ATTACHMENT SIX

ASSUMPTIONS & METHODS
POPULATION PROJECTIONS 2007

1. MAG Geography

- Maricopa County is subdivided into 29 Municipal Planning Areas (MPAs), 148 Regional Analysis Zones (RAZs), 1955 Socioeconomic Analysis Zones (SAZs) or Traffic Analysis Zones (TAZs).
- Traffic Analysis Zones (TAZs) are required for transportation planning and are set by the MAG Street Committee with input from the MAG POPTAC. The TAZ is only within the transportation modeling area and its numbering system is sequential.
- Socioeconomic Analysis Zones (SAZs) are consistent with TAZs for the same projection year.
- Each projection series requires a reevaluation of SAZs. If a SAZ is not split, the number remains the same in all projection series. If a SAZ is split, the old number is discarded and new unique numbers are assigned. This avoids invalid comparisons of new data to old data.
- SAZs are modified as expected growth in a 30-year horizon expands geographically or densities in existing SAZs warrant SAZ splits.
- Each municipality has its own Municipal Planning Area (MPA), which delineates the area of planning concern for each jurisdiction. SAZs and Regional Analysis Zones (RAZs) fall completely within only one MPA, as SAZs add up to RAZs, and RAZs add up to MPAs.
- SAZs used for the 2007 projections will be identified as SAZ2007.

POPTAC Recommendation Requested: For information and discussion only.

2. Base July 1, 2005 Population and Housing Variables

- The MAG socioeconomic models require a July 1, 2005 base population, housing and households by SAZ2007 from which to begin its modeling process.
- The MAG transportation models use number of households (occupied housing units) by SAZ as the base for trip-generation.
- With the completion of Census Survey 2005, the following data are available:
    a) 2005 Census Survey data by jurisdiction for September 1, 2005 housing units; occupied housing units and population in households and group quarters.
    b) Census 2000 data for April 1, 2000 with detailed population and housing data by unit type accumulated from Census geographies to SAZ2007.
    c) Residential Completions for April 1, 2000 to July 1, 2005 submitted by each member agency.
- Use the following method to create July 1, 2005 totals consistent with the 2005 Census Survey:

    - Using residential completions between July 1, 2005 and September 1, 2005 and results of Census Survey 2005 create July 1, 2005 housing units, occupied housing units, and population by jurisdictions.
- Use the following method to create base housing and population information by MPA:
    - Proportionally distribute the population and housing in unincorporated County parts for each MPA based on their individual proportion of Census 2000 data augmented by residential completions between April 1, 2000 and July 1, 2005.
    - Cumulate housing units from Census 2000 and residential completions (between April 1, 2000 and July 1, 2005) to MPA2007. Stratify the data by incorporated and unincorporated portions of each MPA.
    - Derive overall vacancy rates and persons per household for the incorporated part of the MPA from the jurisdiction level rates from the 2005 Census Survey.
    - Derive overall vacancy rates and persons per household for the unincorporated parts of the MPA by adjusting the 2000 unincorporated SAZ data to match the Balance of County from the 2005 Census Survey.
    - Factor housing units by MPA where needed to ensure a match on households and population in households with the 2005 Census Survey. It is assumed that these areas may have been miscounted by the 2000 Census.
    - Cumulate the housing units, households, and population for the incorporated and unincorporated areas to derive total housing and population data by MPA.
- Use the following method to create base housing and population information by SAZ2007:
    - Cumulate housing units by type (single and multi family) from Census 2000 and residential completions between April 1, 2000 and July 1, 2005 to SAZ2007.
    - Factor the housing unit data by SAZ2007 where needed to ensure consistency with the 2005 Census Survey. It is assumed that these areas may have been miscounted by the 2000 Census.
    - Calculate the SAZ level vacancy rates and persons per household by unit type from Census 2000.
    - Create vacancy rates and persons per household by unit type by SAZ2007 by keeping the same relationship as the Census 2000 vacancy rates and persons per household, but matching the MPA level rates derived from Census 2005.
    - Calculate occupied households and population in households by unit type by applying the corresponding vacancy rates and persons per household.

POPTAC Recommendation Requested:

- Use the method as described above for cumulating the base July 1, 2005 population and housing data to SAZ2007.

3. Base July 1, 2005 Employment by Sector

- The MAG transportation models require employment projections by 5 land use types, namely, Retail, Office, Public, Industrial, and Other, and 2 non-land use types, Work at Home and Construction.
- For effective transportation modeling, the employment by sector must be identified by land use sector and not by SIC categories. Thus, if an office is in a retail center, and the underlying land use is "Retail," then the office employees are in a Retail sector. Care must thus be taken to ensure proper interpretation of the results.
- The MAG socioeconomic models, therefore, require a base July 1, 2005 employment by the same 5 land use types, namely, Retail, Office, Public, Industrial, and Other, and 2 non-land use types, Work at Home and Construction, from which to begin its modeling process.
- For the July 1, 2005 employment base, a database of employment of 3 or more employees at any one site was collected by MAG. This database included, among other items, the name, address, SIC code and number of employees at the site. This database was updated with the 2005 Maricopa County Trip Reduction data and reviewed by MAG member agencies.
- A coverage of existing land use as of January 2005 was collected by MAG and was reviewed by each MAG member agency. This coverage was based on land use categories approved by POPTAC prior to beginning the creation of the coverage. Changes and updates were made to the coverage as identified by the member agencies.
- The employment locations are address matched, compared to a database of employment-based buildings, and assigned to the underlying land use sector as identified in the existing land use database.
- Where employment appears incompatible with land use sectors, such as Residential, the land use code as derived from the NAICS code is used. This will account for possible issues with small parcels of employment-based land use not identified on the existing land use database.
- Where employment appears in a multiple use land use sector, such as Business Park, the underlying base employment is derived from the NAICS code.
- After all of the known employment is allocated, the residual employment is assumed to be the employees per site that are not collected in the MAG Employment Database. This employment is allocated to the employment-based land use sectors identified on the existing land use coverage with limited or no employment. A database of employment-based buildings is also used. Floor Area Ratios and Employment Density factors are used to allocate this remaining employment at the appropriate densities.
- The majority of construction employment is not located at the corporate offices of the company, but at construction sites across the region. Therefore, construction employment is assigned spatially to locations where new construction was identified in the prior years, using both the Residential Completions database and the Development database. This employment is considered to be in the Other Sector and follows new construction.
- Work-at-Home employment was derived separately using the Census 2000 data on home employment factored using the 2005 total employment. This was prorated to SAZ using Census 2000 data and new residential development.

- Non-Basic employment was derived separately as identified in 5 below.

POPTAC Recommendation Requested:

- Use the method as described above for cumulating base July 1, 2005 employment by sector to SAZ2007.

4. County-level Employment Projections by Land Use Classification Sector

- The MAG transportation models require employment projections by 5 land use types, namely, Retail, Office, Public, Industrial, and Other, and 2 non-land use types, Work at Home and Construction.
- For effective transportation modeling, the employment by industry sector must be identified by land use sector and not by NAICS categories. Thus, if an professional services office is in a retail center, and the underlying land use is "Retail," then these employees are in a Retail sector.
- Arizona Department of Employment Security (AZ-DES) created a population data series to be consistent with the results of the 2005 Census Survey.
- AZ-DES Population Projections have prescribed age distributions, which affect household formation and size and labor force control totals.
- Calculate total labor force participation by using econometric forecasted participation rates applied to the AZ-DES population by age.
- Calculate employed persons by county of residence using econometric forecasted unemployment rates.
- Using historic multiple job holding rates for the nation and Arizona, calculate the number of additional jobs and total jobs held by residents.
- Based on the current patterns of firm location patterns by industry within each land use category, the regional employment projections by industry were transformed into employment by land use categories.
- Based on econometric forecasted industry change patterns, recalculate employment by industry to match adjusted total employment levels. Additionally, produce final employment levels for other employment activities.

POPTAC Recommendation Requested:

- Use the method as described above for calculating regional employment projections and distributing then into the identified land use categories for each five years to 2035.

5. Basic/Non-Basic Employment

- The MAG Socioeconomic model assigns employment to areas based on land use designations in MAG Member Agency General Plans.
- Since the General Plans are general in nature, many large tracts of residential land use will have some non-basic retail, public and other employment associated with them and should have some retail, public and other employment assigned to them as population growth occurs.
- Based on an analysis of non-basic employment in larger tracts of existing land use, it appears that in future years 10% of retail employment, 5% of public

employment and 10% of other employment should be held back for non-basic employment. This non-basic employment should be assigned to the Socioeconomic Analysis Zones where large tracts of residential development exist and where population growth has occurred.

POPTAC Recommendation Requested:

- Use the method as described above for assigning non basic employment to large tracts of residential land.

6. Buildout Population and Housing Variables

- The MAG socioeconomic models require a buildout population, housing and households to identify the population and housing potential in an area for its modeling process.
- The buildout analysis was performed for minimum, target and maximum densities as described in the accompanying paper (Paper 1), "Buildout Procedure for Population and Housing Variables."

  See also, attached paper (Paper 1) on Buildout Procedure for Population and Housing Variables

POPTAC Recommendation Requested:

- Use the method for projecting and cumulating buildout population and housing data to SAZ2007 as identified in the accompanying paper (Paper 1), "Buildout Procedure for Population and Housing Variables" for target population and housing.

7. Buildout Employment Variables

- The MAG socioeconomic models require a buildout employment by land use sector to identify the employment potential in an area for its modeling process.
- The buildout analysis was performed for minimum, target and maximum densities as described in the accompanying paper (Paper 2), "Buildout Procedure for Employment Variables."

  See also, attached paper (Paper 2) on Buildout Procedure for Employment Variables

POPTAC Recommendation Requested:

- Use the method for projecting and cumulating buildout employment data to SAZ2007 as identified in the accompanying paper (Paper 2), "Buildout Procedure for Employment Variables" for target employment.

8. Vacancy and Occupancy Rates

- Census Survey 2005 provided data on total occupancy rates for all housing units by jurisdiction only.
- Occupancy rates by unit type by SAZ are needed by the socioeconomic models.
- Occupancy rates will be derived from the 2000 Census by dividing the total number of occupied housing units (by unit type single family or multi-family) by the total number of housing units (by unit type).
- Total housing units (by unit type) and total occupied housing units (by unit type) by block will be allocated to SAZ, which in turn will be summed to Regional Analysis Zones and Municipal Planning Areas.
- When there is not enough information at the SAZ zone level for projecting occupancy rates, the next level of geography (RAZ) is used.
- When there is not enough information at the RAZ zone level for projecting occupancy rates, the next level of geography (MPA) is used.
- The sum of occupied housing units by jurisdiction are made consistent with Census Survey 2005 results by adjusting the SAZ level occupancy rates.
- MAG member agencies will be asked for input to identify areas where changes in occupancy rates are expected over time.

POPTAC Recommendation Requested:

- Use the method described above to develop occupancy rates consistent with Census Survey 2005 for single family and multi-family units by SAZ2007.
- Maintain the derived occupancy rates over time with necessary modifications, as identified by MAG member agencies.

9. Persons per Household

- Census Survey 2005 provided data on persons per household for all housing units by jurisdiction only.
- Persons per household by unit type by SAZ are needed by the socioeconomic models.
- Persons per household will be derived from the 2000 Census by dividing the total population in households (by unit type single family or multi-family) by the total number of occupied housing units (by unit type).
- Population in households (by unit type) and total occupied housing units (by unit type) by block will be allocated to SAZ, which in turn will be summed to Regional Analysis Zones and Municipal Planning Areas.
- When there is not enough information at the SAZ zone level for projecting persons per household, the next level of geography (RAZ) is used.
- When there is not enough information at the RAZ zone level for projecting persons per household, the next level of geography (MPA) is used.
- The sum of population in households by jurisdiction is made consistent with Census Survey 2005 results by adjusting the SAZ level persons per household.
- MAG member agencies will be asked for input to identify areas where changes in persons per household are expected over time.

POPTAC Recommendation Requested:

- Use the method described above to develop persons per household consistent with Census Survey 2005 for single family and multi-family units by SAZ2007.
- Maintain the derived persons per household rates over time with necessary modifications, as identified by MAG member agencies.

10. Multiple Use Definitions by Geographic Location

- The MAG projections are consistent with member agency General Plans and Planned Area Developments.
- Many of these plans, however, have areas defined as multiple use areas that can generate various types and densities of housing or employment.
- In order to use these designations in socioeconomic modeling, the multiple use categories must ultimately be converted to one or more of the standard land use categories.
- The MAG socioeconomic models have been enhanced to accommodate such multiple use categories. The models are flexible enough to allow for each individual area to have different proportions of standard land use categories.
- Default categories are consistent with past local multiple use development but can be modified, area by area, by the member agencies.
- The default categories and areas are defined in the accompanying papers: Paper 1, "Buildout Procedure for Population and Housing Variables" and Paper 2, "Buildout Procedure for Employment Variables."

  See also, attached Paper 1 on Buildout Procedure for Population and Housing Variables and Paper 2 on Buildout Procedure for Employment Variables.

POPTAC Recommendation Requested:

- Accept default land use proportions by area category, which may be modified by individual member agencies.
- Accept default land use proportions by MPA, which may be modified by individual member agencies.
- Maintain all land use proportions over time, unless modified by individual member agencies.

11. Single Family / Multi-family Split for Maricopa County by Time

- The MAG projections are consistent with member agency General Plans and Planned Area Developments.
- The data is then used in MAG transportation models to project future transportation behavior.
- The current version of the model requires long-term projections of the distribution of future housing units into single family and multifamily types.
- MAG socioeconomic models can determine the distribution of housing provided a county-wide control total is known.
- Census 2000 and Residential Completions from April 1, 2000 to June 30, 2005 data provide unit type information for the 2005 Base.

- This is consistent with the split identified for 2005 in attached Paper 3 on Single Family / Multi-family Split.
- General Plans give good future projections of land for single family and multi-family units.
- A split between single family and multi-family units over time at the county level should be identified.

See also, attached paper (Paper 3) on Single Family / Multi-family Split.

POPTAC Recommendation Requested:

- Use single family/multi-family split over time as identified in the accompanying paper (Paper 3), "Single Family / Multi-family Split."

12. Non-residential Cluster Size, Floor Area Ratios (FAR) and Employment Density

- The MAG transportation models require employment projections by 5 land use types, namely, Retail, Office, Public, Industrial, and Other.
- Cluster Size represents the average parcel size of employment land use.
- FAR represents the ratio of the square footage of the building to the square footage of the parcel of land.
- Employment Density represents the floor space required by employees. This is calculated as Employees per 1000 square feet of floor space.
- The MAG models convert a parcel of land to the square feet of employment space and then to the number of employees on that parcel. This requires an understanding of average employment areas.
- Cluster Size, FAR and Employment Density differ for each non-residential land use type.
- Although there appear to be no adequate surveys and methods for projecting Cluster Size for Employment over time, it is likely that Cluster Size, FAR and Employment Density will not change appreciably over time.

See also, attached paper (Paper 4) on Cluster Size, FAR and Employment Density

POPTAC Recommendation Requested:

- Accept the Cluster Size, FAR and Employment Density values by land use type as identified in Table 1 of the accompanying paper (Paper 4), "Cluster Size, FAR and Employment Density."
- Maintain Cluster Size, FAR and Employment Density values over time for the employment projections.

13. Residential Development Density, Cluster Size and Velocity Curves

- In developing SAZ population projections, the MAG socioeconomic models project residential dwelling units from parcels identified for residential uses in the General Plans or areas anticipated to be residential in the Development database.

Households and Population by SAZ are subsequently calculated from the dwelling unit projections.

- Three General Plan Residential Density figures (dwelling units/acre) have been collected from the member agencies. These include the minimum, maximum and target residential density anticipated for each residential land use type in the General Plan. The models use Target Density as the base for new residential growth. The Maximum density set by the MPA caps the residential density. These densities may be changed, polygon-by-polygon by the member agencies if desired.
- Areas covered by the Development database have the number of dwelling units being built/planned and thus do not need to use the densities identified in the General Plan.
- Cluster Size represents the average parcel size of residential land use.
- Residential Density and Cluster Size differ for each residential land use type.
- Although there appear to be no adequate surveys or methods for projecting Density and Cluster Size for Residential uses over time, it is likely that Residential Density and Cluster Size will not change appreciably over time.
- Development Velocity Curves represent the life cycle of residential development projects. These are used to estimate the development trends of residential units coming into the market.
- The Development Velocity curves are based upon an analysis of the life cycles of all completed projects in Maricopa County over the 1979 to1999 time period.
- The size of the development project (total number of units to be built) decides the development Velocity Curve to be used for the particular project. The percent of built units constructed is used as an indicator of the stage the development project is on the Velocity Curve. The total number of units built during a five-year time period shall not exceed the number indicated by the velocity curve by more than 10%.

See also, attached papers (Papers 5 & 6) on Residential Cluster Size and Residential Velocity Curves

<u>POPTAC Recommendation Requested:</u>

- Accept the Residential density methodology as identified above.
- Accept the Cluster Size and Development Velocity Curves as identified in Table 1 of the accompanying paper (Paper 5), “Residential Cluster Sizes” and Figure 1 of the accompanying paper (Paper 6), “Residential Development Velocity Curves” respectively.
- Maintain the Residential Density, Cluster Size and Velocity Curve values over time for population projections.

14. Group Quarters

- All residents not living in households are classified as living in Group Quarters. Population in Group Quarters is a part of the socioeconomic projections required by MAG transportation models.
- Methods for projecting the different components of population in Group Quarters (military quarters, prisons and jails, college dormitories, nursing homes, and other

group quarters) have been identified by MAG Consultants as part of the GIS and Database Enhancement Project produced in 2000.

- The Group Quarter Population by SAZ shall be based upon the results of the 2005 Census Survey and the Group Quarter inventory prepared for the full count prior to the 2005 Census Survey.
- The group quarters projections are calculated as follows:
    i. Military quarters = held constant at the current population of Luke Air Force base.
    ii. Prisons and jails = 1.128 percent of the Maricopa County population age 20 through 44.
    iii. College dormitories = 8.951 percent of the Maricopa County population age 18 to 19.
    iv. Nursing homes = 5.433 percent of the Maricopa County population age 75 or older.
    v. Other group quarters = 0.417 percent of the entire Maricopa County population.

POPTAC Recommendation Requested:

- Use the methodology for Group Quarter Population as identified above.

PAPER 1

BUILDOUT PROCEDURE FOR POPULATION AND HOUSING VARIABLES

PURPOSE

To prepare minimum, target and maximum buildout numbers by Socioeconomic Analysis Zone for population and housing variables to be used to evaluate the population and housing potential for the next set of socioeconomic projections.

BASE DATA

- Population: Census Survey 2005
- Residential Completions: April 1, 2000 to June 30, 2005, submitted and reviewed by MAG member agencies
- Existing Land use: Land use current as of Jan. 2005, reviewed by MAG POPTAC
- Future Plans: Future Plans current as of 2006 or later, reviewed by MAG POPTAC
- Development Data: Year 2006 data current as 2006 or later, reviewed by MAG POPTAC
- SAZ system: SAZ2007

MODEL

SAM-IM version 3.1 was used for this buildout analysis. The analysis was conducted with a Grid Cell size of 220 feet on each side.

ASSUMPTIONS

Minimum, Target and Maximum Densities: In developing SAZ buildout projections, the MAG socioeconomic models project residential dwelling units from parcels identified as residential in the General Plans or areas anticipated to be residential in the Development database. Households and Population by SAZ are subsequently calculated from the dwelling unit projections.

Three General Plan Residential Density figures (dwelling units/acre) are collected from the member agencies, the minimum, maximum and target residential density anticipated for each residential land use type in the General Plan. Thus, three buildout scenarios may be generated for the Minimum, Target, and Maximum densities. These densities may be changed, polygon-by-polygon by the member agencies if desired.

Those areas covered by the Development database that have the number of dwelling units being built/planned and thus do not need to use the densities identified in the General Plan.

Net Density: The density figures mentioned above for the residential areas in the General Plans have been assumed to be indicating the Gross residential density. As part of the MAG GIS and Database Enhancement Project, Arizona State University collected information on the gross acres and net acres of different land use types. This buildout analysis uses the net residential density for General Plan residential areas. Net density adjustment is not required in areas

covered by the development areas since the total number of units is known. Table 1 indicates the gross and net acres by land use type used in the buildout analysis.

TABLE 1
NET RESIDENTIAL DENSITY

LUCODE	Land Use	Description	Gross Acres	Net Acres
110	Rural Residential	<= 1/5 du per acre	50	50
120	Estate Residential	1/5 du per acre to 1 du per acre	46	46
130	Large Lot Residential (SF)	1 du per acre to 2 du per acre	45	45
140	Medium Lot Residential (SF)	2-4 du per acre	25	19
150	Small Lot Residential (SF)	4-6 du per acre	20	15
160	Very Small Lot Residential (SF)	>6 du per acre (includes mobile home parks)	20	15
170	Medium Density Residential (MF)	5-10 du per acre	26	20
180	High Density Residential (MF)	10-15 du per acre	17	14
190	Very High Density Residential (MF)	> 15 du per acre	18	13

Source: Arizona State University, 2001
MAG GIS and Database Enhancement Project

Persons per Household: Persons per household was derived from the 2005 Census Survey by dividing the population in households by the number of occupied housing units. Total housing units, total occupied housing units and population in households was identified by Census block. These variables were then allocated to Socioeconomic Analysis Zones using the data from Census 2000, which was then adjusted to match the Census Survey 2005 results.

MAG derives persons per household at the lowest level of geography possible. For deriving a projection data set for the transportation models, MAG cumulates information to the Socioeconomic Analysis Zone (SAZ). For this purpose, persons per household are refined as follows:

- For SAZs where the existing development in 2005 is less than fifty percent of buildout, persons per household from the Regional Analysis Zone (RAZ) level will be utilized. This is essential since figures resulting from a sparsely developed SAZ may not adequately reflect future trends in the SAZ.

- Similarly, for RAZs where the existing development in 2005 is less than fifty percent of buildout, persons per household from the Municipal Planning Area (MPA) will be used.

- A maximum persons per household at buildout will be set at 5.0 persons per household.

It is important to note that the Census Bureau defines population as those people who are residents of the jurisdiction. If the individual reports himself/herself as usually housed elsewhere, the Census Bureau will not count the population at that unit and will designate the

unit as a vacant unit even though people reside in the unit. These individuals would be included in the MAG nonresident population projections.

Occupancy Rate: Buildout has been defined as the potential of the area. For buildout analysis use occupancy rate by SAZ developed for use in the projections series. This buildout is more indicative of the maximum for socioeconomic modeling.

Mixed Use : This buildout analysis is consistent with member agency General Plans and Planned Area Developments. Many of these plans, however, have areas defined as multiple use areas that can generate various types and densities of housing or employment. In order to use these designations in socioeconomic modeling, the multiple use categories must ultimately be converted to one or more of the standard land use categories. The MAG socioeconomic models have been enhanced to accommodate such multiple use categories. The MAG GIS and Database Enhancement Project has identified default categories for member agencies to use that are consistent with past local multiple use development.

Some of the factors found to have the strongest influence on the type of development were regional planning issues/factors that are not adequately delineated by MPA boundaries. For these areas, a set of recommended land use proportions were developed based on the proximity of a property to urban core areas (downtowns), railroads, freeways and airports. The criteria used for these assignments were: location within a developed downtown area (currently Phoenix, Mesa, Tempe, Scottsdale, Glendale, and Chandler); location within approximately one mile of a freeway; location within approximately one mile of a rail line; location within approximately two miles of a commercial airport. Table 2 indicates the mixed-use proportions used for the four areas in order of dominance.

A priority system is used for areas that fell within more than one of the location types. The location types were therefore evaluated in the following order:

1 - Downtown
2 - Proximity to Railroad Corridors
3 - Proximity to Airports
4 - Proximity to Freeways

For those areas that did not fall within one of the defined special areas, the recommended land use proportions by MPA and General Plan land use category were used. These recommendations were derived from base data from field surveys, discussions with city planners, and further modifications to improve reasonableness for areas with a lack of data. These recommendations were then reviewed and modified by MAG POPTAC. Table 3 indicates the results of this analysis.

TABLE 2
LAND USE PROPORTIONS BY AREA CATEGORY

Area Category	Structure Code	Land Use	Acres	Percent of Area
Downtown Area	AP	Multifamily	3	18%
	OF	Office	7	43%
	RH	Resort/Hotel	1	6%
	RT	Retail	5	33%
			16	100%
Freeway Area	AP	Multifamily	114	7%
	IN	Industrial	873	54%
	OF	Office	257	16%
	PB	Public buildings	6	0%
	RH	Resort/Hotel	44	3%
	RT	Retail	309	19%
			1,602	100%
Airport Area	AP	Multifamily	9	1%
	IN	Industrial	466	46%
	OF	Office	452	45%
	RH	Resort/Hotel	15	1%
	RT	Retail	72	7%
			1,014	100%
Railroad Area	IN	Industrial	1,332	97%
	OF	Office	17	1%
	PB	Public buildings	20	1%
	RH	Resort/Hotel	1	0%
	RT	Retail	9	1%
			1,379	100%

Source: Applied Economics, 2001.

TABLE 3
LAND USE PROPORTIONS BY MPA

MPA	Generic Category	General Plan Category	Land Use	Percentage
Avondale	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35
Buckeye	Business Park	Business Park	Retail	10
			Office	10
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35
Carefree	Business Park	Business Park	Retail	10
			Office	30
			Industrial	60
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Cave Creek	Business Park	Business Park	Retail	10
			Office	30
			Industrial	60
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Chandler	Business Park	Commercial/Office/	Retail	10
		Business Park	Office	20
			Industrial	70
	Mixed Use	Employment	Multifamily	10
			Retail	5
			Office	20
			Industrial	65
El Mirage	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35
Fountain Hills	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35
Gila Bend	Business Park	Business Park	Retail	10
			Office	10
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35

TABLE 3
LAND USE PROPORTIONS BY MPA

MPA	Generic Category	General Plan Category	Land Use	Percentage
Gila River	Business Park	Business Park	Retail	10
			Office	10
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35
Gilbert	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Business Park	Regional Commercial	Hotel	5
			Retail	80
			Office	15
	Mixed Use	Village Center	Multifamily	15
			Hotel	10
			Retail	35
			Office	40
Glendale	Business Park	Business Park	Retail	5
			Office	15
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Goodyear	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Guadalupe	Business Park	Commercial Mixed Use	Office	15
			Industrial	80
			Public	5
	Mixed Use	Mixed Use	Multifamily	35
			Retail	40
			Office	25
Litchfield Park	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Maricopa County	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	25
			Retail	35
			Office	40

TABLE 3
LAND USE PROPORTIONS BY MPA

MPA	Generic Category	General Plan Category	Land Use	Percentage
Mesa	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use/Employment	Multifamily	20
			Retail	25
			Office	30
			Industrial	25
Paradise Valley	Business Park	Business Park	Retail	10
			Office	70
			Industrial	20
	Mixed Use	Mixed Use	Multifamily	10
			Retail	40
			Office	50
Peoria	Business Park	Business Park	Retail	10
			Office	15
			Industrial	75
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Phoenix	Business Park	Commerce Park	Retail	25
			Office	25
			Industrial	50
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Queen Creek	Business Park	Employment - Type B	Office	20
			Industrial	80
	Mixed Use	Town Center	Multifamily	15
			Retail	35
			Office	40
			Public	10
Scottsdale	Business Park	General Employment (34)	Office	25
			Industrial	75
	Business Park	Minor Employment (33)	Office	20
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35

TABLE 3
LAND USE PROPORTIONS BY MPA

MPA	Generic Category	General Plan Category	Land Use	Percentage
Surprise	Business Park	Employment	Office	50
			Manufacturing	38
			Hotel	12
	Mixed Use	Mixed Use Gateway	Single Family	5
			Townhouse	5
			Multifamily	20
			Retail	30
			Office	25
			Industrial	5
			Public	10
	Mixed Use	Surprise Center	Single Family	5
			Townhouse	5
			Multifamily	10
			Retail	30
			Office	40
			Public	10
Tempe	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	35
			Retail	35
			Office	30
Tolleson	Business Park	Business Park	Retail	10
			Office	10
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	35
			Retail	35
			Office	30
Wickenburg	Business Park	Business Park	Retail	10
			Office	10
			Industrial	80
	Mixed Use	Mixed Use	Mixed Use	30
			Retail	45
			Office	25
Youngtown	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	35
			Retail	40
			Office	25

Source: Applied Economics, 2001.
Maricopa Association of Governments GIS and Database Enhancement Project

METHOD

1. Use the SAZ allocation of housing units and population for July 1, 2005 as the base (existing) data.

2. If the land is not identified as a Planned Area Development, determine additional housing units and population from the General Plan. Calculate developable residential acres by land use category (*land use codes 100 – 199, 820 and 830*) by SAZ. For this scenario, acreage is considered developable residential if it meets all of the following criteria:
   a) The 2005 land use was either agriculture or vacant.
   b) The land use was not in a flood plain as defined by the MAG Desert Spaces Plan.
   c) The General Plan land use was residential or mixed use - land use codes 100-199, 820 and 830. In the case of mixed use, apply the percentages identified previously.

   Calculate additional housing units by land use category as developable residential acres * net density (minimum/target/maximum) for the residential category. Sum categorized residential housing units to obtain total additional housing units by SAZ.

3. If the area is identified as a Planned Area Development, then allocate the new residential units from the development database to the parcel. Apply the mixed-use proportions in cases where the development is mixed use. Sum categorized residential housing units to obtain total additional housing units by SAZ.

4. Using SAZ persons per occupied housing unit from the 2005 Census, calculate additional population by SAZ as total additional housing units * SAZ occupancy rate * SAZ persons per occupied unit.

5. Add additional housing units and population to the 2005 base housing units and population to obtain total buildout figures.

6. Although control totals for Group Quarter population will be generated for projection years, it is not possible to generate Group Quarter population control totals for buildout. Buildout population in Group Quarters by SAZ was determined by keeping the 2005 proportion of Group Quarter population to the resident population in households constant by SAZ except for:
   a) Military: The population was held constant at base levels based upon recommendations from Arizona State University as part of the MAG GIS and Database Enhancement Project.
   b) Prisons: The total Group Quarter population in prisons was determined by keeping the proportion of the prison population in 2000 to the total population in households constant by SAZ. This is constrained by the capacity of the land use acres of existing facilities.

PAPER 2

BUILDOUT PROCEDURE FOR EMPLOYMENT VARIABLES

PURPOSE

To prepare minimum, target and maximum buildout numbers by Socioeconomic Analysis Zone for employment variables to be used to evaluate the employment potential for the next set of socioeconomic projections.

BASE DATA

- Employment: Employment July 1, 2005 Base
- Existing Land use: Land use current as of Jan. 2005, reviewed by MAG POPTAC
- Future Plans: Future Plans current as of 2006 or later, reviewed by MAG POPTAC
- Development Data: Year 2006 data current as 2006 or later, reviewed by MAG POPTAC
- SAZ system: SAZ2007

MODEL

SAM-IM version 3.1 was used for this buildout analysis. The analysis was conducted with a Grid Cell size of 220 feet on each side.

ASSUMPTIONS

Employment Densities: In developing SAZ buildout projections, the MAG socioeconomic models project employment from parcels identified as employment-based in the General Plans or areas anticipated to be non-residential in the Development database.

As part of the GIS and Database Enhancement Project, Floor Area Ratios (FAR) and Employment Density (employees per 1000 square feet) factors were developed by Arizona State University (Table 1). Thus:

Total square feet of employment space = FAR * Area of polygon in square feet
Number of employees = Total square feet of employment space * Employees per 1000 square feet

Generally, areas covered by the Development database have the square feet of employment areas being built or planned. Thus to derive the employment only the Employees per 1000 square feet value need to be used. In cases where the planned square footage was not available, the FAR factors for the particular land use is used.

TABLE 1
FLOOR AREA RATIOS AND EMPLOYEES PER 1000 SQUARE FEET
2000

DESCRIPTION	FAR	EMPLOYEES/1000 SQFT
RETAIL		
Neighborhood	0.23	1.18
Community	0.23	.72
Regional	0.27	1.24
Strip	0.25	1.30
OFFICE		
Small	0.78	3.13
Large	3.36	3.08
INDUSTRIAL		
Warehouse	0.37	2.54
Manufacturing	0.34	2.82
PUBLIC		
Schools	0.21	1.21
Government	0.33	3.98
HOTEL/MOTEL/RESORT		
Hotel/motel	0.70	0.68
Resorts	0.62	0.45

Net Acres: The figures mentioned above for the employment areas indicate the gross density. In order to determine employment, a net density figure must be derived. This is due to the fact that the MAG existing land use database includes non-buildable land, such as roadways and right-of-ways. Therefore, an analysis was conducted to account for the percentage of the land use that is likely not to be developed in the future. The target future densities assumed this percentage continues in the future. The minimum densities assume the percentage is 25% higher in future development, and the maximum densities assume the percentage is only that area necessary for transportation needs. These results are shown in Table 2, which identifies net acres as a percentage of total acres for each of the major land use categories.

TABLE 2
NET ACRES AS PERCENT OF TOTAL ACRES
FOR MINIMUM, TARGET AND MAXIMUM EMPLOYMENT BUILDOUT

Code	Definition	Minimum	Target	Maximum
200s	Commercial	50%	60%	90%
300s	Industrial	50%	60%	90%
400s	Office	50%	60%	90%
500s	General & Public	60%	70%	95%

Spatial Multiplier Factor: To understand the variation of employment density spatially, an analysis was conducted on the existing employment and land uses in the entire metro area, as well as the following:

a. Downtowns – Phoenix, Tempe, Scottsdale, Mesa, Glendale, Chandler
b. Freeway corridors – 1 mile buffer around the freeways
c. Airports – 2 mile buffer around the airports
d. Rail roads – 1 mile buffer around the railroads
e. None of the above (all other areas)

Table 3 summarizes the findings of the analysis. It was found that more than 70% of the total employment is located within these identified areas. Also the density variation indicates that the employment density on Retail, Office and Public land uses in downtown areas is generally double than other areas.

TABLE 3
SPATIAL MULTIPLIER FACTORS
FOR EMPLOYMENT SECTORS

Sector	Metro	Downtown	Freeway	Airport	Railroad	Other
Retail	1.0	2.0	1.0	1.0	1.0	1.0
Office	1.0	2.0	1.0	0.5	0.75	1.0
Industrial	1.0	1.0	1.0	1.0	1.0	0.5
Public	1.0	2.0	1.0	0.5	0.75	1.0
Other	1.0	2.0	2.0	1.5	1.5	0.5

Mixed Use: This buildout analysis is consistent with member agency General Plans and Planned Area Developments. Many of these plans, however, have areas defined as multiple use areas that can generate various types and densities of housing or employment. In order to use these designations in socioeconomic modeling, the multiple use categories must ultimately be converted to one or more of the standard land use categories. The MAG socioeconomic models have been enhanced to accommodate such multiple use categories. The MAG GIS and Database Enhancement Project has identified default categories for member agencies to use that are consistent with past local multiple use development.

Some of the factors found to have the strongest influence on the type of development were regional planning issues/factors that are not adequately delineated by MPA boundaries. For these areas, a set of recommended land use proportions were developed based on the proximity of a property to urban core areas (downtowns), railroads, freeways and airports. The criteria used for these assignments were: location within a developed downtown area (currently Phoenix, Mesa, Tempe, and Scottsdale); location within approximately one mile of a freeway; location within approximately one mile of a rail line; location within approximately two miles of a commercial airport. Table 4 indicates the mixed-use proportions used for the four areas in order of dominance.

A priority system is used for areas that fell within more than one of the location types. The location types were therefore evaluated in the following order:

1 - Downtown
2 - Proximity to Railroad Corridors
3 - Proximity to Airports
4 - Proximity to Freeways

For those areas that did not fall within one of the defined special areas, the recommended land use proportions by MPA and General Plan land use category were used. These recommendations were derived from base data from field surveys, discussions with city planners, and further modifications to improve reasonableness for areas with a lack of data. Table 5 indicates the results of this analysis.

TABLE 4
LAND USE PROPORTIONS BY AREA CATEGORY

Area Category	Structure Code	Land Use	Acres	Percent of Area
Downtown Area	AP	Multifamily	3	18%
	OF	Office	7	43%
	RH	Resort/Hotel	1	6%
	RT	Retail	5	33%
			16	100%
Freeway Area	AP	Multifamily	114	7%
	IN	Industrial	873	54%
	OF	Office	257	16%
	PB	Public buildings	6	0%
	RH	Resort/Hotel	44	3%
	RT	Retail	309	19%
			1,602	100%
Airport Area	AP	Multifamily	9	1%
	IN	Industrial	466	46%
	OF	Office	452	45%
	RH	Resort/Hotel	15	1%
	RT	Retail	72	7%
			1,014	100%
Railroad Area	IN	Industrial	1,332	97%
	OF	Office	17	1%
	PB	Public buildings	20	1%
	RH	Resort/Hotel	1	0%
	RT	Retail	9	1%
			1,379	100%

Source: Applied Economics, 2001.

TABLE 5
LAND USE PROPORTIONS BY MPA

MPA	Generic Category	General Plan Category	Land Use	Percentage
Avondale	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35
Buckeye	Business Park	Business Park	Retail	10
			Office	10
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35
Carefree	Business Park	Business Park	Retail	10
			Office	30
			Industrial	60
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Cave Creek	Business Park	Business Park	Retail	10
			Office	30
			Industrial	60
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Chandler	Business Park	Commercial/Office/	Retail	10
		Business Park	Office	20
			Industrial	70
	Mixed Use	Employment	Multifamily	10
			Retail	5
			Office	20
			Industrial	65
El Mirage	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35
Fountain Hills	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35

TABLE 5
LAND USE PROPORTIONS BY MPA

MPA	Generic Category	General Plan Category	Land Use	Percentage
Gila River	Business Park	Business Park	Retail	10
			Office	10
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35
Gilbert	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Business Park	Regional Commercial	Hotel	5
			Retail	80
			Office	15
	Mixed Use	Village Center	Multifamily	15
			Hotel	10
			Retail	35
			Office	40
Glendale	Business Park	Business Park	Retail	5
			Office	15
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Goodyear	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Guadalupe	Business Park	Commercial Mixed Use	Office	15
			Industrial	80
			Public	5
	Mixed Use	Mixed Use	Multifamily	35
			Retail	40
			Office	25
Litchfield Park	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Maricopa County	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70

TABLE 5
LAND USE PROPORTIONS BY MPA

MPA	Generic Category	General Plan Category	Land Use	Percentage
Mesa	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use/Employment	Multifamily	20
			Retail	25
			Office	30
			Industrial	25
Paradise Valley	Business Park	Business Park	Retail	10
			Office	70
			Industrial	20
	Mixed Use	Mixed Use	Multifamily	10
			Retail	40
			Office	50
Peoria	Business Park	Business Park	Retail	10
			Office	15
			Industrial	75
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Phoenix	Business Park	Commerce Park	Retail	25
			Office	25
			Industrial	50
	Mixed Use	Mixed Use	Multifamily	20
			Retail	35
			Office	45
Queen Creek	Business Park	Employment - Type B	Office	20
			Industrial	80
	Mixed Use	Town Center	Multifamily	15
			Retail	35
			Office	40
			Public	10
Scottsdale	Business Park	General Employment (34)	Office	25
			Industrial	75
	Business Park	Minor Employment (33)	Office	20
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	30
			Retail	35
			Office	35

TABLE 5
LAND USE PROPORTIONS BY MPA

MPA	Generic Category	General Plan Category	Land Use	Percentage
Surprise	Business Park	Employment	Office	50
			Manufacturing	38
			Hotel	12
	Mixed Use	Mixed Use Gateway	Single Family	5
			Townhouse	5
			Multifamily	20
			Retail	30
			Office	25
			Industrial	5
			Public	10
	Mixed Use	Surprise Center	Single Family	5
			Townhouse	5
			Multifamily	10
			Retail	30
			Office	40
			Public	10
Tempe	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	35
			Retail	35
			Office	30
Tolleson	Business Park	Business Park	Retail	10
			Office	10
			Industrial	80
	Mixed Use	Mixed Use	Multifamily	35
			Retail	35
			Office	30
Wickenburg	Business Park	Business Park	Retail	10
			Office	10
			Industrial	80
	Mixed Use	Mixed Use	Mixed Use	30
			Retail	45
			Office	25
Youngtown	Business Park	Business Park	Retail	10
			Office	20
			Industrial	70
	Mixed Use	Mixed Use	Multifamily	35
			Retail	40
			Office	25

Source: Applied Economics, 2001.
Maricopa Association of Governments GIS and Database Enhancement Project

METHOD

1. Use the SAZ allocation of July 1, 2005 employment by land use sector as the base (existing) data.

2. Determine additional employment from the General Plan and Development database. Calculate developable employment-based acres by land use category *(land use codes 200 - 830)* by SAZ. For these scenarios, acreage is considered developable for employment if it meets all of the following criteria:
   c) The 2005 land use was either agriculture or vacant.
   d) The land use was not in a flood plain as defined by the MAG Desert Spaces Plan.
   e) The General Plan land use was employment use or mixed use - land use codes 200 – 830. In the case of mixed use, apply the percentages identified previously.

   Calculate additional employment by land use category as developable employment use acres * net density factors (identified above) * Floor Area Ratio * Employment per 1000 square feet for the appropriate employment land use. Sum employment by sector by SAZ.

3. Add additional employment by sector to the 2005 base employment by sector to obtain total buildout figures.

PAPER 3

SINGLE FAMILY / MULTI-FAMILY SPLIT

The MAG projections are consistent with member agency General Plans and Planned Area Developments. The data is then used in MAG transportation models to project future transportation behavior. The latest version of the model requires long-term projections of the distribution of future housing units into single family and multifamily types. MAG socioeconomic models can determine the distribution of housing provided a county-wide control total is known. This paper recommends a split between single family and multi-family units over time.

Before beginning to explore how residential units may be split between single family and multifamily types in the future, it is useful to understand how this distribution has changed in the relatively recent past. In order to analyze past trends, housing inventory information from several previous Censuses were compiled, along with estimates for 2000.

The results of the data collection for the historic inventory breakdown by unit type are shown in Table 1, below. Over the past thirty years the total housing inventory in Maricopa County has increased by 281 percent, from about 317,000 housing units in 1970 to more than 1.2 million units in 2000. Despite this incredible increase in housing inventory, the overall change in the breakdown of housing units by type has changed relatively little. In 1970 nearly 80 percent of the inventory was comprised of single family units, compared with about 73 percent in 2000. While these figures reflect a modest decrease in the single family share of housing inventory, the decline has been relatively small compared with the amount of urbanization that has taken place.

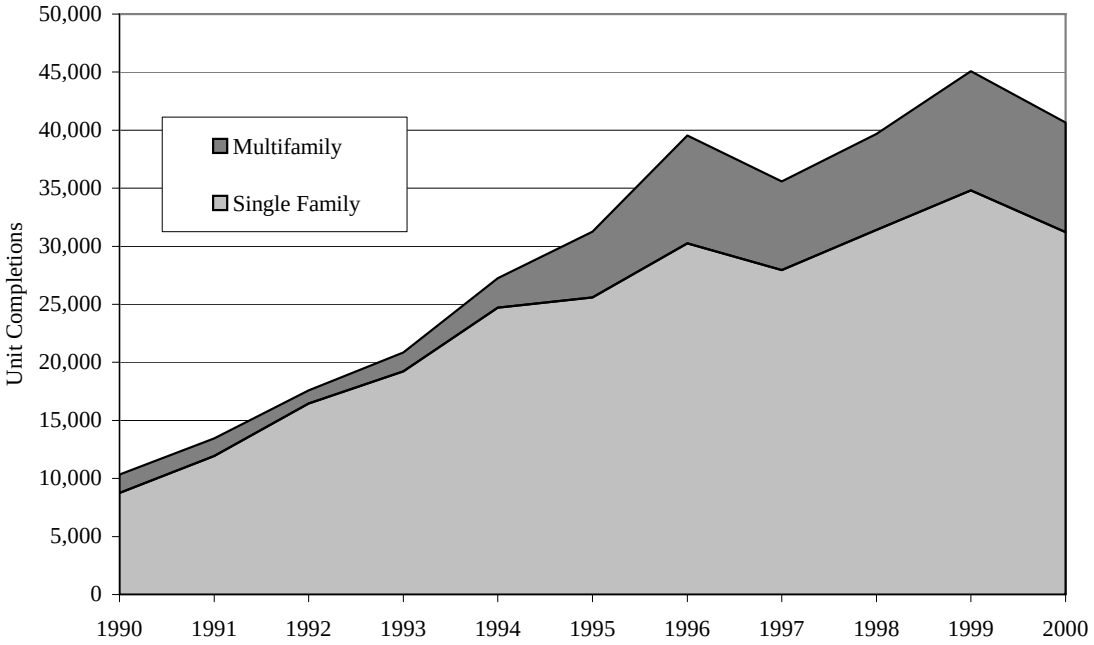
TABLE 1
RESIDENTIAL INVENTORY BY UNIT TYPE
MARICOPA COUNTY: 1970 – 2000

	Units		Single Family Share	
Year	Single Family	Multi-family	Percent of Total	Percent of Change
2000	883,380	325,122	73.10%	78.48%
1995	733,366	283,976	72.09%	97.37%
1990	669,781	282,260	70.35%	60.60%
1985	549,917	204,344	72.91%	64.27%
1980	450,591	149,135	75.13%	69.74%
1970	253,428	63,580	79.94%	

Sources:
1970, 1980, 1990, 1995: U.S. Bureau of the Census.
1985: Estimate based on occupied units by type.
2000: Estimate based on 1995 Census plus building completions.

The current year estimate of housing units by type was based on 1995 Census inventory data, supplemented with MAG Building Permit Completion data for 1995 through 1999. The Building Permit Completion data supplied by MAG provided individual records of new single family and multifamily units, from 1990 through 2000. The total number of units by type by year is shown in Figure 1 below.

FIGURE 1
UNIT TYPE BREAKDOWN OF RECENT HOUSING ADDITIONS



Source: Maricopa Association of Governments, Building Permit Completions Database.

The housing unit completion information is added to the 1995 Census baseline housing unit information to estimate year 2000 housing inventory. This resulted in 733,366 single family units in 1995, representing 72.1% of the housing stock, 150,014 new units from 1995 to 1999, representing 78.5%, for a total of 883,380 units, or 73.1% of the total housing stock.

Based on the consistency of the 1995 Census unit-type split data with estimates developed based on existing land use data, and the reasonable and consistent share of single family units in the general plan land use data, it is reasonable to construct a time-series for the breakdown of units by type by interpolating between the current (2000) and future (general plan) levels. Table 2 shows the County-level results of performing this interpolation. Under that scenario, the single family share of housing inventory would fall from 73.1 percent currently, to 70.6 percent at 2050, a change of only 2.5 percent.

TABLE 2
SINGLE FAMILY SHARE OF INVENTORY BY MARICOPA COUNTY: 1995 - 2050

Year	Single Family Share of Inventory
1995	72.1%
2000	73.1%
2005	72.8%
2010	72.6%
2015	72.3%
2020	72.1%
2025	71.8%
2030	71.6%
2035	71.3%
2040	71.1%
2045	70.8%
2050	70.6%
Build-out	70.6%

Sources:
1995: U.S. Bureau of the Census.
2000: Estimate based on 1995 Census plus building completions.
2005 - 2050: Projection based on General Plan Land Use interpolation.

PAPER 4

CLUSTER SIZE, FLOOR AREA RATIOS, AND EMPLOYMENT DENSITY

The MAG transportation models require projections of the number of employees in 5 different land use categories. The MAG socioeconomic models are land-use based and identify development by acres. It is therefore necessary to identify the number of acres in a typical development parcel (cluster size); the size of typical building on the parcel of land (floor area ratio) and the number of employees generated from the typical building (employees per 1000 square feet of building, or employment density). Table 1 presents the results of the most recent survey on cluster size, floor area ratio, employment density and compares the results to the previous survey in 1989.

Cluster Size: Cluster sizes are estimated in Table 1. Most cluster sizes have expanded due to larger buildings being built, especially in the retail sector. In the office sector, the cluster size grew more due the concept of the phasing of new buildings. Phasing would allow the developer to buy a large parcel and build one building with a plan to add others as the market allows. The cluster size for the hotel/motel sector has declined because most of the present development has focused on the smaller motel with no amenities such as restaurants and conference centers. Thus, the buildings are smaller and the land need is less

Floor Area Ratio (FAR): This concept represents the relationship between the structure and the land. Acquiring the land accounts for one of the largest costs associated with commercial development, frequently representing 25 to 30 percent of the final cost. Although the ratio measures the relation of the building to the land with a fairly typical ratio being around 25 percent, the building is not the only improvement on the land. The FAR does not include such land uses as the parking lot, landscaping, land use regulations creating open space between structures, and outlying structures such as PADs and parking structures in the determination of building square feet.

Table 1 indicates the Floor Area Ratios (FAR) for the various land use types and compares it to 1989 surveys. The greatest change was in large offices, which moved from 0.75 to 3.36. Some of this change is due to fact that the larger buildings are frequently built on parking garages. But also, many of the sites examined for 1989 have added new buildings with no additional land. For example, there are now four buildings on the Esplanade site, not just two. The average FAR for a 1-story building is 0.40, .77 for 2-story building and 7.03 for 10 or more stories. Changing FARS represent differing intensity of land usage, which can be dictated by a wide-range of factors including market conditions, tenant requirements, land use regulations and market characteristics of the area.

Employment Density: In a very competitive economic environment, most companies are trying to improve the “bottom-line” by increasing the productivity of employees and space utilization. In order to enhance employee productivity, there is a greater use of technology and work scheduling. Thus, in the retail market the employment density has decreased, while in the office building market and the industrial market the employment density has increased. Table 1 indicates the employment per 1000 square feet that have been identified by the consultant for 2000.

FACTORS INFLUENCING CHANGE

FARs and employment densities are changing as firms work to gain efficiencies to improve their profitability. The following identify some of the forces that are changing the structure of commercial development.

Work schedule. Until the last ten years, it was fairly typical that most people worked 8 to 5 Monday thru Friday. In order to better serve customers and/or reduce personnel costs, companies are moving to different work schedules such as extended hours (6 AM to midnight for the entire week) or a 24/7 schedule. Thus, a company might employ three hundred people but they are spread though the week and over the day. For example, a typical Walgreens drug store employs 25 people at each store but a 24-hour drug store has nearly 40 people. Another example is the America West reservations center in Tempe. The employment density is 18.7 people per 1,000 square feet due to the 24/7 schedules and the use of part-time people.

Part time versus full time. In the past, most jobs were full-time (typically 40 hours with benefits). Now more jobs are considered part time (under 20 hours with limited benefits) and can found in most areas of employment, especially retailing and services. For example, only 4-6 people in a Walgreens out of a total workforce of 25-40 people are full-time and practically all of the 250 people at a Wal-Mart are part-time. The use of part-time people is frequently associated with changing concepts of the work schedule.

Services offered. The number of people employed at a site can be greatly influenced by the services being offered. For example, a grocery store typically employs fewer than 100 people but if a pharmacy is added then typically 6 people are added to the employment base. The number of services being offered also may increase the size of the store. Fry's stores frequently have pharmacies and banks and so are larger than Bashas, which frequently do not offer these services

Work location. People used to go to a site to work. Now, there are more options such as work-at-home, at the employer's site or at a client's site. Many supermarkets had on-site butchers, but now many are working from a central site and transporting the cut meat to site. This reduces the number and expense of on-site butchers. It is also difficult to identify the true employee density for such operations as delivery or construction workers.

Use of technology. Technology has a tremendous impact on location. For example, many grocery stores are introducing self-checkouts to reduce the number and/or hours worked of human checkers. The most typical use of technology is the increasing ability to work at home and communicate with the office site and/or clients.

Land use management. Many cities are implementing regulations that will influence FARs and employee densities. For example, cities are recommending more mixed-use projects that will draw residential and commercial usages to a single site.

Land usage. The drive to heighten efficiencies increases FARS as developers try to make the greatest economical use of a site. More and more stores are trying to combine uses. For example, Wal-Mart superstores combine a supermarket with a discount operation; developers are making more use of PADs where a restaurant such as McDonalds can share the land with the

shopping center. Thus, FARS may continue to increase but not at the rate evident in the last few years. Further, tenants will try to enhance the efficiency of their space to sure that most of the space is allocated to revenue generation. For example, the inclusion of a bank within a grocery store gains both market attraction (both uses bring customers) and space efficiencies.

Economy. Prior to the 2001 economic downturn, several firm such as Wells Fargo, American Express, and Charles Schwab were considering the development of corporate campuses, similar to the USAA campus in north Phoenix, which is over 700 acres. The idea of such a campus is to bring all workers to a single location with a set of office buildings and other features such as restaurants, day-care, and recreation facilities. The purpose was to create a corporate identity and a desirable place that would attract the needed skilled workers. However, as the economy slowed, many of the plans were shelved, and whether the concept will come back is largely unknown.

Table 1
FAR, Employment densities and Cluster
1989 and 2000

Description	1989 FAR	1989 Employees per 1000 SqFt	1989 Cluster Size (Acres)	2000 FAR	2000 Employees per 1000 SqFt	2000 Cluster Size (Acres)
RETAIL						
Neighborhood	0.23	1.43	16	0.23	1.18	21
Community	0.23	1.84	48	0.23	.72	49
Regional	0.25	2.26	92	0.27	1.24	144
Strip	0.23	1.86	4	0.25	1.30	5
OFFICE						
Small	0.25	3.21	1.3	0.78	3.13	4.9
Large	0.75	2.50	3.3	3.36	3.08	4.8
INDUSTRIAL						
Warehouse	0.27	1.37	2.1	0.37	2.54	2.8
Manufacturing	0.27	2.23	6.1	0.34	2.82	10.7
PUBLIC						
Schools	0.25	1.44	8.3	0.21	1.21	20.3
Government	0.25	2.50	NA	0.33	3.98	NA
HOTEL/MOTEL/RESORT						
Hotel/motel	0.25	2.61	6.2	0.70	0.68	3.9
Resorts	0.25	1.96	18	0.62	0.45	NA

NA=sample too small—data not available

PAPER 5

RESIDENTIAL CLUSTER SIZES

Introduction

In analyzing subdivisions, the average size of subdivisions prior to 1985 was 280 lots. Since then, the average subdivision size has steadily declined from 129 during the 1985-89 time period to 103 lots in the 1990-94 time period to the current 98 lots. There are many reasons for the decline in size. Now, most subdivisions are part of a master planned community, which might encompass thousands of lots such as McDowell Mountain. Further, many subdivisions within a community might be started at the same time by different builders and for different market segments. Thus, the smaller size allows builders to adjudge market acceptance of specific plans. Land costs within a master planned community can be quite high in order to sustain the front costs of the amenity features such as lakes, golf courses and jogging trails. Thus, to keep capital costs low relative to expected returns, a builder might buy smaller parcels.

An additional reason is the local homebuilding industry has come to be dominated by national builders such as Pulte and KB Homes. These companies are basically production builders. They need to sustain a level of construction to support their corporate infrastructure and capital needs. Thus, they tend to build at all times, even in weak markets, with the idea of being able to attract a buyer through attractive financing, pricing arrangements or other marketing concessions. Given the large scale of these companies, local speculative products do not typically represent a large share of their national production. But to minimize risk, national builders do keep their current exposure low by building small subdivisions, which allow them to more quickly adjust to changing market conditions. Thus there really no reason to expect a sudden increase in subdivision sizes above the typical 100-lot subdivision.

The average lot size has not changed appreciably, with the average being 7,475 square feet for pre-1985; 7,525 for 1985-89; 7,984 for 1990-94; and 7,690 currently. The difference is that range of sizes appears to have become greater with more subdivisions moving into the 5,500 sq.ft. range or lower with cluster style housing. Thus, many builders, in order to maintain affordability of housing with higher land prices, are trying to get more homes in a subdivision by lowering lot sizes.

Based on average lots sizes, the typical subdivision has allocated 16 acres (net acres) for housing. The issue then becomes how much is being allocated for other uses such as streets and open space. Typically, about 25 percent of a subdivision is allocated for streets and other public access, although some subdivision are allocating another 10 to 15 percent for public open space such a trails and/or parks. This is especially evident where subdivisions are using a small lot concept.

Larger lots, with 2 units or fewer per acre, do not have a decrease in acres for usable acres. Similarly, the highest density units typically have about three acres of non-buildable space.

Based on an analysis of the development database and the Greater Phoenix Housing Study, Table 1 details the cluster sizes by residential land use type.

Table 1
Residential Cluster Sizes

Land Use Code	Density	Gross Acres	Net Acres*
Rural Residential (Limited Sample)	Under 1 DU/Acre	50	50
Estate Residential	DU/Acre	46	46
Large Lot Residential	1-2 DUI/Acre	45	45
Medium Lot Residential	2-4 DU/Acre	25	19
Small Lot Residential	4-6 DU/Acre	20	15
Medium Density Residential	4-10 DU/ Acre	26	20
High Density Residential	10-15 DU/Acre	17	14
Very High Density Residential	More than 15DU/Acre	18	13

*Net acres based on the assumption that the proposed subdivision would lose a certain percentage of its gross acreage for streets right-of ways, etc.

PAPER 6

RESIDENTIAL DEVELOPMENT VELOCITY CURVES

Introduction

In forecasting residential activity, it important to understand the development trends of units that come to market. Typically, growth is fairly slow in the beginning of a project, but beyond a certain point the continued growth accelerates until it reaches another point at which it begins to decrease and tails off towards its limits. Hence the curve typically takes on a "S" shape and is frequently referred to as Life Cycle Analysis.

A typical life cycle of a small area can be described as an "S-Curve" indicating that development of an area will start slowly, speeds up velocity and stops when all homes are absorbed. Based on an analysis of the Greater Phoenix Housing Study (The Meyers Group, Landiscor), a series of S-curves were developed and are presented in FIGURE 1. Subdivision sales activity is analyzed over the 1979 to 1999 time period.

Factors impacting Development Velocity:

Size of Subdivisions: On the metropolitan (Metro) level, over 90 percent of starts were sold by the end of year 5. Except for the 500+ housing units subdivisions, most subdivisions approached sell-out by the end of year 6. Most of the activity occurred in the first few years with the remaining activity being focused on probably less desirable lots and models. The 500+ projects tend to be very consistent over time with half of the project being started by the end of year 7. This scale of projects has always been relatively rare in the area and typically associated with active adult communities such as Sun City or Sun Lakes. Currently, most active adult communities are smaller subdivisions within master planned communities.

Time Dimension: The time dimension seems to show the greatest differences. In the 1980s, subdivisions tended to take longer time to sell out with nearly 20 percent of the lots remaining by year 12. The 1995-1999 time period is much quicker with a subdivision typically being sold out by the end of year 4. There are probably two key reasons for the difference. In the 1980s, subdivisions tended to be larger, which historically have longer sell-out periods. The other is the robust housing market of the 1990s, with low interest rates that drove sales at record paces.

Lot Size: Another dimension of sales activity is lot size. Basically, as lots get larger, which could well denote more expensive homes, the sales rate slows. This is especially evident in the early years, but all categories of lot sizes have over 90 percent of the homes sold at the end of year 4.

Market Conditions: Although the health of the housing market seems to be important, it is still true that the vast majority of developments sell out within five years and have less than 200 units.

Based on the analysis of the above parameters, it is recommended that the development velocity associated with 100-199 starts be used for projects with up to 200 units. FIGURE 1 details the velocity curves for various sized developments.

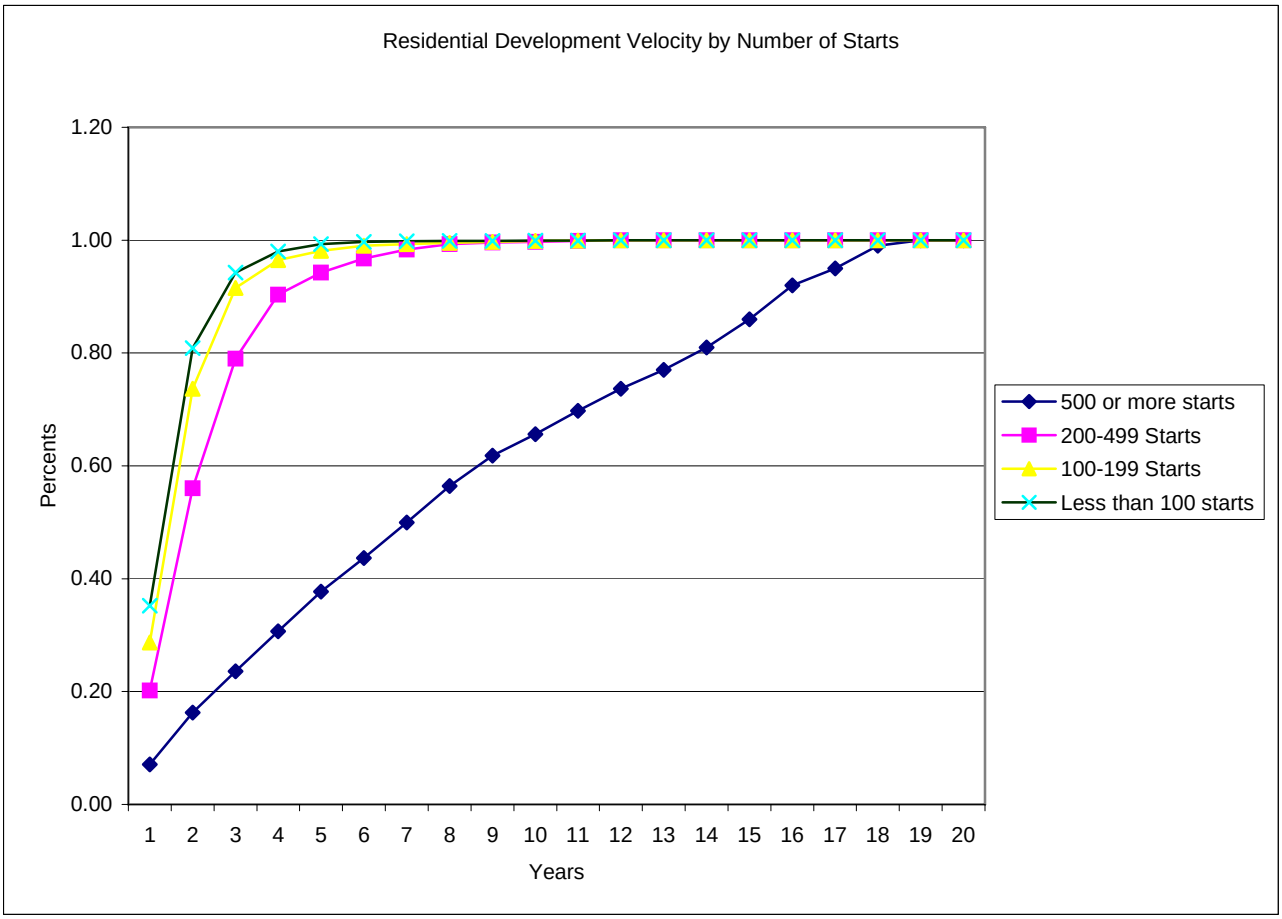



FIGURE 1: RESIDENTIAL VELOCITY CURVES