

MARICOPA ASSOCIATION OF GOVERNMENTS

POPULATION PROJECTIONS ISSUE PAPER

Prepared for:

Maricopa Association of Governments

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1. SUMMARY

Purpose: The purpose of this paper is to develop a possible 2050 population level for Maricopa County as an alternative to the DES population forecast for Maricopa County prepared in 1997. The 2050 alternative will form the basis for the formulation and analysis of alternative growth scenarios in the Maricopa Association of Government’s Regional Transportation Plan Update (MAG RTP) for the MAG region. In addition to the Maricopa County growth, growth in adjacent counties that may be influenced by growth in the MAG region will be examined. A macro approach has been adopted that reviews key population forecast issues and identifies a range of possible alternative population forecasts, and then recommends use population control totals of 5,835,000 around 2025, rising to 9,017,000 around 2050.

Historic Population and Demographics: It is helpful to place Maricopa County’s population growth in historical and geographic context. Maricopa County has undergone tremendous growth during the last 50 years. During the last decade the population of Maricopa County increased by almost 1.0 million persons which is the largest absolute increase in population to date. Generally, the growth of Maricopa County mirrored that of larger geographic areas (e.g. Arizona and the U.S.), although the rate of growth in Maricopa County was faster.

A number of demographic trends are clearly having a major affect on population growth rates from the national to local levels, including international migration, proportional and absolute growth in the Hispanic population, higher fertility rates among Hispanic women, and increasing life expectancies. The impact of these trends is certain to have contributed to Maricopa County’s strong recent growth and future growth.

DES Projections: The Population Statistics Unit of the Arizona Department of Security (DES) prepares the official state population estimates and forecasts. The latest population forecasts were released in February 1997. DES utilizes a cohort component model based primarily on the latest decennial Census. The projections for the state are simply based on the total of the county-level projections. Projections are made by single year of age and sex using four components: deaths; births; in-migration; and out-migration.

The DES 1997 model projected that Maricopa County would have a population of 2,954,157 in 2000, while the Census 2000 population for Maricopa County was 3,072,149, which is 117,992 or 3.8 percent higher. Similarly, the DES 1997 model under projected the 2000 population for Pinal County by 10.1 percent and by 3.3 percent for Arizona. It is notable, though, that the U.S. Census Bureau also under projected the 2000 population by 2.2 percent. The higher error rate of the DES

model may be attributable to the lack of consideration of race/ethnicity, the lack of a true economic model, as well as the possible impact of the demographic trends noted above.

Other States: It is useful to review the population projection methodology adopted by states experiencing comparable population growth rates and demographic trends, such as California, Florida and Texas. This review reveals that recent population projections for these states were more accurate than those for Arizona. Each of these states used a cohort component projection model similar to Arizona, however, the other states also took race/ethnicity into consideration, which probably resulted in better accuracy. Even so, the projections for these states were plus or minus approximately 2.5 percent compared to the 2000 Census figures, an indication of the difficulty of making population projections.

Alternative Projections: Due to the imminent updating of the DES projections in 2002, it is not considered appropriate to create completely new projections for Maricopa County. Instead, a relatively simple process of adjusting the growth rates utilized to produce the DES 1997 population projections is proposed. In short, the adjustment made takes into consideration the error rate between the 1997 DES projection for 2000 and the Census population figure, and adjusts the DES 1997 projected growth rates to produced alternative population projections.

The DES 1997 model projected the Maricopa County population at approximately 4,953,000 around 2025 and 7,265,000 in 2050. Three alternative population projections were developed for Maricopa County by applying a correction factor to take into account the difference between the projected DES 2000 population and the Census 2000 population. Averaging the three alternatives results in a forecast Maricopa County population of 5,535,000 around 2025 and 8,570,000 around 2050.

A similar process was used to develop alternative projections for Pinal County and to account for the geographic proximity of this group to Maricopa County. On this basis, approximately 300,000 Pinal County residents are expected to interact on a regular basis with Maricopa County around 2025, rising to 447,000 around 2050.

Recommended Projections: The recommended projected population (i.e., control totals) for use in the MAG RTP alternative growth scenarios is 5,835,000 around 2025, rising to 9,017,000 around 2050.

2. PURPOSE

The purpose of this paper is to provide a review of the official Arizona Department of Economic Security (DES) population projections for Maricopa County and to develop possible alternative population projections based on historical trends and factors not currently accounted for in the DES projection methodologies. This analysis has been completed as a part of the Maricopa Association of Government's Regional Transportation Plan (MAG RTP) and is intended to provide possible population projections for two approximate time horizons, 2025 and 2050.

A key component of the MAG RTP is the formulation and detailed analysis of alternative long-term growth scenarios for Maricopa County, and adjacent county areas influenced by Phoenix Metropolitan Area growth. The analysis of the alternative growth scenarios (e.g. status quo, clustered growth, in-fill growth and revitalization) is necessary to determine what transportation networks will be required to serve future growth. Consideration of a long time horizon is required for two reasons: first, entitled development (i.e. already approved) in Maricopa County could accommodate approximately 500,000 housing units, or about 1.3 million persons, roughly a fifteen years supply; and second, lead time necessary for the development of major new transportation networks is considerable, oftentimes ten or more years.

It is beyond the scope of this paper to address each of the numerous and interacting factors affecting population forecasts. Instead a macro approach has been followed to focus on key population forecast issues and to identify a range of population projection scenarios. The following are the specific tasks that were undertaken in order to complete the analysis of possible population projections for use in the MAG RTP:

- Review of historic population growth in Arizona, Maricopa County and Pinal County.
- Outline of DES population projection methodologies and identify key variables affecting projections.
- Compare historic DES population projections with Census population.
- Hypothesize about deviations between projected and Census population.
- Review population projections in comparable states.
- Discuss possible alternative population projections for Maricopa and Pinal County population for two planning horizons, 2025 and 2050.

3. HISTORIC POPULATION AND DEMOGRAPHICS

Before reviewing population projection methodologies and the projections themselves, it is helpful to place Maricopa County's population in historical and geographic context. A review of demographic trends affecting population growth and projections is also useful.

3.1 Population

Given the projection time horizons, 2025 and 2050, a long-term approach is warranted. Comparison with other geographic regions, such as Pinal County, Arizona and the U.S., are also useful.

According to the U.S. Census Bureau, the population of Maricopa County increased from 20,457 in 1900 to 3,072,149 in 2000 as shown in Figure 1 and Table 1 on the next page.¹ This increase of 3,051,692 equates to nearly 15,000 percent growth. While this number is large, it is a function of both the large amount of growth experienced in Maricopa County, as well as the small base from which growth began.

The population of Pinal County, Arizona and the U.S. are also shown for reference purposes. During the period 1900-2000, Maricopa County's proportion of Arizona's population has grown from 17 percent in 1900 to 60 percent in 2000. This clearly demonstrates Maricopa County's impact on population growth in Arizona.

The amount of population growth, in absolute terms, for Maricopa County has increased in eight of the last ten decades, as shown in Figure 2 and Table 2. The two exceptions were the Depression decade (1930-1940) and the post-Baby Boom decade (1960-1970). These two lulls in absolute population growth also occurred in Pinal County, Arizona and the U.S. as a whole.

¹ The Census figures used in this paper are for resident population as defined by the U.S. Census Bureau, which defines a resident of a specified area as a persons "usually resident" in that area. Unless otherwise noted, Census figures are for the date of July 1st.

Figure 1: Population, 1900-2000

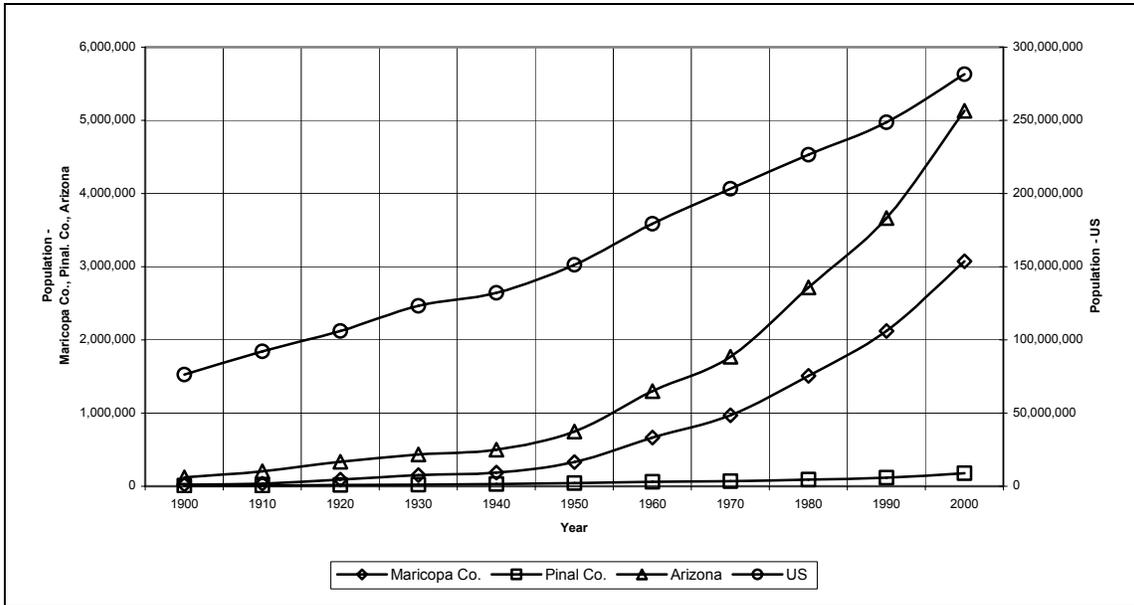


Table 1: Population, 1900-2000

Year	Maricopa County	Pinal County	Arizona	United States
1900	20,457	7,779	122,931	76,212,168
1910	34,488	9,045	204,354	92,228,496
1920	89,567	16,130	334,162	106,021,537
1930	150,970	22,081	435,573	123,202,624
1940	186,193	28,841	499,261	132,164,569
1950	331,770	43,191	749,587	151,325,798
1960	663,510	62,673	1,302,161	179,323,175
1970	967,522	67,916	1,770,900	203,211,926
1980	1,509,052	90,918	2,718,215	226,545,805
1990	2,122,101	116,379	3,665,228	248,709,873
2000	3,072,149	179,727	5,130,632	281,421,906

Source: U.S. Census Bureau, May 2001a; U.S. Census Bureau, May 2001e; U.S. Census Bureau, March 1995.

Figure 2: Population Change, 1900-2000

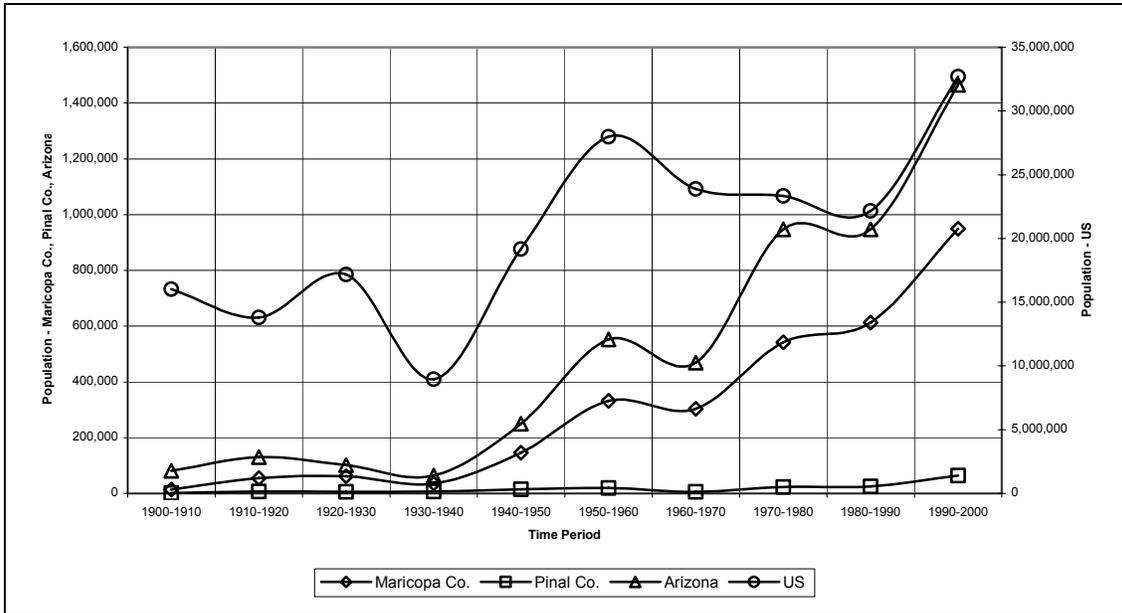


Table 2: Population Change, 1900-2000

Years	Maricopa County	Pinal County	Arizona	United States
1900-1910	14,031	1,266	81,423	16,016,328
1910-1920	55,079	7,085	129,808	13,793,041
1920-1930	61,403	5,951	101,411	17,181,087
1930-1940	35,223	6,760	63,688	8,961,945
1940-1950	145,577	14,350	250,326	19,161,229
1950-1960	331,740	19,482	552,574	27,997,377
1960-1970	304,012	5,243	468,739	23,888,751
1970-1980	541,530	23,002	947,315	23,333,879
1980-1990	613,049	25,461	947,013	22,164,068
1990-2000	950,048	63,348	1,465,404	32,712,033
Total	3,051,692	171,948	5,007,701	205,209,738

Source: U.S. Census Bureau, May 2001a; U.S. Census Bureau, May 2001e; U.S. Census Bureau, March 1995.

Figure 3: Population Compound Annual Growth Rates, 1900-2000

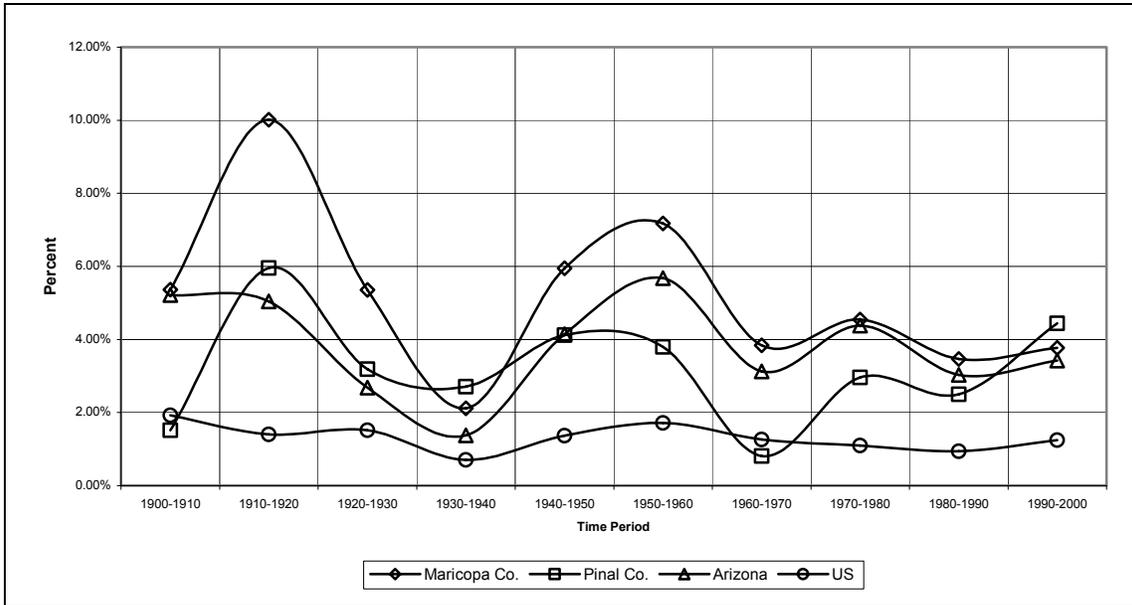


Table 3: Population Compound Annual Growth Rates, 1900-2000

Years	Maricopa County	Pinal County	Arizona	United States
1900-1910	5.36%	1.52%	5.21%	1.93%
1910-1920	10.01%	5.96%	5.04%	1.40%
1920-1930	5.36%	3.19%	2.69%	1.51%
1930-1940	2.12%	2.71%	1.37%	0.70%
1940-1950	5.95%	4.12%	4.15%	1.36%
1950-1960	7.18%	3.79%	5.68%	1.71%
1960-1970	3.84%	0.81%	3.12%	1.26%
1970-1980	4.55%	2.96%	4.38%	1.09%
1980-1990	3.47%	2.50%	3.03%	0.94%
1990-2000	3.77%	4.44%	3.42%	1.24%

Source: U.S. Census Bureau, May 2001a; U.S. Census Bureau, May 2001e; U.S. Census Bureau, March 1995.

While the absolute increase in population in Maricopa County is impressive, particularly during the past decade, it is useful to examine the Compound Annual Growth Rate (CAGR) by decade.² The CAGR in Maricopa County has fluctuated over the past decades, from a high of 10.01 percent in 1910-1920 to a low of 2.12 percent in 1930-1940, as shown in Figure 3 and Table 3. Since 1960, the CAGR in Maricopa County has varied between a high of 4.55 percent in 1970-1980 and a low of 3.47 percent in 1980-1990. During the last decade, 1990-2000, Maricopa County's population CAGR increased to 3.77 percent. Variations in Maricopa County's CAGR by decade are similar to those in Pinal County, Arizona and the U.S. as a whole.

3.2 Demographics

Population projections typically rely on a number of historical demographic factors as inputs into the projection methodology. Chief among the demographic factors utilized to make population projections are the following primary factors: births (fertility rates); deaths (survival rates); in-migration; and out-migration. These are typically defined on an age-specific and sex-specific basis. Secondary factors which directly or indirectly affect the primary factors used to make population projections include the following: race/ethnicity; nativity (citizenship at birth); employment; and household formation rates.

It is beyond the scope of this paper to address historic and projected changes in these factors in detail. However, some recent trends and relationships among these factors are identifiable which may significant bearing on population projections. National trends among these factors are reviewed below:

- While fertility rates among women in the U.S. overall have stabilized over the last 20 years, wide variations occur by race and ethnicity. For example, in 1998 the fertility rate among Hispanic women age 15-44 was the highest among all race and ethnicity groups at 84.0 births per 1,000 women.³ This compares to the fertility rate for White non-Hispanic women of 57.2 births per 1,000 women, and an average of 60.7 births per 1,000 for all women (U.S. Census Bureau, September 2000).

² The Compound Annual Growth Rate (CAGR) is the rate of growth necessary to increase a number (X) at a starting point in time (t) to reach a number (X') at a future point in time (t'). The mathematical formula for CAGR is as follows: $CAGR = (X'/X)^{1/(t'-t)} - 1$. CAGR is not the same as an arithmetic average, which does not account for compounding interest effects as is done with the CAGR.

³ Hispanics may be of any race.

- According to the U.S. Census Bureau's June 1998 Current Population Survey, Hispanic women age 40-44 have had an average of 2.4 births each, thereby exceeding the population replacement level of 2.1. By contrast, Black and Asian/Pacific Islander women had fertility levels close to the replacement level, and White non-Hispanic women were significantly below replacement level at 1.8 births each. There were an estimated 7.4 million Hispanic women in the age group 15-44, equal to 12.2 percent of all women in this age group. However, Hispanic women in this age group accounted for 17 percent of all births in 1998 and had the highest fertility rate among all racial/ethnic groups, 84.0 births in 1998 for Hispanic women aged 15-44 versus an average of 60.7 for all women (total of 60.5 million women age 15-44). (U.S. Census Bureau, September 2000).
- Fertility rates vary widely between native and foreign born women.⁴ Among women age 15 to 44, foreign born women had a birth rate of 72.8 per 1,000 women in 1998, versus 59.0 per 1,000 native women. The birth rate was 77.6 births per 1,000 women born in Latin America, and even higher at 88.8 per 1,000 women born in Mexico. There were an estimated 7.3 million (12.0 percent) foreign born women age 15-44 in 1998, versus a total of 60.5 million women age 15-44 (U.S. Census Bureau, September 2000).
- As with fertility rates, wide differentials in mortality exist by race/ethnicity in the U.S. as well as between males and females. These differentials in mortality rates are expressed in varying life expectancies at birth by race/ethnicity and gender. For example, the Census Bureau estimated that all males born in 1999 would live to 74.1 years and all females would live to 79.9 years^{5,6}.

⁴ Native is used to designate people born in the U.S., Puerto Rico, the Virgin Islands or the outlying areas or territories of the U.S., or who were born abroad to parents, at least one of whom was a U.S. citizen. Foreign born means all other people.

⁵ Unless otherwise indicated, all references to Census Bureau estimates or projections are based on the Middle Series which is considered the most likely scenario and is the most widely used. Alternatives to this scenario are the Low Series, High Series, and Zero International Migration Series. Demographic factors contributing to population projections, such as fertility rates, migration rates, and life expectancies, are allowed to vary for each series. As a result, the population projections for 2050 vary from 313.5 million in the Low Series, to 403.7 million in the Middle Series, to 552.8 million in the High Series. The projected population variations are even wider to 2100, when population is projected to decline to 282.7 in the Low Series, increase to 571.0 million in the Middle Series, and approach 1.2 billion in the High Series (U.S. Census Bureau, January 2000).

⁶ Based on preliminary 1999 death rate information, the National Center for Health Statistics had slightly different life expectancies of 73.9 years for all males and 79.4 for all females in 1999 (National Center for Health Statistics, June 2001).

According to the Census Bureau's Middle Series, by 2050, these rates are expected to increase, respectively, to 81.2 years for all males and 86.7 years for all females. Among Hispanics, the life expectancy in 1999 was 77.2 years for males and 83.7 years for females. By 2050, Hispanic males are expected to live to 83.0 years and Hispanic females are expected to live 88.4 years (U.S. Census Bureau, January 2000).

- International migration has been a major contributor to the increase in the U.S. population over the recent decades. In 1997, the U.S. Census Bureau estimated that there were 25.8 million foreign born residents in the U.S., the largest in U.S. history and considerably higher than the 9.6 million foreign born residents in 1970. This equated to an estimated one in ten persons in the U.S., the highest level since 1930. One-half, or 13.1 million persons, of the estimated foreign born residents in 1997 were from Latin America, a significant increase over the one in five (1.8 million) residents in 1970 from Latin America (U.S. Census Bureau, August 2000).
- Despite the tremendous increase in foreign born population in the U.S. during recent decades, international migration is the component for which demographic science offers the least quantitative guidance. This is due to the potential effect of policy changes as well as gaps in the availability of detailed or even complete data. Despite this situation, according to the Census Bureau's Middle Series, net international migration (migration to the U.S. and emigration of legal residents from the U.S.) is expected to decline from 954,000 in 1997, to 912,000 in 2025, then to increase to 984,000 in 2050 (U.S. Census Bureau, January 2000).
- The Hispanic population in the U.S. increased from 22.4 million in 1990 to 35.3 million in 2000, an increase of 12.9 million persons. On a proportional basis, Hispanic population increased from 9.0 percent to 12.5 percent of U.S. population (U.S. Census Bureau, May 2001). By 2050, when according to the Census Bureau's Middle Series U.S. population is forecast to increase to 403.7 million, Hispanic population is forecast to increase to 98.2 million or 24.3 percent of the U.S. population, making it the second largest racial/ethnic group in the U.S. behind Whites (U.S. Census Bureau, February 2000).
- Household size has declined over the recent decades as the number of non-family households increases as a proportion of the total number of households.⁷ According to the Census Bureau, the average household size in

⁷ Households are arranged in two types: family households and non-family households. Family households contain at least two persons, a householder and at least one other person related to the

2000 was 2.59, down from 2.63 in 1990. By 2010, the average household size is forecast to decline further to 2.53 (U.S. Census Bureau, May 2001; U.S. Census Bureau, December 1999; U.S. Census Bureau, May 1996).

Clearly, these trends will have a major impact on the size and composition of the U.S. population. Identification and consideration of these trends is very important since they have a significant effect on population projections. Furthermore, the impact of these trends is likely to be even stronger in Maricopa County, Pinal County, and Arizona than at the national level, as evidenced by the following:

- Maricopa County's Hispanic population was 763,341 persons, or 24.8 percent, in 2000, up from 345,4982, or 16.3 percent, in 1990. The number of persons per household was 2.59 in 2000, down from 2.67 in 1990 (U.S. Census Bureau, May 2001; U.S. Census Bureau).
- The Hispanic population in Pinal County increased to 53,571 persons or 29.9 percent in 2000, up from 34,062 persons or 29.3 percent in 1990. The number of persons per household decreased to 2.68 in 2000, down from 2.83 in 1990 (U.S. Census Bureau, May 2001; U.S. Census Bureau).
- Arizona's Hispanic population increased to 1,295,617 or 25.3 percent in 2000, up from 688,338 or 18.8 percent in 1990. However, in contrast to the U.S. and the above counties, the average household size increased in Arizona to 2.64 in 2000, versus 2.62 in 1990 (U.S. Census Bureau, May 2001; U.S. Census Bureau)

householder by birth, marriage or adoption. A non-family household may contain only one person, the householder, or more persons who are not relatives of the householder.

4. DES PROJECTIONS

The Arizona Department of Economic Security's (DES) Population Statistics Unit prepares the official population estimates and projections for the State of Arizona. The Population Statistics Unit also serves as the lead agency for the State Data Center program and provides improved access to Census products and information.

4.1 *Methodology*

Preliminary county population projections are prepared by DES twice per decade, once after the Decennial Census and once after the mid-decade Census. The projections are first distributed for review by POPTAC.⁸ Following the resolution of POPTAC's concerns and comments, DES completes and distributes the county projections to POPTAC for final review and recommendation, and these are then forwarded to the DES Director for approval.

DES and the regional Councils of Government (COGs) then prepare sub-county projections, which are then distributed for regional review. Following the regional review process, the projections are distributed to POPTAC for its review and recommendation, and then forwarded to the DES Director for approval and release for distribution.

Projections for the state, counties and incorporated places are based on methodologies and standards established by DES and recommended by POPTAC.⁹ The projections for the state are based on a bottom-up model, with county populations projected first and then totaled to get the state population projection.

⁸ POPTAC is comprised of twenty voting members and six non-voting members. The following are the voting members of POPTAC: Department of Commerce; Department of Economic Security; Department of Education; Department of Health Services; Department of Revenue; Department of Transportation; Department of Water Resources; Arizona State University; Northern Arizona University; University of Arizona; Maricopa Association of Governments (MAG); Pima Association of Governments (PAG); Northern Arizona Council of Governments (NACOG); Western Arizona Council of Governments (WACOG); Central Arizona Council of Governments (CAAG); South Eastern Arizona Governments Organization (SEAGO); League of Arizona Cities and Towns; Inter-Tribal Council of Arizona; The Navajo Tribe. The following are the nonvoting members of POPTAC: City of Phoenix; Maricopa County; Department of Insurance; Yuma Metropolitan Planning Organization; Arizona Land Department; Department of Environmental Quality.

⁹ Standards for DES population estimates and projections are given in detail at the following website: www.de.state.az.us/links/economic/webpage/popweb/POPTAC.html.

According to DES, the projections from 1997 were made using a cohort-survival model, with four components modeled by single-age and sex: deaths; births; in-migration; and out-migration. Population is projected by modeling the four components and by aging the population, both by single year of age. Each of the four components is affected by the population's age and sex structure, and each component affects the other four components. For example, in-migration may increase the female population in the child-bearing age groups resulting in higher births and higher population levels.

Deaths were projected by surviving the single-age and sex population from the most recent Census enumeration (1995 in Maricopa County) by one year by using age and sex specific survival rates. These rates were based on the most recent age- and sex-specific population data and the average number of deaths over the time period 1993 to 1995. Survival rates were kept constant throughout the projection period. To improve the accuracy of its projections, DES should trend these into the future based on projected national changes in mortality rates by age/sex/race.

To project births, fertility rates of women were calculated by dividing the average number of births during the period 1993 to 1995 by age of mother by the number of women in that population group. Constant fertility rates were then applied to age-specific female cohorts to project total births during the projection period. Male to female birth ratios were calculated based on a twenty year average and applied to the total projected births to project male and female births. To improve the accuracy of its projections, DES should trend these into the future based on projected national changes in fertility rates by age/race.

To project in-migration, age- and sex-specific population in-migration rates were multiplied by the age- and sex-specific net projected national population (net of the county population being projected). The in-migration rates were calculated from the in-migration during the period 1985 to 1990, divided by an adjusted 1985 national population.¹⁰ This explains why the projections are so low, since migration into the County dropped from 1987 to 1990 with the economic downturn.]

Similarly, out-migration was projected using age- and sex-specific population out-migration rates, multiplied by the age- and sex-specific county population. The out-

¹⁰ The national population was adjusted as follows: national population, minus the population of the county being projected, plus in-migration into the county being projected during the period 1985 to 1990, minus the out-migration from the county during the same period.

migration rates were calculated via the out-migration for the period 1985 to 1990, divided by an adjusted 1985 county population.¹¹

The model begins with the most recent Census enumeration by single-age and sex as the base population. The 1990 Census figures are used for most counties, however, a Special Census was held for Maricopa, Graham and Yuma Counties, with the more recent figures used for these counties. The model is projected to the current year estimate and compared to the current year estimate (control total). If there is a difference, the age-specific in- and out-migration rates are iteratively adjusted until the projection exactly matches the estimate. The adjusted migration rates are then held constant throughout the projection period.

4.2 Population

The most recent DES population projections were released in February 1997 and were based on either the 1995 Special Census (Maricopa, Graham and Yuma Counties) or the Census 1990 (all other counties). According to DES, Maricopa County should have had a resident population of 2,954,157 persons in 2000 and should have a resident population of 7,264,731 by 2050, as shown in Figure 4 and Table 4.

The projections for Pinal County, Arizona and the U.S. are shown for comparison purposes. Maricopa County's proportion of Arizona's population is projected to increase from 60 percent in 2000 to 65 percent in 2050.

These projections equate to a significantly declining Compound Annual Growth Rates (CAGRs).¹² Maricopa County's CAGR is forecast to decline from 3.36 percent during the period 1990-2000, to 1.44 percent during the period 2040-2050, as shown in Figure 5 and Table 5. Despite this decline, Maricopa County's forecast CAGR is expected to remain above Arizona's CAGR.

¹¹ The county population was adjusted as follows: county population, minus in-migration during the period 1985 to 1990, plus out migration in that county over the same period.

¹² The Compound Annual Growth Rate (CAGR) is the rate of growth necessary to increase a number (X) at a starting point in time (t) to reach a number (X') at a future point in time (t'). The mathematical formula for CAGR is as follows: $CAGR = (X'/X)^{1/(t'-t)} - 1$. CAGR is not the same as an arithmetic average, which does not account for compounding interest effects as is done with the CAGR.

Figure 4: DES Projected Population, 2000-2050

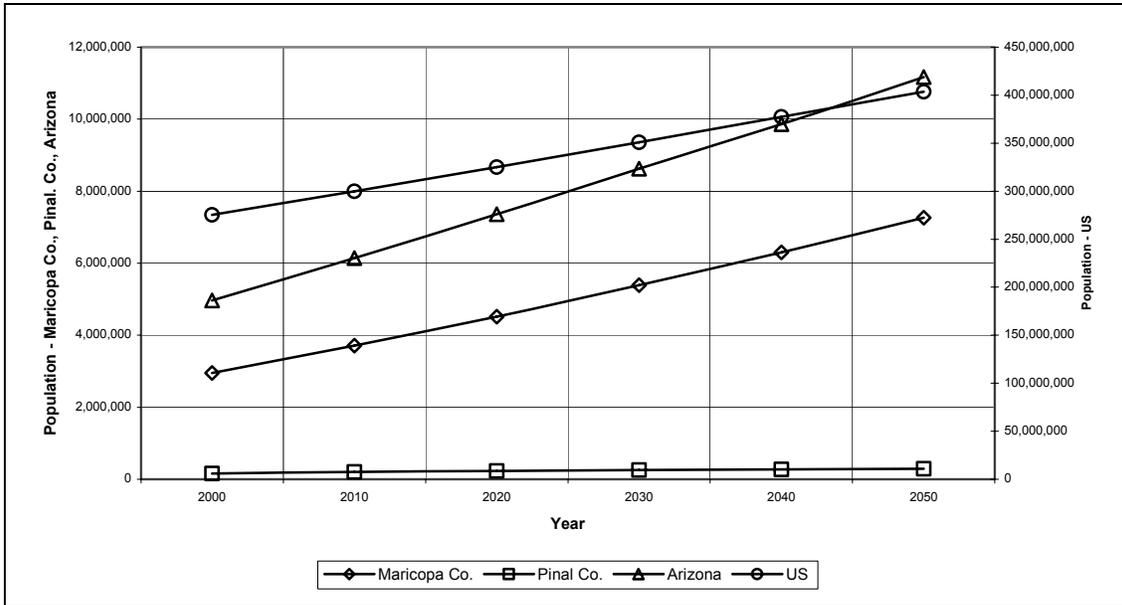


Table 4: DES Projected Population, 2000-2050

Year	Maricopa County	Pinal County	Arizona	United States
2000	2,954,157	161,630	4,961,953	275,306,000
2010	3,709,566	199,715	6,145,108	299,862,000
2020	4,516,090	231,229	7,363,604	324,927,000
2030	5,390,785	255,695	8,621,114	351,070,000
2040	6,296,219	273,057	9,863,578	377,350,000
2050	7,264,731	288,529	11,170,997	403,687,000

Note: DES projections (Maricopa County, Pinal County, Arizona) are for July 1, while U.S. projections are for April 1.
 Source: Arizona Dept. of Economic Security, February 1997; U.S. Census Bureau, February 2000; U.S. Census Bureau, March 1995.

Figure 5: DES Projected Population CAGRs, 1990-2050

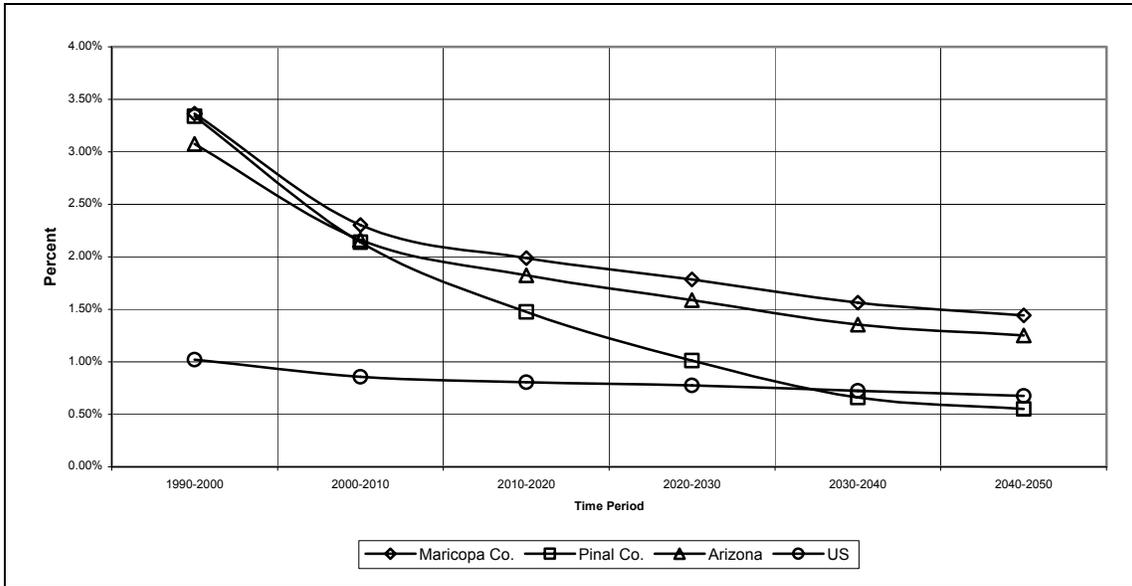


Table 5: DES Projected Population CAGRs, 1990-2050

Decade	Maricopa County	Pinal County	Arizona	United States
1900-2000	3.36%	3.34%	3.08%	1.02%
2000-2010	2.30%	2.14%	2.16%	0.86%
2010-2020	1.99%	1.48%	1.83%	0.81%
2020-2030	1.79%	1.01%	1.59%	0.78%
2030-2040	1.56%	0.66%	1.36%	0.72%
2040-2050	1.44%	0.55%	1.25%	0.68%

Note: DES projections (Maricopa County, Pinal County, Arizona) are for July 1, while U.S. projections are for April 1.
 Source: Arizona Dept. of Economic Security, February 1997; U.S. Census Bureau, February 2000; U.S. Census Bureau, March 1995.

Remarkably, the forecast CAGR for Pinal County is set to decline from 3.34 percent during the period 1990-2000, to 0.55 percent during the period 2040-2050, well below Arizona's forecast CAGR. This rate is in stark contrast to the high number of proposed and approved residential and master planned communities in Pinal County (Lima and Associates, September 2000).

On a proportional basis, Maricopa County's CAGR during 2040-2050 is expected to be less than one-half of the rate during 1990-2000. This is roughly in-line with the expected decline in Arizona's as a whole. Since Maricopa County is 60% plus the population of the state, and since the State projection is a "bottoms-up" method, trends seen in Maricopa County will be reflected in the state CAGR. By contrast, the U.S. Census Bureau's CAGR in 2040-2050 is expected to be approximately two-thirds the forecast CAGR during 1990-2000.

Using Census 2000 data, it is possible to evaluate the DES population forecasts for 2000.¹³ As noted above, based on the 1995 Special Census, DES forecast in 1997 that Maricopa County's population would increase to 2,954,157 in July, 2000, a projected increase of 831,956 persons above the population of 2,122,201 in April, 1990. According to the April, Census 2000, Maricopa County's population increased by 949,948 persons to 3,072,149, or by 117,992 persons more than DES had forecast, as shown in Figure 6 and Table 6.

The DES forecast for Maricopa County was 3.8 percent lower than the Census figures and equated to a CAGR of 3.36 percent over the period 1990-2000. Using the Census figures, the CAGR was 3.77 percent, or 0.41 percentage points higher than forecast.

Similarly, the DES forecast for Pinal County's population in 2000 was 161,130 versus the Census figure of 179,727. The DES projection was 10.1 percent lower than the Census figures. The DES forecast equated to a CAGR of 3.34 percent, while the Census figures indicate a CAGR of 4.44 percent, or 1.10 percentage points higher than forecast.

¹³ Note that the Census Bureau figures are for April 1, 2000, while the DES projections are for July 1, 2000. This three month difference equates to 5.0 percent of the five year or 60 month period from the date of the Special Census in Maricopa County on July 1, 1995 to the DES projected population on July 1, 2000. Presumably, if the Census Bureau figures had been for July 1, the difference between the DES projections and Census Bureau figures would have been even greater.

Figure 6: DES Projected Population Versus Census Population, 2000

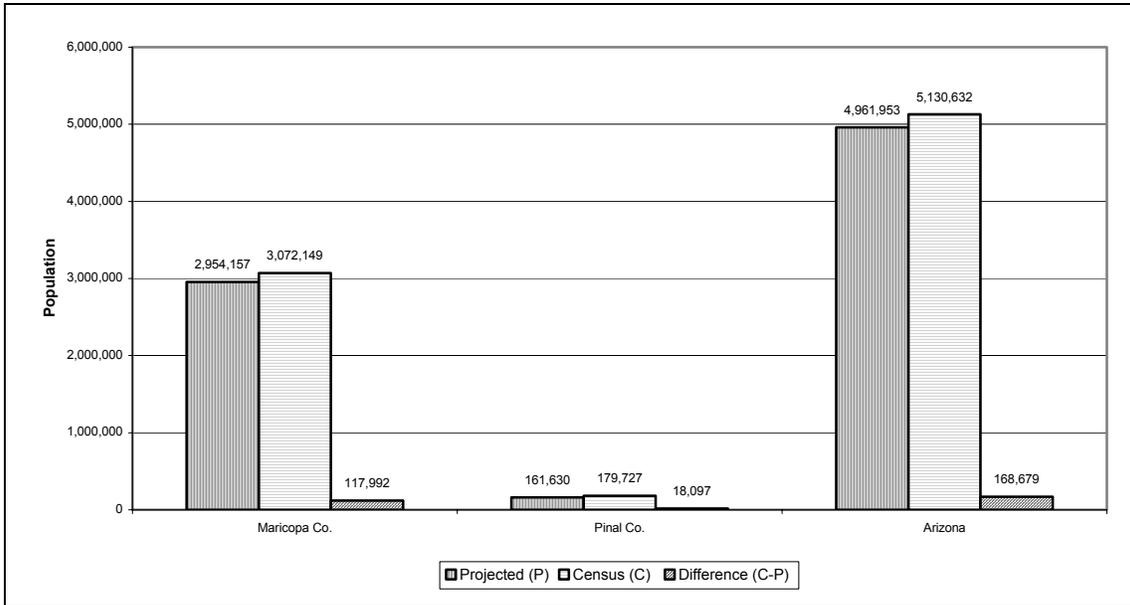


Table 6: DES Projected Population Versus Census Population, 2000

	Maricopa County	Pinal County	Arizona	United States
Projected (P)	2,954,157	161,630	4,961,953	275,306,000
Census (C)	3,072,149	179,727	5,130,632	281,421,906
Difference (C-P)	117,992	18,097	168,679	6,115,906
Difference/Census	3.8%	10.1%	3.3%	2.2%

Note: DES projections (Maricopa County, Pinal County, Arizona) are for July 1, while U.S. projections are for April 1.
 Source: Arizona Dept. of Economic Security, February 1997; U.S. Census Bureau, February 2000; U.S. Census Bureau, May 2001a; U.S. Census Bureau, May 2001e.

The DES forecast for Arizona over the same period was also low, at 4,961,953 versus the Census figure of 5,130,632. This equated to a projection 3.3 percent lower than the Census figure. The Census figure equates to a CAGR of 3.42 percent, versus 3.08 percent for DES.

It is notable, however, that DES was not alone in its low projections. The Census Bureau forecast a U.S. population of 275,306,000 in 2000, while the Census 2000 figure is 281,421,906. That said, the Census Bureau projection was only 2.2 percent below the Census 2000 figure, over 1.1 percentage points more accurate than DES' projection for Arizona.

4.3 Limitations

As discussed above, DES significantly under projected the 2000 population for Maricopa County, Pinal County and Arizona. The U.S. Census Bureau also significantly under projected U.S. population in 2000, albeit by a lower margin of error than DES. This highlights the difficulty of making projections, as well as possibly providing some insight into limitations of the DES projection methodology.

The high rate of international migration during the last decade and the lack of consideration of a variety of race/ethnicity trends are probably the most important factors in the under projection by DES. As described above, the increase in Hispanic population was very significant in Maricopa County, Arizona, and the U.S. during the last decade. Given the higher fertility rate among Hispanic women, as well as the higher life expectancy for Hispanics, the potential impact of Hispanics on population growth should not be ignored when projecting population.

Similarly, trends in fertility rates (births), survival rates (life expectancy), and migration rates should not be ignored. However, these are held constant by the DES model, which again probably contributes to the model under-projecting population. On the other hand, the Census Bureau explicitly takes historical trends into consideration in its projections.

Finally, DES gives no consideration to economic conditions and projections. The same is true, however, of the Census Bureau, most states, and population projections agencies.

5. OTHER STATES

Prior to hypothesizing about alternatives to the DES forecasts, it is useful to analyze the approach adopted by similar organizations in states that are contending with comparable population growth and demographic trends. Besides being among the largest states in the country, California, Texas and Florida each experienced absolute population increases of over three million residents from 1990 to 2000. They also experienced substantial increases in Hispanic population during this period.

Due to time and budget restrictions, it is necessary to restrict this analysis to state level data. Even so, the review conducted below suggests that the use of cohort component models with cohorts specified by age and sex, and by race/ethnicity results in more accurate projections than those that do not account for race/ethnicity. It is notable, however, that all three of the states (as well as the U.S. Census Bureau) under or over projected population just two years prior to the Census 2000. This highlights the difficulties of accurately projecting population.

5.1 California

California was the most populous state in the nation in both 1990 and 2000, and it experienced the largest absolute increase in population during this period. Furthermore, California's Hispanic population was already large in 1990 and increased significantly by 2000.

The Demographic Research Unit of the California State Department of Finance (CSDF) is responsible for preparing the official population estimates and projections used by state agencies, counties and municipalities, and the like. The Department of Finance uses a cohort-component method to project population by age, gender, and race/ethnicity.

Prior to the Census 2000, the CSDF released projections in December 1998 in ten-year increments from 2000 to 2040, utilizing a single projection scenario. The Census figures from 1990 were used as the base for projections, with corrections for known age distribution errors integrated. Five mutually exclusive race/ethnicity groups are specified (White, Hispanic, Asian or Pacific Islander, Black, and American Indian). In counties where special populations (e.g. college students, military personnel, prisoners) were a significant proportion of the population, they were removed from the population base and projected separately. State-level fertility and mortality rates were used, which were assumed over time to converge toward national rates. Migration was forecast to be higher in earlier years and lower in later years.

The CSDF population projection for 2000 and the Census 2000 figure are shown in Table 7. The CSDF projection was higher than the Census figure by 781,747 or 2.3 percent. The deviation between the projection and the Census figure was on par with the Census Bureau's error of 2.2 percent (see Table 6). By comparison, DES' projection for Arizona deviated by 3.3 percent.

	2000 Population		Difference (C-P)	
	Projected (P)	Census (C)	Absolute	Percent
California	34,653,395	33,871,648	-781,747	-2.3%

Source: California State Department of Finance, December 1998; U.S. Census Bureau, May 2001b.

For reference purposes, California's Census population in 1990 was 29,760,021 (U.S. Census Bureau). Therefore, California's Census population increased by 4,111,627 or 13.8 percent during the period 1990-2000. In-line with national trends, the state's Hispanic population was 7,557,550 or 25.4 percent in 1990. This increased to 10,966,556 or 32.4 percent in 2000, an increase of 3,409,006, which is equivalent to 82.9 percent of the state's population increase during 1990-2000.

5.2 Florida

Florida had the fourth largest population in the U.S. in both 1990 and 2000, and it experienced the third largest absolute population increase during this period. The Hispanic population in Florida also increased substantially during the last decade.

The Florida Legislature Office of Economic and Demographic Research (FLOEDR) releases the official Florida population estimates and projections, which are for the date of April 1st. The projections are produced annually using hybrid methodology in which formal projections are combined with expert opinions via consensus estimating conferences to generate low, medium and high projections. Driving short term (one year) projections are current economic trends and conditions, while long term projections (five, ten and more years) are driven by more formal models.

The long-term projections are made by the Bureau of Economic and Business Research at the University of Florida. A cohort component model is used to project state population in five-year intervals on the basis of age, sex and white/non-white population. At the county level, four extrapolation methods are used (linear, exponential, share of growth, and shift-share), with between one and three time horizons (last five years, last ten years, last fifteen years) used to project population, which is then controlled to reach the state population projection (Smith, August 2001)

Prior to the Census 2000, the most recent projections released by FLOEDR were released in June 2000. These projections were below the Census 2000 figures by 2.4 percent, as shown in Table 8. This projection error was in-line with the U.S. Census Bureau's projection error of 2.2 percent (see Table 6).

	2000 Population		Difference (C-P)	
	Projected (P)	Census (C)	Absolute	Percent
Florida	15,594,318	15,982,378	388,060	2.4%

Source: Florida Legislature Office of Economic and Demographic Research, June 2000; U.S. Census Bureau, May 2001c.

For reference purposes, the Florida population was 12,937,926 in 1990. The Census 2000 population was 15,982,378, an increase of 3,044,452 or 23.5 percent. This was coupled with a large increase in Hispanic population. In 2000, Hispanic population was 2,682,715 or 16.8 percent of the state population, up from 1,555,031 or 12.0 percent of the state's population in 1990. The Hispanic population increased by 1,127,684 residents or 72.5 percent during the period 1990-2000. The absolute increase in Hispanic population is equivalent to 37.0 percent of the total population increase in Florida (U.S. Census Bureau, May 2001d; U.S. Census Bureau).

5.3 Texas

The Texas State Data Center (TSDC) produces the official population estimates and projections used by state and other agencies in Texas. To produce the population projections, the TSDC uses a cohort-component projection model with single-year-of-age cohort for males and females of four racial/ethnic groups (Anglo, Black, Hispanic, and Other). Variables incorporated into the projection model include special populations (e.g. college students, military personnel, prisoners, illegal immigrants), fertility rates, mortality rates, and residual migration rates.

The Census 1990 provided the baseline for the most recent population projections by the TSDC. The Census 1990 data was adjusted for age and race/ethnicity reporting problems. In addition, the projections have been revised using post-1990 data where available. A state control total population was first computed, after which individual county populations were computed and then adjusted to the state control total.

Prior to the Census 2000, the TSDC released four projection scenarios in May 2000, which vary in terms of the net migration assumptions. The titles of these four scenarios are self-explanatory: Zero Migration (0.0) Scenario; One-Half of 1980-90 Migration (0.5) Scenario; 1980-90 Migration (1.0) Scenario; and 1990-98 Migration

(90-98) Scenario. The TSCD population projections from 2000 and the Census Bureau population estimate are shown in Table 9.

Scenario	2000 Population		Difference (C-P)	
	Projected (P)	Census (C)	Absolute	Percent
Zero Migration	18,673,143	20,851,820	2,178,677	10.4%
One-Half 1980-90 Migration	19,473,091	20,851,820	1,378,729	6.6%
1980-90 Migration	20,344,834	20,851,820	506,986	2.4%
1990-98 Migration	20,472,285	20,851,820	379,535	1.8%

Source: Texas State Data Center, May 2000; U.S. Census Bureau, December 2000d.

The most accurate projection methodology was the scenario accounting for migration trends during 1990-98. This scenario still resulted in a population 1.8 percent lower than the Census Bureau's Texas population. That said, it was more accurate than the U.S. Census Bureau's projection of U.S. population released in February 2000 prior to the Census 2000, which was short by 2.2 percent (see Table 6). Even utilizing the older 1980-90 Migration rates, the TSDC projections were only 2.4 percent below the Texas population according to the Census 2000 figures. By comparison, DES' projections for Arizona were 3.3 percent below the Census 2000 figures (see Table 6).

For reference purposes, the Census 1990 population in Texas was 16,986,510 residents, the third largest state in the nation. The Census 2000 population was 20,851,820, an increase of 3,865,310 or 22.8 percent, making it the second largest state. This increase in population was coupled with a significant increase in Hispanic population. In 2000, Hispanic population was 6,669,666 or 32.0 percent of the state population, up from 4,339,905 or 25.5 percent of the state's population in 1990. The increase in Hispanic population by 2,329,761 residents or 53.7 percent during the period 1990-2000, which is equivalent to 60.3 percent of the total population increase in Texas (U.S. Census Bureau, May 2001d; U.S. Census Bureau).

The relatively high degree of accuracy of the TSDC's 1990-98 Migration scenario generally underscores the impact of migration on population. It also highlights the importance of integrating race/ethnicity cohorts into projections, particularly during times of major race/ethnic shifts.

6. ALTERNATIVE PROJECTIONS

The preceding examples detailing the wide variations between the projected 2000 population and the Census 2000 population underscore the difficulty and somewhat speculative nature of population projections. Census 2000 population for the three other states reviewed varied from 2.3 percent below projected to 2.4 percent above projected. The Census 2000 population of the U.S. was 2.2 percent above the Census Bureau's own projections.

By comparison, the Census 2000 population of Arizona was 3.3 percent above the DES projection. Likewise, the Census 2000 population of Maricopa County was 3.8 percent higher than the DES projection. Even more remarkable, the Census 2000 population of Pinal County was 10.1 percent higher than the DES projection. These errors occurred despite the fact that the projections were released only three years prior to Census 2000.

Given the upcoming release of new projections by DES in 2002, it is not deemed possible or appropriate to create completely new projections. Instead, the approach used to develop the alternative forecasts below is based on the following:

- Use of Census 2000 population as the starting point.
- Projection of the population in ten-year increments to 2050.

On this basis, the following three alternative population projection scenarios have been developed, with the results of each discussed thereafter:

- Alternative 1: Application of the Compound Annual Growth Rates (CAGR) per decade from the DES projections released in 1997 using the Census 2000 population as the new base.¹⁴
- Alternative 2: Modification of the Alternative 1 CAGRs per decade by an amount equal to one-half of the difference between DES projections released in 1997 and the Census 2000 population.¹⁵

¹⁴ The Compound Annual Growth Rate (CAGR) is the rate of growth necessary to increase a number (X) at a starting point in time (t) to reach a number (X') at a future point in time (t'). The mathematical formula for CAGR is as follows: $CAGR = (X'/X)^{1/(t'-t)} - 1$. CAGR is not the same as an arithmetic average, which does not account for compounding interest effects as is done with the CAGR.

¹⁵ Using Maricopa County as an example, the difference between the Census 2000 population and the DES projected population was computed using the Special Census population of Maricopa County in 1995 of 2,551,765, the DES population projection for 2000 of 2,954,157, and the Census 2000

- Alternative 3: Modification of the Alternative 1 CAGR by an amount equal to the difference between DES projections released in 1997 and the Census 2000 population.

The three alternative population projection scenarios are analyzed separately for Maricopa County and Pinal County below, with a recommended population figure for the MAG RTP alternative growth scenarios given thereafter.

6.1 Maricopa County

The variation between the DES 1997 population projections for Maricopa County and Alternative 1 is relatively minor, as shown in Figure 7 and Table 10. The DES 1997 projections indicate a population of approximately 5.0 million residents in Maricopa County in 2025, rising to some 7.3 million in 2050.

Alternative 1 results in a projected population of approximately 5.2 million in 2025 and 7.6 million in 2050.¹⁶ The projected population increases substantially in Alternative 2, with a projected population of roughly 5.5 million in 2025 and 8.5 million in 2050. The projected population is highest in Alternative 3 at approximately 5.9 million in 2025 and 9.6 million in 2050. An average of the three alternative forecasts indicates that the population of Maricopa County will be 5.5 million around 2025 and 8.6 million around 2050.

The difference between the DES 1997 projections and the Alternatives is highlighted in Figure 8 and Table 11. Alternative 1 results in a rather small increase in population by 2050 of some 290,000 residents versus the DES 1997 projections. Alternative 2 produces an increase of approximately 1.3 million residents above the DES 1997 projections. Alternative 3 results in some 2.4 million more residents than the DES 1997 projections.

population of 3,072,149. Over the 1995-2000 period, DES projected a CAGR of 3.0 percent, whereas the Census figures results in a CAGR of 3.8 percent. The product of the difference between the two CAGRs divided by the DES CAGR is 27.2 percent. The CAGR in Alternative 2 is computed as follows: $\text{Alt. 2 CAGR} = (\text{Census 2000 CAGR}_{1995-2000} / \text{DES 1997 CAGR}_{1995-2000}) / 2 \times \text{DES 1997 CAGR}_{t-t'}$. The CAGR in Alternative 3 is computed as follows: $\text{CAGR Alt. 3} = (\text{CAGR Census 2000}_{1995-2000} / \text{CAGR DES 1997}_{1995-2000}) \times \text{DES 1997 CAGR}_{t-t'}$.

¹⁶ All figures for 2025 are a straight interpolation between the projections for 2020 and 2030: $\text{Population}_{2025} = (\text{Population}_{2030} - \text{Population}_{2020}) / 2 + \text{Population}_{2020}$.

Figure 7: Alternative Maricopa County Population Projections, 2000-2050

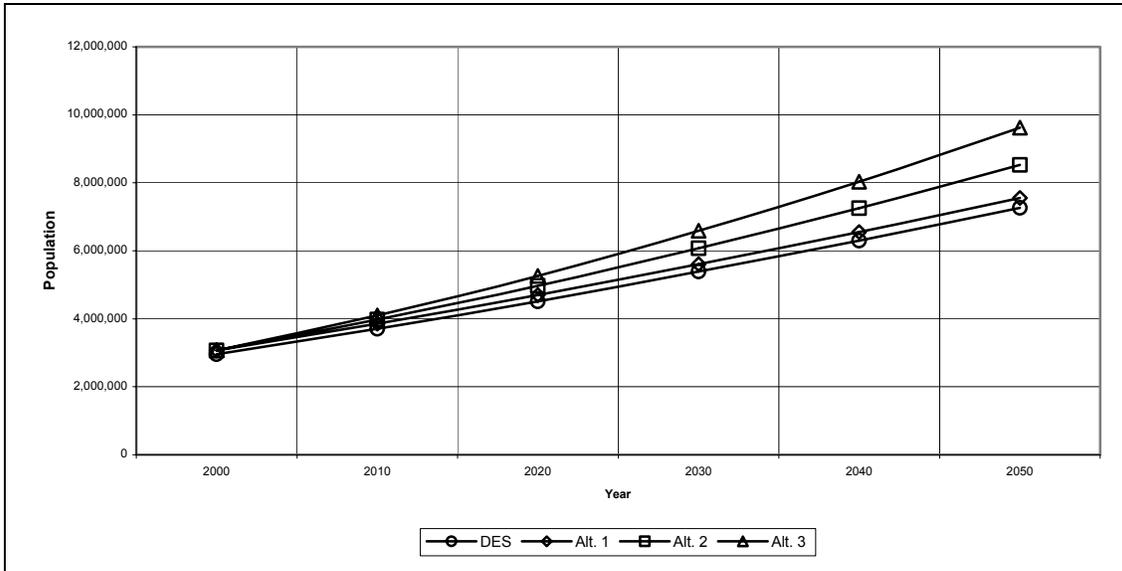


Table 10: Alternative Maricopa County Population Projections, 2000-2050

Year	DES	Alternative 1	Alternative 2	Alternative 3
2000 (Base Year)	2,954,157	3,072,149	3,072,149	3,072,149
2010	3,709,566	3,857,730	3,977,691	4,101,000
2020	4,516,090	4,696,467	4,972,573	5,264,049
2030	5,390,785	5,606,098	6,079,121	6,590,602
2040	6,296,219	6,547,696	7,250,599	8,026,838
2050	7,264,731	7,554,892	8,529,246	9,626,358

Note: DES projections are for July 1.

Source: Arizona Department of Economic Security, February 1997; U.S. Census Bureau, May 2001a; BRW, September 2001.

Figure 8: Difference Alternative Maricopa County Projections Versus DES Projections, 2000-2050

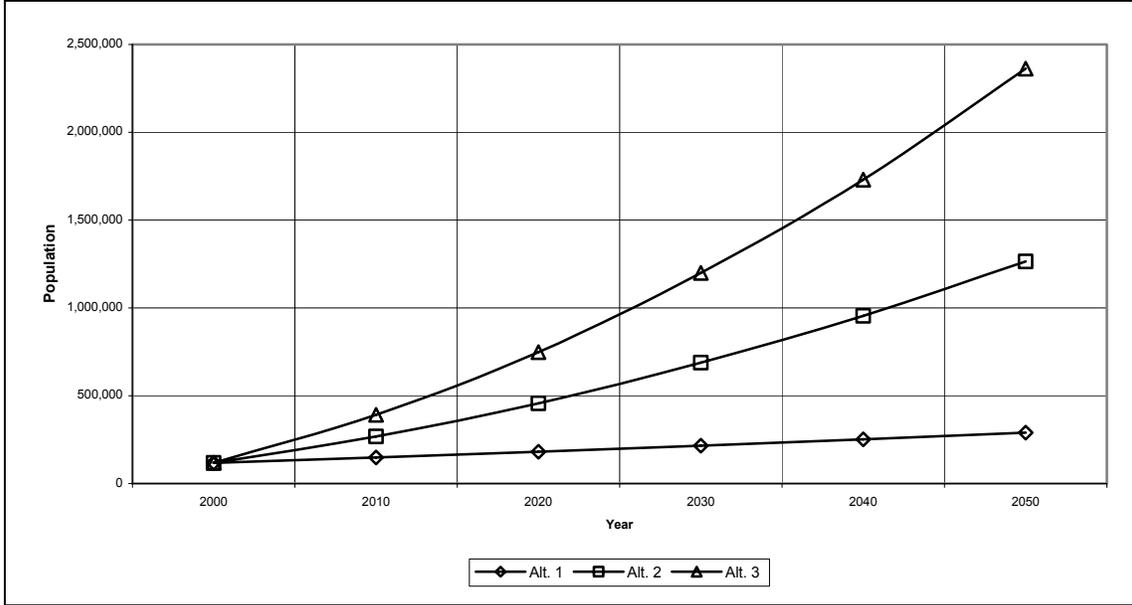


Table 11: Difference Alternative Maricopa County Projections Versus DES Projections, 2000-2050

Year	Alternative 1	Alternative 2	Alternative 3
2000 (Base Year)	117,992	117,992	117,992
2010	148,164	268,125	391,434
2020	180,377	456,483	747,959
2030	215,313	688,336	1,199,817
2040	251,477	954,380	1,730,619
2050	290,161	1,264,515	2,361,627

Note: DES projections are for July 1.
 Source: Arizona Department of Economic Security, February 1997; BRW, September 2001.

Figure 9: Alternative Maricopa County Population Projection CAGRs, 2000-2050

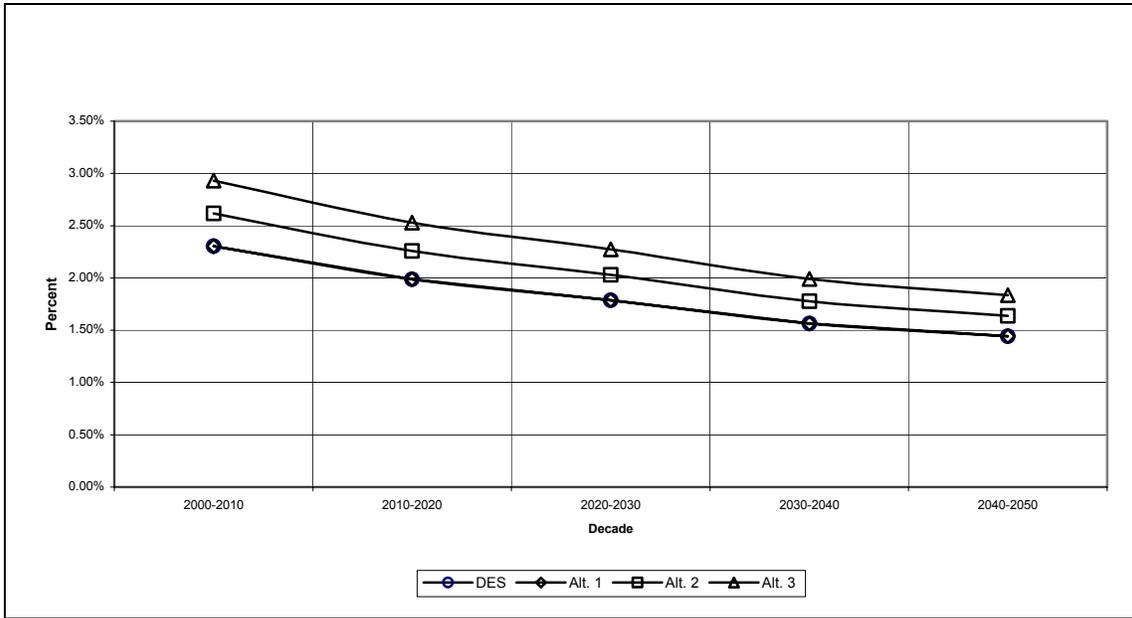


Table 12: Alternative Maricopa County Population Projection CAGRs, 2000-2050

Decade	DES	Alternative 1	Alternative 2	Alternative 3
2000-2010	2.30%	2.30%	2.62%	2.93%
2010-2020	1.99%	1.99%	2.26%	2.53%
2020-2030	1.79%	1.79%	2.03%	2.27%
2030-2040	1.56%	1.56%	1.78%	1.99%
2040-2050	1.44%	1.44%	1.64%	1.83%

Note: DES projections are for July 1.

Source: Arizona Department of Economic Security, February 1997; BRW, September 2001.

The Compound Annual Growth Rates (CAGR) utilized to produce the DES 1997 projections and the Alternative projections are shown in Figure 9 and Table 12. The DES 1997 projections and Alternative 1 use the same CAGRs. The CAGRs in Alternative 1 and Alternative 2 equals the DES 1997 CAGR modified in a linear manner, respectively, by one-half and the whole of the proportional error rate between the DES 1997 projected population and the Census 2000 population. As expected, the CAGRs in Alternatives 2 and 3 are higher.

6.2 Pinal County

The variation between the DES 1997 population projections for Pinal County and Alternative 1 is relatively minor, as shown in Figure 10 and Table 13. The DES 1997 projections forecast a population of approximately 256,000 residents in Pinal County in 2025, rising to 289,000 residents by 2050.¹⁷

Applying the same methodology for Pinal County as for Maricopa County, three alternative population projections were developed. Alternative 1 results in a projected population of approximately 271,000 in 2025 and 321,000 in 2050. The projected population increases substantially in Alternative 2, with a projected population of roughly 313,000 in 2025 and 395,000 in 2050. The projected population is higher in Alternative 3 at approximately 363,000 in 2025 and 485,000 in 2050.

The difference between the DES 1997 projections and the Alternatives is highlighted in Figure 11 and Table 14. Alternative 1 results in a rather small increase in population by 2050 of some 32,000 residents above the DES 1997 projections. Alternative 2 produces an increase of approximately 106,000 residents in 2050 above the DES 1997 projections. Alternative 3 results in some 196,000 more residents in 2050 than the DES 1997 projections.

To place the three alternatives in context, the population of Pinal County increased by approximately 63,000 residents during the period 1990-2000. If this absolute amount of growth were maintained (implying a declining rate of growth), the population of Pinal County would increase to roughly 337,000 by 2025 and 495,000 by 2050. These figures are generally in-line with those of Alternative 3, suggesting that the three alternatives may be conservative.

¹⁷ All figures for 2025 are a straight interpolation between the projections for 2020 and 2030:
 $Population_{2025} = (Population_{2030} - Population_{2020}) / 2 + Population_{2020}$.

Figure 10: Alternative Pinal County Population Projections, 2000-2050

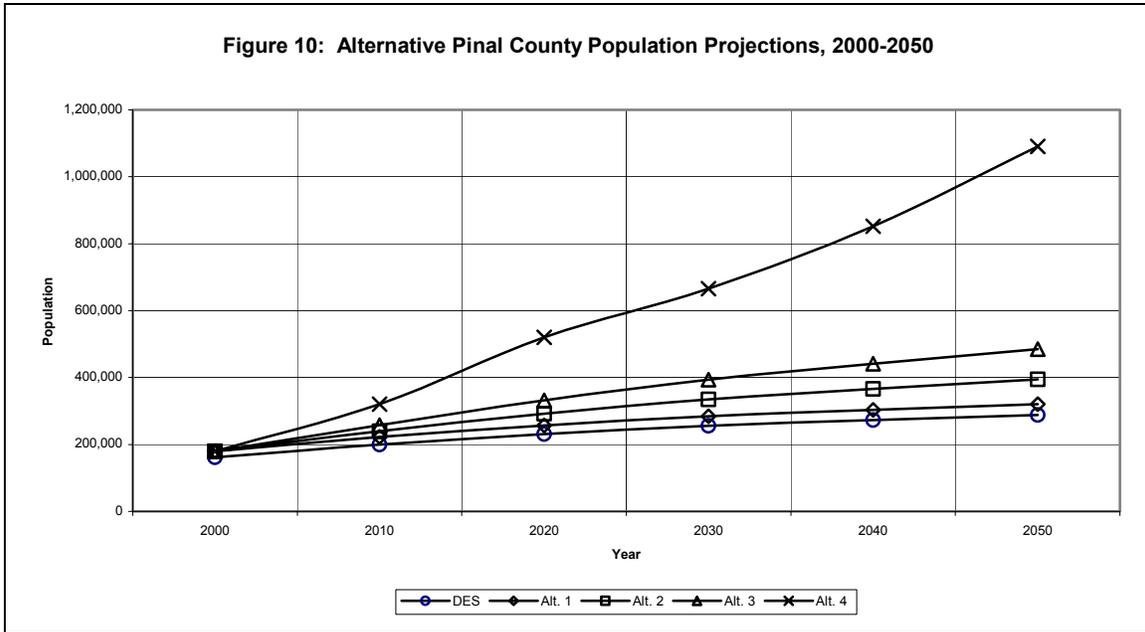


Table 13: Alternative Pinal County Population Projections, 2000-2050

Year	DES	Alt. 1	Alt. 2	Alt. 3	Alt. 4
2000 (Base Year)	161,630	179,727	179,727	179,727	179,727
2010	199,715	222,076	239,441	258,018	320,000
2020	231,229	257,119	292,126	331,623	520,000
2030	255,695	284,324	334,896	394,082	665,644
2040	273,057	303,630	366,179	441,162	852,081
2050	288,529	320,834	394,673	484,990	1,090,735

Note: DES projections are for July 1.
 Source: Arizona Department of Economic Security, February 1997; BRW, September 2001.

Figure 11: Difference Alternative Pinal County Projections Versus DES Projections, 2000-2050

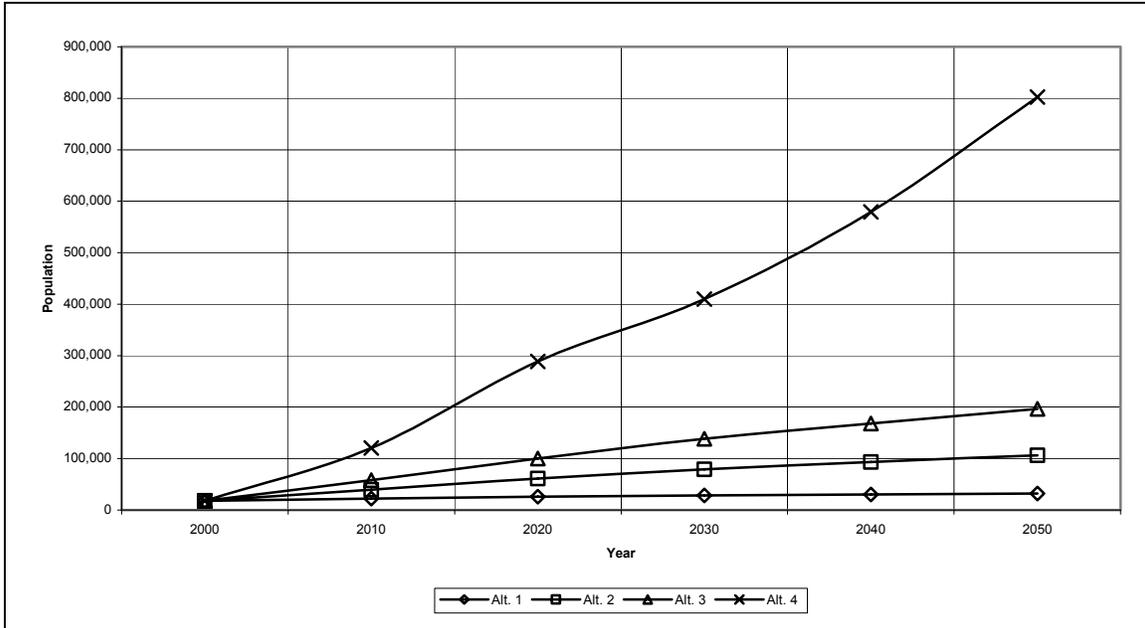


Table 14: Difference Alternative Pinal County Population Projections Versus DES Projections, 2000-2050

Year	Alt. 1	Alt. 2	Alt. 3	Alt. 4
2000 (Base Year)	18,097	18,097	18,097	18,097
2010	22,361	39,726	58,303	120,285
2020	25,890	60,897	100,394	288,771
2030	28,629	79,201	138,387	409,949
2040	30,573	93,122	168,105	579,024
2050	32,305	106,144	196,461	802,206

Note: DES projections are for July 1.
 Source: Arizona Department of Economic Security, February 1997; BRW, September 2001.

Figure 12: Alternative Pinal County Population Projection CAGRs, 2000-2050

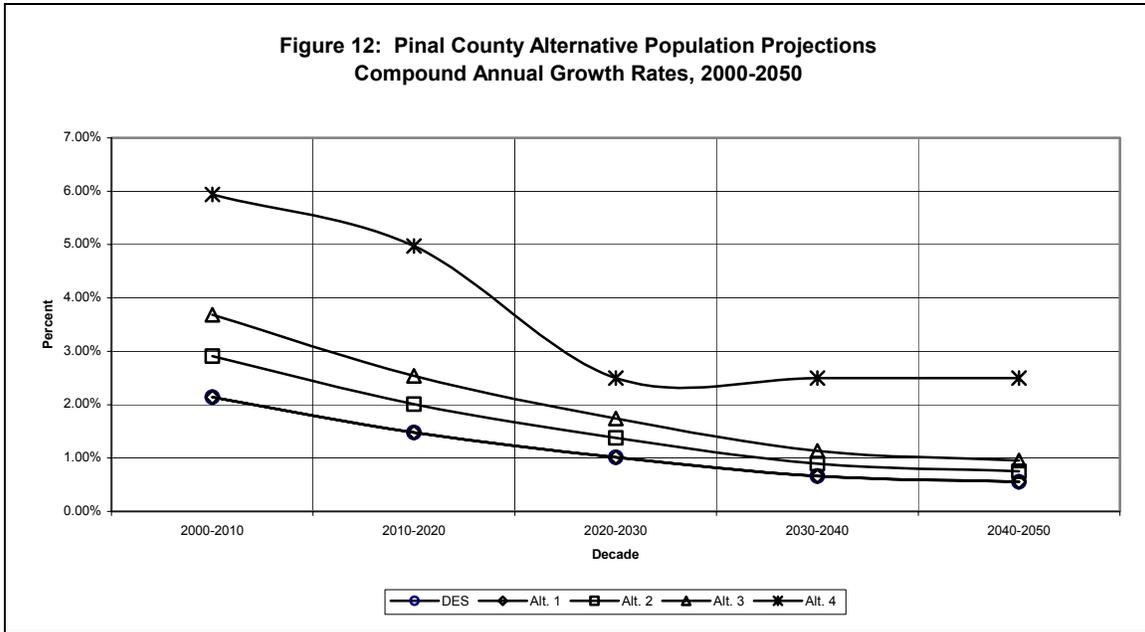


Table 15: Alternative Pinal County Population Projection CAGRs, 2000-2050

Year	DES	Alt. 1	Alt. 2	Alt. 3	Alt. 4
2000-2010	2.14%	2.14%	2.91%	3.68%	5.94%
2010-2020	1.48%	1.48%	2.01%	2.54%	4.97%
2020-2030	1.01%	1.01%	1.38%	1.74%	2.50%
2030-2040	0.66%	0.66%	0.90%	1.13%	2.50%
2040-2050	0.55%	0.55%	0.75%	0.95%	2.50%

Note: DES projections are for July 1.
 Source: Arizona Department of Economic Security, February 1997; BRW, September 2001.

This opinion is supported by the *Pinal County Transportation Plan 2000 Update*. This study, completed by Lima and Associates, projects Pinal County's population to be much higher than those from DES and the three alternatives presented above. This is primarily due to two factors: detailed consideration of the numerous large residential and master planned communities that are planned at various locations throughout Pinal County; and the fact that the *1994 Pinal County Transportation Study* population projections for Pinal County in 2013 were already surpassed by 1999.

Lima and Associates initially projected Pinal County population for 2005, 2010 and 2020. However, due to the rapid rate of growth in the County, the inaccuracy of recent projections, and the uncertainty of the build-out time frame for the planned developments, it was decided that a population level rather than a specific year was more appropriate. On this basis, Lima and Associates projected population levels for Pinal County of 220,000 around 2005, 320,000 around 2010, and 520,000 around 2020.¹⁸

Effectively, the population level is projected to reach 520,000 around 2020, some 30 years before the end time horizon of the MAG RTP, suggesting that the population could be significantly higher by 2050. If this population is projected forward at a relatively modest rate of 2.5 percent annually to 2050, the projected population would increase to approximately 1.1 million, some 802,000 persons more than the DES projection. This projection is referred to as Alternative 4 in the figures and tables.

An average of the four alternative forecasts indicates that the population of Pinal County could be 385,000 around 2025 and 573,000 around 2050.

6.3 Pinal County Impacts on Maricopa County

Many of the residents of Pinal County are expected to travel to Maricopa County on a regular basis and, therefore, will have a significant effect on the transportation system in Maricopa County. The likelihood of this occurring is most strongly related to geographic proximity, i.e. those residents of Pinal County residing most closely to Maricopa County are expected to have the greatest propensity to travel to Maricopa

¹⁸ The methodologies used by Lima and Associates to reach the three Pinal County population levels are briefly reviewed here. An average annual growth rate of five percent for the six year period of 1999 to 2005, in line with estimated growth from 1990 to 1999. An average annual growth rate of nine percent was applied to the 220,000 population level for five year (i.e. 2006 to 2010). A seven percent annual growth rate is assumed for the ten year period following achievement of the 320,000 population level (i.e. 2011 to 2020).

County. Therefore, it is important to consider this population when developing the MAG Regional Transportation Plan.

A generalized drive time analysis indicates that roughly 78 percent of the projected population in Pinal County will live within 45-minutes of the Maricopa County border and within approximately one-hour of several potential employment and/or commercial activity centers within Maricopa County.¹⁹ The potential attractiveness of these activity centers (and others) and the relatively short drive times are expected to regularly generate a large number of trips from Pinal County residents into Maricopa County.

The 78 percent figure can then be applied to the average of the three alternative population forecasts for Pinal County. On this basis, forecasts for Pinal County residents that would regularly interact with Maricopa County are 300,000 around 2025 and 447,000 around 2050.

¹⁹ The generalized drive time analysis was conducted utilizing MapQuest.com to determine drive times from several major transportation junctions within southeastern Maricopa County to cities in Pinal County. For example, according to MapQuest, the drive time is approximately one hour from Power Road at U.S. 60 to Superior and Florence, and the same time is required from Country Club/S.R. 87 at U.S. 60 to Casa Grande and Sacaton. The area defined by a polygon including these cities and the area north/west there from to Maricopa County comprises roughly 40 percent of the geographic area of Pinal County, but accounts for approximately 78 percent of the projected population in 2020 according to a Traffic Analysis Zone (TAZ) map and corresponding population figures in *Pinal County Transportation Plan 2000 Update* by Lima and Associates.

7. RECOMMENDED PROJECTIONS

Choosing a specific population projection for use in the MAG RTP alternative growth scenarios study is difficult in light of the long projection time horizon and the large impact of relatively minor variations in projected growth rates. However, based on the preceding analyses, the following population projections appear reasonable:

- The average of the three alternative population projections for Maricopa County suggest a population 5,535,000 around 2025 and 8,570,000 around 2050.
- A relatively conservative estimate indicates that 300,000 Pinal County residents will live within a forty-five minute drive time of the Maricopa County border around 2025, rising to 447,000 around 2050.
- Combined, this gives a total projected population of 5,835,000 around 2025, rising to 9,017,000 around 2050.

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