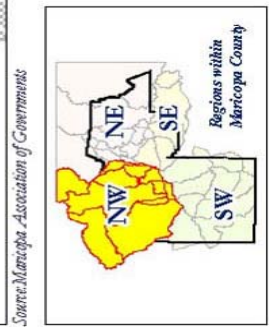


**MAP 4-15**  
**RESIDENTIAL**  
**COMPLETIONS**



NOT TO SCALE  
 For Reference Purposes Only

- Residence Completed, 1990-1999
- Residence Completed, 1999-2002



Source: Maricopa Association of Governments



### 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 4-16](#). These watersheds contain 3,591 square miles of which 3,474 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 Saucedo. 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 Saucedo 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 50 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



*Waterman Watershed May 2000*



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 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 33 percent. Agriculture accounts for just four 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 compared to nearly nine percent for the county as a whole. [Map 4-17](#) shows the land use patterns throughout the region.

Land ownership is mainly government held with federal at 42 percent of the area and military at 35 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 consistent with the county average of five percent overall. There are no National Forest Service holdings in this region, however, there are numerous conservation and preserve areas.

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 13,633 people in 2000. This was less than one-half of one percent of the total population for Maricopa County in 2000. This Region is by far the least populated region in terms of numbers of people. Population is projected to reach 54,503 people by 2020. This increase of 40,870 people is a percentage increase of over 299 percent for the 20-year period or about 2,044 people per year. The Theba and Waterman Watersheds are expected to see the largest increase in population in the Southwest Region. [Map 4-18](#) shows the land ownership and population projections over this region.

#### **4.3.4.5. 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. The percentage rate of growth over the next 20 years will far exceed that for the county as a whole. But, by 2020, total population in this region will still be just one-ninth of the county's total population.



Areas where development is projected include Goodyear and Avondale, which are located in the far northeastern corner of the region.

However, 2,004 linear miles of delineations out of 3,613 still remain to be done so that these new residences will not develop in flood and erosion hazard areas. There are 10 structures in the floodway and 119 structures in the delineated floodplains as identified in a count using 2004 aerial photography.

About 1,215 drainage clearance permits and 43 floodplain use permits were issued from 1993 to 2003. [Map 4-19](#) shows the number of residential completions during this same year. With over 2,527 new builds over a ten-year period, this region ranks the lowest in projected growth.

The District will continue its public education and regulatory programs to prevent loss from flood hazards. Specific 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:

- ADMPs need to be completed for those areas not yet studied and those studies completed over ten years ago need to be revisited.
- Evaluation of the remaining 2,004 linear miles of watercourses needs to be done to determine prioritization for additional delineation.
- The Floodprone Properties Acquisition 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.



*Elliot Road - Estrella Mountain Ranch, May 2002*

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 03/04 to 07/08 CIP to mitigate these flooding hazards for the watersheds in the Southwest Region.



**4.3.4.6. District Activities Completed**

**4.3.4.6.a. Flood Hazard Identification Program**

A number of Area Drainage Master Studies and Area Drainage Master Plans have been completed or are in process for the Southwest Region and are listed below. Watercourse delineations, totaling 253 linear miles, have been completed in the Northwest Region out of an estimated 3,613 linear miles from the 100,000 scale USGS Hydrography. Delineations have been done in seven of the ten watersheds, with the most in the Painted Rock Watershed. These studies are also listed.

Program	Watershed	Project Name / Description	Completed	
Planning	Gila Bend	Gila Bend ADMP	1980's, 2001	
	Painted Rock	Gila Bend ADMP	1980's, 2001	
	Theba	Gila Bend ADMP	1980's, 2001	
	Waterman		Rainbow Valley/Waterman Wash ADMS	1980's
			El Rio Watercourse Master Plan	2005
	Gillespie	No Studies done		
	Lower Gila	No Studies done		
	Santa Rosa	No Studies done		
	Sentinel	No Studies done		
	Ajo	No Studies done		
	Vekol	No Studies done		

Program	Floodplain Delineation Studies	River Miles	Year
Delineations	Gila Bend	15	1991
	Gila Bend Canal FIS	23	1990
	Gila Bend FDS, LOMR for Unnamed Wash No. 1 & 2	40	1999
	Little Rainbow Valley	12	1991
	Rainbow Wash	12	1990
	Waterman Wash FIS	35	1988
	Lower Gila Topo/FIS	30	1986
	Total Linear Miles		167

Program	Project Name / Description	Completed
Structures Retrofit	Phase 1 – West Valley Structures Assessment of opportunities to retrofit existing flood control facilities to provide landscaping and aesthetic treatments and recreational multi-use opportunities	2000
	Coordination with Maricopa County Trails Commission in the possible utilization of 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	2003



Program	Project Name / Description	Completed
<b>Structures Retrofit</b>	IGA's have been completed and approved by the cities of Avondale, Glendale, and Peoria and the District Board of Directors for Recreational Use of District Property for the cities' use and management of along the Agua Fria River and New River. Multi-use trail projects are planned by the cities for these river corridors.	2002-2004
	Landscape Character Elements applied in the following studies or projects: El Rio Vision Study, Gila Bend ADMP	various

**4.3.4.6.b. Flood Hazard Remediation Program**

Program	Watershed	Project Name / Description	Completed
<b>Structural / CIP</b>		No structural projects have been completed by the District in the Southwest Region.	

**Remediation – Buyout**

The Arlington School has been acquired and relocated. The District is researching the possibility of leasing the land for agricultural use.

**4.3.4.7. Future Activities (Presently Identified)**

**4.3.4.7.a. Flood Hazard Identification Program**

**Planning** – Planning studies, delineations and other non-structural projects that are to be started in the watersheds for the Northeast Region are noted below:

- Rainbow Valley ADMS for the Waterman Watershed to be started in 2005-2006.

**Structures Assessment /Dam Safety Program** – There are currently no District structures in this region.

**Other Non-Structural** – 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 285 linear miles outside of the ADMPs 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.

**Landscape Aesthetics and Recreational Multi-Use Projects** – The implementation of the District's Landscaping and Aesthetic Treatment Policy includes tasks in the scope of work for WCMPs and ADMPs 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 projects planned in the near future in support of the Landscape Aesthetics and Multi-Use Opportunities Program for the Northeast Region:

- 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.b. Flood Hazard Remediation Program**

The CIP for Fiscal Years 2003/2004 to 2007/2008 indicates that there are no projects planned for the Southwest Region.

**Recommended Projects** – Additional projects, for the southwest area, that were recommended through the FY 04/05 Capital Improvement Project process, but not yet included in the CIP are the following:

<i>Project Title</i>	<i>Project Description</i>	<i>Original FY Date Prop.</i>	<i>Project developed from</i>	<i>Structures/Utilities/ Population Protected</i>	<i>Total Initial Cost Estimate</i>	<i>Proposed Cost Share</i>
Gila River Bank Stabilization/Levee	Bank/ stabilization Levee	2003	El Rio WCMP	The benefited area includes six farm operations, and the Liberty School. The populations directly and indirectly benefited by the project are the citizens of Rainbow Valley, Town of Buckeye and the City of Goodyear.	\$4.5M	10% Buckeye 25% BWCD
Southern Pacific Railroad Drainage Improvement	Drainage Improvement	1994	Durango Regional Outfall Project	Approximately 130 residences and 12 industrial/commercial buildings.	\$1.5M	100% District
Van Buren Street Drainage	Storm Drain	1994		School campus	\$1.0M	100% District

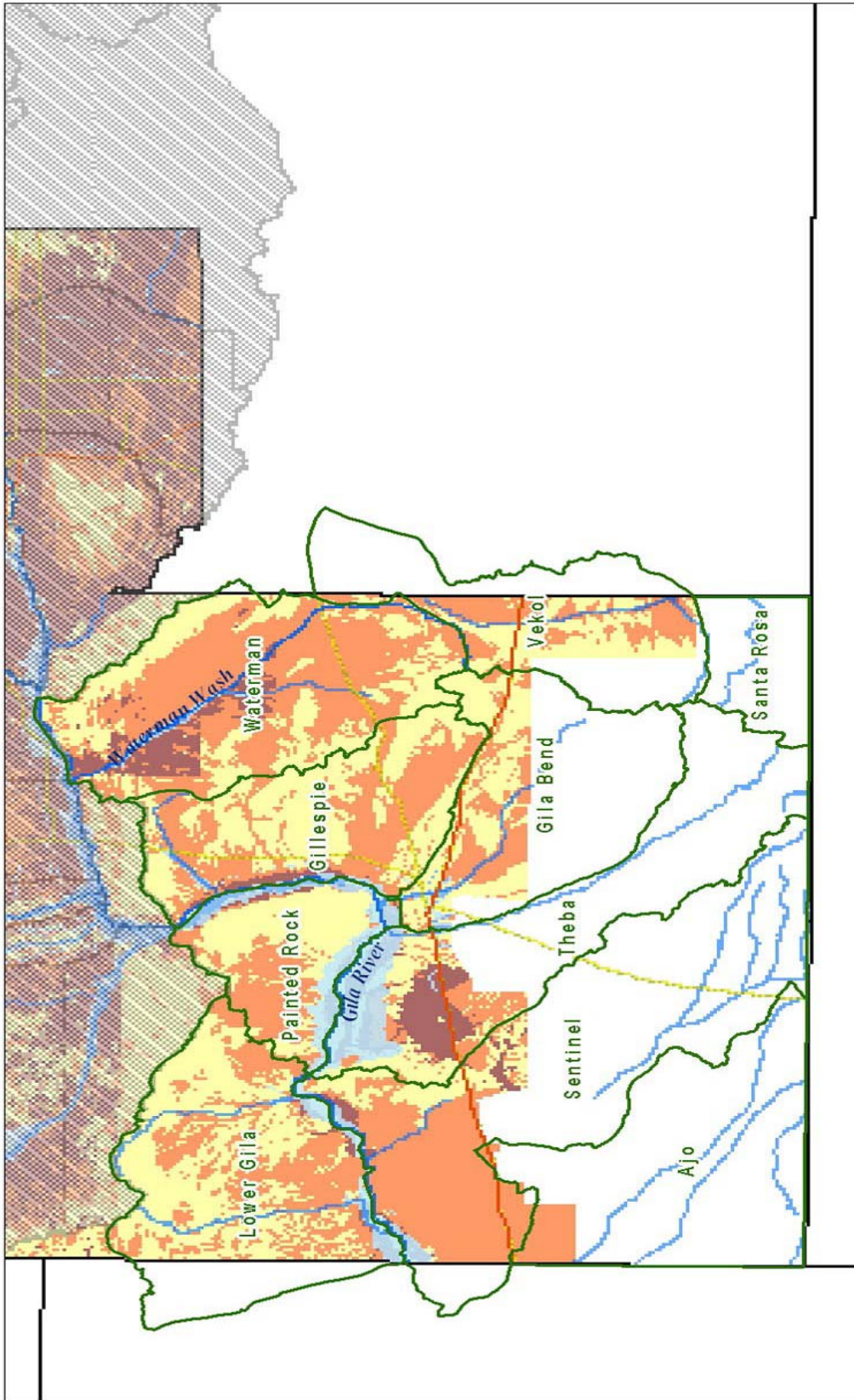
**4.3.4.8. Summary**

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.

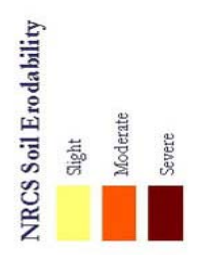




**SOUTHWEST REGION**



Source: NRCS

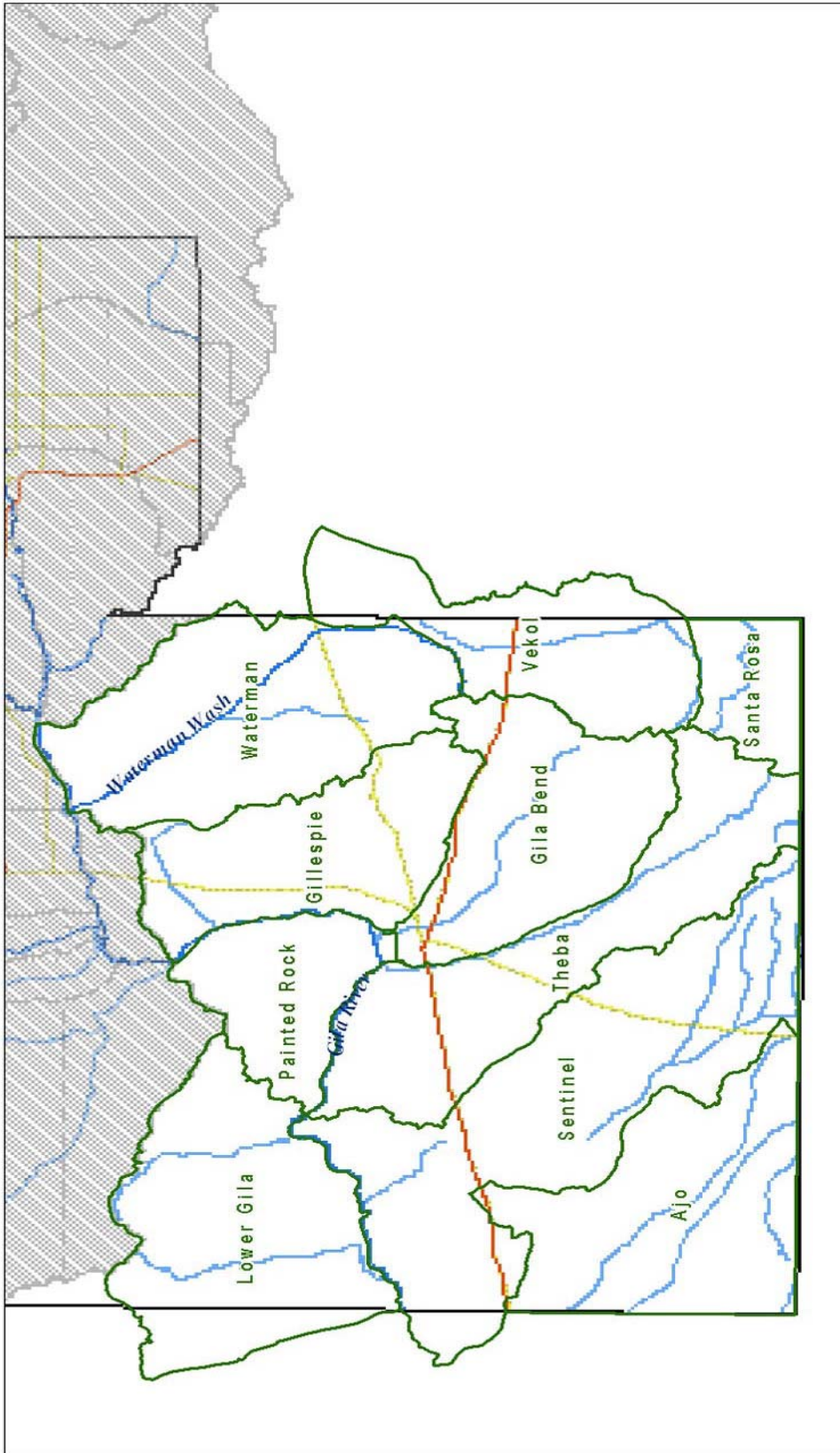


**NCTTO SCALE**  
For Reference Purposes Only

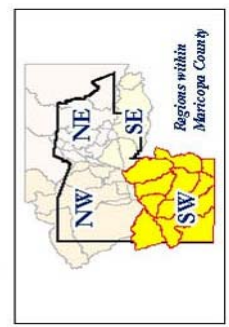
**MAP 4-16**  
**SOIL EROSION**  
*and*  
**FLOODPLAINS**



**SOUTHWEST REGION**



Source: NRECS



NOT TO SCALE  
For Reference Purposes Only

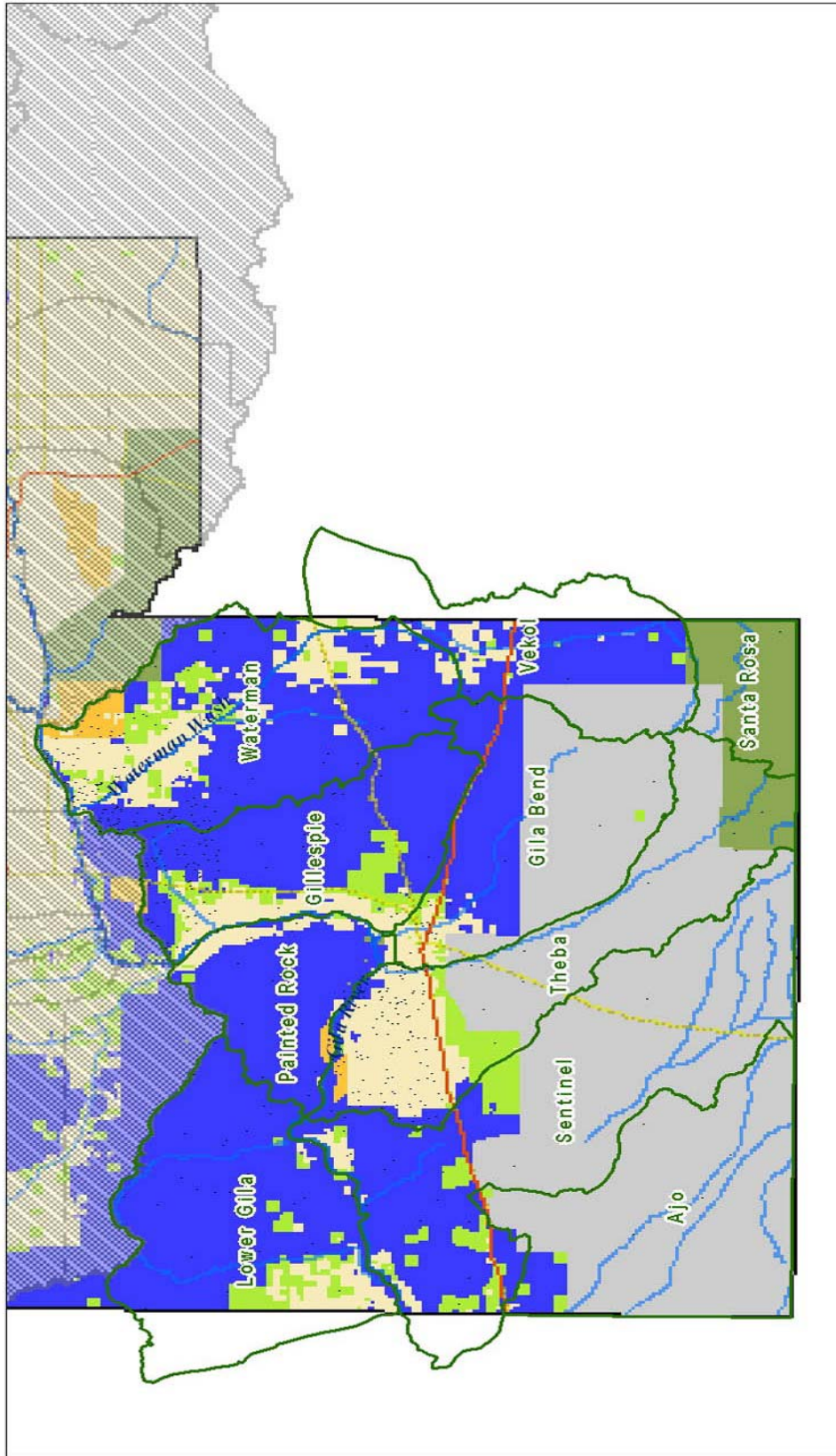


MAP 4-17

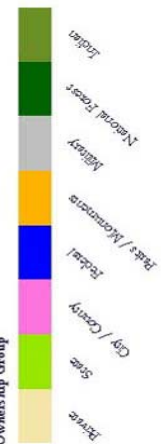
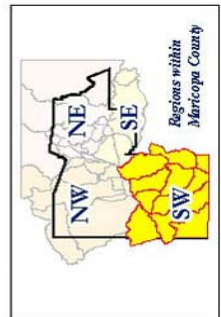
**LAND USE**



**SOUTHWEST REGION**



Source: NFCS



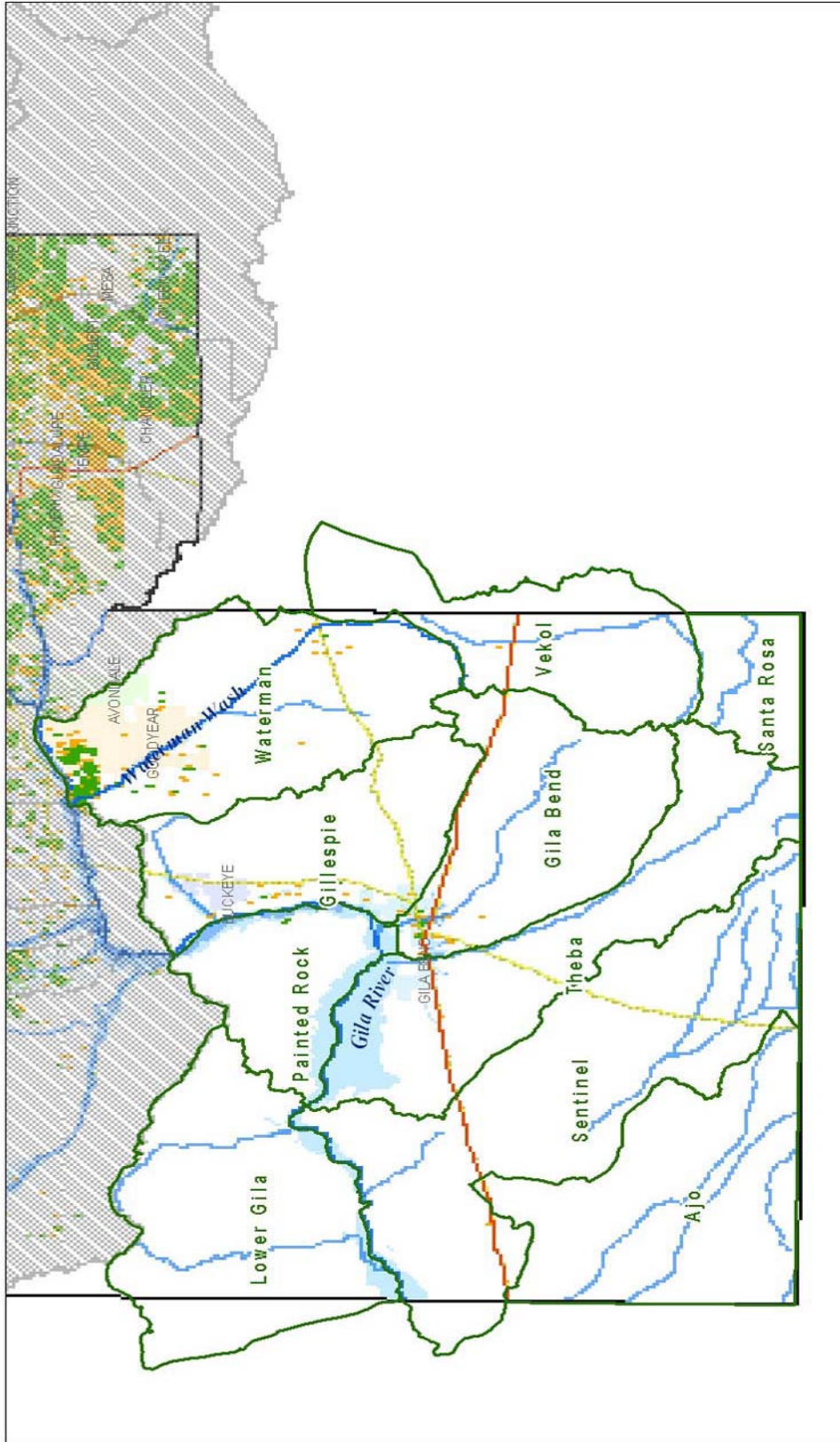
MAP 4-18  
**LAND OWNERSHIP**  
*and*  
**POPULATION PROJECTIONS**

NOT TO SCALE  
 For Reference Purposes Only

2020 Population Projection, 1 dot = 100 people

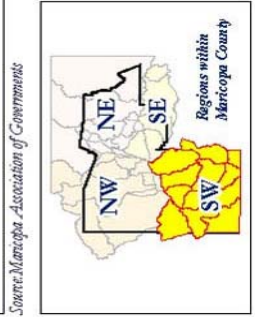


**SOUTHWEST REGION**



**MAP 4-19  
 RESIDENTIAL  
 COMPLETIONS**

NOT TO SCALE  
 For Reference Purposes Only





#### 4.4. Regional Summary

Considerable measures have been taken to minimize or eliminate flood control hazards throughout the county. 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 capital improvement program since the 1963 Report. Many of the urban area problems have been addressed. However, many areas of concern still remain to be addressed in the heavily developed portions of the Metropolitan Area. Also, through the ADMP Program, the District now has the opportunity to get ahead of development in identify flooding hazards and preventing similar situations from happening in the future. The upcoming ADMP projects 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 some of the critical elements used to determine level of risks by watershed.

Critical Elements	Region				
	Southeast	Northeast	Northwest	Southwest	Total
Area inside County Boundary	877	2,013	2,853	3,477	9,220
Population (2000)	1,967,176	922,522	186,364	13,633	3,089,695
Population (2020)	2,636,293	1,358,863	377,170	54,503	4,426,829
Population Change (2000 - 2020)	669,117	356,244	190,806	40,870	1,257,037
100,000 Scale USGS Hydrography (linear miles)	910	2,442	3,034	3,613	9,999
Approximate & Detailed Delineations completed (linear)	97	276	765	253	1,391
Delineations remaining to be done (linear miles)	680	565	2,104	2,004	5,353
Potentially Developable Land (square miles)	279	355	1,458	544	2,637
% Developable	32%	18%	51%	16%	
% Undevelopable	68%	82%	49%	84%	
% of County	10%	22%	31%	38%	
Structures in the Floodway	57	148	247	13	465
Structures in the Floodplain	10,107	10,224	1,426	119	21,876
Floodplain Use permits issued	548	724	617	43	1,932
Drainage clearance permits issued	15,235	25,886	20,621	1,215	62,957
Residential Completions	162,609	106,724	57,926	2,527	329,786



## End Notes

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- <sup>1</sup> Maricopa County. 2001. 2020: Eye to the future. Accessed 1/30/05  
<http://www.maricopa.gov/planning/compln/>



## CHAPTER 5. FLOODPLAIN MANAGEMENT PLAN

### 5.1. Overview

Maricopa County is too vast to determine all of the flood hazard problems in a short time frame or all at once, and thus a five-year plan is presented to the Flood Control Advisory Board annually for the upcoming planning program studies, Delineations program, and Capital Improvement Program (CIP). The focus of the studies and delineations has been in the rapidly developing watersheds (see Chapter 4 for individual watershed information). Population figures and projections are identified for 34 of the 39 watersheds that constitute the “community” of Maricopa County in order to determine level of risk from flood hazards. Population is projected to double over the 2000 base population of 3.1 million in Maricopa County by 2030 to an anticipated total of 6.1 million expanding further out in the county, outside of the flood control dams and flood retarding structures that provide protection to the Metropolitan Area. It is likely that the additional population will locate in these outlying areas, and program emphasis will follow the growth pattern. The long-range planning activities addressed above allow the District to get ahead of development thus minimizing the risk to citizens.

Approximately 1,400 square miles of land in Maricopa County are within municipal boundaries, leaving the District responsible for 7,785 of the 9,226 square miles within the county limits. However, the District does perform floodplain management for 13 of the 26 municipalities within Maricopa County. 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 Barry M. Goldwater Gunnery Range and steep slopes; but still contributes to the flood hazards. Delineations or studies may not be done for these areas, but any contributory effects must be studied and addressed. Although attention will be directed to the new growth areas, there are still urbanized areas that have not been completely delineated. The District’s planning program has two prongs: get ahead of development to keep people from moving into harm’s way and to continue eliminating flood hazards in the already urbanized areas. 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 flood hazards in Maricopa County, 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.

#### **5.1.1. Floodplain Management Plan Organization (CRS 511.a.1 & 2)**

This Plan is a compilation of the many Area Drainage Master Studies/Plans (ADMS/ADMP), Water Course Master Plans (WCMP), and Delineation Studies done by the District to identify flood hazards. Each of these studies has a separate committee that is composed of the stakeholders specific to that area. Public involvement is conducted for each study and



specialized to that study area. The committee lists and public involvement information is included in Appendix B. The compilation of the data from the location specific studies and the additional text that constitutes the District's Comprehensive Plan is 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 frequently to gather and process data, for the regular update of the Comprehensive Plan. An additional strategy session was held with District Division and Branch Managers to brainstorm goals and action items. The sign-in sheet for this session is located in Appendix B. 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. The Plan is available to all cities and towns in Maricopa County for their review as these communities may benefit from District projects and programs.

### **5.1.2. 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. This document is the Comprehensive Plan. 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 area only. The Floodplain Management Plan for the Community of Maricopa County is a section of the District's Comprehensive Plan. Municipalities must prepare their own 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 309 points are provided for a series of planning steps. Those steps are the following:

<b>Subsection</b>	<b>Step</b>	<b>Max. Points</b>
511.a. 1.	<b>Organize to prepare the plan</b>	<b>10</b>
511. a.2.	<b>Involve the public</b>	<b>72</b>
511. a.3.	<b>Coordinate with other agencies</b>	<b>18</b>
511. a.4.	<b>Assess the hazard</b>	<b>20</b>
511. a.5.	<b>Assess the problem</b>	<b>35</b>
511. a.6.	<b>Set goals</b>	<b>2</b>
511. a.7.	<b>Review possible activities</b>	<b>30</b>
511. a.8.	<b>Draft an action plan</b>	<b>70</b>
511. a.9.	<b>Adopt the plan</b>	<b>2</b>
511. a.10.	<b>Implement, evaluate, and revise</b>	<b>35</b>
511. b.	<b>Adopt a Habitat Conservation Plan (optional)</b>	<b>15</b>

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. The efforts of the Comprehensive Plan/Floodplain Management Plan are coordinated with the development of the Maricopa County Unincorporated Area Hazard Mitigation Plan.





## 5.2. Repetitive Loss Areas (CRS 511.a.4)

The county currently has one federally recognized repetitive loss area along the Salt, Gila and Agua Fria rivers, which is shown on Figure 5-1. There are 41 properties in the floodway in this area. There are 72 property owners in this area, known as Holly Acres, who receive information from the District regarding repetitive loss and the NFIP. A study was completed to identify a viable solution to mitigate the flood hazards in this area. The proposed project is a levee that will take 21 homes out of the floodway. This levee is expected to be constructed in two phases over the next few years, with construction completion presently expected by the end of 2007. Drawings for the first phase are complete, and are approaching the 60 percent level of completion for the second phase. The Floodprone Properties Acquisition Program will be offered to property owners not taken out of the floodway and floodplain to mitigate the flood hazards for the remaining 13 homes.

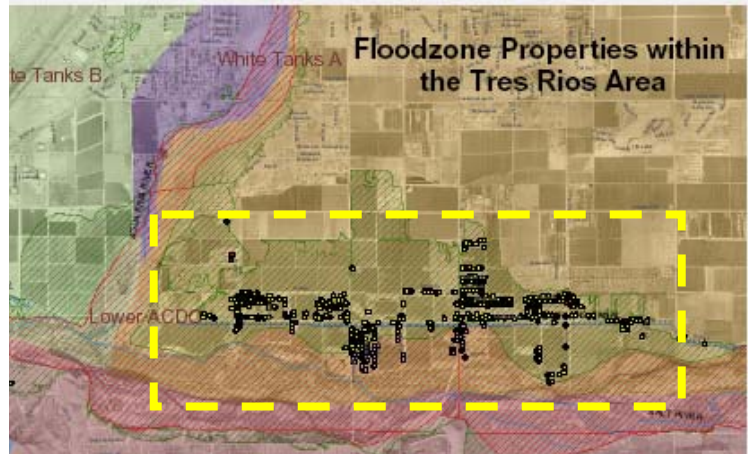


Figure 5-1 Repetitive Loss Area

## 5.3. Identifying the Hazards

Chapter 1 of this document discussed the history of the District and flooding problems to familiarize the reader with the area and its needs for floodplain management. Chapter 2 details the environmental conditions that bring on or contribute to the flooding issues in Maricopa County. Chapter 2 also goes into detail on the demographics that influence the decision making for where future studies and projects will be and are needed to protect the population. Chapter 3 covers the District organizational makeup and programs offered to provide floodplain and stormwater management. Chapter 4 identifies the hazards by watershed in detail and list of the past projects that have been completed and future projects planned to mitigate flood hazards within the county. This chapter details the approaches used to determine what the hazards are and how projects are determined.

## 5.4. Assessing the Hazards and Problems (CRS 511. a.4, 5)

A generalized, broad assessment of hazards and problems has been done for all 39 watersheds within the Community of Maricopa County. This overview is detailed in Chapter 4 of this Comprehensive Plan. A summary of this information gathered for hazard assessment was recorded in a spreadsheet (Table 4-4), listing variables that combine risk and development potential for each watershed. Each watershed could then be ranked to determine priority areas to begin a District study.

Maricopa County's vast size requires assessment of the specific hazards and problems be done by watershed through the ADMS/ADMP program. An ADMP may cover one or more watersheds or part of a watershed. Rivers and major washes are studied under the WCMP



Program. Delineation studies complete the hazard assessment by picking up watercourses not covered in studies completed or underway. The entire county (CRS Community) is over 9,200 square miles with five rivers and numerous major washes. The ADMS/ADMP study areas range from 50 to 300 square miles. 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. Study teams are multi-disciplinary groups that include engineers, planners, landscape architects, regulatory staff, cultural and historical resource specialists, and fluvial geomorphologists. District, local agency, affected state and federal staff, and citizens participate on the study teams.

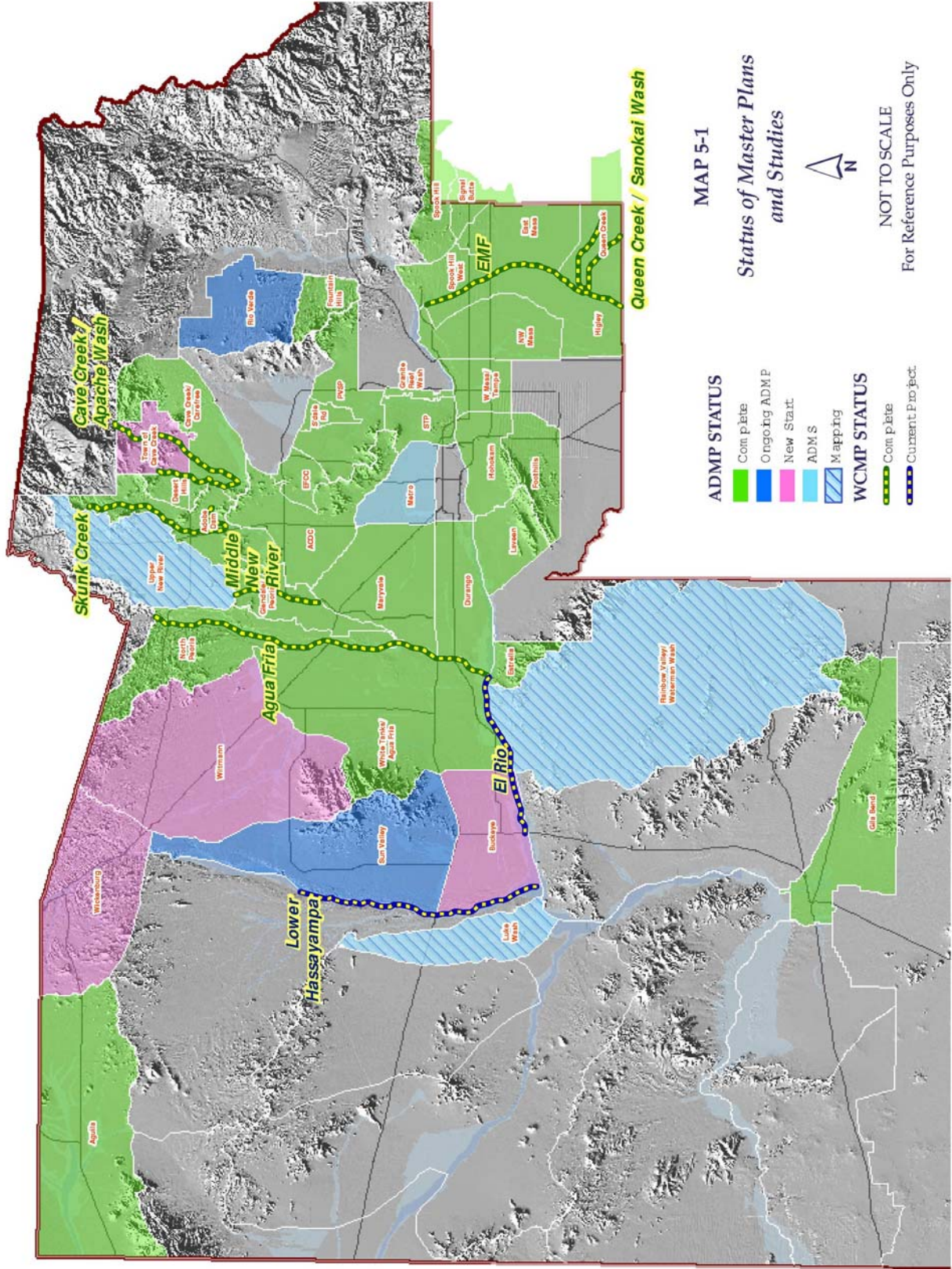
#### **5.4.1. General Assessment**

Several studies are started each year, encompassing hundreds of square miles of the county. Eight of these studies were begun in FY 2002-2003 with five of these studies being completed by the end of FY 2004-2005. 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 watersheds where studies are starting up.

In the 44 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 details of completed and future projects and studies by region are identified in Chapter 4 and summary tables of this data are in Appendix C. A general list of issues countywide is as follows:

- 15 of the 37 watersheds within the County’s boundary have not yet been studied.
- Approximately 11 of these studies are over ten years old.
- Approximately 8,000 linear miles of 100,000 scale USGS Hydrography need to be evaluated for possible delineation.
- An estimated 250 residential structures have been built in the delineated floodways and 22,000 structures constructed in delineated floodplains. Of the 22,000 buildings countywide about 60 percent are within municipal boundaries. The District will coordinate with these municipalities 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.
- 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.

The above issues will be resolved by prioritizing watersheds to determine which areas should be studied next, revisiting older studies for needed updates, continuing the efforts of the Capital Improvement Program, and continuing other District programs.





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. This Chapter addresses the elements of the CRS requirements for a Floodplain Management Plan. The sections of this Chapter present goals, activities, and an Action Plan to frame the process for implementation of the overall Comprehensive Plan. Implementation of the Plan will result in continued identification and mitigation of flood and erosion hazards.

**5.4.2. Specific Assessment by Study**

The District’s approach for the identification of the flooding and erosion hazards is done through a long-range planning process where the Community of Maricopa County is divided into regions and a certain number of planning studies are done in each region based on a risk assessment of hazard. See Chapter 4 for information on criteria. The following studies were recently completed for various watersheds and watercourses in Maricopa County since the 1999 FEMA community assessment:

Name	Study Area Sq. Miles	LA and Environmental	Floodplain Delineations	CIP Projects
Upper Cave Creek/Apache Wash WCMP	-	Yes		
Agua Fria WCMP	-	Yes		
Spook Hill ADMP	35	Yes	No	Yes
Scottsdale Road DMP	9	Yes	No	Yes
Glendale/Peoria ADMP	80	Yes	14 approx.	Yes
North Peoria ADMP	73	Yes	36 detailed, 54 EHZ	No
Gila Bend ADMP	51	Yes / No	20 detailed, 12 approx	No
Town of Carefree ADMP	24	Yes	10 detailed	Yes
Durango ADMP	53	Yes	12 detailed	Yes
Loop 303 Corridor/White Tanks ADMP	220	Yes		Yes
Adobe Dam Desert Hills ADMP	100	Yes	9 detailed, 3 approx	Yes

Specific solutions and preferred recommendations/alternatives for remediation of flooding and erosion hazards were identified for the study watersheds based on technical data and input from affected government agencies and the property owners of the area. The public involvement program and response for each of these studies is included in Appendix B.

**5.5. Floodplain Management Goals (CRS 511. a.6)**

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. The Board adopted the *Maricopa County Unincorporated Area Hazard Mitigation Plan (HMP)* per the



requirements of the Disaster Mitigation Act of 2000 in July 2004. The HMP encompasses elements and the goals presented in this planning document.

The District recognizes the need to continually move forward on these mitigation efforts. The District sets a general course for future direction and type of projects to be done through the annual Managing for Results strategic planning process. The Action Plan, Section 5.7 of this document, gives specific activities to provide floodplain management to mitigate hazards due to flooding.

#### **5.5.1. Managing for Results Strategic Plan (2004)**

A team made up of staff members from the District's Divisions meets annually to prepare this District's portion of the Managing for Results Strategic Plan. The Board of Directors then adopts the Strategic Plan. The FY 2003-2004 Managing for Results strategic planning process for the District presents the following Floodplain Management Goals:

1. By 2007, the Flood Control District will have the requisite number of 500 points to increase its CRS rating from a level 5 to a level 4. The Flood Control District will also have assisted those communities in Maricopa County that are in the CRS program in adding points to achieve their next level, and will have assisted those communities that are not in the program to enter the program.
2. Each year for the next five years, the Flood Control District will participate in Maricopa County's One-Stop-Shop (OSS) and meet the OSS' goals for cycle time, quality, and quantity. The Flood Control District will also integrate its OSS-based reporting elements through the One-Stop-Shop's lead agency, the Department of Planning and Development.
3. By 2005, the Flood Control District will have evaluated all of the existing District-owned flood control facilities, and, if necessary, will have initiated 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. For the next five years, the Flood Control District will implement the program designed to document processes and procedures that are in the institutional memory and develop a new generation of leadership to replace its aging workforce.
5. During the next five years, the Flood Control District will continue to secure the means of increasing its operating budget so that more cost-effective flood control measures can be implemented.
6. During the next five years, the Flood Control District, recognizing the impacts of major public works projects on the community in which they are constructed, will incorporate appropriate strategies to mitigate these impacts to the extent allowed by enabling statutes, and where feasible and appropriate design and construct facilities to include provisions for multiple use opportunities incorporating the principles of landscape architecture and land use planning in their siting, planning, and design.



7. For the next five years, within the constraints of its enabling legislation, the Flood Control District will continue to serve as an agent of Maricopa County in managing, NPDES and AZPDES Phase I and Phase II mandates.
8. During the next five years, the Flood Control District will continue to execute its mission of providing flood hazard identification, regulation, remediation, and education to the people of Maricopa County so that they can reduce their risks of injury, death, and property damage due to flooding while enjoying the natural and beneficial values served by floodplains.
9. During the next five years, the Flood Control District will continue to prioritize proposed projects and institute a funded CIP to the maximum extent of its resources while maintaining a responsible fund balance.

### **5.5.2. Flood Control District Comprehensive Plan**

District staff identified the following goals for floodplain management in a brainstorming session in June 2004:

1. Identify and implement regulatory processes to enhance and enforce updated floodplain regulations.
2. Support floodplain manager training programs.
3. Refine processes and procedures by increasing efficiency.
4. Maximize multi-use opportunities coincident to flood hazard.
5. Develop alternative strategies for mitigating existing structures within identified flood hazard areas.
6. Reduce cost to taxpayer for flood hazard mitigation without reducing risk mitigated.
7. Maximize information technology to assimilate and present information more efficiently.
8. Update all regulation manuals/methodology as needed.
9. Work toward compliance of all sand and gravel operations with floodplain regulations.

### **5.5.3. Maricopa County Unincorporated Hazard Mitigation Plan**

The County's HMP was adopted by the Board of Supervisors on August 18, 2004, and accepted by FEMA in December of 2004. The following goals are from that plan. The goals in bold are those that pertain to floodplain management.

- 1. Promote disaster-resistant future development.**
- 2. Promote public understanding, support and demand for hazard mitigation.**
- 3. Build and support local capacity to warn the public about emergency situations and assist in their response.**
- 4. Improve hazard mitigation coordination and communication within the County.**
- 5. Reduce the possibility of damage due to floods.**



6. Reduce the possibility of damage and loss to business, homes and county-owned facilities due to wildfires.
7. **Reduce the possibility of damage and losses due to severe weather.**
8. **Reduce the possibility of damage and losses due to drought.**
9. Reduce the possibility of damage and losses due to infestations and diseases.
10. **Reduce the possibility of damage and losses due to geological hazards.**
11. Prevent and minimize damage and losses due to hazardous materials (HAZMAT) incidents.
12. Reduce the possibility of damage and losses to existing assets due to other human-caused hazards.

#### **5.5.4. Maricopa County Comprehensive Plan 2020**

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 statutes 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 Plan 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.*

The coordination of several layers of government and documents is necessary to achieve the county's flood mitigation success. Once these are coordinated possible activities for mitigation can be determined.

## **5.6. Review of Possible Activities (CRS 511.a.7)**

The District cannot fund programs, studies, and projects for the entire county all at once, nor is there a need to do so. Population growth, development trends, flood incidents, and other related information are tracked by District staff to determine the level of activity necessary to keep residents and property from flood hazards. Flood hazard mitigation is an ongoing process in this large, rapidly growing county. This purpose of this Floodplain Management Plan is to identify the program of activities that will best mitigate Maricopa County's vulnerability to the hazards identified in the District's various studies and master plans. The five-year ADMP, Delineations, and CIP Programs allow the District to plan ahead and spread these projects out over a reasonable time frame based on highest need.

### **5.6.1. General Review**

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 hazards exist and therefore where ADMS/ADMP, WCMPs or Flood Insurance Studies 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, wildcat subdividing), 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. General activities identified for the entire Community are the following:

- The Regulatory Branch would continue to provide floodplain management where development is occurring through its activities, which are detailed in Chapter 3. The District staff can anticipate issuing approximately 200 floodplain use permits each year. County Planning and Development processes about 6,300 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 325 miles of new delineations planned for the Fiscal Year 2005-06.
- Flood Hazard Education, mainly through the District's Public Information Office, is an ongoing process in conjunction with all other District programs and activities. New programs are being initiated.
- Placement of flood warning and data collection devices 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.
- The Floodprone Properties Acquisition Program internal review committee will continue to evaluate and refine the risk assessment criteria for property eligibility and acquisition.

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.

### **5.6.2. Specific Activities**

Chapter 4 identified completed projects and upcoming construction activity for the FY 2003-2004 to 2007-2008 Capital Improvement Program. These projects are generated as a result of the Planning Studies. The District is mainly responsible for unincorporated county, however the political and taxing structure encompasses the municipalities within the county. The District partners on projects within municipal boundaries with the respective cities and towns. Specific activities reviewed and identified for the entire Community are the following:

- Structural projects identified in the five-year CIP are underway or set for construction. See Chapter 4, Table 4-3.
- Four ADMS/ADMPs will be completed and four to six new studies will begin.
- Three to six delineation studies will be started.
- Additional floodprone structures will be purchased through the FPAP.



There are additional activities that occur in conjunction with the structural mitigation and studies. Section 5.7. below identifies action items for floodplain management for the District to achieve in the areas under its jurisdiction. Many of the action items are specific to addressing unincorporated county issues. However, because of the legal make-up of the District a number of the action items involve partnership with other agencies.

## 5.7. Action Plan (CRS 511.a.8)

### 5.7.1. Current and Ongoing

The action plan items listed below specify those activities that the District expects to continue or complete over the next years. This list is not inclusive of all District activity, but captures key elements.

ACTION	TIMEFRAME
<b>5.7.1.1. Preventive</b>	
The District will continue to work with County Planning and Development on a cooperative effort to notify developers of ADMPs and floodplain regulations early on in the development process.	Ongoing
The District will requests the Board of Supervisors adopt the Watershed Area Plans as they are completed.	Ongoing
The District will implement the Sand and Gravel Guidelines.	Ongoing
The District's updated Floodplain Regulations will be implemented.	Ongoing
The District will complete the following plans/studies: Buckeye/Sun Valley ADMS, Wittmann ADMS, Rio Verde ADMP, Adobe Dam/Desert Hills ADMP, El Rio WCMP	2005-2006
The District will complete 300 or more miles of floodplain delineations.	Fiscal Year 2005-2006
<b>5.7.1.2. Property Protection</b>	
The District staff will wrap up the first round of applications for the recently adopted Floodprone Properties Acquisition Program, and begin the process on the second round.	June 30, 2005 – end first round, July 1, 2005 start second
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.	Ongoing
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.	Ongoing
<b>5.7.1.3. Natural Resource Protection</b>	
The District will continue to account for and incorporate wetland protection and mitigation sites into the planning process when preparing new studies for watercourses.	Ongoing
The District will delineate a number of miles of Erosion Hazard Zones as part of the ADMS/ADMP Program.	Fiscal Year 2005-06
The District will continue to incorporated low-impact structural alternatives with multi-use opportunities into ADMP studies.	Ongoing



ACTION	TIMEFRAME
<b>5.7.1.4. Emergency Services</b>	
Emergency Action Plans (EAP) for the remaining four structures of the 22 dams maintained by the District will be updated.	Ongoing
The individual Structures Assessment for two of the remaining 22 dams structures will be completed.	Fiscal Year 2005-2006
The District will continue to provide the ALERT and other flood warning and response programs as needed based on flood hazard risks.	Ongoing
The District will continue conducting emergency drills.	Ongoing
<b>5.7.1.5. Structural Projects</b>	
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. There are currently 25 structural projects identified in the FY 2003-2004 to 2007-2008 CIP. The projects are listed in Chapter 4 by watershed and region.	Fiscal Years 2003-04 through 2007-08
Additional phases of the Structures Retrofit Program are in process. This program looks at incorporating multi-use opportunities into existing structures, make them more aesthetically pleasing, and blend with the environment.	Ongoing
<b>5.7.1.6. Public Information</b>	
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.	Ongoing
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 three years)	Ongoing
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.	Ongoing
The District will continue to maintain 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 ( <a href="http://www.fcd.maricopa.gov">www.fcd.maricopa.gov</a> ). Pamphlets on basic flood preparedness will continue to be available for distribution.	Ongoing
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.	Ongoing
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.	Ongoing
District staff will send out 1,600 CRS brochures and mailings on the FPAP.	July-August 2005



**5.7.2. Completed Action Items (2002- 2004)**

In addition to the ongoing programs and activities that the District performs each year, the District has completed specific projects since the *2002 Floodplain Management Plan* was submitted for the NFIP Community Rating System. These are noted below.

**5.7.2.1. Preventive**

- The District started 13 major studies involving floodplain delineations since the Comprehensive Plan 2002 was adopted on September 18, 2002. The following is a list of these major studies. Delineation of 1,100 miles of detailed and approximate floodplains was done as part of these studies.

Study Name	Notice to Proceed
Tempe Canal	03/06/2003
Chandler Gilbert	03/03/2003
Waterman Wash Watershed	03/06/2003
Buckeye/Sun Valley ADMS	06/18/2003
Wittmann ADMS Update	04/21/2003
Sonoqui Wash	06/25/2003
Upper New River West Tributaries	01/28/2004
Lower Centennial Zone A	06/02/2004
Lower Hassayampa WCMP	05/19/2004
Moon Valley Wash	11/09/2004
Camp Creek Tributaries	11/09/2004
Cave Creek from CAP to Canal to Loop 101	11/09/2004
Cline Creek Redelineation	11/09/2004

- The following ADMS/ADMPs were completed and adopted by the Board of Directors: Glendale/Peoria ADMP, North Peoria ADMP, Laveen ADMP, Agua Fria WCMP. Additional Plans completed were Durango ADMP (2002), Tres Rios Study – USACE (2002), Town of Carefree ADMP (2002), Spook Hill ADMP (2002), Agua Fria WCMP (2002), Aguila ADMP (2004), Sols Wash CAR (2004), and Loop 303 Corridor/White Tanks ADMP (2002).
- The District staff updated 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.
- The District applied for and prepared a Stormwater Management Plan in accordance with the Phase II NPDES stormwater regulations on behalf of Maricopa County (including FCD interests). The County received the AZPDES permit. The *Volume III – Erosion Control Manual* will incorporate new Phase II stormwater concerns as part of the county’s permit.



- Maricopa County adopted an Open Space Element for the *Comprehensive Plan 2020 – Eye to the Future*. See 5.5.4. Floodplain Management Goals.

#### **5.7.2.2. Property Protection**

- The Floodprone Properties Acquisition Program was adopted by the Board of Directors (Resolution 95-01A) on July 30, 2003 for the purpose of buying out residences in the floodprone areas.
- The District staff completed the public information pieces and ranking assessment process for the FPAP. Thirty applications were received for the FY 2004-2005 acquisition.
- Elevation Certificates have been scanned and are available to the public through the District's web page.

#### **5.7.2.3. Natural Resource Protection**

- Revision of the *Volume III - Erosion Control Manual* addressed Phase II stormwater issues.
- The District completed delineation of erosion hazard zones in its current studies. Over 100 lineal miles of 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).
- Partnerships with surrounding jurisdictions to provide trails along various rivers and washes were done.

#### **5.7.2.4. Emergency Services**

- Emergency Action Plans for 18 of the 22 dams maintained by the District were updated by the end of 2004.
- Individual Structures Assessment for 19 of the 22 dams were completed by the end of 2004. The District has been working with the NRCS do to the rehabilitation of White Tanks #3, and therefore there is no need for an Individual Structures Assessment for it.
- Information continued to be added to the ALERT system.

#### **5.7.2.5. Structural Projects**

- 20 structural projects identified in the FY 2001-2002 to 2005-2006 CIP have been completed. The projects are listed in Chapter 4 by watershed and region. The projects consisted of a series of levees, channels, storm drain diversions, and retention basins. Total costs = approximately \$100 million.

#### **5.7.2.6. Public Information**

- Results of studies are now included in the District's Geographic Information System (GIS).
- District Public Information Staff made presentations to schools on flood safety and made presentations to the real estate community.



- The District's library continues to be expanded with copies of studies and other flood related information.
- The District participates in general education through its website, print media, electronic media, and staffed display booths at trade shows. Public education is also included at the many public information meetings held on all of the District studies and projects.

### **5.8. New Initiatives (CRS 511.a.7)**

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.

#### **5.8.1. 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.

#### **5.8.2. 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 as it relates to floodplain management. 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.

#### **5.8.3. River Corridor Management**

A major part of the District's mission is developing and implementing watercourse master plans to either remedy existing flooding problems in already developed areas or to provide a template for managing the major river corridors as they face new development.

While the District does own parts of the river corridors, most of the land is either privately owned or owned by other government agencies such as the US Bureau of Reclamation, Arizona State Land Department, US Fish & Wildlife Service, Arizona Game & Fish Department, and Maricopa County Parks & Recreation. Jurisdiction over river corridor lands involves many of the valley's cities as well as unincorporated Maricopa County. In order to fulfill its flood protection mission, the District must often partner with other interests, such as



the various cities, private property owners, and other government agencies to accommodate their needs within the context of flood protection. These needs include habitat restoration, recreational trails and parks, groundwater recharge, transportation, and development. A number of cooperative river corridor projects are underway and are described below.

#### **5.8.3.1. River Corridor Projects**

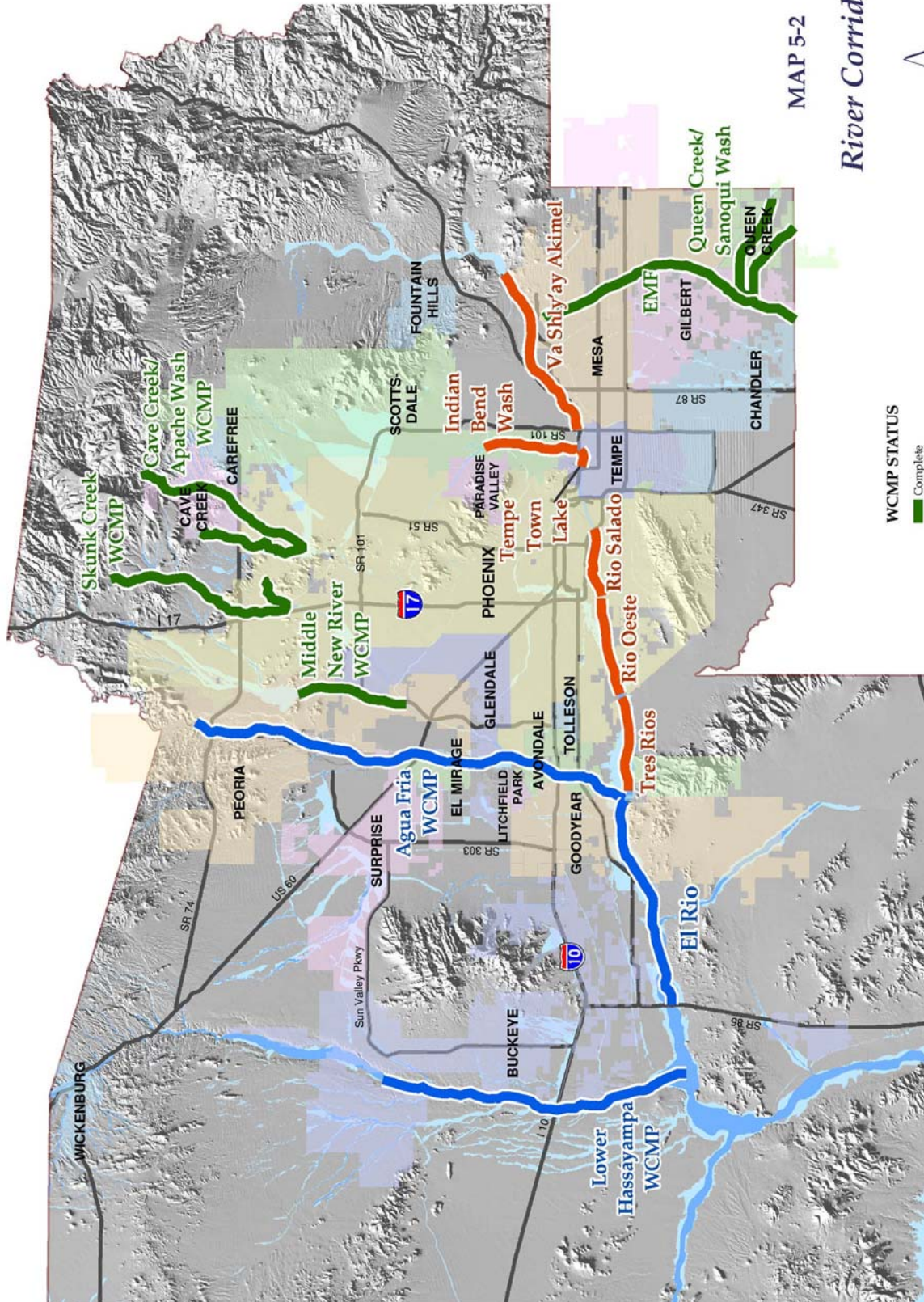
The major river corridors in the valley drain large watersheds, and extend beyond the County boundary. Depending on location, the District either leads planning efforts on different segments of the river corridors or takes a supporting role. The project descriptions below define the segments and identifies lead agency. [Map 5-2](#) shows the location of these river corridors.

**Va Shly'ay Akimel** – This project covers the 14-mile stretch of the Salt River between the Granite Reef Diversion Dam and the Loop 101-Loop 202 traffic interchange. Most of this area lies within the Salt River Pima- Maricopa Indian Community (SRPMIC). The rest is within the City of Mesa, with some smaller portions of unincorporated Maricopa County. This area has seen a large amount of disturbance to the natural river regime due to diversion of the once perennial river flows due to the construction of upstream water supply dams and extensive sand and gravel mining activities. The USACE, in cooperation with the City of Mesa and the SRPMIC, has developed a plan to restore the natural function of the river corridor by reestablishing native vegetation, preserve historic and sacred Native American sites, provide recreational opportunities, protect bridges and other infrastructure, while improving flood protection. The USACE's feasibility study cost on the order of \$3 million, while the overall restoration project is estimated to cost \$143 million. The District will contribute to the design and construction efforts for those portions of the project that address flood protection outside of Tribal jurisdiction.

**Rio Salado** – The Rio Salado/Tempe segment of the river includes an approximately five-mile section of the Salt River between the Loop 101-Loop 202 interchange and the western boundary of Tempe with Phoenix. It includes the Tempe Town Lake project and the habitat restoration upstream of the lake and at the confluence of the Indian Bend Wash. The City of Tempe has the lead, in cooperation with the Corps of Engineers and the Salt River Project. The purpose is to transform a once neglected riverbed into a focal point for high-quality recreation and development along the banks. The District has a supporting role to ensure the integrity of the flood protection component.

**Rio Salado** – This five-mile segment of the Salt River through downtown Phoenix has been historically impacted by channelization to protect Sky Harbor Airport, sand and gravel mining and other industrial activities, and landfills that predate restrictions on their placement adjacent to major river floodplains in Arizona. The District constructed a low flow channel and grade control structures between 28<sup>th</sup> Street and 19<sup>th</sup> Avenue to provide effective protection of bridges and other structures along the river. The City of Phoenix leads the effort to transform the area into a park-like setting by introducing native vegetation and other amenities that will help transform the adjacent corridor from the back of warehouses and industrial sites to attractive commercial and residential development. The total cost of the project is \$99 million, with two-thirds of the cost paid by the USACE.





MAP 5-2

River Corridors

**WCMP STATUS**

- █ Complete
- █ Current Project
- █ Corps

NOT TO SCALE  
 For Reference Purposes Only



**Rio Salado Oeste** – This project is led by the City of Phoenix. In the planning stages, it is meant to close the seven-mile gap between the Rio Salado Project and the Tres Rios Project. The City of Phoenix and the USACE have the lead and have completed the Reconnaissance Study and are in the process of completing the Feasibility Study. The District supports about 10 percent of the total \$3.8 million feasibility study costs with the USACE and City of Phoenix sharing 50 percent and 40 percent of the cost, respectively.

**Tres Rios** – This project is primarily intended to restore natural habitat in the area from around 83<sup>rd</sup> Avenue, past the confluence of the Gila River, to just upstream of the Agua Fria confluence with the Gila, near Dysart Road. A major component of this effort is to provide natural wetland treatment of effluent from the 91<sup>st</sup> Avenue Wastewater Treatment Plant. The City of Phoenix is the lead agency with support from the US Bureau of Reclamation.

**El Rio** – The El Rio Project is intended to provide a template for impending development along the 18-mile reach of the Gila River from the confluence with the Agua Fria River to the State Route 85 Bridge. The District is the lead on this project in cooperation with the cities of Avondale and Goodyear and the Town of Buckeye. Currently in the planning phase, the \$2.4 million master plan is scheduled for completion in 2005.

**Agua Fria** – The Agua Fria River is controlled by the New Waddell Dam at Lake Pleasant. The river corridor below the dam is unique in the quality of sand and gravel aggregate and has been mined extensively. The goal of the District-led WCMP is to transform this highly disturbed riverbed into a low-flow channel with a high-flow channel/terrace capable of accommodating parks and other recreational amenities such as the Maricopa Regional Trail System across the adjoining cities of Peoria, El Mirage, Youngtown, Glendale, Phoenix, Goodyear, and Avondale. Study costs to date amount to approximately \$1.8 million. Estimated cost of implementation is approximately \$100 million.

**Hassayampa River** – The Hassayampa River extends from its headwaters in the mountains behind Prescott, Arizona to the confluence with the Gila River at Buckeye, approximately six miles west of State Route 85. While the Hassayampa River is essentially undeveloped at this time, with the exception of agricultural development south of the I-10 corridor, proposed master planned communities within the expanded limits of the Town of Buckeye and unincorporated Maricopa County are expected to bring a population comparable to Tempe to the northern portion of this 32-mile segment of the river between I-10 and the Central Arizona Project Canal, near the alignment of Bell Road. The District-led Lower Hassayampa Watercourse Master Plan is in its first phase, meant to determine the existing conditions in terms of flooding and lateral erosion potential as well as existing infrastructure, environmental conditions, and the relation to proposed development. The \$980,000 first phase will result in recommendations for a phase two master plan.

#### **5.8.4. Designing Flood Protection Facilities to Complement Visual Landscapes**

Preservation of the natural landscapes of Maricopa County and protection of local community character are primary objectives of the Flood Control District's Board adopted *Policy for Landscaping and Aesthetic Treatment of Flood Control Facilities*. These objectives are



accomplished by planning and designing flood protection facilities to complement the positive visual characteristics of the landscape settings in which they are located.

The District routinely evaluates and implements a variety of non-structural and structural methods of providing flood protection in the Area Drainage and Watercourse Master Planning, Project Pre-Design and Final Design. These flood protection methods vary in their physical and visual characteristics and in their ability to complement landscape setting. The ability of flood protection methods to complement the visual character of the settings in which they are situated largely depends upon the degree to which the visual characteristics of the flood protection method will contrast with the valued visual characteristics of the landscape setting. [Table 5-1](#) is a summary comparison of the characteristics of flood control structures, their components, and the relative flood protection methods utilized.

Flood protection methods whose visual characteristics emulate and blend with the positive or valued visual characteristics found in a landscape setting will tend to be complementary to that setting. Conversely, flood protection methods whose visual characteristics are antipathetic to the setting, are likely to introduce negative deviations that will detract from the valued character of the setting. In general, non-structural and soft structural methods of flood protection exhibit a higher ability to blend with and/or introduce positive variety into the widest range of landscape settings found within Maricopa County. Hard structural methods, in general, exhibit the most limited ability for blending and offer the greatest potential for introducing negative deviations into the landscape settings.

**Table 5-1 Comparison of Flood Protection Methods – Super Structural and Structural Components Types and Treatments**

Flood Protection Methods	Super Structure				Structural Components				
	None	Earthen		Hard		None	Concealed or Disguised	Aesthetic Treatment	Standard Eng. Design
		Aesthetic Treatment	Standard Eng. Design	Aesthetic Treatment	Standard Eng. Design				
1. Non Structural	x					x			
2. Soft Structural		x					x		
3. Semi-Soft Structural		x						x	
4. Semi-Hard Structural			x						x
5. Hard Structural				x				x	
6. Standard Hard Structural					x				x

### 5.9 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.

**Hazard Mitigation Plan** – Maricopa County Emergency Management Department initiated a county-wide effort in 2002 to prepare a multi-jurisdictional All-Hazard Mitigation Plan in accordance with the Disaster Mitigation Act of 2000. In addition to unincorporated County, the team included the Flood Control District of Maricopa County, the 24 incorporated municipalities in the County, several of the Native American Communities, and the quasi-governmental Salt River Project. Coordinating all the long-range planning and hazard mitigation issues with this many entities was a considerable undertaking. As hazards have no political boundary, this multi-jurisdiction plan is much more effective than if each city did their own mitigation plan in a vacuum.

**No Adverse Impact** – No adverse impact (NAI) floodplain management is a managing principle developed by the Association of State Floodplain Managers (ASFPM) to address the shortcomings of today's typical local floodplain management program. The NAI approach offers tools for communities to provide a higher level of protection for citizens and to avoid increased flooding now and in the future. NAI is an approach by which the action of any community or property owner, public or private, is not allowed to adversely affect the property or rights of others. An adverse impact can be measured by an increase in flood stages, flood velocity, flows, the potential for erosion and sedimentation, degradation of water quality, cost of public services, or other factors. No adverse impact floodplain management extends beyond the floodplain to include managing development in the watersheds where flood waters originate.

NAI does not mean “no development”; it means that any adverse impact that is or would be caused by a project—or the cumulative impact of projects—must be mitigated, preferably as provided for in the community or watershed based plan. For local governments, NAI floodplain management is a more effective way to tackle flood problems. The concept offers communities a framework to design programs and standards that meet their needs, not just the requirements of a federal or state governmental program. NAI floodplain management empowers communities to work with stakeholders and build a program that is effective in reducing and preventing flood problems. Also, it is about communities being proactive, understanding potential impacts, and implementing mitigation activities before the impacts occur.<sup>1</sup>

**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 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.

## **5.9. Implementation (CRS 511.a.10)**

Implementation of all activities identified in this Plan is underway. Sections 5.3.4., 5.6. and 5.7. indicated progress to date of flood hazard mitigation efforts. 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. 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 are to be implemented as noted below.

- Additional public information and education as it relates to this Plan will be achieved by making the *Comprehensive Plan 2005 – Flood Control Program Report* available to the public on the web site and mailed by request.



- 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.

The summary lists provided throughout this Comprehensive Plan indicate the Flood Control District's progress in implementing successful flood control projects and floodplain management strategies. The staff and elected officials have made a commitment to the consistent, long-range planning efforts to mitigate flood and erosion problems county-wide.

### **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 county residents 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. Simple steps of having access to floodplain maps, studies, or the District's library available on the internet can help toward the goal of keeping structures out of harm's 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 every five years at a minimum in coordination with the budget, CIP, Planning, and Delineation programs by the District's Planning Branch staff.



## End Notes

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<sup>1</sup> Excerpts taken from Association of State Floodplain Managers (ASFPM) “*No Adverse Impact Floodplain Management Community Case Studies 2004*”.



## 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.