
Socioeconomic Projections

Documentation

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SOCIOECONOMIC PROJECTIONS
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I. PURPOSE

The purpose of this document is to explain the socioeconomic projections process used to prepare socioeconomic projections by municipal planning areas (MPA) and regional analysis zones (RAZs) for population and employment variables.

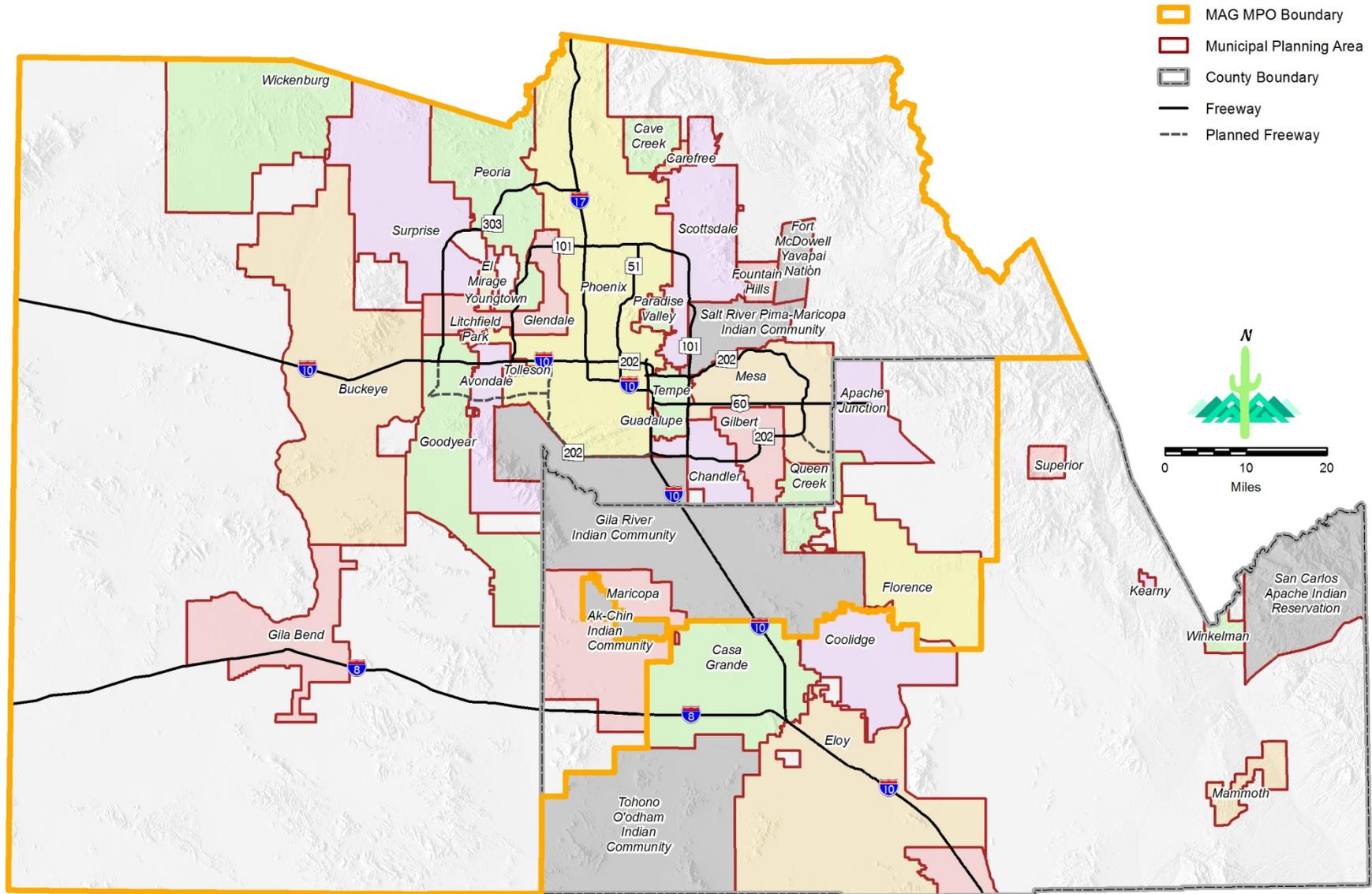
Executive Order 2011-04 requires that the Arizona Department of Administration (ADOA) develop population projections for a minimum of 25 years for the State, its counties, its incorporated jurisdictions and the unincorporated balance of each county. It also authorizes councils of governments (COGs) to prepare sub-regional projections using the county population as a control total. In preparing these projections, MAG is required to follow standards established by ADOA.

Sub-regional projections are used

- by MAG as input into the MAG transportation models to predict automobile traffic.
- by MAG as input into the MAG air quality models to predict emissions and concentrations.
- by local governments to evaluate infrastructure improvements.
- for gauging regional development and land use plans.
- by local governments to prepare general plans.
- by developers to identify sites for residential and commercial development.
- by human services providers for planning.
- by school districts for planning infrastructure.

The Phoenix-Mesa-Glendale Metropolitan Statistical Area (MSA) is designated by the Census Bureau as all of Maricopa County and Pinal County. The MAG Metropolitan Planning Organization (MPO) region includes all of Maricopa County, and portions of Pinal County: the City of Maricopa Metropolitan Planning Area (MPA), Town of Florence MPA, the Pinal County portions of the Apache Junction and Queen Creek MPAs, and portions of unincorporated Pinal County commonly referred to as Gold Canyon and San Tan Valley. In order to ensure consistent projections were produced, and consistent projections methodology was used, across the MSA and MAG MPO region, MAG worked closely with staff from Central Arizona Governments (CAG) to develop projections for the entirety of Maricopa County and Pinal County. Figure I-1 includes a map of Maricopa County and Pinal County, delineating the MAG MPO boundary and the boundary of each MPA in the two counties.

**Figure 1-1: Municipal Planning Areas (MPA), 2016
Maricopa and Pinal Counties, Arizona**



Source: MAG and the MAG Member Agencies, CAG
Date: May 2016

Figure 1-1: MAG MPO and Individual MPA Boundaries

While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

2. BASE DATA

The development of population and socioeconomic projections requires the collection of a substantial amount of base data. These base data include, but are not limited to, the following:

- Population and Housing: 2010-2014 American Community Survey (ACS) 5-year estimates
- Group Quarters (Institutional and Non-institutional): MAG Group Quarters Inventory
- Detailed Population Characteristics: ACS Public Use Microdata Sample (PUMS) - 5-year data (2009-2013),
- Employment: Employment July 1, 2014 base
- Residential Completions: April 2, 2014 to June 30, 2014, submitted and reviewed by MAG member agencies
- Existing Land Use: Land use current as of December 2014, reviewed by MAG Population Technical Advisory Committee (POPTAC)
- Built space: Maricopa County Assessors data current as of July 2014
- Future Plans: General and Comprehensive plans current as of 2015 or later, reviewed by MAG POPTAC
- Development Data: Year 2015 data current as of 2015 or later, reviewed by MAG POPTAC
- TAZ system: TAZ2016
- Educational institutions: Inventory of schools from Arizona Department of Education and post high school institutions, reviewed by MAG member agencies in December 2014
- Mobile Home and RV Parks: Inventory of mobile home and RV parks, reviewed and updated by MAG member agencies in December 2014
- Airport 2014 and projected enplanements for Sky Harbor and Williams Gateway airports
- Retirement Areas: Age restricted communities reviewed by MAG POPTAC
- Hotels/Motels/Resorts: Inventory of hotels/motels, reviewed and updated by MAG member agencies in December 2014

2.1 Census Data

The following variables were extracted from the 2010-2014 American Community Survey (ACS) 5-year estimates and used as a part of the projections base: resident population in households, resident population in group quarters, total housing units, occupied housing units and vacant housing units. Figure 2-1 shows the population density derived from the census. Figures 2-2 and 2-3 show the vacancy rates and persons per household respectively.

Because the 2010-2014 American Community Survey (ACS) 5-year estimates targets April 1, 2014, it was necessary to adjust the database to July 1, 2014 to provide a mid-year benchmark for the projections series. This adjustment was carried out by adding the sum of housing units constructed from April 2, 2014 through June 30, 2014 and demolitions during the same time period, from the April 1, 2014 housing unit figure. By applying census occupancy rates and persons per occupied household to the July 1, 2014 housing stock, a July

1, 2014 population was derived and subsequently matched to ADOA July 1, 2014 population update by 2014 Census place.

The MAG projections needed a 2014 base of housing units and population by TAZ. To derive this base, MAG added to the April 1, 2014 census housing unit count by TAZ new residential housing units completed, less any demolitions between April 1, 2014 and July 1, 2014.

2.2 Employment Database

Total 2014 employment at the county-level was derived from a population control total developed by the ADOA and Quarterly Census of Employment and Wages (QCEW) data. Total employment includes self-employed as well as wage and salary workers.

Using the 2014 employment control total, 2014 sub-regional employment estimates were prepared. An employer database for Maricopa County and Pinal County employers was purchased from Dunn & Bradstreet/ Harris InfoSource. This database was merged with employers from the Trip Reduction Program, records from public agencies, with records verified via telephone, email and the internet, subjected to quality control measures and reviewed by MAG member agencies.

Each employer was geocoded and employment then summed by land use classification to TAZs. These estimates were then adjusted to the county employment control totals for employment not captured in the major employer database based on the underlying land use. This resulted in sub-regional employment estimates which, in turn, were summed to RAZ and MPA. Figure 2-4 shows the distribution of employment locations and the number of employees at each site.

2.3 Residential Building Completions

A residential building completion requires a certificate of occupancy for each new residential unit. Since April 1990, MAG has collected residential building completions by unit type from MAG member agencies. The four unit types are single family, condo/townhouse, apartment and mobile home.

After initial collection efforts, the number of residential completions are summed by unit type and forwarded to MAG member agencies for review and verification. Adjustments to the total residential completions by unit type require the submittal of documentation. Each completion is also geocoded, enabling MAG to aggregate new development by MAG geography. Residential completions to July 1, 2014 were used in calculating the base for the 2016 projections. Figure 2-5 shows the distribution of residential completions over time.

2.4 Existing Land Use

The Existing Land Use database identifies the current land use pattern in the urban area. MAG maintains a 100+ land use category classification that was established by MAG in

concert with its member agencies. The table of MAG land use codes is updated by MAG staff periodically and approved by POPTAC members.

The Existing Land Use database was created by MAG staff based on input from MAG member agencies and then circulated to the agencies for review and verification. Changes were made based on comments provided. Figure 2-6 depicts the existing land use derived from this process.

The existing land use coverage is important to the projections process because it establishes areas that have already been developed or are not suitable for further development. The developed areas become ineligible for the allocation of population and employment growth, except where the area is planned for redevelopment. Non-developable areas include open space or environmentally sensitive lands, or areas where the relief makes construction infeasible.

2.5 General Plan Land Use

The General Plan Land Use database is based upon the plans of MAG member agencies and identifies both the type of development that is anticipated to occur in the future and the density of that development. For example, rural residential land use allows for up to one unit per acre. In those areas designated rural residential, a maximum is established so that the projections model does not exceed the one unit per acre density authorized.

The General Plan Land Use database uses the standard MAG land use categories that allows for a direct comparison between existing and planned land use. The difference between the existing and planned land use databases helps determine where development may take place.

MAG tracks general plan land use data for all member agencies. Member agency land use codes are translated into a common region-wide land use category system through a lookup table. The lookup table tracks minimum, target, and maximum development densities for both dwelling units and employment land uses. Land use lookup values can be modified through comments by MAG member agencies.

- Selected attributes in the General Plan Land Use dataset are:
 - *MPA Land Use Code* – Land use category created by jurisdiction.
 - *MAG Land Use Code* – MAG land use categories creating a common coding system for the region.
 - *Density Range* – Derived from general plan descriptions.
 - *Minimum* – Least dense development allowed by land use.
 - *Target* – Expected development density by land use.
 - *Maximum* – Most dense development allowed by land use.
 - *Mixed Use Split* – Further definition of mixed use; defines mixed use as percentages of single land use types. For example, Business Park mixed use could be 70% industrial and 30% office. See more information on mixed use areas in the next section.

Notes on Mixed Use Areas

- The MAG projections are consistent with member agency general plans and planned area developments.
- Many plans have areas defined as multiple or mixed 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.
- In many cases MAG member agencies have provided the multiple use categories. In some cases MAG has estimated the multiple use categories based on descriptions in the general plan or used default multiple use categories.
- Default categories are consistent with past local multiple use development but can be modified, area by area, with member agency input and feedback.

2.6 Development Projects

The Developments database was developed in conjunction with MAG member agencies. Information is collected on residential and non-residential developments including number of units or square footage by land use parcel. An estimated date for the initiation of the development is also determined at the same time. Member agencies review the Developments database regularly for completeness and accuracy. The Developments database includes redevelopment and age restricted projects as well. Figure 2-8 depicts major developments.

- Major attributes in the Developments database are:
 - *MAG Land Use Code* - MAG land use typology creating common coding system for region.
 - *Age Restricted Project Flag* – Denotes a development restricted to people age 55+.
 - *Redevelopment Project Flag* – Denotes a project that will replace existing development.
 - *Development Status* – Defines how close a project is to completion:
 - *Conceptual* – Project has not started jurisdiction review.
 - *Anticipated* – Project is going through jurisdiction review.
 - *Final Plat* – Project has been approved by jurisdiction. This category also includes non-residential site plans.
 - *Active* – Project is under construction.
 - *Start Year* – Estimated year project will start construction.
 - *End Year* – Estimated year project will be completed.
 - *Total Units* – Amount of units to be built in project.

- o *Mixed Use Split* – Further definition of mixed use; defines mixed use as percentages of single land use types. For example, Business Park mixed use could be 70% industrial and 30% office.

2.7 Future Land Use

Future Land Use is the combination of the Existing Land Use, General Plan Land Use, and Developments databases. Future Land Use shows what the buildout conditions will be based on current plans. Developable lands in the Existing Land Use are replaced by land uses in the General Plan and Developments. Redevelopment of existing structures is possible when a development project has been proposed for existing built structures. Figure 2-7 depicts future land use.

2.7 MAG Sub-regional Geography

Maricopa County is subdivided into 29 MPAs, 153 RAZs and 2,321 TAZs. Pinal County is divided into 16 MPAs, 73 RAZs, and 730 TAZs. MPAs include the corporate limits of a municipality plus any adjacent areas that are anticipated to become a part of those corporate limits in the future. RAZs are subunits of MPAs. RAZs are further divided into TAZs. The TAZ is the smallest unit for which MAG prepares projections. Their boundaries are defined using major streets and landmarks. In addition, MAG also includes parts of Yavapai and Gila Counties in its transportation modeling area, as transportation needs are partially dictated by the people living and working in Yavapai and Gila Counties.

Figure 2-9 shows the MPAs and RAZs in Maricopa County and Pinal County.

2.8 Base Population and Housing Variables

AZ-SMART and MAG transportation models require a July 1, 2014 base population, housing, and household total by TAZ2016 along with a detailed synthesized population and housing dataset from which to begin the modeling process.

The following data were used to produce the base July 1, 2014 population and housing variables:

- ACS 2010-2014 data by block, block group, tract, place and county for April 1, 2014 housing units by type, occupied housing units by type, population, households, and group quarters population.
- American Community Survey (ACS) 2010-2014 household and person level characteristics by 2010 Census block group.
- Arizona Department of Economic Security July 1, 2014 Population Update by Census 2010 place approved by MAG Regional Council.
- MAG Built Space database developed by combining and cross checking data from the Maricopa County Assessor's Office database, US Census Bureau Housing Data, MAG's Residential Completions database, and MAG's Major Group Quarters, Apartment, and Mobile Home/RV Park database.

All data sources are developed and maintained for July 1, 2014, but it is necessary to adjust and reconcile different data sources. MAG staff utilizes to use the following methodology to allocate and reconcile the totals to the TAZ2016 geography:

- The MAG housing inventory is reviewed and adjusted to match ACS 2010-2014 dwelling unit counts at the census block group geography. This review was done in conjunction with the Maricopa County Assessor's data.
- MAG staff utilized UrbanSim's built in micro-population synthesizer called SynthPop (<https://github.com/UDST/synthpop>). SynthPop is used to synthesize individually linked household and person records from the census Public Use Microdata Sample (PUMS) sample records to match modified ACS 2010-2014 totals (modification described in the next bullet point) at a specially created geography called "pseudo-block groups." Pseudo-block groups are census block groups combined with the census place geography. This allows SynthPop to use household and person level aggregations from the 2010-2014 American Community Survey (ACS) 5-year average at the block group geography while synthesizing the output to match the population at the census place geography simultaneously.
- It is necessary to adjust the aggregations from ACS 2010-2014, which are only available at the census block group level, to both a slightly different geography (pseudo-block group) and timeframe (July 1, 2014). The totals will be updated proportionally based on a ratio of total households and population from April 1, 2014 to July 1, 2014 at the block group geography.
- Once the ACS 2010-2014 totals are adjusted for both space and time, SynthPop can produce individual household and person records at the pseudo-block group geography. This data is then input into AZ-SMART to match the individual household and person records to the MAG housing inventory at the Assessor Parcel geography. Households and persons are matched by comparing and ranking attributes from the PUMS record (e.g. dwelling unit size, household income, etc.) to similar attributes obtained from the MAG housing inventory (e.g. dwelling unit size, dwelling unit value per square foot, etc.). The end result of this process is a very detailed parcel level database of land, built space, and individual households and person records matching census totals. While the data are very detailed, it is a synthetic or hypothetical representation of real households that reflects their characteristics.
- The resulting database is then aggregated to the TAZ2016 geography for review by POPTAC members.

Another segment of the base population that needs to be accounted for is group quarters population. Group quarter populations are split into five categories based on the living facilities: dorms, prisons, nursing homes, military, and other. It is proposed to use the following methodology to estimate the control totals and allocate to the parcel level database:

- Military totals are obtained and the totals confirmed by directly contacting the individual agencies (e.g. Luke AFB).
- The allocation will begin by comparing the MAG Major group quarters inventory with the MAG Built Space database. New built space records are added to the built space inventory as needed to accommodate group quarters population.

- When the ACS 2010-2014 block group contains group quarters population, and there is one or more built space records of group quarters type to accommodate the population, the group quarters population is assigned there.
- When the ACS 2010-2014 indicates there is group quarters population in a block group where the built space inventory does not have an appropriate record for allocation, allocate the total to vacant housing units from the housing inventory. It is expected that these records indicate the presence of small group homes.
- The resulting database of group quarters at the parcel level is then aggregated to the 2015 TAZ geography.

2.9 Base Employment by Land Use and Industrial Sector

AZ-SMART and the current MAG transportation models require employment classified by both land use categories, including work-at-home and construction, and North American Industry Classification System (NAICS) sector based employment.

The following data sources are available for the creation of the required employment databases: Bureau of Labor Statistics (BLS) and the Quarterly Census of Employment and Wages (QCEW) annual totals by 3-digit NAICS categories, the MAG Employment database (with spatial locations built from various public and private sources), the Department of Defense Statistical Information Analysis Division for military employment, and the ACS 5-year average (2010-2014) data for unincorporated self-employed (USE) totals.

Detailed analysis of the MAG Employer database against the build space database has indicated a presence of non-site-based (NSB) jobs. These include workers that are not located at one site; examples include temporary workers, and workers involved in construction, landscape, and janitorial services. To develop base July 1, 2014 employment control totals for Maricopa County, it is proposed to make some adjustments to the county employment totals both within NAICS categories and to split some proportion of each NAICS category to include work-at-home (WAH) employment and NSB employment utilizing the following methodology:

- Compare BLS-QCEW and military county totals to the MAG Employer database and adjust to a new county total based on this analysis.
- Allocate USE county total employment to NAICS categories based on estimates provided by a MAG consultant white paper (Applied Economics, 2009).
- In 2009, a MAG consultant conducted an analysis of the employer database by NAICS categories and suggested the proportions of each sector that are work-at-home and non-site-based.
- Re-allocate some larger public employment categories to new NAICS codes to better reflect the purpose of the employment. For instance, move some large State employment (e.g. ASU) to the education category and some local employment (e.g. Maricopa Integrated Health Systems) to the appropriate medical category.
- Estimate WAH and NSB employment totals for the county by NAICS categories by analyzing the MAG Employer database. Employment points falling onto parcels with a residential land use are split into WAH and NSB categories:
 - Up to two employees on a residential land use in the NAICS code as WAH

- o Additional employees beyond two on a residential land use as NSB.

Once an adjusted total employment for Maricopa County by NAICS categories is complete it is next necessary to allocate the totals sub-regionally and convert them to land use-based employment totals. MAG staff proposes to rely upon the MAG Employer, Existing Land Use, and Built Space databases for this spatial allocation and conversion:

- Compute the difference between total employment by category in the MAG employer database and the total employment control totals by category for the county.
- Factor up (or down) this difference in employment by category utilizing the existing MAG Employer database points to match the county level control totals.
- Check the number of jobs in each built space record and compute the number of square feet each job occupies. If this number falls below the number set in a previously estimated “building square foot per job” table (which specifies for each building type how much floor space each job requires) then expand the built space record’s square footage and value to accommodate the number of jobs assigned to it.

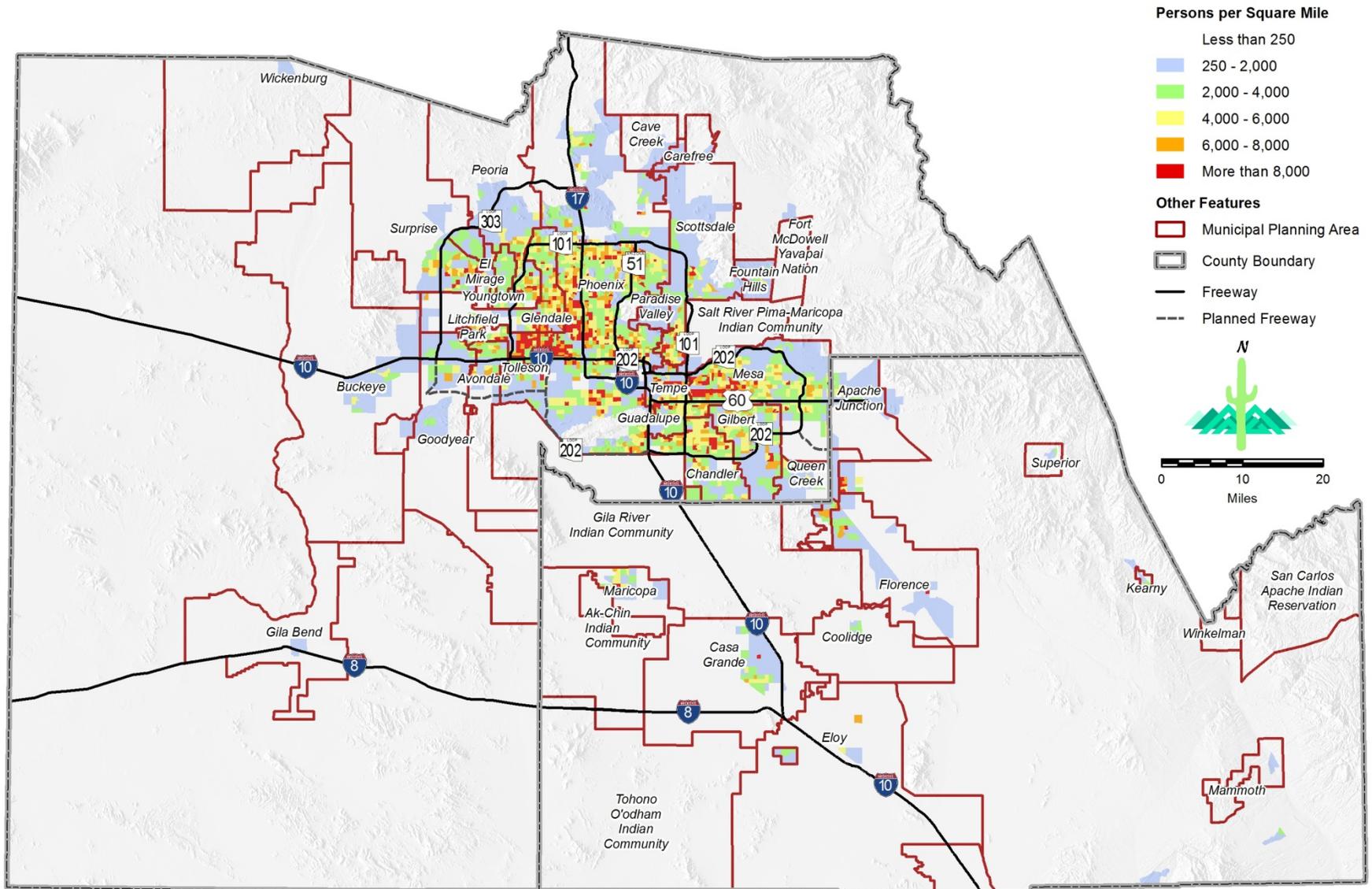
After all of the employment by category is assigned to built space records at the parcel level of geography, the jobs must be summed up by land use category and TAZ2016 for review by POPTAC members:

- Generalize MAG’s 2014 Existing Land Use database into five categories: Retail, Office, Industrial, Public, and Other.
- Overlay the modified Employer database onto the Generalized Land Use database and compute the total employment by the five land use categories and two additional categories of work-at-home and non-site-based.
- Aggregate the land use based employment totals to the TAZ2016 geography.

2.10 Other Data Collection Efforts

Other data needed by the modeling process include post high school institutions and enrollment, elementary and secondary school institutions and enrollment, mobile home and recreational vehicle parks and number of residential and non-residential units, current and projected enplanements for Sky Harbor and Phoenix-Mesa Gateway airports, current and projected retirement areas, built space inventories which are parcel level datasets derived from County Assessor master tables for both residential and non-residential buildings, and hotels, motels and resorts and number of beds and employees. The data on recreational vehicle parks, hotels, motels and resorts are used to develop estimates and projections of non-resident population. The MAG Population Technical Advisory Committee (POPTAC) reviewed this information and provided comments. Figures 2-10 to 2-13 show some of the databases derived from this process.

**Figure 2-1: Population Density
Maricopa and Pinal Counties, Arizona**

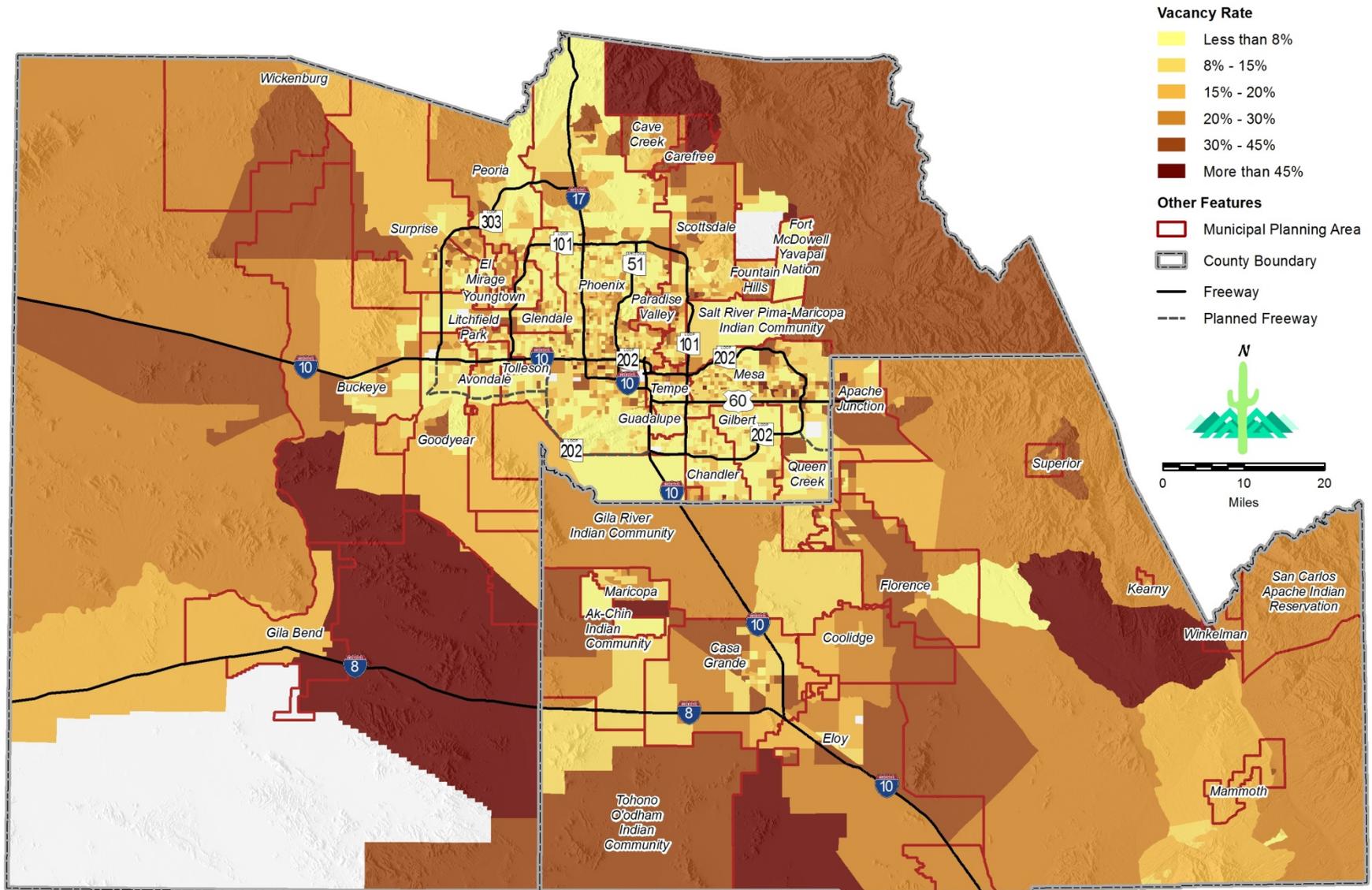


Source: American Community Survey, 2010 to 2014 5-Year Estimates
Date: May 2016

Figure 2-1: Population Density

While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

**Figure 2-2: Vacancy Rate
Maricopa and Pinal Counties, Arizona**

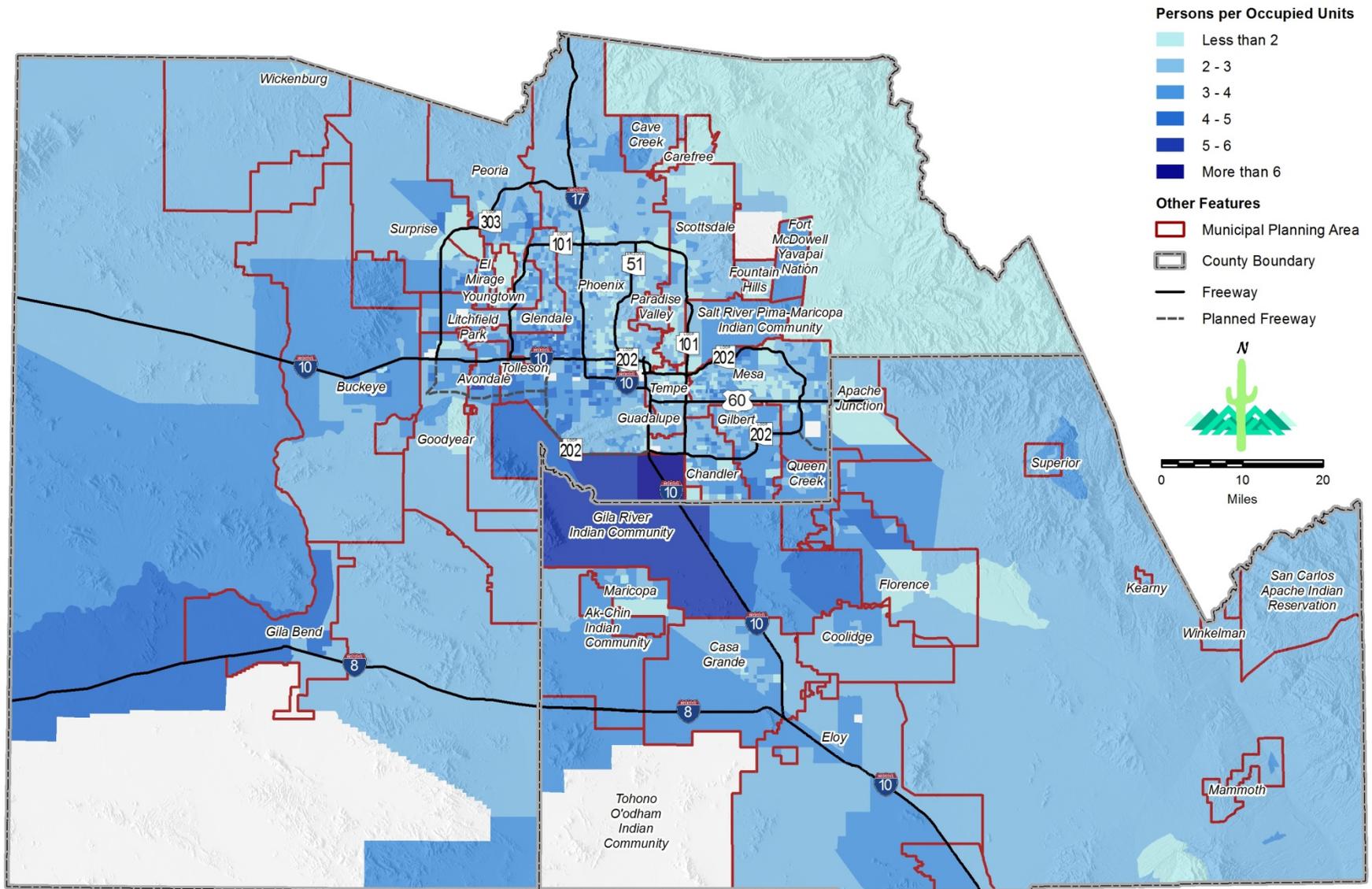


Source: American Community Survey, 2010 to 2014 5-Year Estimates
Date: May 2016

Figure 2-2: Vacancy Rates

While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

**Figure 2-3: Persons per Occupied Housing Unit
Maricopa and Pinal Counties, Arizona**



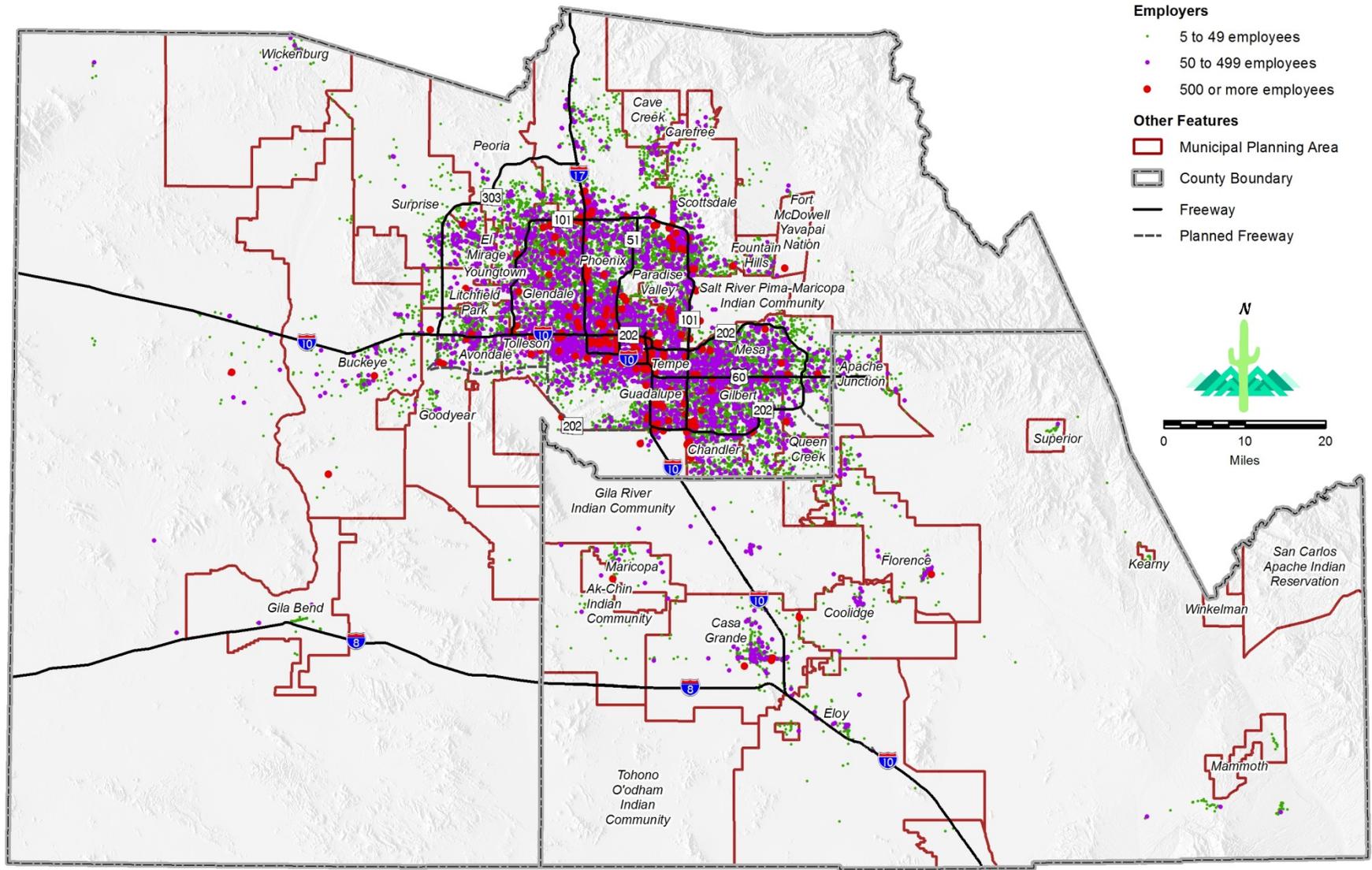
Source: American Community Survey, 2010 to 2014 5-Year Estimates

Date: May 2016

Figure 2-3: Persons per Occupied Unit

While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Figure 2-4: Employment Locations, 2014
Maricopa and Pinal Counties, Arizona

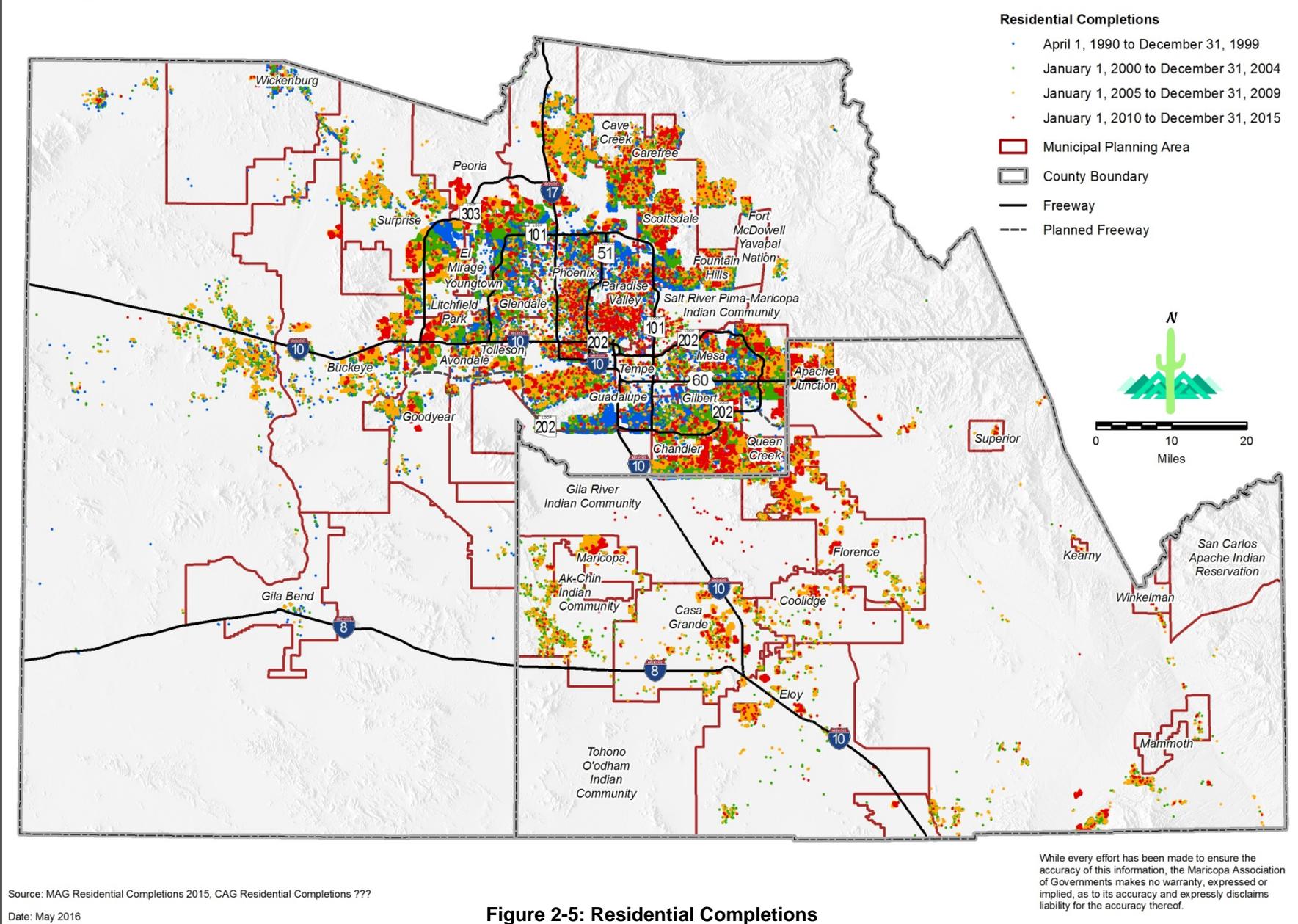


Source: MAG Employers Database 2014
 Date: May 2016

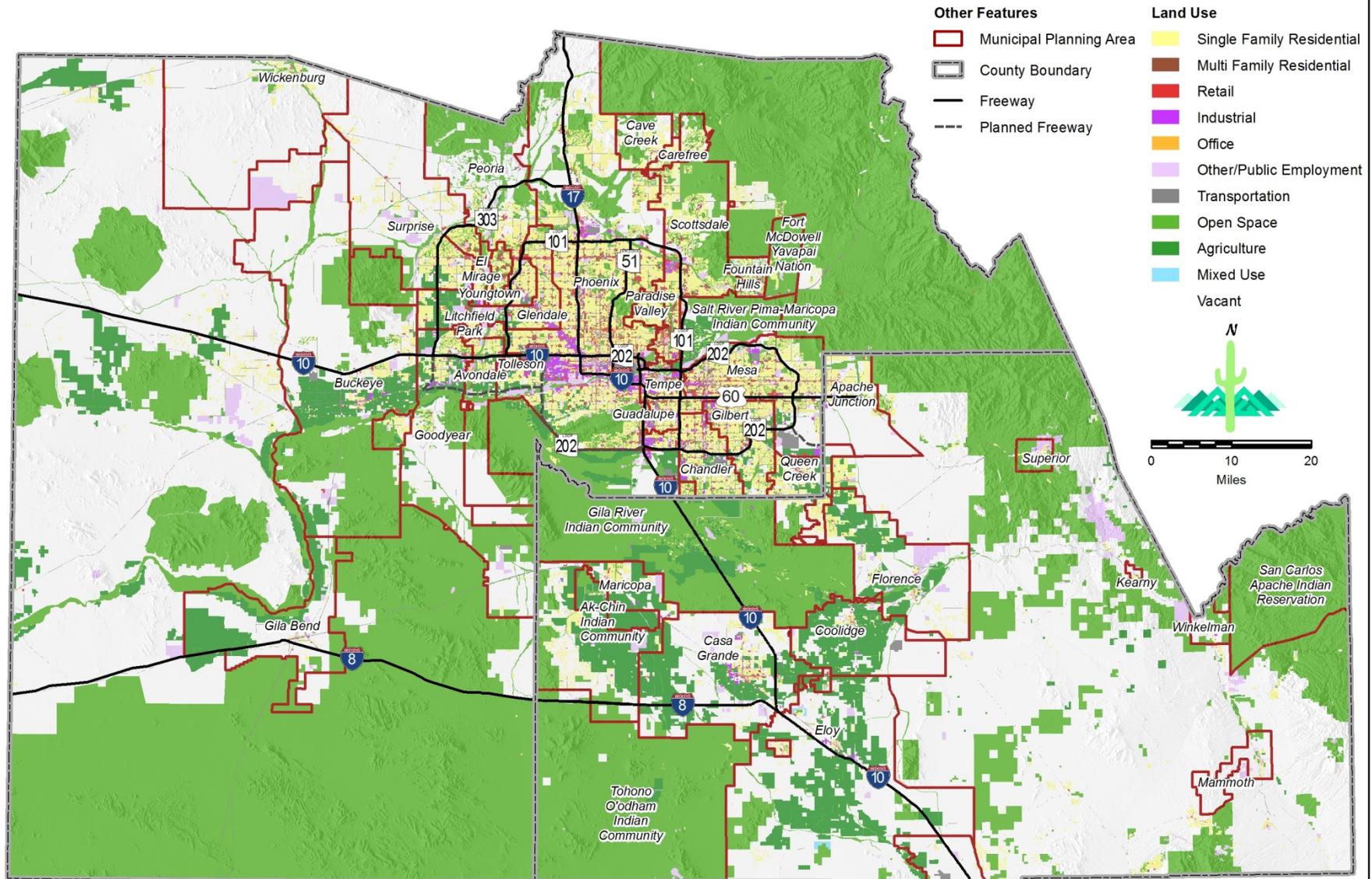
Figure 2-4: Employment Locations

While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Figure 2-5: Residential Completions, 1990 to 2014
Maricopa and Pinal Counties, Arizona



**Figure 2-6: Existing Land Use 2014,
Maricopa and Pinal Counties, Arizona**



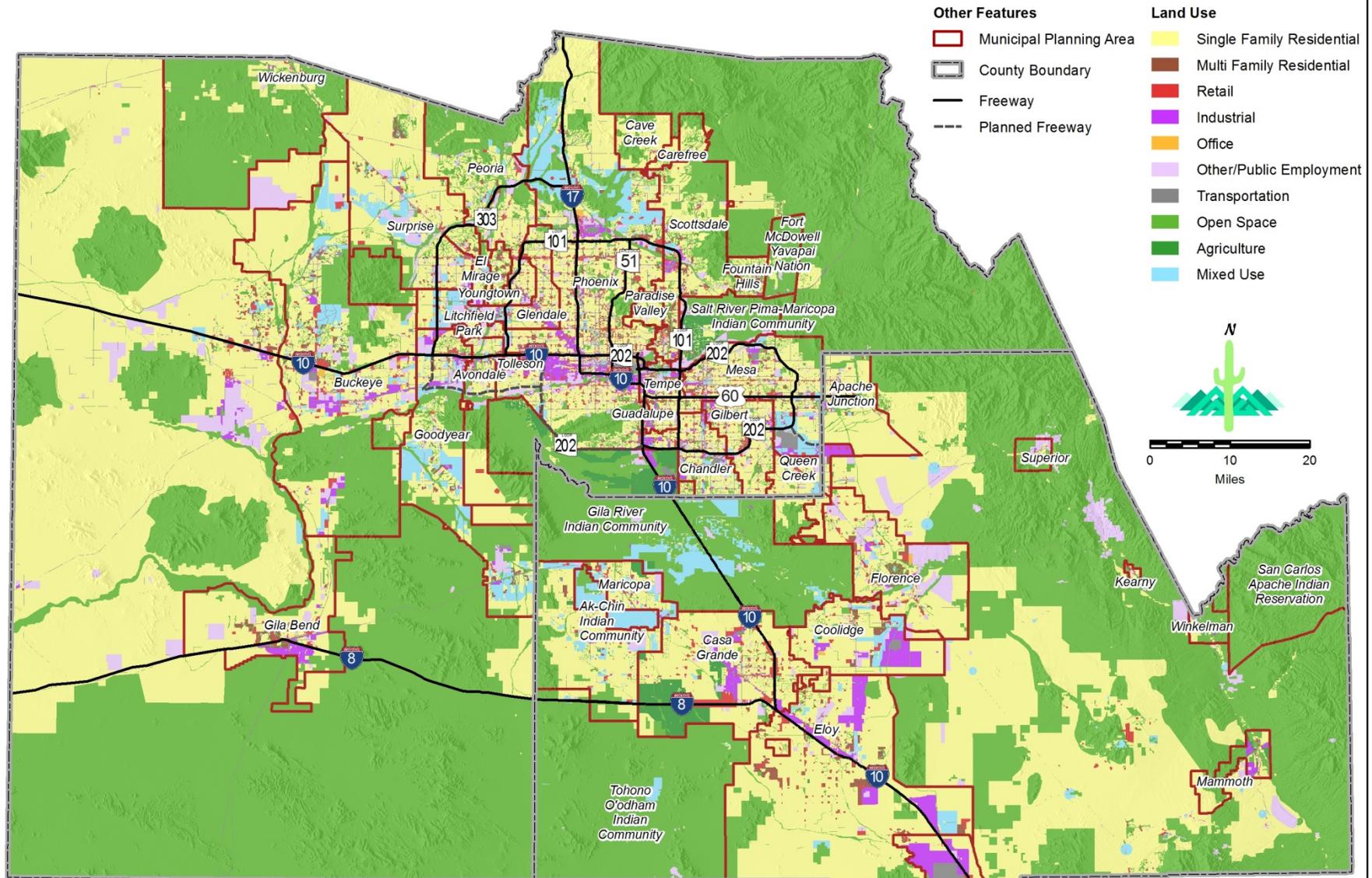
While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Source: MAG Existing Land Use 2014

Date: May 2016

Figure 2-6: Existing Land Use

**Figure 2-7: Future Land Use,
Maricopa and Pinal Counties, Arizona**



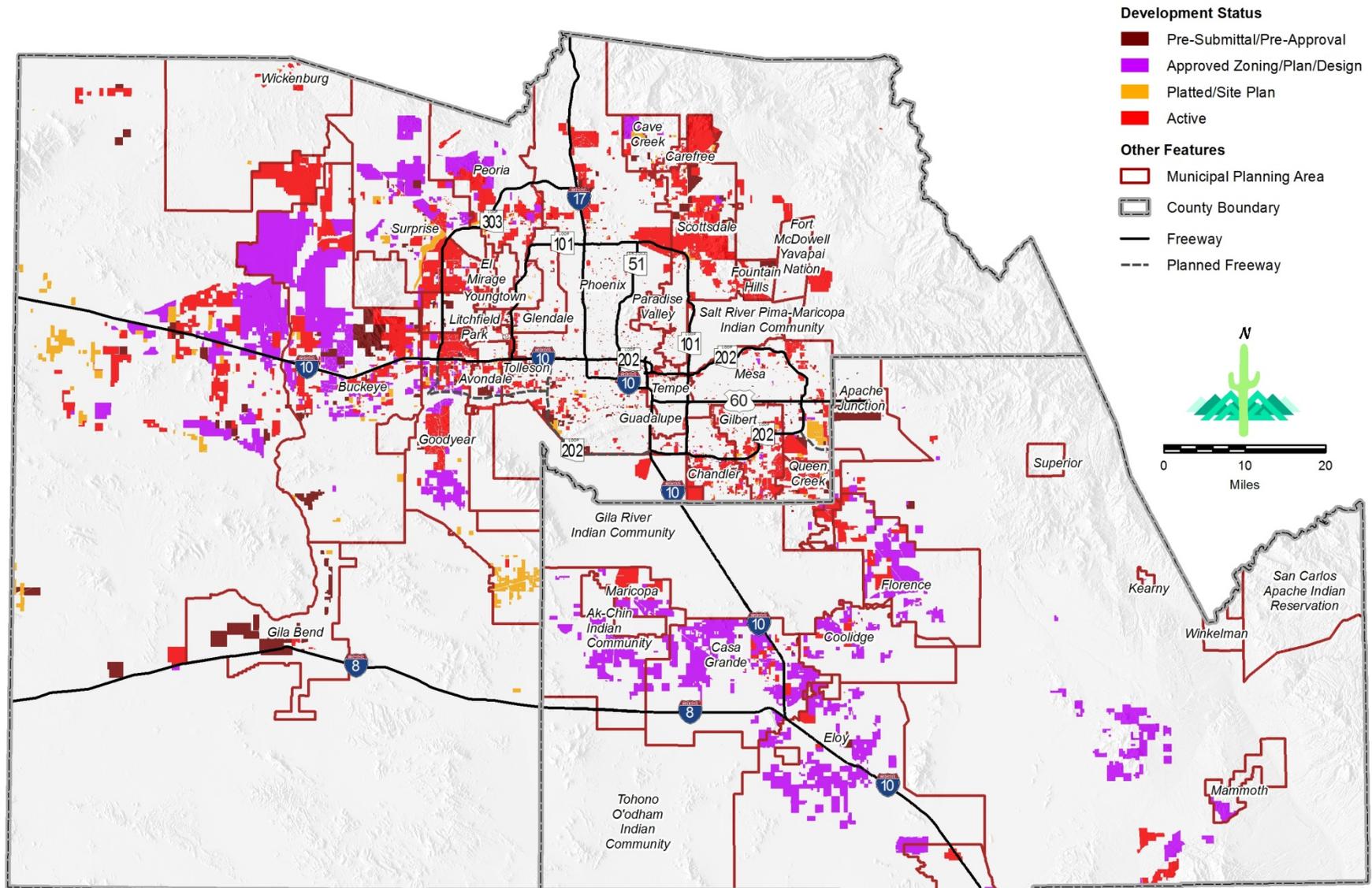
Source: MAG Future Land Use Database 2014

Date: May 2016

While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Figure 2-7: Future Land Use

**Figure 2-8: Major Developments, 2014
Maricopa and Pinal Counties, Arizona**



While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Source: MAG Developments Database 2014, CAG Developments Database 2012

Date: May 2016

Figure 2-8: Developments

**Figure 2-9: Regional Analysis Zones (RAZ), 2016
Maricopa and Pinal Counties, Arizona**

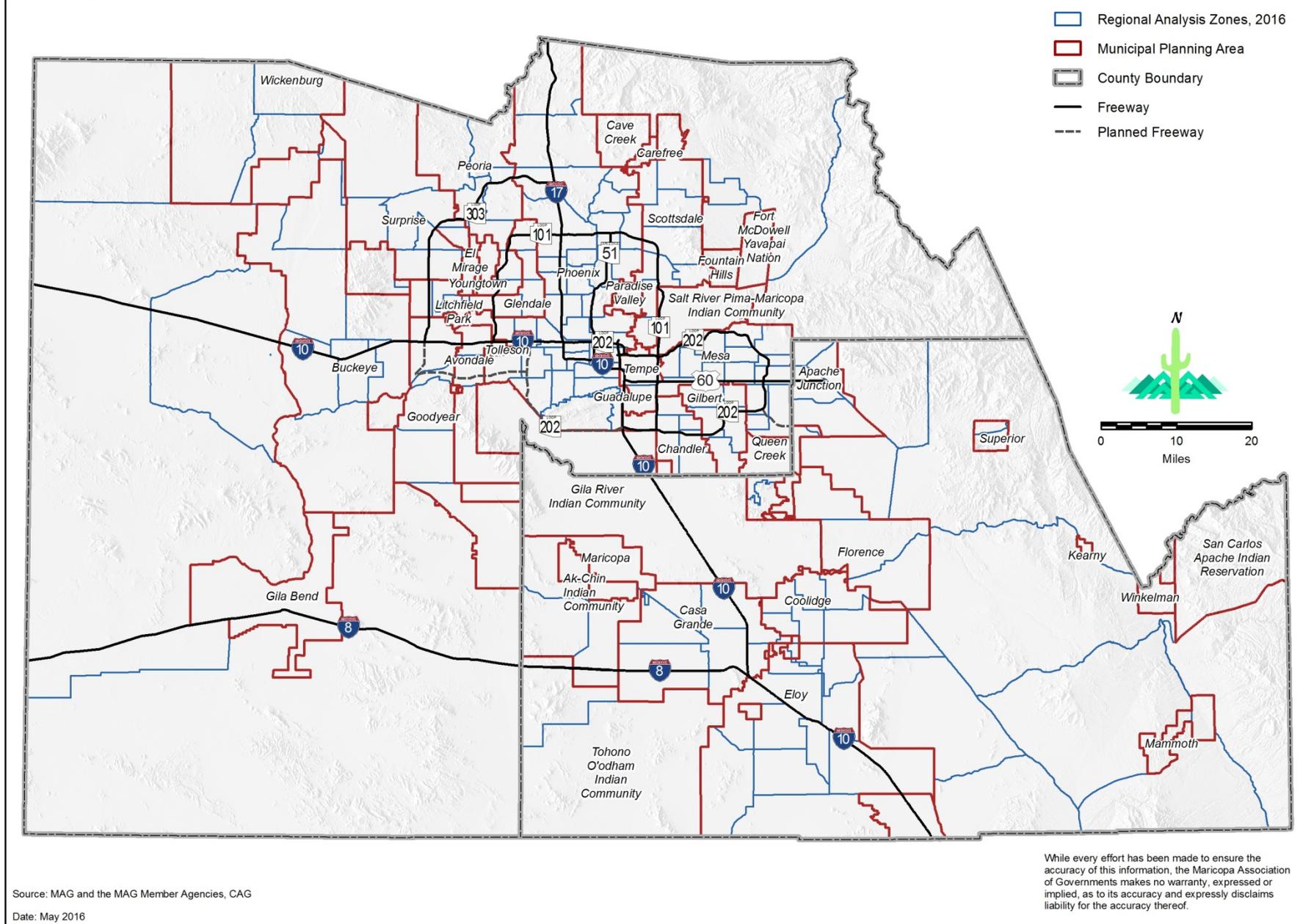


Figure 2-9: Regional Analysis Zone Geography

Figure 2-10: Schools, 2016
Maricopa and Pinal Counties, Arizona

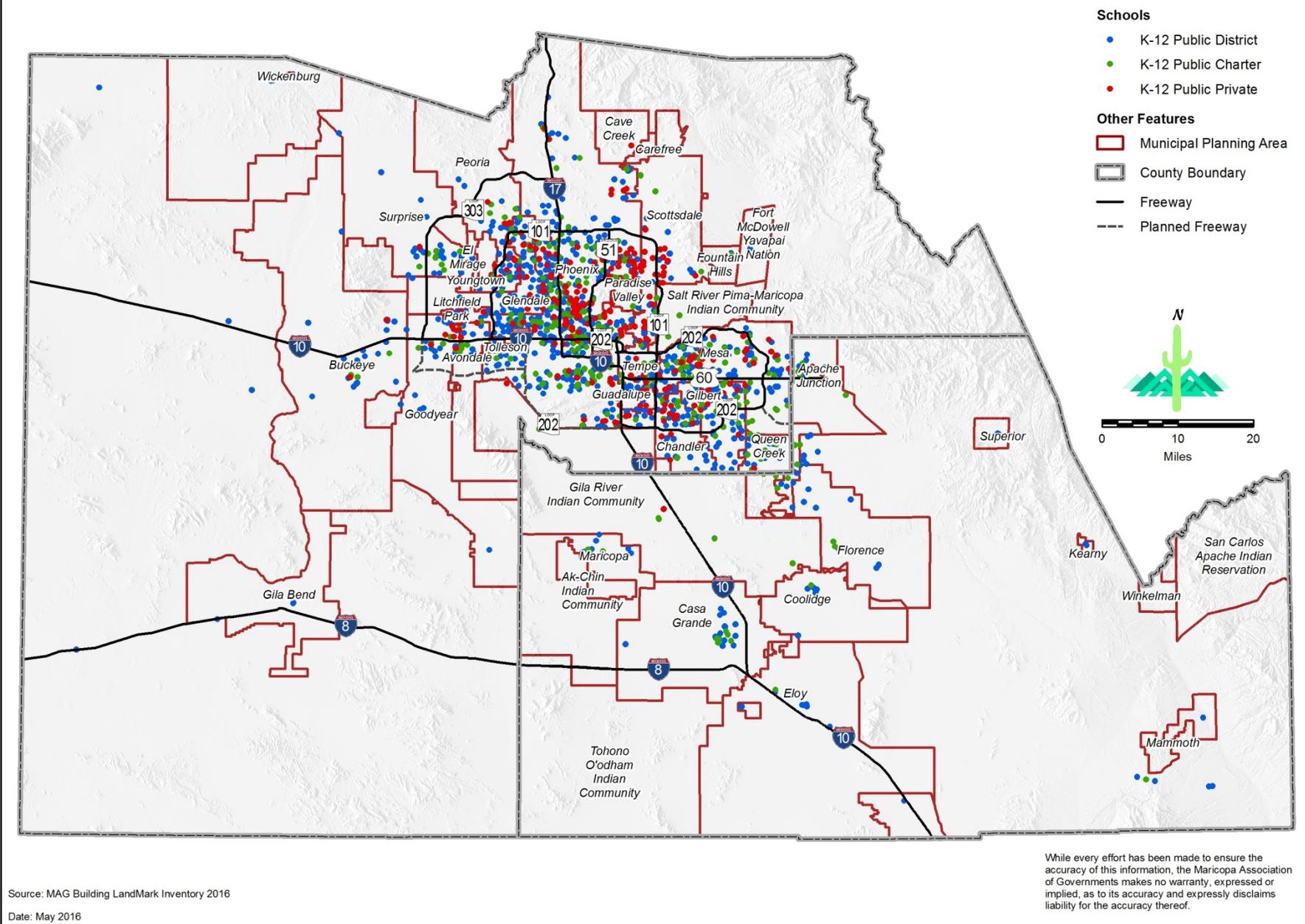


Figure 2-10: Schools

**Figure 2-11: Post-Secondary Educational Institutions, 2016
Maricopa and Pinal Counties, Arizona**

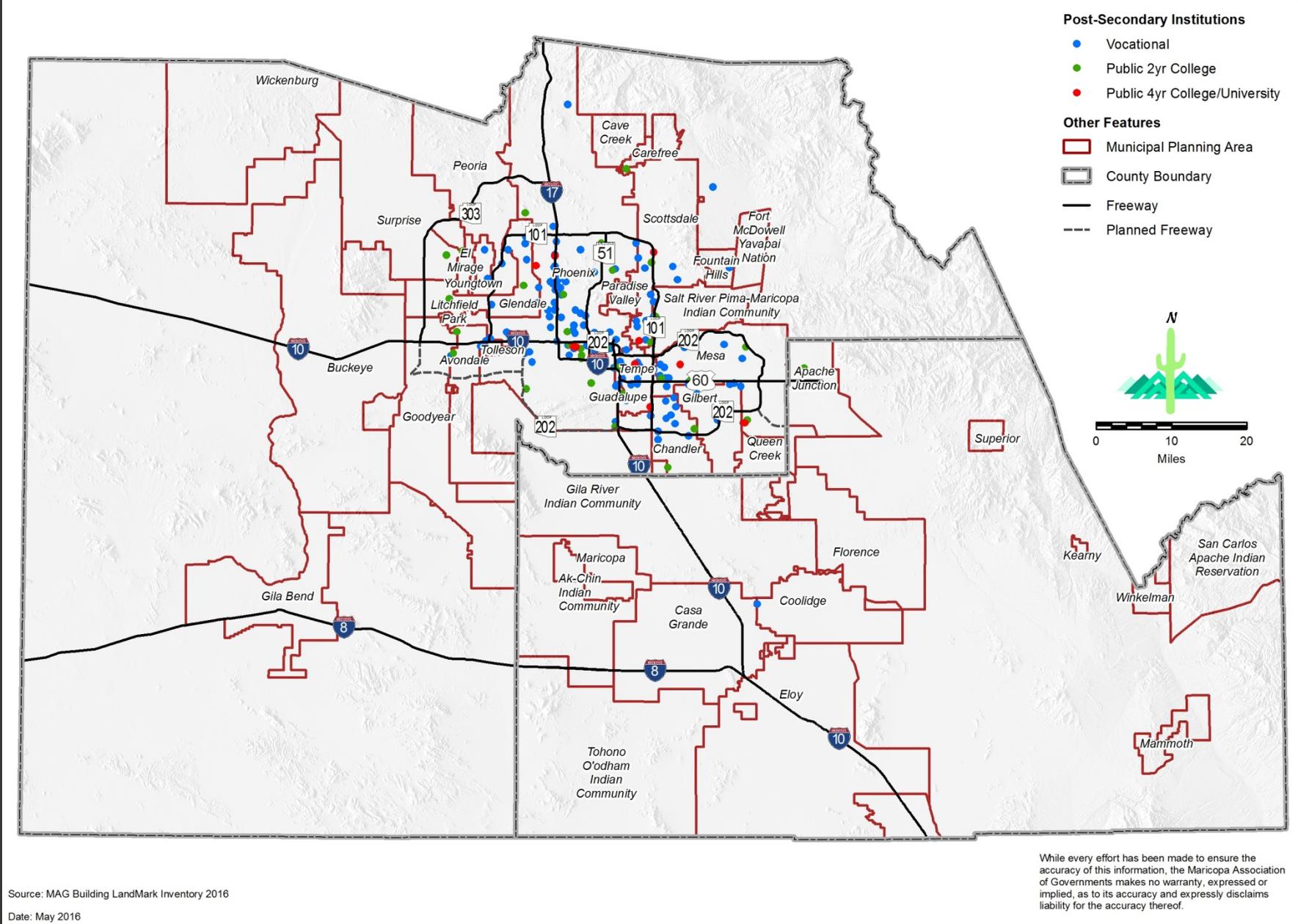


Figure 2-11: Post-Secondary Educational Institutions

**Figure 2-12: Hotels and Motels, 2016
Maricopa and Pinal Counties, Arizona**

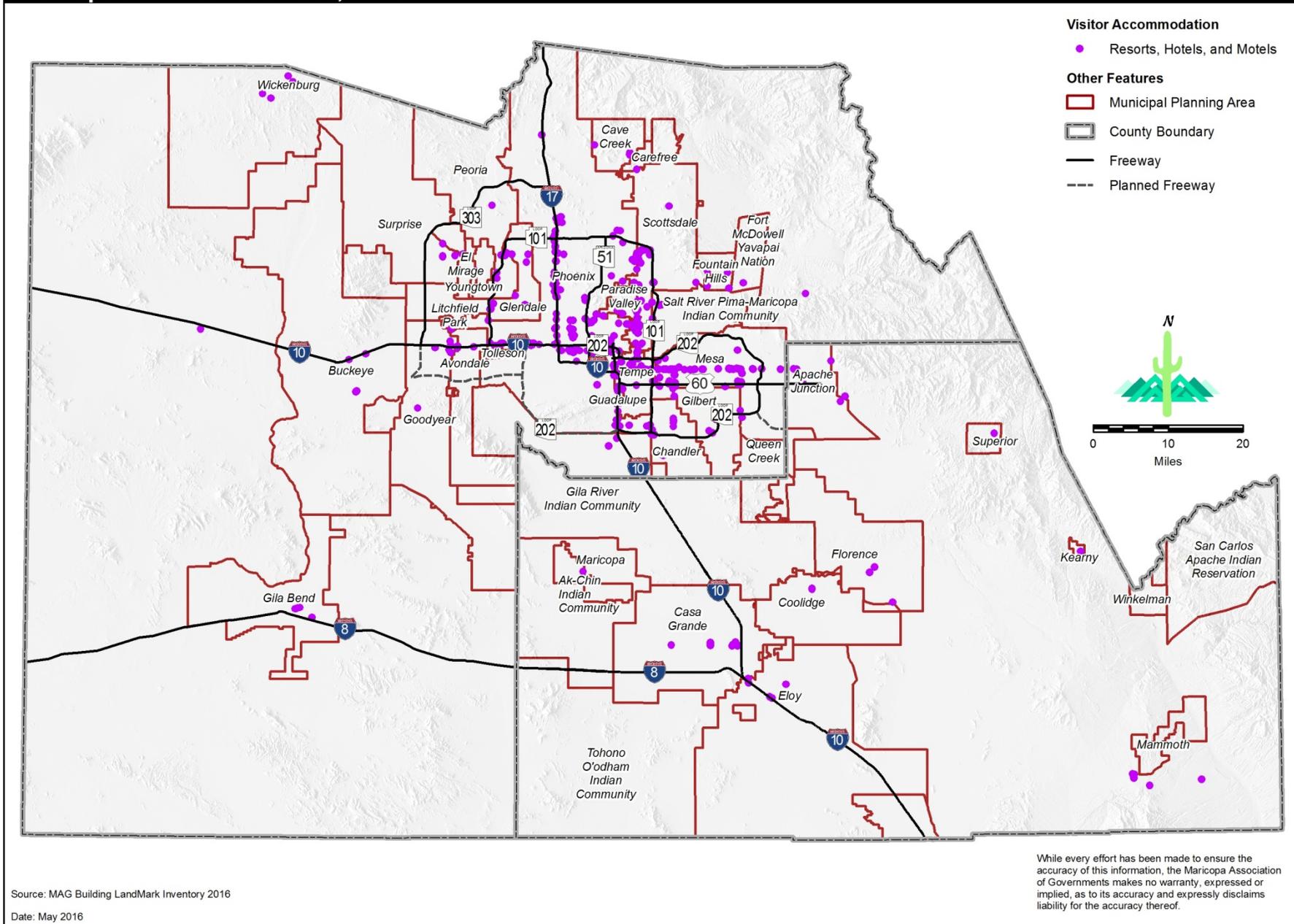


Figure 2-12: Hotels and Motels

**Figure 2-13: Mobile Home and RV Parks, 2015
Maricopa and Pinal Counties, Arizona**

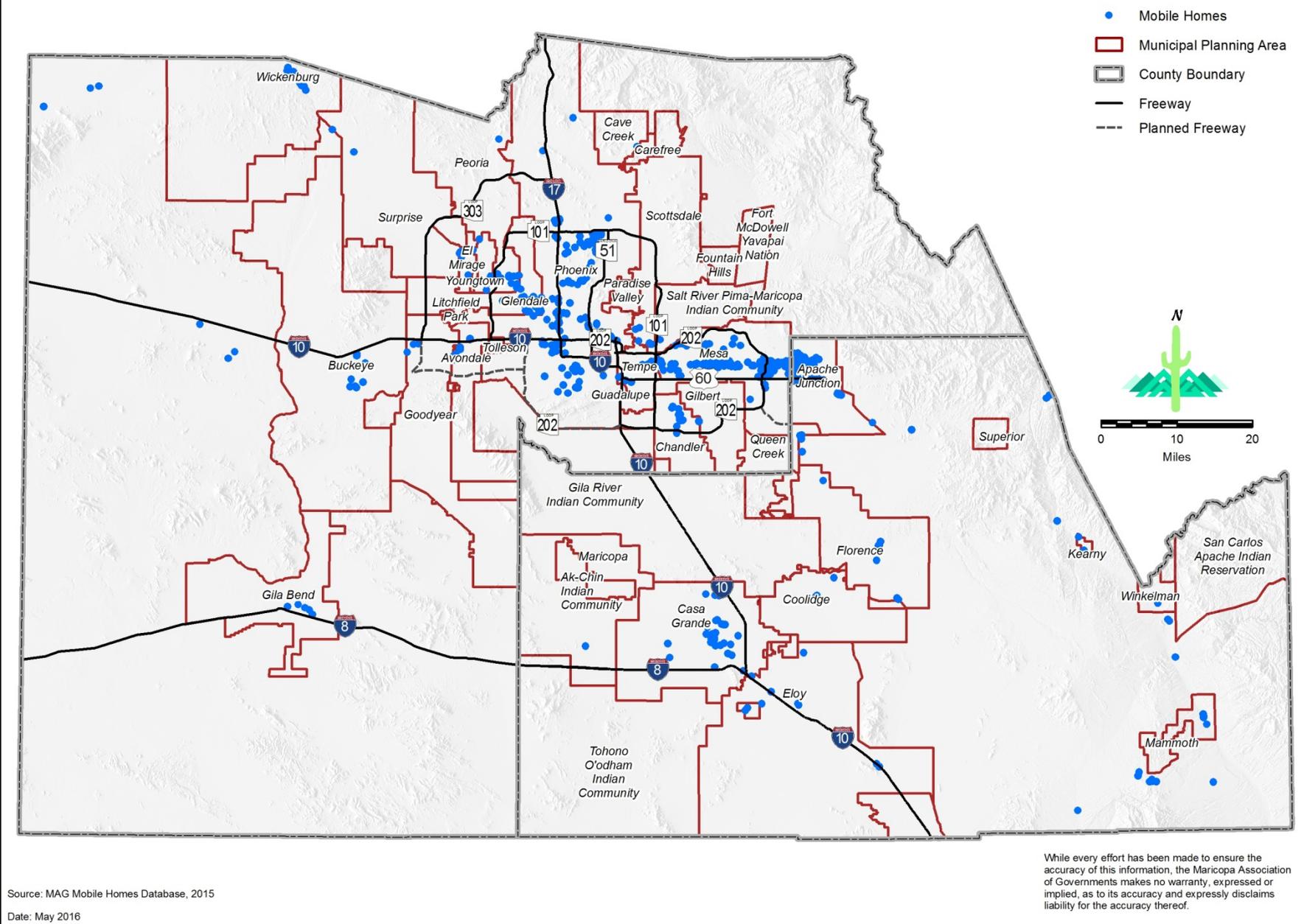


Figure 2-13: Mobile Home and RV Parks

3. MODELS AND MODELING PROCESS

The primary purpose of the population and socioeconomic projections developed by MAG is for input into the MAG transportation and air quality models. These projections are also used for a wide variety of regional planning programs such as human services, regional development and by MAG member agencies in developing long range plans.

Some important objectives of the modeling process are to

- Establish a linkage between transportation, land use and air quality models. A representation of this linkage is depicted in Figure 3-1.
- Incorporate a geographic information system (GIS) into the process for better data sharing and review with member agencies and for maintaining an innovative approach to land use planning.
- Establish a process by which MAG member agencies can contribute their local knowledge into the model results so they are well-suited to usage by member agencies.
- Test various policy alternatives and land use scenarios on an as-needed basis to assist in regional planning.

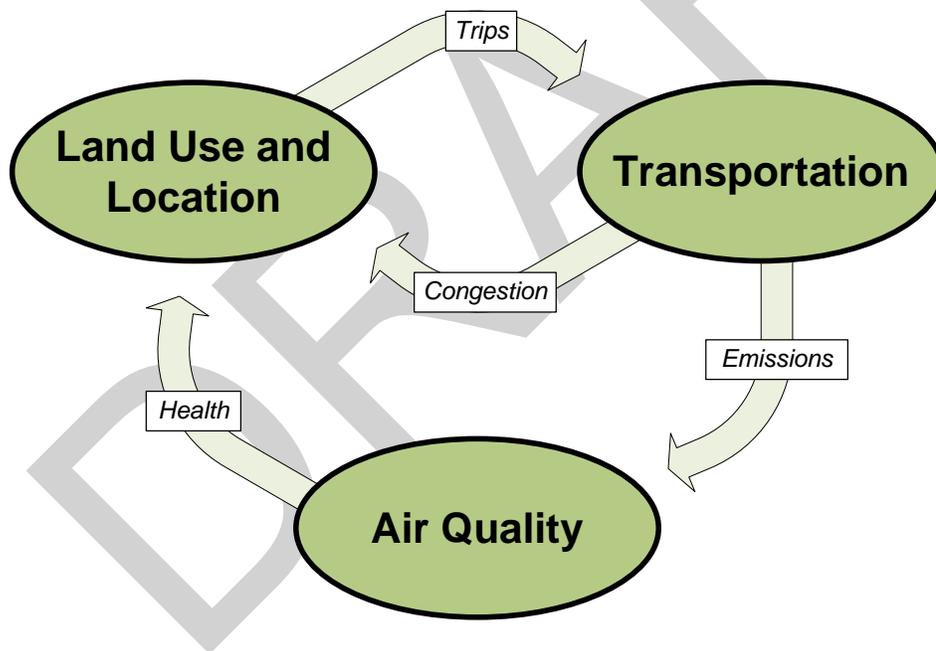


Figure 3-1: Links in the MAG Modeling Process

3.1 AZ-SMART and UrbanSim

Arizona's Socioeconomic Modeling, Analysis and Reporting Toolbox (AZ-SMART) is a modeling suite that supports socioeconomic activities at MAG, other councils of governments (COGs) and metropolitan planning organizations (MPOs), and elsewhere throughout the state. This modeling suite is a platform on which to build, calibrate, run, and analyze socioeconomic projections and projection models. It also seamlessly integrates with other third party models. The UrbanSim model system constitutes the bulk of the third party model used in the system and is described below.

UrbanSim is a software-based simulation system for supporting planning and analysis of urban development, incorporating the interactions between land use, transportation, the economy, and the environment. It is intended for use by MPOs, cities, counties, non-governmental organizations, researchers and students interested in exploring the effects of infrastructure and policy choices on community outcomes such as motorized and non-motorized accessibility, housing affordability, greenhouse gas emissions, and the protection of open space and environmentally sensitive habitats. It was developed by Prof. Paul Waddell at the University of Washington. Prof. Waddell is now the chair of the Department of City and Regional Planning at the University of California at Berkeley. UrbanSim is used worldwide and is the most widely used land use model in the United States. It is being used in at least 10 MPOs¹. Documentation for UrbanSim, its various models and configurations, and numerous scholarly papers can be found at the UrbanSim.org website².

3.2 Methodology for Preparing Projections

The land use, population, and socioeconomic models are based on a three-tier modeling process as shown in Figure 3-2. The first tier (green box) is a demographic model that is used to produce county control totals. The second tier involves using a parcel-level simulation model to allocate the county control total population and employment to Assessor parcels. The third tier allows for the aggregation of the parcel-level population and employment to Metropolitan Planning Areas (MPAs), Transportation Analysis Zones (TAZs), Regional Analysis Zones (RAZs), or almost any other geography that parcels aggregate into. The system draws upon the detailed GIS representation of Assessor parcels in the second tier. This also provides a feedback mechanism whereby MAG staff may review simulation results with interested stakeholders and utilize that feedback to revise the model results.

¹ See <http://www.urbansim.com/urbansim> (last accessed 5/24/2016)

² See <http://www.urbansim.com/> (last accessed 5/24/2016)

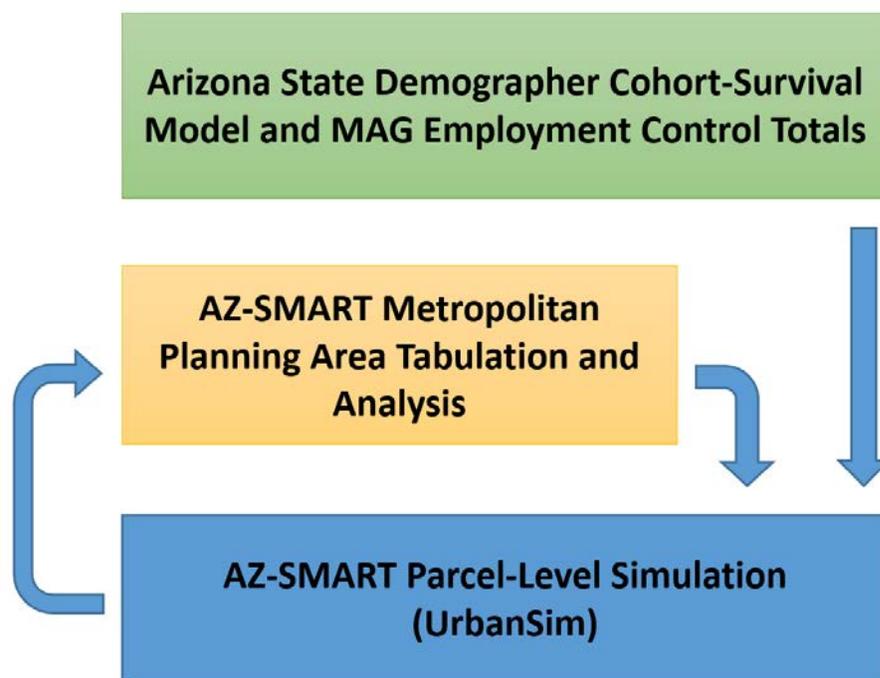


Figure 3-2: Three Tier Modeling Process

3.3 County-level Model

The first tier in the modeling process is a county-level model. In accordance with Executive Order 2011-04, the preparation of county and state level population projections is the responsibility of the Arizona State Demographer at the ADOA. This model is a cohort-component demographic model projecting births, deaths and net migration in each county annually out to 2050. This model incorporates population by single year of age, sex, 6 race/ethnicity categories, birth rates, death rates, and net migration trends. The model takes into account short-term economic conditions, but not long-range employment trends. The Arizona State Demographer, using this model, created a population data series, to be consistent with the results of the 2015 population estimate.

The county-level cohort component model was developed with input from the Council for Technical Solutions (CTS), which is made up of representatives from each of the Regional Councils in Arizona, representatives from each of the State universities, representatives from the Department of Health Services (DHS) and the Arizona Department of Transportation (ADOT), along with demographic experts. CTS evaluated the methods and results of the model. In addition, MAG staff regularly reported the findings of CTS to the POPTAC.

Since the MAG transportation models require employment projections as well as population projections, MAG's regional economist started with projections of employment by industry category (NAICS) obtained from Moody's Analytics' Economy.com, then adjusted them by using an employment to population ratio, the MAG employer database, along with local knowledge, trends, and input from MAG member agencies. These methods and results were also presented to and approved by the MAG POPTAC.

3.4 Parcel-Level Simulation Model

The Parcel Level Simulation Model is designed to allocate population and employment from the county level down to Assessor parcels. This simulation model utilized a customized version of UrbanSim. Once simulation results are allocated to the parcel level, results can be aggregated as necessary to other geographies such as the TAZ. Assessor parcels are a collection of parcels that are slightly modified when necessary to cover the entire county in a GIS based on contiguous land uses while respecting other essential geographies such as TAZs. The Parcel Level Simulation Model is a micro-simulation model that tracks the individual parcels, the built space on those parcels, and the individual “agents” (households and persons, and jobs) that occupy the built space. A more detailed description of the Parcel Level Simulation Model follows; also see Figure 3.3.

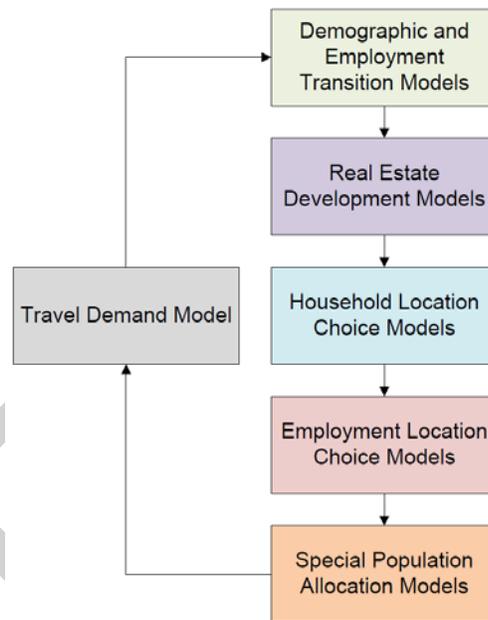


Figure 3.3: Parcel Level Simulation Model Process

Population and employment by industry sector results from the county level control totals feed the Parcel Level Simulation Model. The Demographic and Employment Transition models calculate the difference between the control total for population and jobs and the current simulation year’s total of population and jobs by market area and industry sector (for employment). If these models find a difference, they clone or delete agents as necessary within the market area until the control totals for the simulation year are met. Any new agents are assigned a status of “unplaced.” Unplaced agents are placed later in the simulation year by the location choice models.

The next step in the simulation process is to model real estate market demand and supply. Demand and supply of new built space is calculated by new, unplaced agents waiting to occupy the space and the current state of vacancy in the market area. A target vacancy rate is used to

determine when to build new space. This target vacancy rate is intended to represent the long-term market clearing rate of vacancy in the market. If the vacancy rate in the market area is below the target vacancy rate, new built space will be constructed until the target is met. If the vacancy rate is above the target, no new space will be built unless there are known active developments in the market area. When locations for new built space are being considered, the location of new construction any given simulation year are constrained by two important datasets: known developments and general plans, both of which are maintained continuously by MAG staff and reviewed annually by member agencies. These datasets are used to estimate how much built space can be constructed on a given parcel, and the earliest simulation year the built space could be constructed from start years given by member agencies. Relative real estate prices per unit are also predicted and utilized in the location decisions.

Once the real estate development models have built new space to match the target vacancy rate by market area, “unplaced” households and jobs are located into the built space according to variables such as location, built space type and size, attributes of other households and jobs, accessibility to jobs and shopping opportunities, etc. The location choice models are specified as multinomial logit models, and are stratified into numerous different equations depending on the type of the agent. This allows different factors to influence the location of, for example, retail jobs vs. industrial jobs. The household location choice models are stratified by household income level, while the employment location choice models are stratified by industry sectors (primarily 2-digit NAICS).

After all agents have been located into built space, the simulation runs several additional models to handle special population types that do not necessarily follow market based development patterns. “Population following” employment such as public jobs (e.g. schools, public administration), non-site-based jobs (e.g. construction workers, landscape workers), transient population (population present for less than two weeks such as hotel visitors), group quarters population (e.g. prison, nursing homes), and seasonal population (defined as population present for greater than two weeks but less than six months) are all examples of special populations handled by these models. These models allocate control totals to built-space or land based on a weighting scheme specific to the population. For instance, transient populations are allocated to hotels and dwelling units, and nursing home populations are allocated only to nursing homes.

3.5 Metropolitan Area Tabulation and Review

For the third tier of the modeling process, data results from the parcel level are aggregated as necessary for review. In this model system almost any geography may be used, however, Metropolitan Planning Areas (MPAs) and Transportation Analysis Zones (TAZs) are the most common. It does this primarily using a point-in-polygon type operation whereby the centroid of parcels are considered to be 100% inside of a single upper-level geography.

At this level the model results are analyzed and evaluated by stakeholders. Stakeholders include MAG Member Agencies and internal MAG staff (staff experts in MAG’s Transportation and Environmental Divisions). The results from the parcel level simulation model are analyzed and

evaluated for consistency and reasonableness using known short-term and expected long-term trends in real estate development, vacancy rates, and other market conditions. MAG Member Agencies provide a critical role in this review level by providing feedback from City staff who are well versed in the local and expected conditions in their respective areas. MAG modeling staff are able to take this feedback and utilize it as input to fuel subsequent AZ-SMART model runs to refine the results to match expected conditions on the ground.

3.6 Travel Demand Model Feedback

Representing the interaction between land use and transportation is an important part of the projections process. To represent this interaction, results from this model were fed to a travel demand model as inputs. A full set of socioeconomic data from UrbanSim was fed to the MAG Regional Travel Demand Model at the TAZ level of geography, including but not limited to total population, total households, dwelling units by type (single and multi-family), households by income quintile, total jobs and jobs by land use type, and special population variables.

Outputs from the travel demand model, in the form of travel time “skims,” are taken from the travel demand model and fed back into the next year of the Parcel Level Simulation Model. These skims take the form of TAZ to TAZ travel time matrices by time of day and mode type. Although many variables were provided in these travel time skims, not all proved to be statistically significant to the simulation’s location choice models. Examples of accessibility variables include, but are not limited to, the natural log of the number of retail jobs within 20 minutes travel time in the off-peak single occupant vehicle mode, population within 30 minutes travel time in the transit combined mode, the number of jobs within 45 minutes travel time in the transit combined mode, and the population with a bachelor’s degree or higher within 15 minutes. Other non-travel time-related variables were also found to be statistically significant in the location choice models. Examples include the straight line distance to the Phoenix CBD, a Boolean variable for whether or not a building is within a quarter mile of a light rail stop (current or future), and Boolean variables for whether or not a building is within a quarter mile of a freeway. Additional details of the specific models, their coefficients, and other diagnostic information is available.

In addition, due to the time that the travel demand model takes to simulate, the travel demand model is not run for every simulation year. The travel model was run based on expert advice from our travel modelers on staff at MAG, consultants, and finally input from member agencies. The years for which the travel model is run correspond to major changes in the travel network and/or the passing of a certain number of years.

4. ASSUMPTIONS AND METHODS

4.1 MAG Socioeconomic Projection Geographies

- Maricopa County is subdivided into 29 municipal planning areas (MPAs), 153 regional analysis zones (RAZs), 2,321 traffic analysis zones (TAZs).
- Pinal County is subdivided into 16 MPAs, 73 RAZs, and 730 TAZs.
- The RAZ and TAZ geographies may be modified through comments by MAG member agencies and by MAG transportation planning/modeling staff.
- Each municipality has its own MPA, which delineates the area of planning concern for each jurisdiction. The following process is followed to define MPA boundaries:
 - Prior to the development of a new set of socioeconomic projections, MAG reviews the MPA boundaries with each member agency through the MAG POPTAC. Maps are distributed showing the MPA boundaries from the last set of projections and input is requested.
 - Any area that has been annexed by a jurisdiction which falls outside the current MPA is automatically added to the MPA. Areas which have been de-annexed are removed.
 - Where a jurisdiction requests a change to its MPA, MAG sets up a meeting with the parties involved. Normally this meeting would include the jurisdiction requesting the MPA boundary enlargement, other affected member agencies, if involved, and possibly adjoining jurisdictions. The County is always invited to participate.
 - If there are no objections from the other entities involved, the change to the MPA is made.
 - If there are objections to the expansion of the MPA, and no consensus compromise is reached by the jurisdictions, MAG will leave the MPA boundaries as they existed in the last set of projections. Ultimately, whichever jurisdiction annexes the territory, will have it included in its MPA.
 - A jurisdiction is responsible for reviewing and providing input on land use, base data, surveys, assumptions and draft socioeconomic projections for the entire MPA.
- TAZs are required for transportation planning with input from the MAG POPTAC.
- TAZs are modified as expected growth in a 30-year horizon expands geographically or densities in existing TAZs warrant TAZ splits.
- TAZ boundaries are delineated utilizing existing and future highway corridors, transit networks, major arterials, waterways/canals, and other natural features such as mountains.
- TAZs and RAZs fall completely within only one MPA, as TAZs add up to RAZs, and RAZs add up to MPAs.
- TAZs used for the 2016 projections will be identified as TAZ2016.

4.2 Population and Employment Projections Control Totals

A. Population

- The Arizona State Demographer created a cohort-component population projection model to be consistent with the results of the 2014 population estimate. The cohort-component model was created with input from the Council for Technical Solutions.

- MAG develops its sub-regional resident population projections to be consistent with population control totals for Maricopa County developed by the Arizona State Demographer.

B. Employment

- The Arizona Department of Administration (ADOA) Office of Employment and Population Statistics (EPS) does not produce county level long-term employment forecasts, therefore it is necessary to obtain employment projections from another source.
- MAG staff, along with a consultant (Jeff Tayman from University of California, San Diego), conducted an analysis of commercial long-term socioeconomic projections for purchase.
- Based on the analysis and consultant recommendations, it was recommended that MAG purchase population and employment projections from Moody's Economy.com and Woods and Poole. These are annual projections of employment by NAICS code for Maricopa County. In addition, MAG subscribes to quarterly employment forecasts for the Phoenix metro area (including Maricopa and Pinal counties) produced by Marshall Vest at the University of Arizona Economic and Business Research Center. The University of Arizona forecasts augment Moody's Analytics' Economy.com (Moody's Economy.com) socioeconomic projections by updating the projection base to the current year and provide a benchmark for the analysis of Moody's Economy.com projections.
- Derive employment growth rates for Maricopa and Pinal counties from Moody's and Woods and Poole's employment projections and for the Phoenix metro area from Marshall Vest's employment projections and conduct a comparative analysis of the employment growth rates and employment to population ratios. The comparative analysis also included a review of the series against the employment forecasts for 2014 and 2015 released by the ADOA EPS and national economic forecasts by the National Association of Business Economists (NABE).
- Calculate projected employment numbers for three components – covered employment, military, and uncovered employment. Based on the analysis, apply growth rates derived from Marshall Vest's employment projections to the base employment data for Maricopa County for uncovered employment. Apply an 11-year average growth rate to project the uncovered employment. Hold military employment at its 12-year average number for the projections. Employment to population ratios were developed utilizing the ADOA draft population projections and were found to be growing for Maricopa County and stable for the Phoenix metro area.
- Derive county level employment by business sector by year from a combination of the two series (Moody's Economy.com and Marshall Vest at the University of Arizona).

4.3 AZ-SMART Classifications and Typologies

AZ-SMART requires a number of classification types for data. These AZ-SMART classifications are utilized internally for simulation purposes only. Classifications can be modified through comments by MAG member agencies.

A. Building Types

AZ-SMART requires a classification of building types. The following is a list of the building types for use in the model.

- Single Family Residential
- Multi-Family Residential
- Mobile Home Residential
- Retail
- Mini Storage
- Warehouse
- Industrial
- Office
- Medical
- Hotel
- Civic
- Education
- Group Quarters
- Public – Federal and State
- Public – Local
- Agriculture
- Transportation
- Other/Open Space

B. Employment Sectors

AZ-SMART requires a classification of NAICS employment sectors. The following is a table of the employment sectors for use in the model.

AZ-SMART Employment Sectors

Employment Sector	NAICS Code
Agriculture, Forestry, Fishing and Hunting	11
Mining, Quarrying, and Oil and Gas Extraction	21
Utilities	22
Construction	23
Manufacturing	31-33
Wholesale Trade	42
Retail Trade	44-45
Transportation and Warehousing	48-49
Information	51
Finance and Insurance	52
Real Estate and Rental and Leasing	53
Professional, Scientific, and Technical Services	54
Management of Companies and Enterprises	55
Administrative and Support and Waste Management and Remediation Services	56
Educational Services	61
Health Care and Social Assistance	62
Arts, Entertainment, and Recreation	71
Accommodation	721
Food Services and Drinking Places	722
Other Services (except Public Administration)	81
Public - Federal and State	Part of 92
Public - Local	Part of 92

Source: US Census Bureau 2007 NAICS

Table 4-1: AZ-SMART Employment Sectors

4.4 Methods and Factors for Developing Housing, Households and Population Projections

A. Residential Density

- In developing TAZ 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 Developments database. Households and population by TAZ 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 Developments database have the number of dwelling units being built/planned and thus do not need to use the densities identified in the general plan.

B. Gross to Net Density

AZ-SMART residential modeling assumes the use of net residential density. Net density means that land area has been taken out for transportation, right of way, and open space areas as part of the density given in the general plan document. An analysis of gross acres and net acres by different residential land use types has been conducted. The results are the basis for converting gross residential density to net residential density as needed.

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	50	50
130	Large Lot Residential (SF)	1 du per acre to 2 du per acre	50	50
140	Medium Lot Residential (SF)	2-4 du per acre	50	38
150	Small Lot Residential (SF)	4-6 du per acre	50	37.5
160	Very Small Lot Residential (SF)	>6 du per acre (includes mobile home parks)	50	37.5
170	Medium Density Residential (MF)	5-10 du per acre	50	38.5
180	High Density Residential (MF)	10-15 du per acre	50	41
190	Very High Density Residential (MF)	> 15 du per acre	50	36
Source: Arizona State University, 2001				
MAG GIS and Database Enhancement Project (Scaled values to a common 50 Gross Acres)				

Table 4-2: Net Residential Density

C. Persons per Household (PPHH)

Persons per household was derived from the ACS 2010-2014 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 the TAZ2016 geography using the data from Census 2010. PPHH is derived at the lowest level of geography possible then refined at the TAZ2016 level. This refinement is important since figures resulting from a sparsely developed TAZ may not adequately reflect future trends in the TAZ. The PPHH refinement is as follows:

- For TAZs where existing development in 2014 is less than 50% of the buildout number, PPHH from the RAZ will be used instead.
- Similarly, for RAZs where the existing development in 2014 is less than 50% of the buildout number, PPHH from the MPA will be used.
- A maximum PPHH at buildout will be set at 5.0.

D. Vacancy Rates

Vacancy rates are used in the buildout analysis and in the simulation model. An analysis of vacancy rates by census place was conducted and used to make a determination about the long-term or “structural” vacancy rate due to the normal migration and relocation of population within the region. This structural vacancy rate (roughly 5% for single family and ranging up to approximately 9% for larger multi-family developments) is used as a target that drives new residential development in the simulation model. For buildout analysis, the vacancy rates were calculated at the census block geography for single family (SF) and multi-family (MF) residential types. A census block to TAZ2016 lookup file was created to re-calculate the vacancy rates by TAZ2016. Vacancy rates were then applied to buildout dwelling units as follows:

- For TAZs where existing development in 2014 is less than 50% of the buildout number, use a 5% vacancy rate for this TAZ. The reasoning is that at the present time we do not know how this TAZ is going to look, so we assume a longer term average vacancy rate of 5%.
- For TAZs where existing development in 2014 is greater than 50% of the buildout number, use the minimum of either 5% or the current vacancy rate minus the percentage of the current dwelling units (DUs) that are considered seasonal use only (from the ACS 2010-2014) then adding the percentage seasonal units back to arrive at a final vacancy rate. The reasoning here is that since the TAZ is mostly built out already, we have a good idea of how many seasonal units there will be in the TAZ and we want to maintain that in the calculation of vacancy rate.

E. County-wide Single Family / Multi-Family Proportions

- An analysis of Future Land Use shows that approximately 71% of residential lands at buildout will be single family.
- An analysis of census data from 1960 to 2010 shows the single family / multi-family split in Maricopa County remaining relatively stable.

MARICOPA COUNTY HOUSING UNITS TYPE PERCENTAGE			
Census Year	Single Family Unit Percentage	Multi-Family Unit Percentage	Mobile Home Unit Percentage
1960	88%	12%	N/A
1970	73%	20%	7%
1980	67%	25%	8%
1985	66%	26%	9%
1990	65%	27%	8%
1995	68%	27%	6%
2000	68%	26%	6%
2010	72%	23%	5%
Sources			
1960, 1970, 1980, 1990, 2000 - U.S. Census Bureau - Decennial Census			
1985, 1995 - MAG Special Census			
2010 - U.S. Census Bureau - American Community Survey 3 year average 2008-2010			
MAG Residential Completions Database			
MAG Future Land Use Database			

Table 4-3: Maricopa County Housing Units Type Percentage

F. Age Restricted Communities

- MAG transportation models require TAZs to have identifiers for age restricted areas.
- A survey of the existing age restricted communities was conducted and a GIS dataset of the communities was created.
- All developments are reviewed with member agencies to identify additional age restricted communities.
- TAZs with fifty percent or more of their residential land area under communities with deed restrictions on age of residents are flagged as age restricted TAZs.
- These age restricted flags are utilized only as an input for the transportation model and do not impact the projection series.

4.5 Methods and Factors for Developing Non-residential Built Space and Employment Projections

A. Employment Density and Floor Area Ratios (FAR)

- 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 building floor space per employee.
- 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.
- FAR and employment density differ for each non-residential land use type.
- An analysis of employment density ranges by land use type was conducted by analyzing data in the MAG Built Space and the MAG Employer databases. Jobs by land use type were compared to building square footage by land use type.

- This analysis was compared to employment density ranges used in the 2003,2007, and 2013 Socioeconomic Projections and found to be in line with employment density data ranges from those projections series.
- This analysis expands employment density ranges for more land use types as required by AZ-SMART and reflects the most current data available for the MAG region.
- The following table shows the results of this analysis.

Employment Density - Square Feet Per Job by Building Type			
Building Type	Minimum Square Feet Per Job	Target Square Feet Per Job	Maximum Square Feet Per Job
Mobile / Manufactured Home	150	250	350
Single Family Detached Home	150	250	350
Multi Family Attached Home	4410	16,700	31,930
Retail	330	640	2,060
MiniStorage	3370	11,760	36,310
Warehouse	240	740	2,090
Industrial	300	700	1,650
Office	140	330	990
Medical	130	330	400
Hotel	420	1,470	3,560
Civic	400	1,410	3,400
Education	240	830	2,000
Group Quarters	400	1,410	3,400
Public - Federal	70	250	610
Public - State	70	250	610
Public - Local	70	250	610
Agriculture	1240	4,350	10,510
Transportation	0	0	0
Other	1240	4,350	10,510
Open Space	0	0	0

Source: MAG 2010 Built Space Database

Table 4-4: Employment Density – Square Feet Per Job by Building Type

- An analysis of FAR ranges by land use type was conducted by analyzing data in the MAG built space database by comparing building square footage to parcel square footage by land use type.
- This analysis was compared to FAR ranges used in the 2003, 2007, and 2013 Socioeconomic Projections and found to be in line with FAR data ranges from those projections series.
- This analysis expands FAR ranges for more land use types as required by AZ-SMART and reflects the most current data available for the MAG region.
- The following table shows the results of this analysis.

Floor Area Ratio by MAG Land Use				
MAG Land Use	Land Use Description	Minimum FAR	Target FAR	Maximum FAR
210	Low Density Commercial	0.01	0.33	5.50
220	Greenhouse Commercial	0.01	0.07	0.71
230	Specialty Commercial	0.01	0.16	7.57
240	Neighborhood Commercial	0.01	0.29	4.91
250	Community Commercial	0.03	0.23	5.44
260	Regional Commercial	0.02	0.26	0.84
270	Super-Regional Commercial	0.08	0.64	3.49
310	Storage Facilities	0.01	0.53	3.26
320	Warehouse	0.01	0.31	1.97
330	Light Industrial	0.01	0.32	3.63
340	Heavy Industrial	0.01	0.25	1.31
410	Office Low Rise	0.01	0.35	8.26
420	Office Mid Rise	0.02	2.40	13.05
430	Office High Rise	3.43	11.12	24.00
510	Hotel/Motel	0.01	0.57	10.02
511	Resorts	0.01	0.26	0.82
520	Educational	0.07	0.26	0.95
521	Preschool / Daycare	0.01	0.20	1.00
522	Schools K-12	0.01	0.18	6.59
523	Post High School	0.01	0.28	2.35
524	ASU	0.01	0.82	3.80
525	Dorms	0.01	1.35	5.15
530	Institutional	0.01	0.26	3.87
531	Religious	0.01	0.17	1.75
532	Medical Offices	0.02	0.28	4.32
533	Hospitals / Medical Centers	0.01	0.67	5.63
534	Nursing Homes	0.01	0.25	1.18
540	Cemeteries	0.01	0.13	0.78
551	Public Offices	0.03	0.94	7.66
552	Public Services	0.01	0.34	7.27
810	Business Park	0.06	0.21	0.32
820	Mixed Use	0.04	2.13	10.35
<i>Source: MAG 2010 Built Space Database</i>				

Table 4-5: Floor Area Ratio by MAG Land Use

B. Non-residential Vacancy Rates

A projection of non-residential vacancy rates by building type is required for the simulation model to develop new non-residential real estate. MAG staff obtained data on the commercial real estate market from the vendor COSTAR. COSTAR data and reports contain longitudinal data going back as far as 2001 on non-residential vacancy rates in the Phoenix Metropolitan Area (which includes parts of Pinal County) and the United States as a whole. COSTAR provides these rates for broad classes of non-residential building types: retail (back

to 2007), office (back to 2001), industrial (back to 2001). The average for each building type in the Phoenix area was compared with the same data at the national level. Where the rates met is where it was assumed that the Phoenix market was similar to the national market, and that rate was used as the long-term structural vacancy rate for the simulation model. The rates are as follows: retail 6.5%, industrial 8%, and office 10.5%.

4.6 Buildout Methodology

A. Buildout Population and Housing Variables

The purpose of the buildout analysis is to examine the implications of each of the datasets that feed into the projections model. The buildout analysis calculates a theoretical maximum amount of housing and population implied by the existing development, the approved developments and the general land use plan datasets. Two types of buildout numbers can be calculated: net and gross buildout. Gross buildout assumes all land is filled to the maximum carrying capacity with dwelling units and each dwelling unit occupied by a household. An average persons per household assumption is applied to the households to calculate a maximum gross population. The net buildout applies a vacancy rate to the dwelling units and households so that there is not 100% occupancy. While still a theoretical exercise, it provides a more realistic vision of maximum households and population. A gross buildout has been created for this analysis.

The following datasets are available to MAG staff to prepare the population and housing buildout analysis:

- Base 2014 population and housing variables analysis
- MAG Existing Land Use database: current as of 2014
- MAG General Plan database: current as of 2014
- MAG Developments database: current as of 2014 or later
- TAZ2016 zone system
- 2014 vacancy rate analysis for single and multi-family households by TAZ2016, RAZ2016, and MPA2016

MAG staff, in collaboration with a consultant, has developed several specialized data development tools within the AZ-SMART system to accept the above datasets as inputs, and along with the following assumptions will output the buildout analysis:

- Existing Development: Existing built land use is considered to be undevelopable unless it is flagged as a redevelopment property. Only agricultural and vacant lands are allowed to be converted to new developments by AZ-SMART.
- Density Assumptions: In developing TAZ buildout projections, AZ-SMART tools project residential dwelling units from parcels identified as residential in the general plans or areas anticipated to be residential in the Developments database. Households and population by TAZ 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 at very detailed levels by the member agencies if desired. Some areas covered by the Developments database have the actual number of planned dwelling units and therefore do not need to use the densities identified in the general plan. Additionally, some Developments database projects may be identified as redevelopment projects. In these cases AZ-SMART is allowed to construct new projects as replacement for existing built structures.

- Persons per household (PPHH): Persons per household was derived from 2010-2014 ACS by dividing the population in households by the number of occupied housing units. Total housing units, total occupied housing units and population in households were identified by census block. These variables were then allocated to the TAZ2016 geography using the data from 2010-2014 ACS. PPHH is derived at the lowest level of geography possible then refined at the TAZ2016 level. This refinement is important since figures resulting from a sparsely developed TAZ may not adequately reflect future trends in the TAZ. The PPHH refinement is as follows:
 - For TAZs where existing development in 2014 is less than 50% of the buildout number, PPHH from the RAZ will be used instead.
 - Similarly, for RAZs where the existing development in 2014 is less than 50% of the buildout number, PPHH from the MPA will be used.
 - A maximum PPHH at buildout will be set at 5.0.
- Vacancy Rates: Vacancy rates were calculated at the census block geography for single family (SF) and multi-family (MF) residential types. A census block to TAZ2016 lookup file was created to re-calculate the vacancy rates by TAZ2016. Vacancy rates were then applied to buildout dwelling units as follows:
 - For TAZs where existing development in 2014 is less than 50% of the buildout number, use a 5% vacancy rate for this TAZ.

For TAZs where existing development in 2014 is greater than 50% of the buildout number, use the minimum of either 5% or the current vacancy rate minus the percentage of the current DUs that are considered seasonal use only (from the 2014 census) then adding the percentage seasonal units back to arrive at a final vacancy rate. The reasoning here is that since the TAZ is mostly built out already, we have a good idea of how many seasonal units there will be in the TAZ and we want to maintain that in the calculation of vacancy rate.

Methodology: AZ-SMART's buildout tool uses the following methodology to produce the output:

1. Use the TAZ allocation of housing units and population for July 1, 2014 as the base (existing) data.
2. If the land is not identified as a planned development from the Developments database, determine additional housing units and population from the general plan. Calculate developable residential acres by land use category (land use codes 100 – 199, 820, 821, 830 and 840) by TAZ. For this scenario, acreage is considered developable residential if it meets all of the following criteria:
 - a. The 2014 land use was either agriculture or vacant.

- b. The general plan land use was residential or mixed use; land use codes 100-199, 820-840. In the case of mixed use, apply the percentages identified previously.
3. Calculate additional housing units by land use category as developable residential acres \times net density (minimum/target/maximum) for the residential category. Sum categorized residential housing units to obtain total additional housing units by TAZ.
4. If the area is identified as a Planned 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 TAZ.
5. Using TAZ persons per household from the 2010-2014 ACS, calculate additional population by TAZ as total additional housing units \times TAZ occupancy rate (1 - vacancy rate) \times TAZ persons per household.
6. Add additional housing units and population to the 2014 base housing units and population to obtain total buildout figures.

B. Buildout Employment Variables

The purpose of the buildout analysis is to examine the implications of each of the datasets that feed into the projections model. The buildout analysis calculates a theoretical maximum amount of employment implied by the approved developments and the general land use plan datasets. The buildout analysis will produce the maximum amount of employment by land use type implied by the approved developments and the general land use plan datasets. In contrast to the case of population and housing buildout, less information is available to assume vacancy rates for non-residential land use types, so a single vacancy rate is applied to the gross buildout number to provide a theoretical net buildout for employment. The following datasets are available to MAG staff to prepare the employment buildout analysis:

- Base 2014 employment by land use analysis
- MAG Existing Land Use database: current as of 2014
- MAG General Plan database: current as of 2014
- MAG Developments database: current as of 2014 or later
- TAZ2016 zone system
- MAG analysis of employees per square foot and floor to area ratios

MAG staff, in collaboration with a consultant, has developed several specialized data development tools within the AZ-SMART system to accept the above datasets as inputs, and along with the following assumptions will output the buildout analysis.

Employment Densities: In developing TAZ 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 Developments database. As part of the buildout analysis, floor area ratios (FAR) and employment density (employees per square foot by built space type) factors were developed internally by MAG staff. Thus:

- Total square feet of employment space = FAR \times area of polygon in square feet.
- Number of employees = Total square feet of employment space \times employees per square foot of building type in question.

Generally, areas covered by the Developments database have the square feet of employment areas being built or planned. Thus to derive the employment only the employees per 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.

Methodology: AZ-SMART's buildout tool uses the following methodology to produce the output:

1. Use the TAZ allocation of July 1, 2014 employment by land use sector as the base (existing) data.
2. Determine additional employment from the General Plan and Developments databases. Calculate developable employment-based acres by land use category (land use codes 200 - 850) by TAZ. For these scenarios, acreage is considered developable for employment if it meets all of the following criteria:
 - a) The 2014 land use was either agriculture or vacant.
 - b) The general plan land use was employment use or mixed use; land use codes 200 - 850. In the case of mixed use, apply the percentages identified previously.
 - c) Calculate additional employment by land use category as developable employment use acres \times FAR \times building square feet per employee for the appropriate employment land use. Sum employment by sector by TAZ.
3. Add additional employment by sector to the 2014 base employment by sector to obtain total buildout figures.

4.7 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 a MAG consultant. The base year group quarters population is based upon the results of the 2010 Census and the group quarter inventory prepared by MAG staff and reviewed by POPTAC previously.

- Military group quarters population: Military group quarters population is held constant at the current population of Luke Air Force Base at the recommendation of a consultant. MAG staff contacted a Luke Air Force Base representative to confirm the latest population of 927.
- Prison and jail population: Prison and jail population is projected as a percentage of the population in the age cohort of 20-44, increasing slightly throughout the projection horizon. Based on analysis of historical census data by a consultant it is recommended that a slight increase in the factor be applied throughout the projection horizon as follows: the rate will start at 1.4% and rise to 1.8% in 2050 in an annual linear fashion. During the simulation model run, the percentage of the population is calculated, then it is

proportionally allocated to existing prison and jail sites in Maricopa County and Pinal County based on the current size of each facility. If a new prison or jail site is included in the simulation as a known development, the model will include that site in the allocation. The simulation model does not predict new prison and jail facilities, however.

- College dormitory population: College dormitory population is calculated as a percentage of the population in the age cohort 18 through 19. This percentage is held at a constant 11% throughout the forecasting horizon of 2050 at the recommendation of a consultant. During the simulation model run, the percentage of the population is calculated, it is then proportionally allocated to existing dormitory sites based on their size. If new dormitory sites are included in a known development in a later simulation year, the model will include those sites in the allocation. The simulation model does not predict new dormitory sites, however.
- Nursing home population: Nursing home population is calculated as a percentage of the population in the age cohort 75 and older. An analysis of historical census data by a consultant indicated a slow but steady downward trend since 1980. The pace of the decline slowed between 2000 and 2010 (0.7 percentage points) compared to the previous decade (3.4 percentage points). The consultant recommended that we trend the 2010 rate downward at a decreasing rate. To this end, the percentage decreases slightly throughout the projection horizon. The rate starts at 3.9% in 2014 and declines in linear fashion annually 3.7% in 2050. During the simulation model run, the percentage of the population is calculated, then this total is proportionally allocated to existing nursing home sites based on their size. If new nursing home sites are included in a known development in a later simulation year, the model will include those sites in the allocation. The simulation model does not predict new nursing home sites, however.
- Other group quarters population: Other group quarters population, such as group homes, is calculated as a percentage of the entire population. At the recommendation of a consultant, the percentage is held at a constant 0.3% throughout the projection horizon of 2050. During the simulation model run, the percentage of the population is calculated, then this total is proportionally allocated to existing other group quarters sites based on their size. If new other group quarters sites are included in a known development in a later simulation year, the model will include those sites in the allocation. The simulation model does not predict new other group quarters sites, however.

4.8 Airport Originations

Daily airport originations are required as part of the MAG transportation model for the two major airport sites in the region: Sky Harbor Airport in Phoenix, AZ and Phoenix-Mesa Gateway Airport in Mesa, AZ. Projections of flight originations for every five years from 2010 through 2050 were obtained from the respective airports master plans. Annual flight originations for both airports were calculated from every five-year numbers using a simple linear interpolation methodology. The originations are simply assigned to the respective airport location in the simulation model. The simulation model does not predict new airport locations.

4.9 Seasonal Population

Seasonal population is defined as residents of the area for two weeks to six months and is a part of the socioeconomic projections required by the MAG transportation models. An inventory of mobile home parks and RV parks was created to gather information on location and characteristics of the parks, expansion plans, as well as the number and types of residents during peak and low seasons. Seasonal residents are divided into three categories for projections, namely those residing in single and multiple family housing units (SFMFS), mobile homes (MHS) and RV parks (RVS). The inventory of mobile home and RV parks was last reviewed and updated by MAG member agencies in summer 2015.

- To calculate base year seasonal households and population by unit type (SFMFS, MHS, RVS), we start with the total units by type from the 2010-2014 ACS (SFMFS and MHS) and use the MAG RV database for RVS. We then apply the seasonal vacancy rate by type from the census to arrive at a total number of seasonal households. Then a constant 1.9 persons per household is assumed to estimate the seasonal population in the base year.
- Using information from the MAG General Plan database, multi-family/single family percentages are calculated for future years. Also, due to economic conditions, the 2014 vacancy rates are assumed to be too high, so using the recommendation of our consultant, we adjust the overall seasonal and non-seasonal rates down to a more normal 3.9% and 5.5% (respectively) by 2020 using a linear interpolation. These rates are held constant from 2020 to the end of the forecast horizon.
- The vacancy rates and multi-family/single family splits are used to forecast seasonal and non-seasonal units by type in the future simulation years.
- In the future simulation years, seasonal population and households by unit type are estimated from the exogenous forecast of total population, using the above calculated and adjusted vacancy rates by unit type.
- The seasonal population forecast totals by unit type are then proportionally allocated to seasonal units annually in the simulation model.

4.10 Transient Population

Transient population is defined as residents of the area for two weeks or less and is a part of the socioeconomic projections required by the MAG transportation models. To estimate transient population, an inventory of hotels, motels, and resorts was created to gather information on their location, number of rooms, occupancy, expansion plans, and information on new facilities. The inventory was last updated by MAG in 2015. Current data on visitor statistics and projections were obtained from the Arizona Office of Tourism (<http://www.azot.gov/research-and-statistics>; Last accessed 1/19/2016) to produce base transient population.

Transient Population is tightly correlated with employment and spending in the Accommodation and Food Services and Leisure and Hospitality sectors of the county economy. A consultant recommended that we base our methodology for generating future control totals on projections of employment.

Using data obtained from the Arizona Office of Tourism from MAG's Regional Employment Forecast, the following factors are used: a combined 19 million annual overnight visitors to Maricopa County and Pinal County, staying an average of 4.4 nights, with an average party size of 2.6 (held constant thereafter), with a 63%/37% split between stays in hotels and other locations respectively.

- First, average daily visitors are calculated by dividing annual visitors (19 million) by the average daily stay (4.4). This number is then split using the aforementioned percentages to get a hotel and other locations split.
- The 19 million annual visitors is increased over time in proportion to the total employment in the aforementioned sectors of the economy, giving us increasing totals for future allocation.
- Then for the future average daily visitors, we apply the same methodology to compute the base year splits by hotels and other locations.
- During the simulation, transient population projections at the county level are proportionally allocated to the hotel, motel, resort, and other sites based on their respective size. If the known developments dataset contains a new hotels, motels, or resorts, the allocation model will take those new sites into account. The simulation model does not predict new transient population sites.

4.11 Schools

School enrollment projections are a component of socioeconomic projections required by the MAG transportation models. Enrollments are projected for three grade levels: Kindergarten through 8th grade, 9th through 12th grade, and post-secondary education. The resulting enrollment projections serve as a primary input for forecasting site-based education employment.

The enrollment projections are based on a series on school site inventories developed by MAG staff. The *K-12 site inventory* details the location, current enrollment and student capacities of existing school sites, and classifies them by their type (public, private or charter) and grade-level (primary, middle, high). The K-12 site inventory was compiled by geo-referencing charter and public school enrollment data from the Arizona Department of Education and geo-referencing private school enrollment data from internet resources. The *post-secondary inventory* details the locations and current enrollments of post high school institutions and classifies them into one of two groups: public schools, which include universities and community colleges, and private schools, which include traditional as well as trade/career schools. This dataset was developed from a phone and internet survey of post-secondary education providers to gather information on current enrollment and expansion plans. The *future sites inventory* contains potential school sites that new enrollments may be allocated to in future years. For future K-12 sites, the timing of the new site is dependent upon changes in enrollment within the school district. For post-secondary sites, the timing is defined in the inventory. The inventory was compiled from various sources, including member agency comments, Maricopa County land ownership data, and the MAG planned developments dataset.

Enrollment participation rates by age cohort, household income quintile, school type and school level were developed by a MAG consultant using data from the American Community Survey (ACS) and Arizona Department of Education. These rates are applied to socioeconomic outputs

from AZ-SMART to generate the enrollment projections for each school type and level. For K-12, school sites are organized into districts and the enrollment in each district is allocated to school sites on the basis of their capacity. When districts exceed their capacity new schools are generated. For post-secondary sites, students are allocated on the basis of their previous enrollment. New sites are generated as prescribed by the future sites inventory.

DRAFT

5 THE MAG REVIEW PROCESS

Preparation for the socioeconomic modeling needed to produce MAG projections has been very extensive. MAG staff reviewed each step of the process. In addition, the MAG Population Technical Advisory Committee (POPTAC) Subcommittee reviewed all data and GIS coverages, recommended specific assumptions to be incorporated into the models, and reviewed the results of the data modeling efforts. Figure 5-1 depicts the socioeconomic data and modeling review process.

MAG member agencies have provided input into the process since at least 2006, when MAG staff began designing a new model system for producing projections. This model system would become known as AZ-SMART.

After a lengthy and thorough review of base data, GIS coverages and assumptions, the MAG POPTAC reviewed the implications of the data collection efforts, in particular the base year 2014 population and employment and the buildout population and employment. MAG staff met with staff from 20 member agencies to ensure the accuracy of the base and buildout figures.

The draft review process began in December 2015 when the Arizona State Demographer's Office released the official medium series projections of population at the county level to the general public. In mid-February 2016, MAG staff released Draft 1 of the 2016 Projections to MAG member agencies within Maricopa County. Draft 1 projections were released for traffic analysis zones (TAZs) for the base year of 2014, and each of the subsequent decades through the projections horizon (2020, 2030, 2040, and 2050). Throughout the course of February and March 2016, MAG staff met with 19 member agencies in person to incorporate local knowledge into subsequent drafts of the projections, and received written comments from three additional member agencies. In late March 2016, MAG coordinated with CAG to release Draft 1 of the 2016 projections to jurisdictions within Pinal County. In mid-April 2016, MAG staff met with four member agencies in Pinal County in person to incorporate local knowledge into subsequent drafts of the projections. CAG staff attended these four meetings, and met in person with other jurisdictions in Pinal County. Typically the comments received at these meetings related to new real estate developments or general plan amendments that had occurred since the last review of those databases. All comments were integrated into the simulation model data and assumptions for Draft 2. Draft 2 projections were released to and reviewed by MAG member agencies within Maricopa County in late April 2016 and to local jurisdictions in Pinal County in early May 2016. MAG staff met with two member agencies and received comments from three others. Additional comments were integrated into the Final Draft. MAG staff sent the final draft to all member agencies in both counties as part of the MAG POPTAC agenda on May 24, 2016, and the final set for approval and recommendation to Management Committee on May 31, 2016.

The results of the 2016 Projections may be seen in Figures 5-2 to 5-6 for population concentrations in years 2020, 2030, 2040, and 2050. Similarly Figures 5-7 to 5-11 depict employment concentrations for the same years.

5.1 MAG Staff

MAG staff is charged with preparing subregional population projections by municipal planning area, regional analysis zone and smaller areas known as traffic analysis zones. Staff also provides support to the Chair of the MAG POPTAC disseminates information to POPTAC members and representatives of member agencies on socioeconomic information, manages consultant contracts, and represents the interests of MAG on the State Council for Technical Solutions.

5.2 MAG POPTAC

The MAG Population Technical Advisory Committee was created to provide technical input in the development of socioeconomic information for the region, including census socioeconomic databases, GIS coverages, resident population estimates, and socioeconomic projections. The MAG POPTAC was also designated by the MAG Regional Council as the lead committee for coordinating preparations for the census in Maricopa County.

The Committee is comprised of representatives of MAG's 27 cities and towns, three Indian Communities, Maricopa County and Pinal County. However, because of limited staff resources, some member agencies have chosen not to send an officially appointed representative to the meetings.

The MAG POPTAC meetings are generally held on a monthly basis. Members may participate in the meetings either by attending in person or via audio conferencing. An agenda, minutes and attachments for the MAG POPTAC are generally sent out in electronic format via e-mail a week prior to the meeting. The meeting agenda and minutes are also posted on the MAG Website at <http://www.azmag.gov>.

5.3 MAG Management Committee

The MAG Management Committee is comprised of the highest administrative officials of each of the member agencies as well as the Regional Public Transportation Authority and Arizona Department of Transportation. Recommendations made by the MAG POPTAC on estimates and projections are forwarded to members of the Management Committee for consideration. The Management Committee will review the proposed estimates and projections and make a recommendation to the Regional Council for their approval. The Management Committee generally meets monthly. Meeting agendas and minutes are posted on the MAG Website.

5.4 MAG Regional Council

The MAG Regional Council is comprised of an elected official of each of MAG's member agencies as well as representatives from the Arizona Department of Transportation and the Citizens Transportation Oversight Committee. The elected official is usually a Mayor, but may be a Councilmember. The Regional Council establishes MAG policy and direction and must

approve MAG socioeconomic estimates and projections before they can be considered officially approved by MAG. The Regional Council generally meets monthly. Meeting agendas and minutes are posted on the MAG Website.

5.5 Council for Technical Solutions

In accordance with Executive Order 2011-04, the Arizona Department of Economic Security (ADES) approves resident population totals for each county, while MAG develops sub-regional estimates and projections based upon the Maricopa County and Pinal County resident population control totals. The function previously performed by ADES moved to the Arizona Department of Commerce in December 2007 and then to the Arizona Department of Administration (ADOA) in June 2010 with the goal of providing more efficient research data and information to Arizona communities, businesses, planners, lawmakers, economists, and others. Executive Order 2009-1 was superseded by Executive Order 2011-04 to update this relationship.

The current Executive Order, 2011-04, specifies the frequency of the preparation of official projections: within two years of a decennial census, and then updated twice before the next decennial census, in years ending in 5 and 8. Meetings are held approximately six to eight times per year. It also established the Council for Technical Solutions. The council is chaired by the State Demographer and has representatives from the three State universities, Regional Councils of Governments in Arizona, and State agencies. The council meets every month and provides recommendations to ADOA on technical means to improve the quality of population data, methodology, and analytical techniques.

Projections Activities 2016

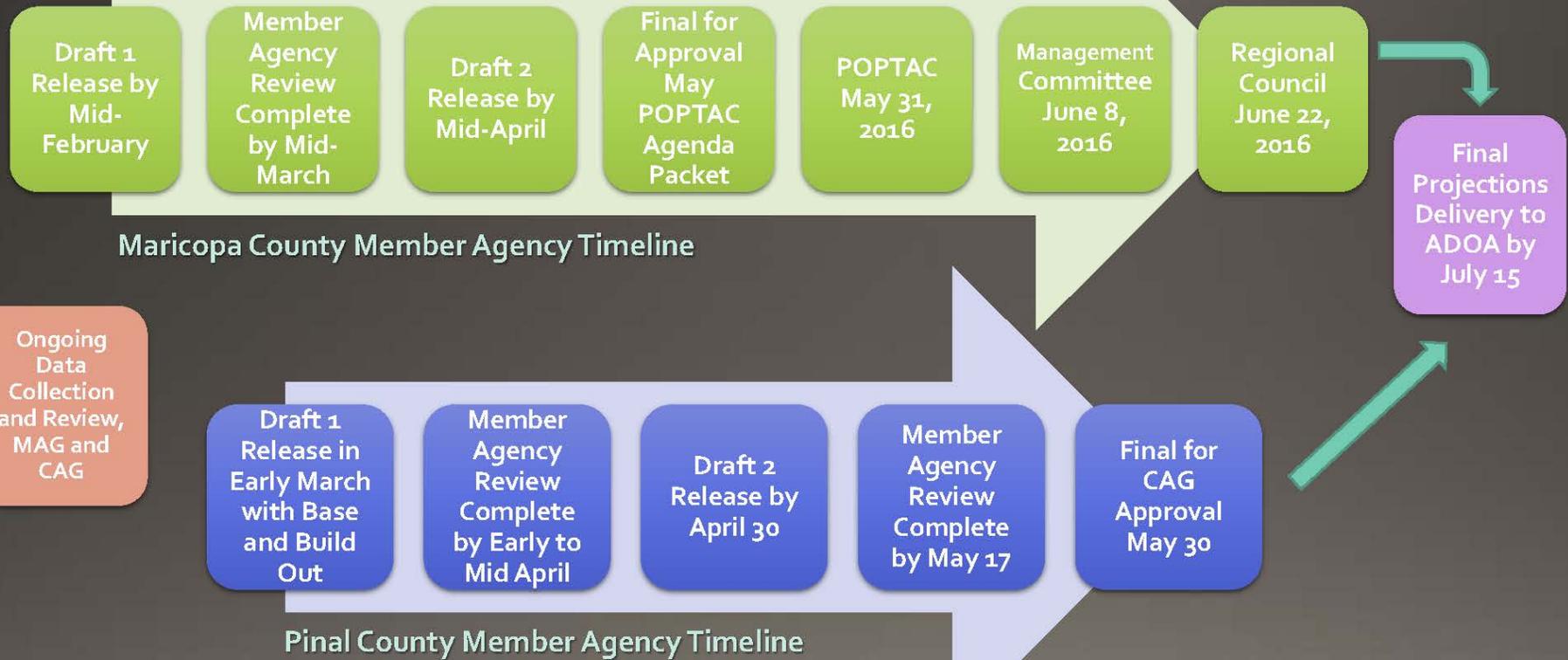
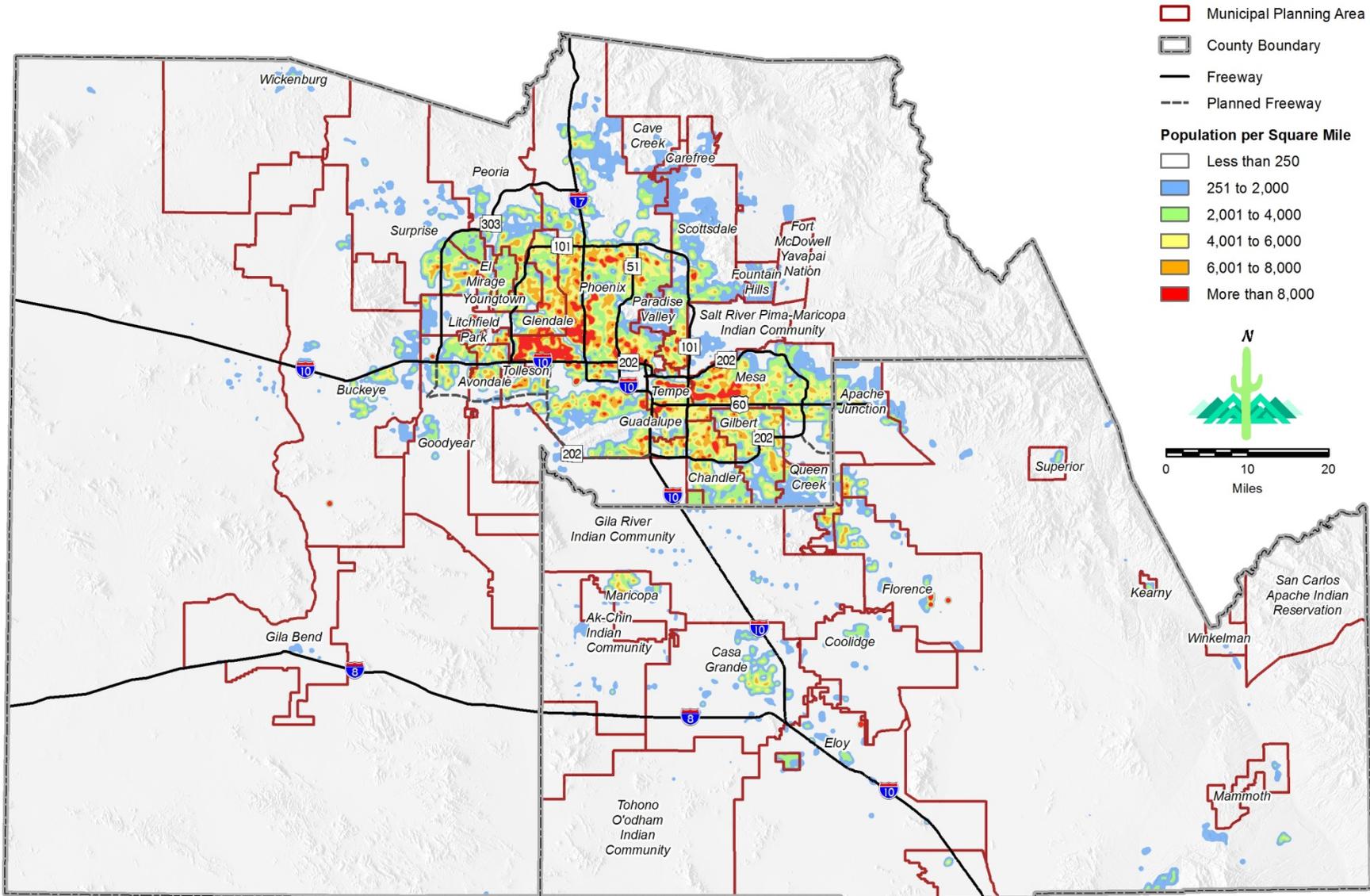


Figure 5-1: Socioeconomic Data and Modeling Review Process

Total Population Concentration, 2015 Maricopa and Pinal Counties, Arizona



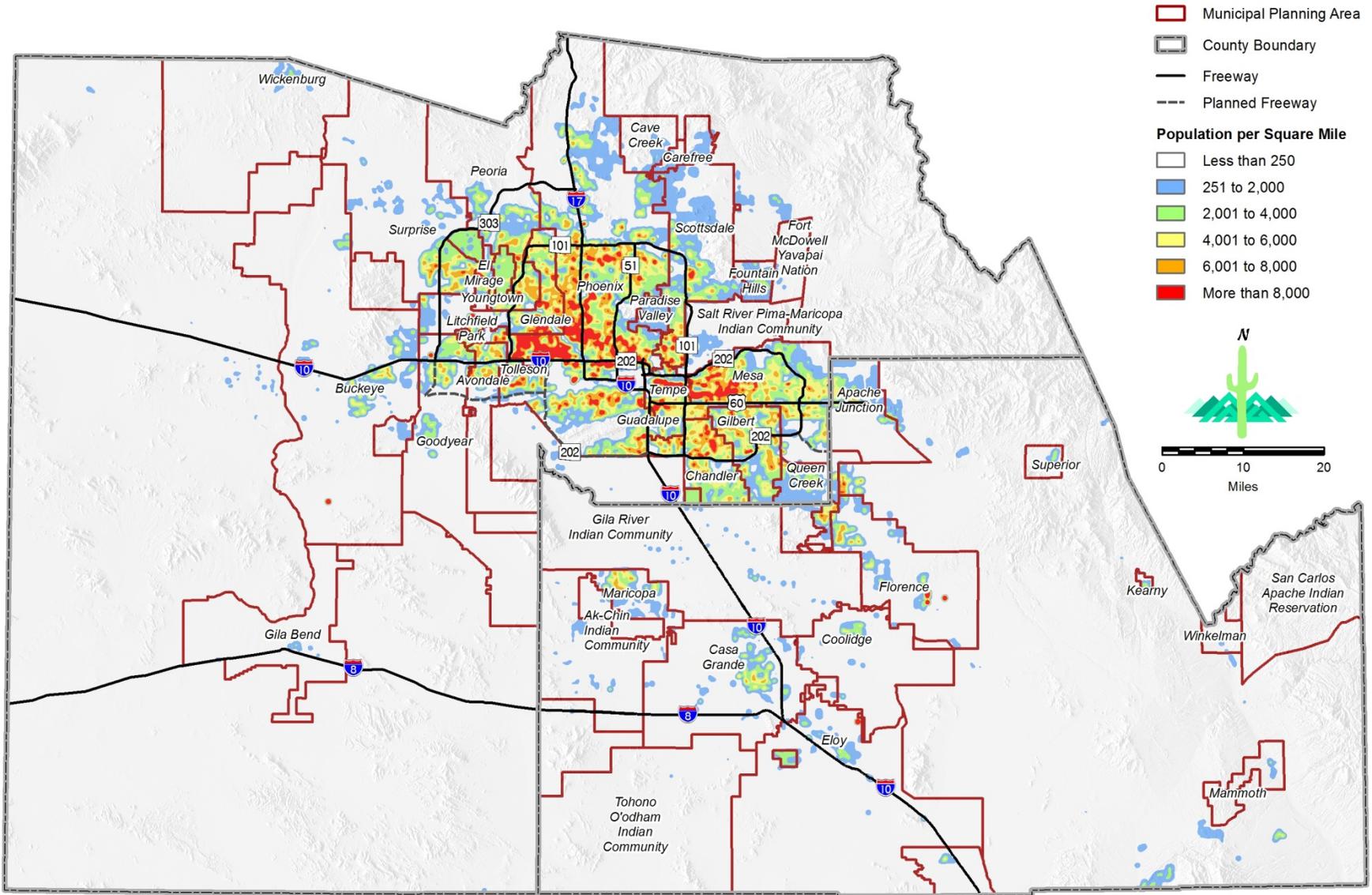
Source: 2016 MAG Socioeconomic Projections

Date: May 2016

Figure 5-2: Population Concentration 2015

While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Total Population Concentration, 2020 Maricopa and Pinal Counties, Arizona

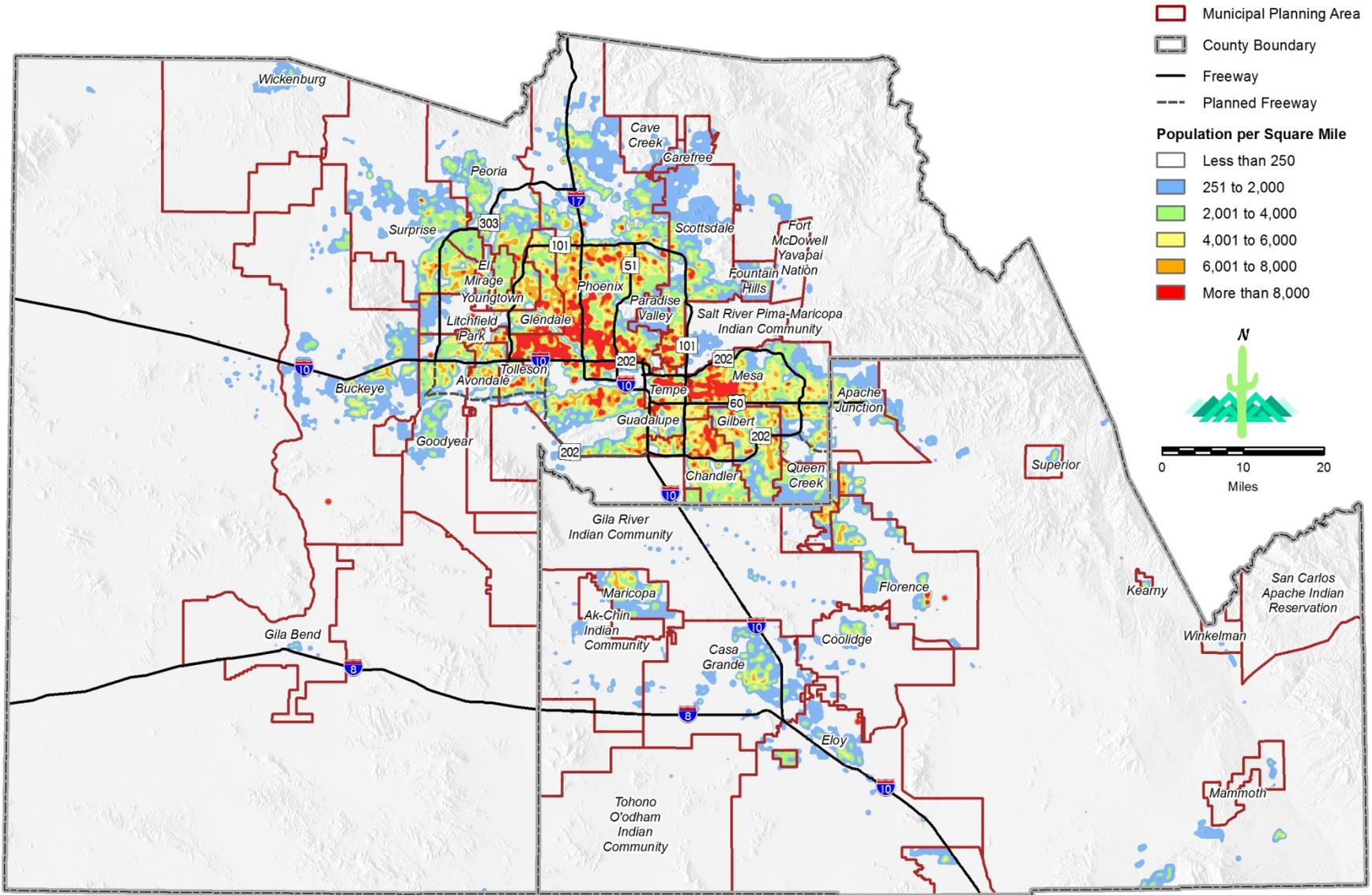


While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Source: 2016 MAG Socioeconomic Projections
Date: May 2016

Figure 5-3: Population Concentration 2020

Total Population Concentration, 2030 Maricopa and Pinal Counties, Arizona

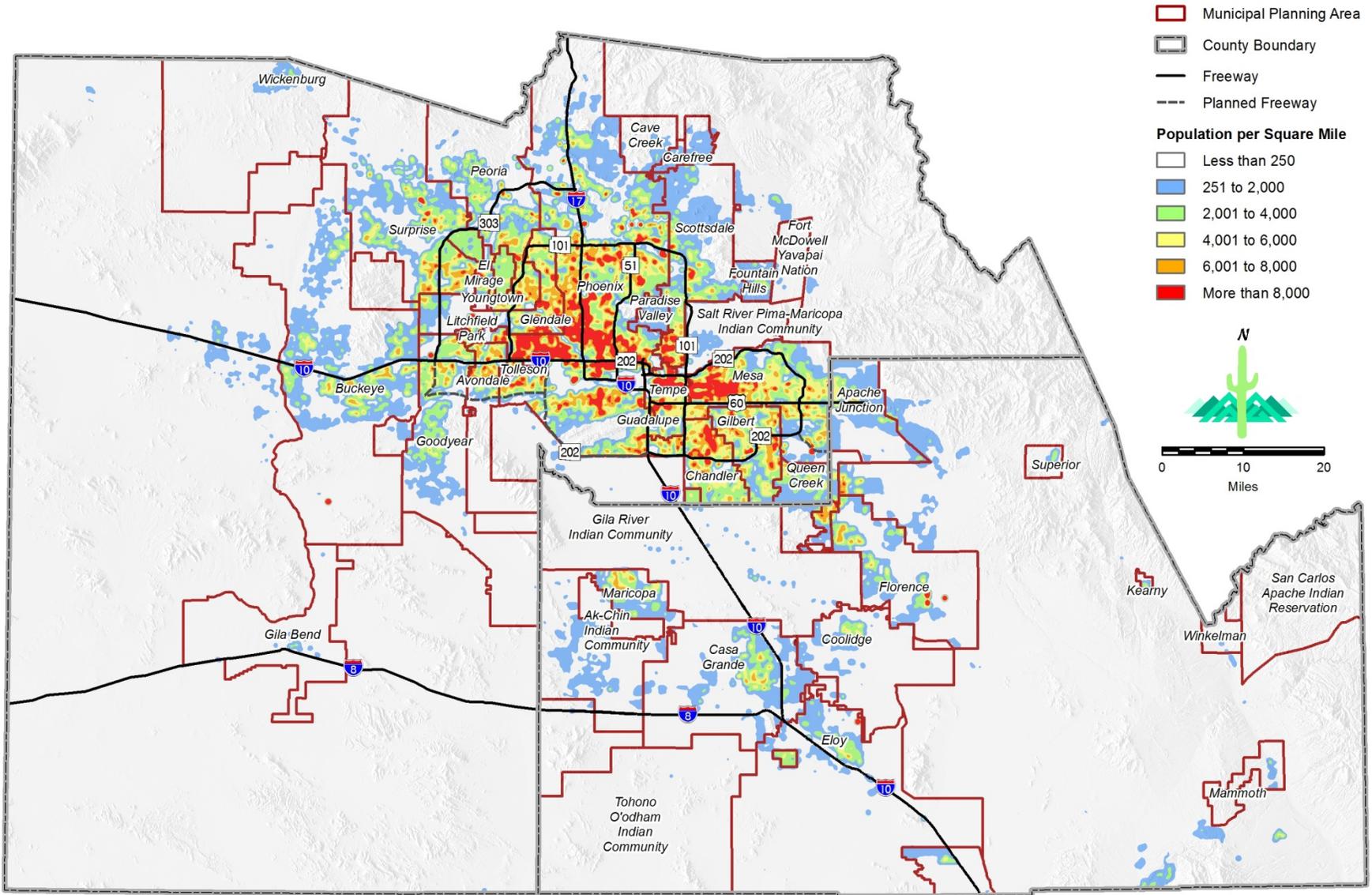


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Source: 2016 MAG Socioeconomic Projections
Date: May 2016

Figure 5-4: Population Concentration 2030

Total Population Concentration, 2040 Maricopa and Pinal Counties, Arizona

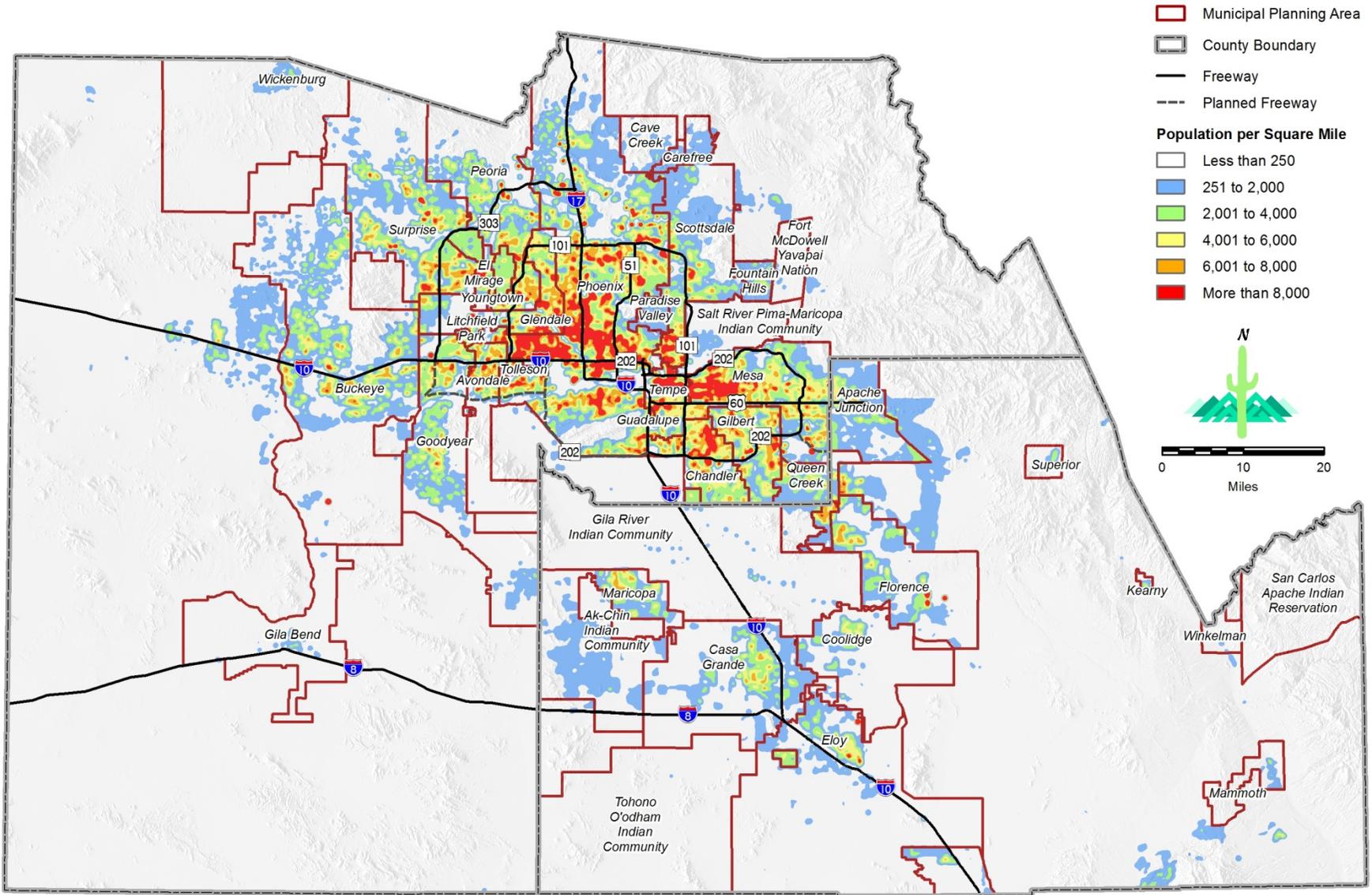


Source: 2016 MAG Socioeconomic Projections

Date: May 2016

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Total Population Concentration, 2050 Maricopa and Pinal Counties, Arizona

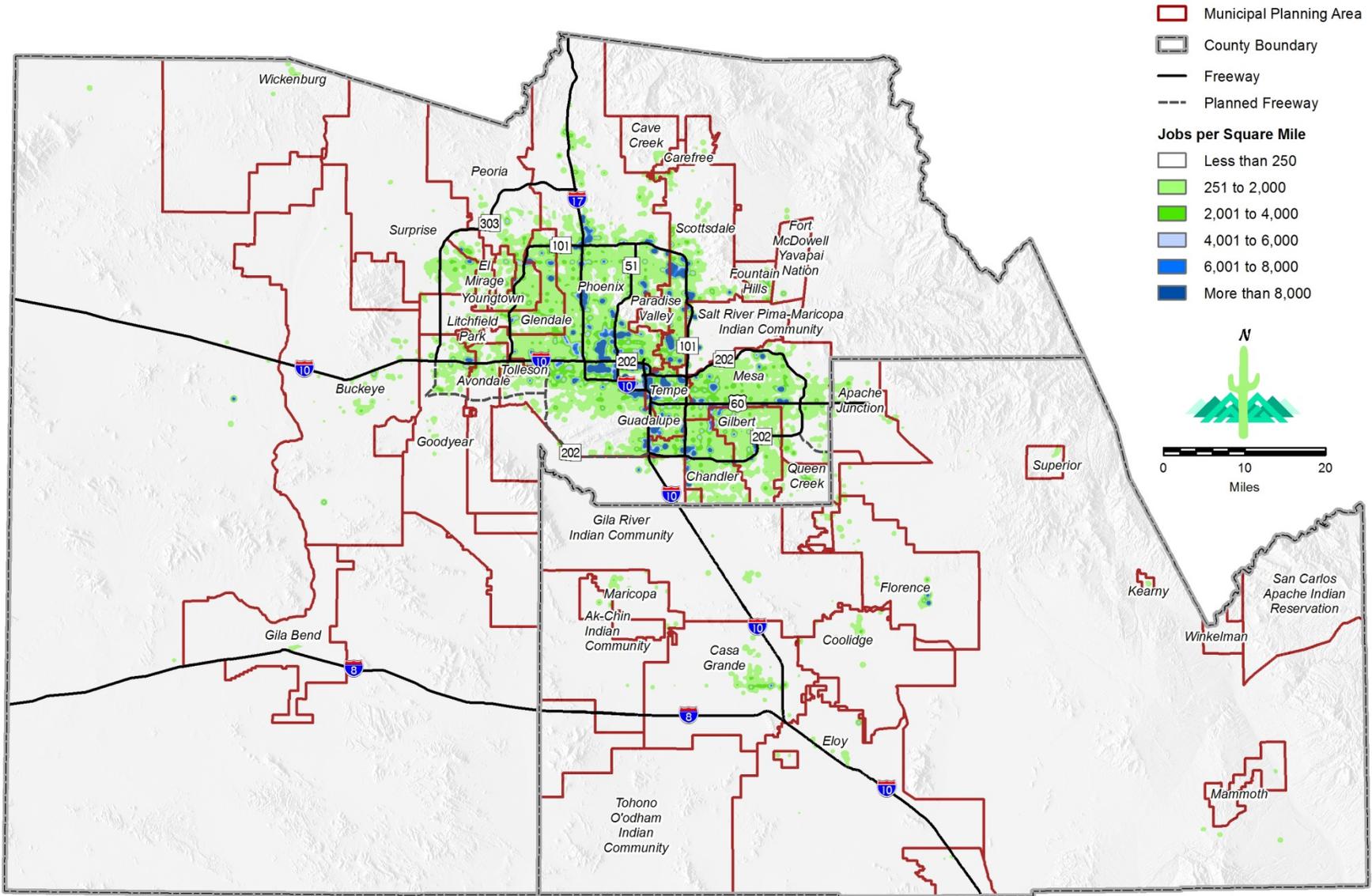


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Source: 2016 MAG Socioeconomic Projections
Date: May 2016

Figure 5-6: Population Concentration 2050

Total Employment Concentration, 2015 Maricopa and Pinal Counties, Arizona

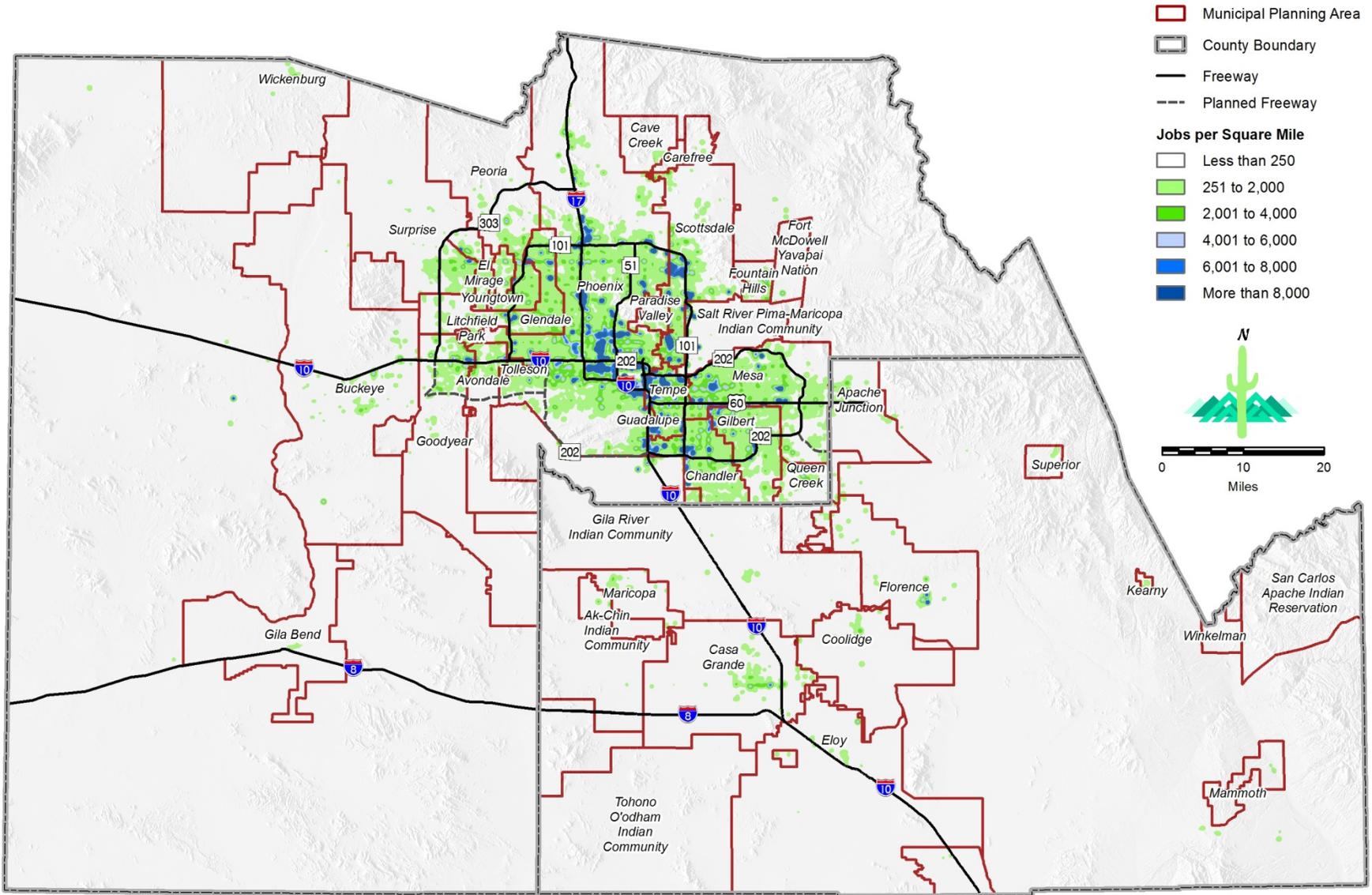


While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Source: 2016 MAG Socioeconomic Projections
Date: May 2016

Figure 5-7: Employment Concentration 2015

Total Employment Concentration, 2020 Maricopa and Pinal Counties, Arizona

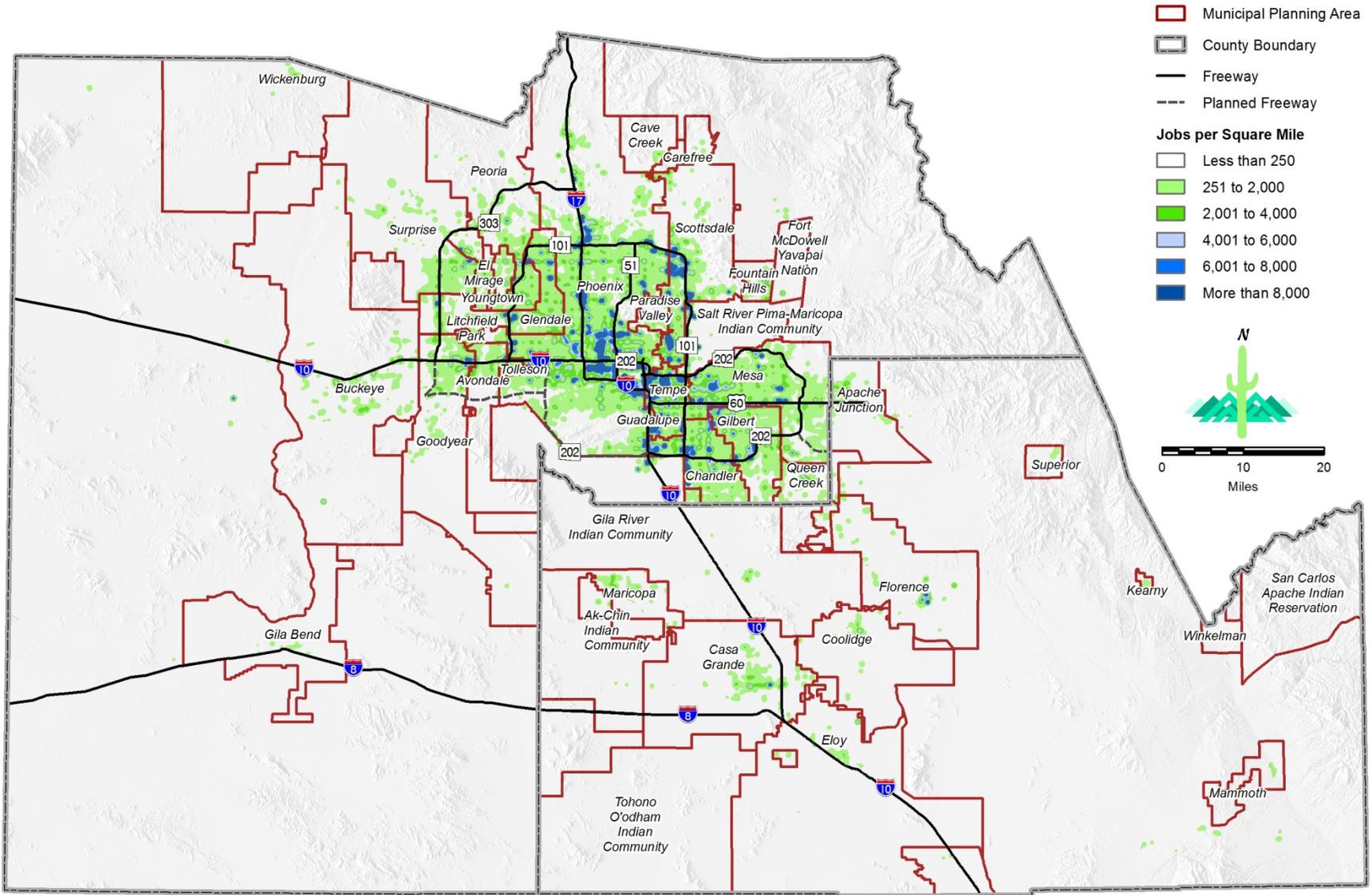


While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Source: 2016 MAG Socioeconomic Projections
Date: May 2016

Figure 5-8: Employment Concentration 2020

Total Employment Concentration, 2030 Maricopa and Pinal Counties, Arizona

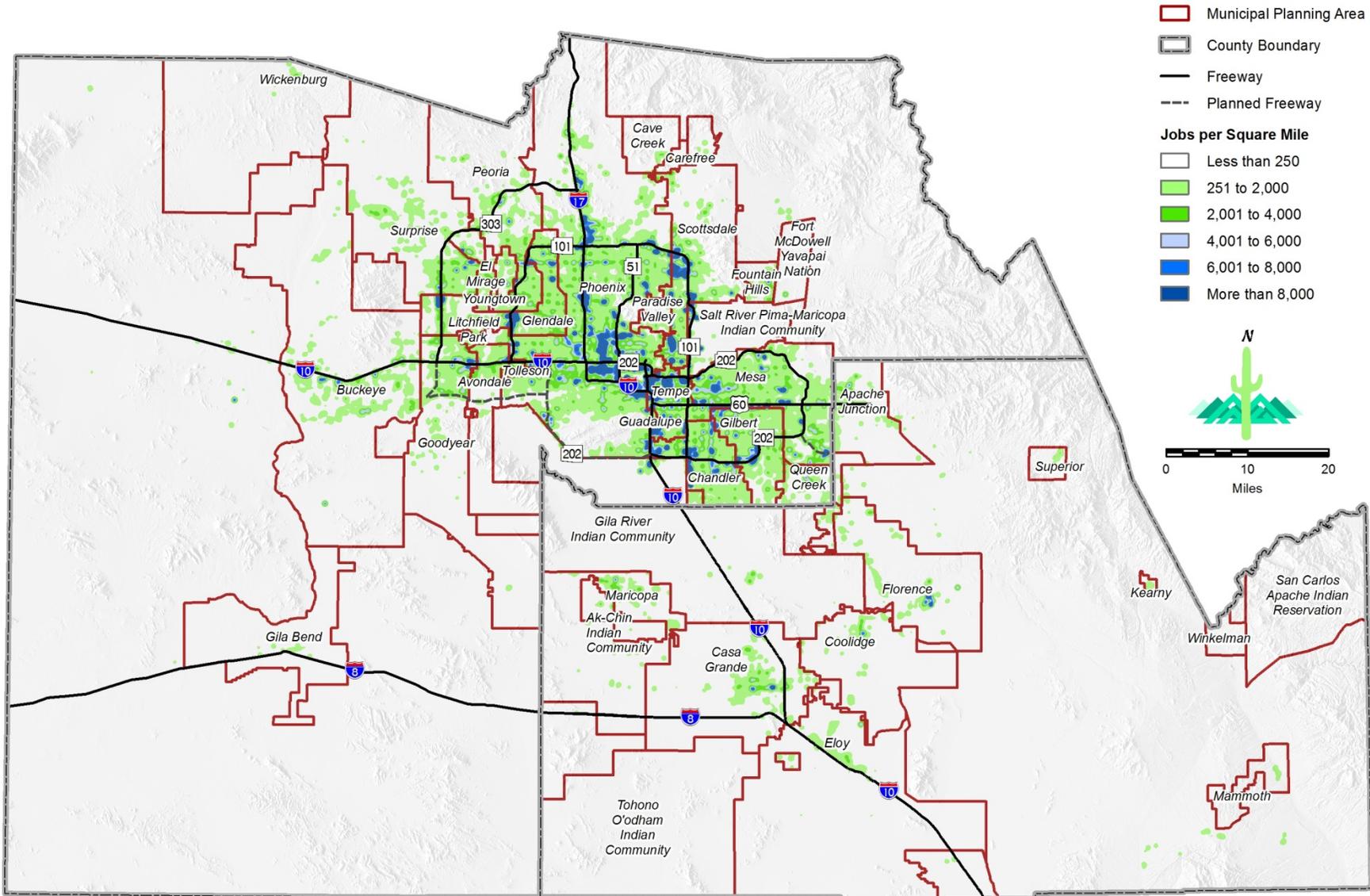


While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Source: 2016 MAG Socioeconomic Projections
Date: May 2016

Figure 5-9: Employment Concentration 2030

Total Employment Concentration, 2040 Maricopa and Pinal Counties, Arizona



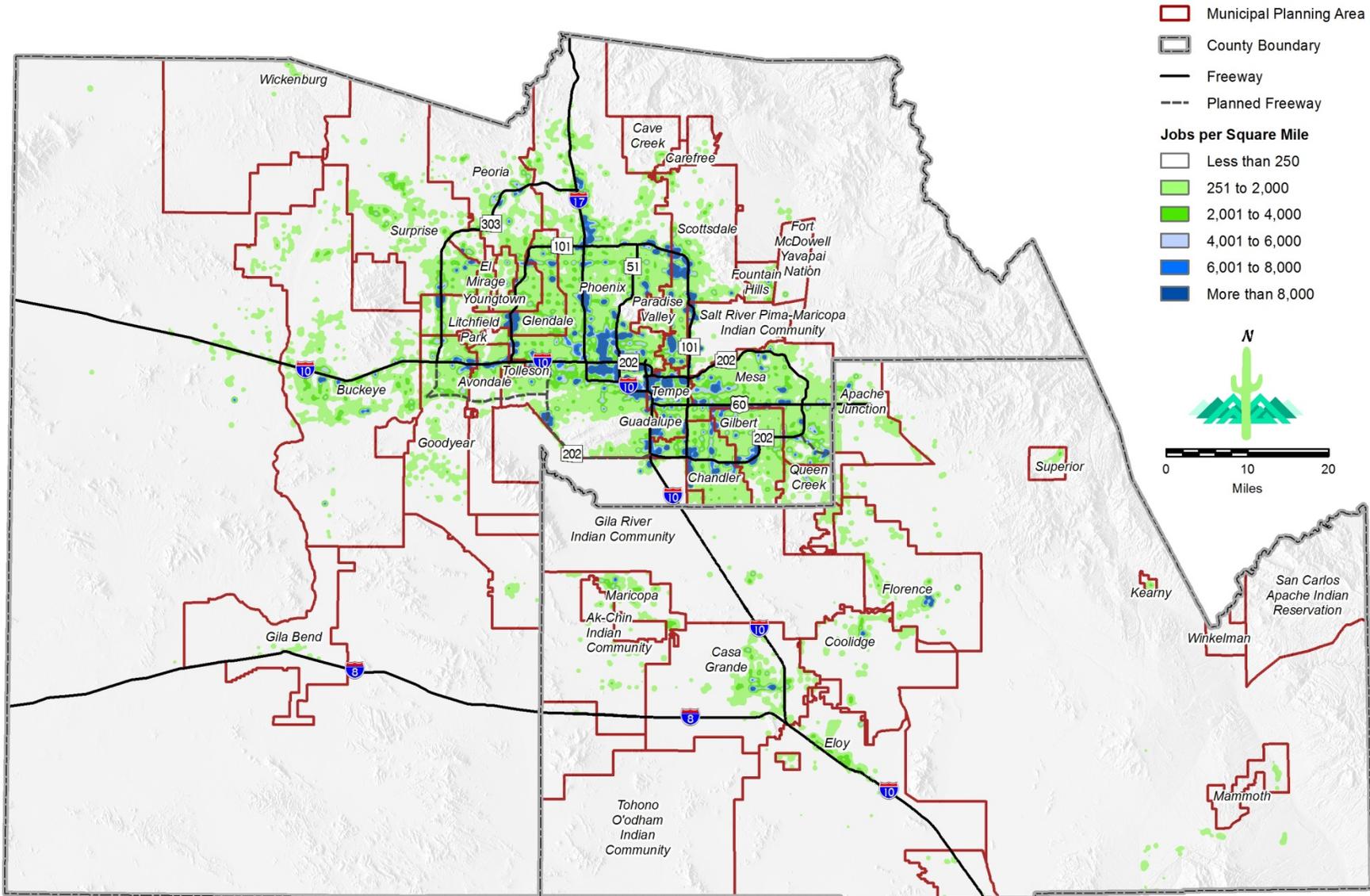
While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

Source: 2016 MAG Socioeconomic Projections

Date: May 2016

Figure 5-10: Employment Concentration 2040

Total Employment Concentration, 2050 Maricopa and Pinal Counties, Arizona



Source: 2016 MAG Socioeconomic Projections

Date: May 2016

While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.

6. NOTES AND CAVEATS FOR 2016 PROJECTIONS

1. The projections by municipal planning area (MPA) and regional analysis zone (RAZ) were prepared to be consistent with the July 1, 2014 and the July 1, 2015, population estimates and have been prepared for July 1st of the base year 2014 and projected for July 1st of 2020, 2030, 2040, and 2050.
2. The 2014 housing and population base was developed by aggregating 2010-2014 American Community Survey data to traffic analysis zones (TAZs). Census place mismatches were corrected in this process and are reflected in the base 2014 MPA and RAZ numbers.
3. The population projections are for resident population only and do not include nonresident seasonal or transient population.
4. The projections are required to use the latest census as the base. The 2010-2014 ACS data were released in December 2015. Subsequent to the release, the Arizona Department of Administration, Office of Employment and Population Statistics, prepared a new set of Maricopa County projections consistent with the 2015 population estimate. These county projections were recommended for approval by the MAG Population Technical Advisory Committee (POPTAC) in November 2015 and the Management Committee in November 2015. The projections were approved by the Regional Council in December 2015.
5. The MAG socioeconomic projections by MPA and RAZ and the annual population projections by local jurisdiction was recommended for approval by the MAG POPTAC on May 31, 2016, and by the MAG Management Committee on June 8, 2016. These projections are DRAFT and not for distribution or attribution.
6. The projections include the Maricopa County portions of Peoria and Wickenburg only.
7. The projections were based upon the latest version of each member agency's land use plan. These plans are subject to change.
8. The databases and assumptions upon which the projections are based have been reviewed by MAG member agencies, revised by MAG staff based on input received and approved by members of the MAG POPTAC.
9. The projections are based upon previous review and local insight by members of the MAG POPTAC.
10. The projections should be used with caution. They are subject to change as a result of fluctuation in economic and development conditions, local development policies and updated data.

7. GLOSSARY OF TERMS

absorption: The amount of undeveloped land that is developed during a given period of time.

area: The total size (land and water) of a specified geographical unit, usually in square miles or acres.

average annual household income: Total money received in a calendar year by all household members 15 years old and over.

base population: Population base for the current estimate, usually the last decennial census or a special census or census survey taken since then.

birth rate (crude): The number of births in a calendar year divided by the mid-year total population ($B/P \times 1000$).

census transportation planning package: A special tabulation of a census of the population for Maricopa County by the traffic analysis zone system.

cohort: A group of persons with a common characteristic such as age group.

cohort survivors: Number of survivors at the end of a specific period as the cohort passes through time (ages).

components of population change: Births, deaths, in-migration and out-migration.

comprehensive plan: A planning document that is developed by a county that provides guidelines and policy statements for the direction, character, magnitude and timing of development that is expected to take place.

construction employment: Employment associated with construction sites across the region but not with a specific land use. This is included in the Other Employment category. Because construction employment follows development, employment projections may show declines in future years.

council of governments (COG): A public organization encompassing a multi-jurisdictional regional community. A COG serves the local governments and the citizens in the region by dealing with issues and needs that cross city, town, county and even state boundaries.

death rate (crude): The number of deaths in a calendar year divided by the mid-year total population ($D/P \times 1000$).

demography: The study of characteristics of human population, size, growth, density, distribution, and vital statistics.

developed employment-related area: The amount of developed employment-related land in an area based on current comprehensive plans of jurisdictions, input from the local planning

community and knowledge about the area.

developed residential area: The amount of developed residential land in an area based on current comprehensive plans of jurisdictions, input from the local planning community and knowledge about the area.

employment: The total number of jobs of persons receiving wage or salary to work in a given industry. This measure of employment only includes persons over the age of 16 and does not include working within the home without outside wage or volunteering. An employee works in the designated weekly time period at least one hour.

employment concentration: Measures the average employment density within a given radius, usually a 1-mile radius. This helps in smoothing out differences in geographies and identifying underlying spatial patterns in the data.

employment density: Derived by dividing total employment within an area by the size of the area in square miles.

employment saturation: The percentage of total employment capacity that is developed based upon the buildout densities.

estimate: Indirect measure of the number of persons inhabiting a specific geographic area for a current or past time period. Actual data sensitive to changes in the population are used to derive the numbers. The data are incorporated into various formulas to produce estimates of population change or components of this change.

fertility: Index relating the number of births to the number of women of childbearing age normally 15-44 years old: $(B/P (15-44) \times 1000)$.

general plan: An official document developed by a city or town containing goals and objectives for future development and policies designed to reach these goals and objectives.

group quarters: Group quarters are places where people live or stay other than the usual house, apartment, or mobile home. Two general types of group quarters are recognized: institutional, i.e. nursing homes, mental hospitals or wards, hospitals or wards for chronically ill patients, hospices, and prison wards; and noninstitutional, i.e. college or university dormitories, military barracks, group homes, shelters, and missions. Group quarters may have housing units on the premises for staff or guests.

Household: An occupied housing unit.

housing unit: A dwelling unit that could be single family, multi-family, mobile home or other type of unit.

industrial employment: Employment in areas designated for industrial land use.

job/housing balance: The ratio of the number of jobs to the number of housing units in a geographical area.

jobs per 100 people: The number of jobs for every 100 people in a geographical area.

land use: The predominant activity that is occurring in a geographic area.

land use controls: Regulations governing how land is to be used in order to implement the general plan. The major controls are subdivision regulation and zoning.

land use planning: Urban planning that focuses on physical development.

large-firm employment: That employment associated with firms employing 100 or more persons at one site.

multinomial logit: A statistical model using the logit form that attempts to predict the probability that one of multiple (more than two, which would be a binary logit) discrete choices will be chosen by an agent. We use multinomial logit models to simulate the location choices of households and jobs in the region.

municipality: A political unit incorporated as a city or town.

municipal planning area (MPA): An MPA represents the area of planning concern for a municipality and is based upon its anticipated future corporate limits.

natural change: The number of births minus deaths during a specific period. If there is an excess of births over deaths, the change is called natural increase; if deaths are larger, it is referred to as natural decrease.

net migration: The net effect of persons moving into an area (in-migration) minus persons moving out of the area (out-migration).

non-site-based (NSB) employment: Jobs that are not site since the nature of the work is such that it cannot be accomplished in a single location, and the location of the work site varies from day to day. Examples of such jobs include temporary work agencies, landscaping companies, and cleaning/janitorial companies. This sector of employment follows population and employment and may show declines in future years.

nonresident: Any person whose principal place of residence is not within Maricopa County or Pinal County.

North American Industry Classification System (NAICS): An industry classification system that groups establishments into industries based on the activities in which they are principally engaged.

occupied housing unit: A housing unit is considered occupied if a resident person or persons are living in it or if the occupant is only away from the unit temporarily, e.g., away on vacation.

occupancy rate: The number of occupied housing units divided by the total number of housing units in a geographical area.

office employment: Employment that is located in areas designated for office land use.

open space: Land or water free of urban development, including land or water used for the production of food or fiber or for the conservation of natural or scenic resources.

other employment: A residual of total employment minus employment in areas designated for industrial, office, public and retail land uses. It includes, but is not limited to, medical, transportation, utilities, communication, hotel/motel, construction and non-site-based employment.

plat: A map or a subdivision.

population concentration: Measures the average population density within a given radius, usually a one mile radius. This helps in smoothing out differences in geographies and identifying underlying spatial patterns in the data.

population in households: The population in occupied housing units.

persons per occupied unit: The total population residing in occupied housing units divided by the total occupied housing units.

population saturation: The percentage of total population capacity that is developed, based upon the buildout densities.

projection: Numerical outcome of a set of assumptions (based on past trends) relating to future trends. The numbers are conditional upon these assumptions being fulfilled.

public employment: Employment located on land designated for public use.

regional analysis zone (RAZ): An area within an MPA. RAZs can be either coterminous with or may be aggregated to form an MPA.

resident: a resident of a geographical area is a person who reports that his or her regular place of residence is within that geographical area.

resident housing unit density: The total number of resident housing units in a geographic area divided by area in square miles.

resident population: Resident population is defined as the people who live in a specific area more than six months a year. Resident population may live in housing units or in group quarters.

resident population density: The total resident population in a geographic area divided by area in square miles.

retail employment: Employment that is located in areas designated for retail land use.

sample survey: Scientifically designed sampling to obtain characteristics of the population.

saturation ratio: The ratio of total developed land to total developable land.

seasonal population: The number of nonresidents who reside within the area at certain times of the year for more than two weeks.

subdivision: The division of a parcel of land into two or more lots for the purposes of sale or development. The former single piece as a whole is then known as a subdivision. Subdivisions may be residential or commercial.

symptomatic indicators: Data series that are reflective of population change; can be used in developing current population estimates.

top-down allocation: An allocation procedure that begins at the highest level of geography and then allocates the variables to the next level of geography. The totals developed at each level serve as control totals for the allocation to the next level. For example, allocation of population from county-level to the RAZ level, then from the RAZ level to the SAZ level represents top-down allocation.

total nonresident population: The combination of seasonal and transient populations.

total resident housing units: The combination of occupied and vacant resident housing units.

total resident population: Includes those residents living in housing units and group quarters.

traffic analysis zone (TAZ): Represents a subarea within a regional analysis zone and is the smallest geographic unit for which variables are forecast for transportation planning purposes.

transient population: The number of nonresidents that reside in the area for less than two weeks, often in hotel, motel, or RV housing units.

travel time: The time, in minutes, that it takes to travel from one point to another. The travel times represent peak-hour traffic conditions.

undevelopable area: The amount of undevelopable land in an area based on the analysis of land use information and planning documents from the various jurisdictions. Undevelopable area includes land in flood plains, land covered with water, land with slopes or other topographic features that make development not feasible, and areas that have been designated for parks and other open space use.

undeveloped employment-related area: The amount of undeveloped employment related land in an area based on current comprehensive plans of jurisdictions, input from the local planning community, and knowledge about the area.

undeveloped residential area: The amount of undeveloped residential land in an area based on current comprehensive plans of jurisdictions, input from the local planning community, and knowledge about the area.

urban edge: The furthest spatial edge of the predominantly developed portion of the MAG region. The identification of these areas of the region was done primarily through aerial photography analysis

and supplemented with County Assessor data and data from MAG member agencies.

vacancy rate: The ratio of the total number of vacant housing units divided by the total number of housing units.

vacant housing unit: A unit in which no resident lives.

vital statistics: Births and deaths data reported by either place of residence or occurrence.

work-at-home employment: Employment where the primary place of work is at home.

zip codes: Administrative entities of the U.S. Postal Service which generally do not coincide with the Census Bureau's geographic or political areas, and change according to postal requirements. Most zip codes do not have specific boundaries, and their implied boundaries do not necessarily follow clearly identifiable physical features.

zoning: The division of a city, town or county into districts for the purpose of regulating the use of land, the size of structures, and the density of population. Accomplished through the passage of a zoning ordinance.