

# HISTORIC LAND USE TEAM: PHASE I REPORT ON GENERALIZED LAND USE



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August 1999

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The Central Arizona-Phoenix Long Term Ecological Research (CAP LTER) project at Arizona State University was funded in 1997 by the National Science Foundation (DEB 9714833) to be one of the first urban sites in the LTER network. CAP LTER provides a unique addition to LTER research by focusing upon an arid-land ecosystem profoundly influenced and defined by the presence and activities of humans. Our investigation of land use and ecological consequences in an urban environment also involves community partners and K-12 schools. Our aim is to understand the changing urban fabric of our arid urban ecosystem and to offer applications to arid cities across the globe.

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# PHASE I REPORT ON GENERALIZED LAND USE

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## INTRODUCTION

The Central Arizona-Phoenix Long Term Ecological Research (CAP LTER) project at Arizona State University has engaged a number of research teams in topics as diverse as aquatic core sampling and urban fringe morphology in CAP LTER's charge to understand the ecology of the Phoenix urban ecosystem. This report discusses Phase I (conducted fall of 1998) of one of those projects, the Historic Land Use Project. During this phase, geographical information system (GIS) software and diverse data sources were used to map the pattern of generalized desert, agricultural, recreational, and urban land uses for the Phoenix metropolitan area for the approximate periods: 1912, 1934, 1955, 1975, 1995.

This report provides a brief history, an outline of the settlement pattern changes, and the data sources used in creating maps for each of the periods. Although interpretations of the patterns are suggested, they remain tentative and the reader is urged to assess any analysis of this data in light of the caveats explained in this report.

Our desire is to provide a general background while making our methods and decisions evident to subsequent researchers who will want to use our data for their own purposes. Federal Geographic Data Committee (FGDC)-compliant metadata is available for the data discussed in this report at the following website: <http://caplter.asu.edu>

## MAPS

Maps and tables for the Salt River Valley - Phoenix metropolitan area showing generalized land use were produced for the approximate periods of 1912, 1934, 1955, 1975, and 1995. Although specific years are associated with each map, reflecting the primary source of data, they in reality are compilations of data from a series of years around that midpoint. Each map utilizes a topographic relief image as its background. This image was created from U.S. Geological Survey (USGS) Digital Elevation Model 1:250,000 data. A hillshade layer was calculated from the raw data using a solar zenith angle of 25° and azimuth of 315°. This hillshade layer was added to each map as an image.

The maps also show streams and lakes taken from the Arizona Land Resource Information System (ALRIS) database, provided by the Arizona State Land Department. All lakes shown are man-made and were added to the appropriate period map, based on dam establishment information from the Salt River Project web site (<http://www.srp.gov>). For the land-use classifications, we employed spatial data from various sources as noted herein. For GIS mapping and analysis, the project used ArcView software, produced by Environmental Systems Research Institute, Inc.

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## 1912

### History

The Salt River Valley lies in the Sonoran Desert in the Basin and Range Province of North America. The Valley contains broad, gentle slopes with rich alluvial deposits and well-drained loamy soils. The Salt River flows through the Valley and has historically provided an abundant source of water. The Hohokam civilization beginning in 500-700 AD excavated canals to water crops of beans, corn, squash, and cotton. However, the Valley was largely abandoned by 1400 and was subsequently under Spanish, Mexican, and U.S. rule, but remained largely unsettled until the late 1800s. In 1863 President Lincoln established the Arizona Territory, and in 1867 the first hay camps were established along the river. In 1870 a Phoenix townsite was delineated to include present-day streets of Central and Washington (Mawn 1979).

Agriculture played a predominant role in the Valley between 1870 and 1920, by which time Phoenix had established itself as the largest city in Arizona. The availability of water from the river determined the initial development pattern, following re-excavation and extension of the Hohokam canals. Agriculture was diversified in these early years and wheat, barley, and corn became the first surplus crops. Later, commercial citrus and fruit crops flourished. Still later on, alfalfa developed as a cash crop and contributed to cattle, horse, and sheep ranching. Dairies were established as well as an ostrich feather industry. In 1902 the National Reclamation Act spurred creation of the quasi-federal Salt River Valley Water User's Association (SRVWUA) who took over private control of canal development and sponsored the Roosevelt Dam Project. Roosevelt Dam was completed in 1911 and provided a steady reliable water source to the Valley, greatly diminishing historical flooding and drought potential. After the construction of Roosevelt Dam, cotton became another important cash crop. The area was actively promoted as a rural area to encourage growth along the agriculture periphery (Mawn 1979).

In 1895 the first railroad service linked the Phoenix area to Southwest, Midwest, and Eastern markets. Street car and trolley line expansion occurred between 1887 and 1915. Between 1900 and 1920, the auto furthered outward development to suburbs that grew up to the north of downtown Phoenix (Mawn 1979).

By the end of its first stage of development, Phoenix was a compact and well-defined city with functional zones for a central business district, industry and residential districts. It had established itself as the a dominant market center between El Paso and Los Angeles (Mawn 1979).

### Settlement Pattern

The population of Phoenix and all of Maricopa County, at this point, was small (see Table 1), distributed in agricultural communities established to take advantage of the possibilities of irrigation from the Salt River. The communities of Phoenix, Tempe, and Mesa, using re-excavated prehistoric canals, mirrored the distribution of major Hohokam settlements in the Valley. The year 1912 is a fine baseline to begin this study in that it represents a major turning point for Phoenix. Roosevelt Dam had been completed, expanding the possibility for irrigation as well as offering more protection against flooding. Phoenix had also been named the capital of the newly admitted 48<sup>th</sup> state in the Union. The major towns were located in the floodplain, only a short distance from the main channel of the Salt River. Some settlements, such as Chandler and Glendale, were substantially farther from the river channel, but still within the reach of the irrigation canals. All of the town development was carved out of potentially useful agricultural land.

TABLE 1. Selected Maricopa County census information: population and approximate land area (km<sup>2</sup>)

| Census Year/<br>Population/Area | Maricopa<br>County | City of<br>Chandler | City of<br>Glendale | City of<br>Mesa | City of<br>Phoenix | City of<br>Scottsdale | City of<br>Tempe |
|---------------------------------|--------------------|---------------------|---------------------|-----------------|--------------------|-----------------------|------------------|
| 1995 Population                 | 2,551,765          | 132,360             | 182,615             | 338,117         | 1,149,417          | 168,176               | 153,821          |
| Area                            | 23,988             | 133                 | 140                 | 317             | 1,220              | 478                   | 103              |
| 1990 Population                 | 2,122,101          | 89,862              | 147,864             | 288,104         | 983,392            | 130,075               | 141,993          |
| Area                            | 23,930             | 125                 | 136                 | 284             | 1,100              | 478                   | 103              |
| 1980 Population                 | 1,509,175          | 29,673              | 97,172              | 152,404         | 789,704            | 88,622                | 106,920          |
| Area                            | 23,730             | 74                  | 106                 | 175             | 860                | 230                   | 94               |
| 1970 Population                 | 971,228            | 13,763              | 36,228              | 63,049          | 584,303            | 67,823                | 63,550           |
| Area                            | 23,803             | 17                  | 44                  | 63              | 645                | 175                   | 66               |
| 1960 Population                 | 663,510            | 9,531               | 15,893              | 33,772          | 439,170            | 10,026                | 24,897           |
| Area                            |                    | 6                   | 10                  | 36              | 487                | 10                    | 46               |
| 1950 Population                 | 331,770            | 3,799               | 8,179               | 16,790          | 106,818            | 2,032                 | 7,684            |
| Area                            | 23,988             | 2                   | 3                   | 17              | 43                 |                       | 7                |
| 1940 Population                 | 186,193            | 1,239               | 4,855               | 7,224           | 65,414             | **2,000               | 2,906            |
| Area                            | 24,001             | 1                   | 3                   | 5               | 25                 |                       | 5                |
| 1930 Population                 | 150,970            | 1,378               | 3,665               | 3,711           | 48,118             | *2,761                | 2,495            |
| Area                            |                    | 1                   | 3                   | 3               | 17                 |                       | 5                |
| 1920 Population                 | 89,576             |                     | 2,737               | 3,036           | 29,053             | *1,047                | 1,963            |
| Area                            | 23,117             |                     |                     |                 | **13               |                       | 5                |
| 1910 Population                 | 34,488             |                     | *1,000              | 1,692           | 11,134             |                       | 1,473            |
| Area                            | 23,117             |                     |                     |                 | **8                |                       | 5                |
| 1900 Population                 | 20,457             |                     |                     | 722             | 5,544              |                       | 885              |
| Area                            | 22,922             |                     |                     |                 | **5                |                       | 5                |
| 1890 Population                 | 10,986             |                     |                     | **500           | 3,152              |                       | **500            |
| Area                            |                    |                     |                     |                 | **1                |                       |                  |
| 1880 Population                 | 5,689              |                     |                     | 151             | 1,708              |                       | 135              |
| Area                            |                    |                     |                     |                 | **1                |                       |                  |
| 1870 Population                 |                    |                     |                     |                 | 240                |                       |                  |
| Area                            |                    |                     |                     |                 | **1                |                       |                  |

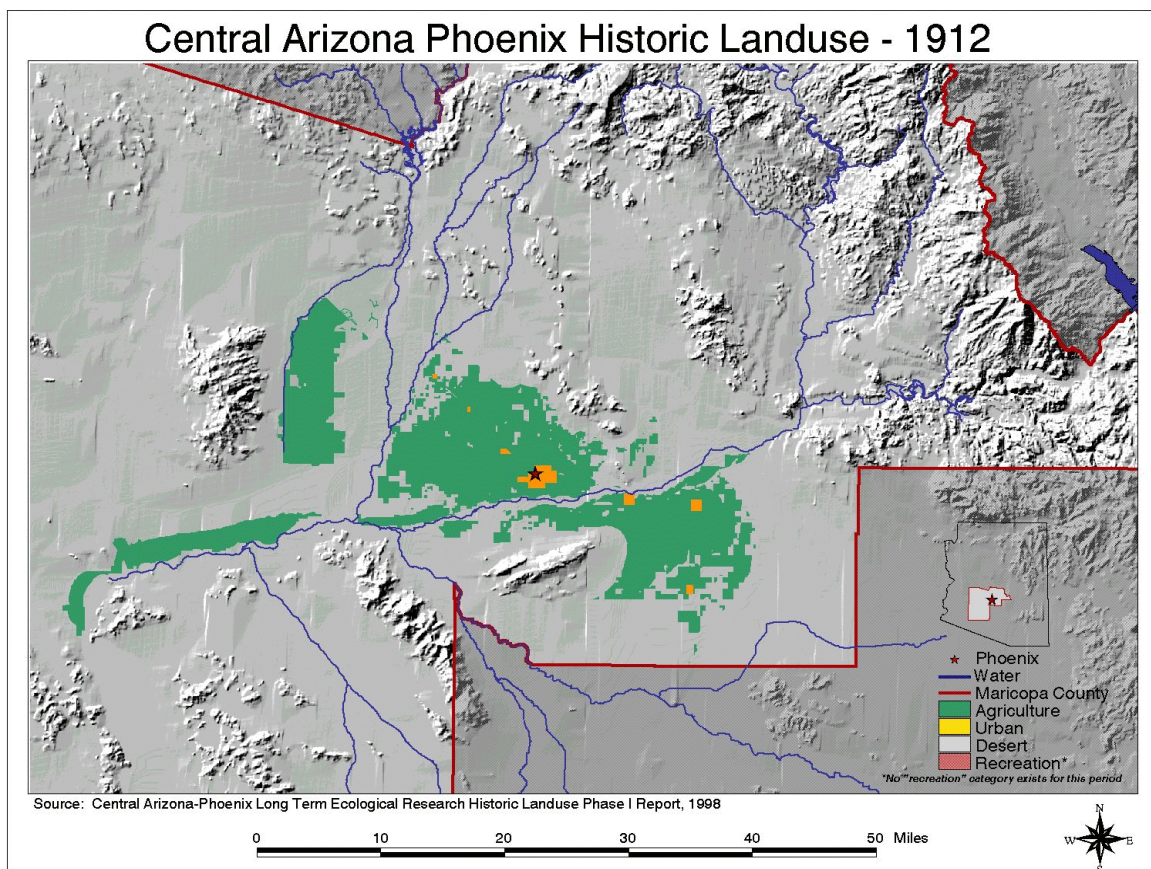
\*Precinct figure: includes all those who voted in the population center. This figure was usually greater than the actual population. \*\*County or City Planning Department estimates (rounded).

SOURCES: Primarily U.S. Census Bureau reports, abstracts, and web site, and 1995 Special Census of Maricopa County. Also consulted were publications and web sites by Arizona Department of Economic Security, Population Statistics Unit; Maricopa Association of Governments; Greater Phoenix Economic Council; Maricopa County; City of Phoenix, Planning Department; City of Tempe, Development Services; and City of Chandler.

## Data Sources

Agriculture in the Salt River Valley almost always requires irrigation. John Keane, of the Salt River Project (SRP), provided SRP spatial data produced in relation to the Kent Decree of 1910. This dataset gives the location of SRP-irrigated lands and when they began receiving irrigation, from which we inferred the years in which the lands were put into production. Keane also provided spatial data related to the SRVWUA irrigation districts. Agricultural production dates for these non-SRP districts were obtained from personal communication with Keane and with representatives of the districts. The Kent Decree data were classified into three categories: A, B, and C. The A category contained those lands that were in cultivation in 1910, the B category contained those lands that were in cultivation prior to 1910 but not in cultivation in 1912, and the C category contained those lands that were not cultivated in 1910 but were by 1925, approximately. We classified all A and B lands as agriculture. Additionally, all SRVWUA districts that were established in 1912 or before were categorized as agriculture.

Urban lands were primarily obtained from 1:24,000 USGS topographic maps for the area, available in the Arizona State University (ASU) Noble Map Library. The available maps were dated from 1906 to 1915. Urban areas were identified as those in which a regular street grid was established with a density of six or more streets per quarter section. Qualifying areas were then digitized onscreen over a township-range-section background. Some topographic maps for the area were unavailable, especially for the northwest portion of the metropolitan area. We used maps obtained from the Glendale Historical Society to estimate the location, size, and shape of the urban cores of Glendale, Peoria, and Alhambra for this period. These urban areas were digitized onscreen over a street background.



Due to the use of multiple data sources, there was some spatial overlap between agricultural and urban classified lands. It was assumed that the urban class, being smaller, took precedence over agriculture. Therefore, a series of spatial manipulations to the data were performed that effectively removed the agricultural classification from lands that were also classed as urban so that, ultimately, there was no area with more than one classification. Finally, agricultural and urban lands were subtracted from a polygon representing Maricopa County, the remaining county area being classified as the third category, desert. There were no regional parks (recreation category) established at this time.

## **1934**

### **History**

Private capital and federal funding implemented major improvements throughout the prosperous 1920s. Roads, bridges, water, and sewer lines were created with federal funding and engineering assistance. This construction boom also produced many "skyline" buildings in downtown Phoenix, as well as industrial development to the south of the downtown area. Cultural development also flourished after 1920, with private support for music, drama, and the arts. Many museums, libraries, schools, and parks were built in the 1920s and the Valley became a regional focus for culture and the arts. Construction came to a halt when the depression hit in 1929 and the 1930s were marked by a time of increased federal funding in the Valley due to dire national economic conditions (Kotlanger 1934).

Water development continued to be a key consideration for the Phoenix area after the construction of Roosevelt Dam and Granite Reef Dam. Cave Creek Dam was constructed in 1922 after "the great flood of 1921" consumed the area just west of downtown Phoenix twice within a week. However, a new problem arose because crops were being watered entirely with surface water, forcing the groundwater table to rise and the soil to become waterlogged with a high alkali content. In 1922, hydraulic pumps were installed to drain the groundwater into canals and thus the first groundwater pumping began. Also in 1922, the first auxiliary power generator was added to Roosevelt Dam so that it now not only provided a reliable water supply but cheap electricity as well. In 1923, Mormon Flat Dam was built; in 1924 Horse Mesa Dam and Apache Reservoir came into being; and in 1927 Stewart Mountain Dam was started and completed in 1930. There were plans to dam the Verde River as well as the Salt, but these were stalled because of the Depression. With federal relief funding, dam construction continued, and Bartlett Dam was constructed on the Verde River between 1936 and 1939 (Kotlanger 1934).

Agriculture continued to be a prime economic activity in the Valley. The cotton crop crashed in the 1920s and there was a return to more diversified crops. In the 1930s, surplus crops were sold to the federal government to keep farmers in business. By the 1940s, crop production returned to pre-depression production levels (Kotlanger 1934).

After the 1920s, the Valley no longer promoted itself with private funding as a rural agricultural mecca but instead used public funding to promote itself as a favored place for tourism, good weather, health care, and the arts (Kotlanger 1934). Due to an aggressive annexing policy established in the 1930s to promote rapid demographic growth, the city gained "metropolitan district" status as a result of the 1940 census results (see Table 1).

### **Settlement Pattern**

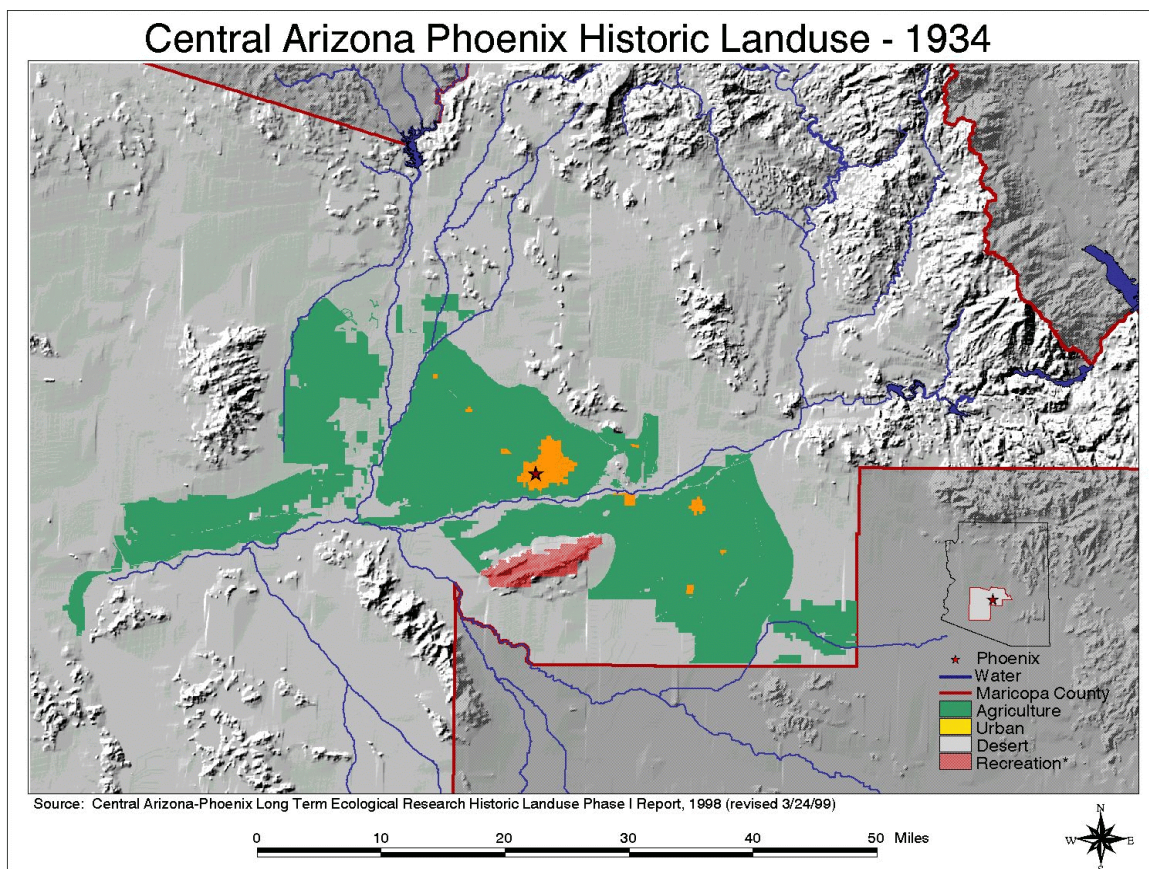
By this time, it is appropriate to refer to Phoenix as a settlement with the diversity of activities and districts that define a true city. Urban growth was largely to the north and northeast of the earlier Phoenix



city center. The other towns in the Valley also expanded beyond their former boundaries. Virtually all of the land consumed for this urban growth was agricultural land with the exception of the small areas around Camelback Mountain and other close-in buttes that would have protruded above the usable floodplain. Settlements were also expanding along the major highway corridor of the Valley, along what was to be U.S. Route 60. Of special note is the creation of South Mountain Park by the city of Phoenix. This remains the largest city park in the nation and established the precedence for setting aside close-in mountain areas as preserved open spaces. With the construction of new dams and the in-flow of population, the land being farmed also increased significantly, from 1,026 km<sup>2</sup> to 1,792 km<sup>2</sup> during 1912 to 1934. This involved filling-in of open areas within already farmed zones and the extension of the area under irrigation, particularly to the southeast and west.

### Data Sources

Lands belonging to the agriculture class for this period were identified from the SRP Kent Decree and SRVWUA irrigation data (see 1912 section for details). SRP classes A, B, and C were all used to designate agricultural lands. SRVWUA districts in production in 1912 were used, as were those coming into production between 1912 and 1934. Urban lands were primarily obtained from 1:24,000 aerial photographs. These photographs used are known as the "Fairchild" photos, made by the U.S. Soil Conservation Service in 1934 and were available from the ASU Noble Map Library. We identified the obvious boundary between urban and agricultural areas as where regular street grids and buildings existed and adjacent agricultural fields.



Qualifying urban areas were then digitized onscreen over a township-range-section background layer. Photographs and topographic maps were once again unavailable for the northwest portion of the metropolitan area. Maps from the Glendale Historical Society were used to estimate the urban areas of Glendale, Peoria, and Alhambra. These urban areas were digitized onscreen over a street background layer. Due to the use of multiple data sources, we again found spatial overlap between agricultural and urban classified lands. This overlap was processed in the same way as for the 1912 data. The urban category was given priority over agriculture, and areas initially classified as both were assigned to urban only. No overlapping categories remain. There was one regional park (the recreation category) established at this time. Its boundary was obtained from the Maricopa Association of Governments (MAG) existing land use spatial dataset for 1995. Estimated establishment date was obtained from Maricopa County Parks and Recreation Department. Finally, we subtracted the agricultural, recreational, and urban lands from a polygon representing Maricopa County. The remaining county area was classified as our fourth category, desert.

## 1955

### History

The population of the Valley more than tripled between 1940 and 1960. In Maricopa County the population in 1940 was 186,193 and by 1960 had grown to 663,510. The land encompassed by Phoenix grew from 25 km<sup>2</sup> in 1940 to 43 km<sup>2</sup> in 1950 to 487 km<sup>2</sup> in 1960 to 645 km<sup>2</sup> in 1970 (Table 1).

There were several reasons for this unprecedented growth. Federal investments in military aviation made it possible for the city to attract high-tech companies during the post-war years. Also many military personnel who were stationed in the Valley during the war returned here afterwards to settle with their families. Additionally, political forces facilitated both spatial and industrial growth after the war. Until 1948, Phoenix was governed by a city commissioner and a mayor that exerted undue influence on the day-to-day operations of the city. This was demonstrated by the fact that there was constant turnover for the positions of city manager, police chief, and city clerk. Government was in general flux, unstable and chaotic. Bootlegging, gambling, narcotics traffic, and prostitution were commonplace in the corrupt environment of local government (Konig 1983, Preisler 1992).

A reformed City Charter was finally adopted in 1948 and in 1949 a Charter Government Committee composed of conservative businessmen and the professional class took control of city administration. This committee set a strong agenda for growth. They promoted spatial as well as industrial growth and improved municipal services. Because members of the committee were also the city's financial, industrial, and professional leaders, they established a more efficient city government. Due to better organization, services such as fire, police, water, and sewer could be offered at better rates. In particular, these better rates could be offered to people who lived on the fringe of the incorporated area to entice them into agreement to annexation.

Phoenix was not alone in its efforts to annex land during this period, as 182 cities around the country annexed additional territory between 1950 and 1960. However, Phoenix and Oklahoma City were two of the largest annexers. One promotional pamphlet distributed to potential annex areas around Phoenix was titled *It Will Pay You to Come In*. The city established a rapport and a positive relationship with the people who lived on the fringes and offered them tax and building code concessions, which led to successful annexation efforts. Annexation in general was a response to a decentralizing population that resulted in competition with other adjacent cities for land and population (Konig 1983, Preisler 1992).

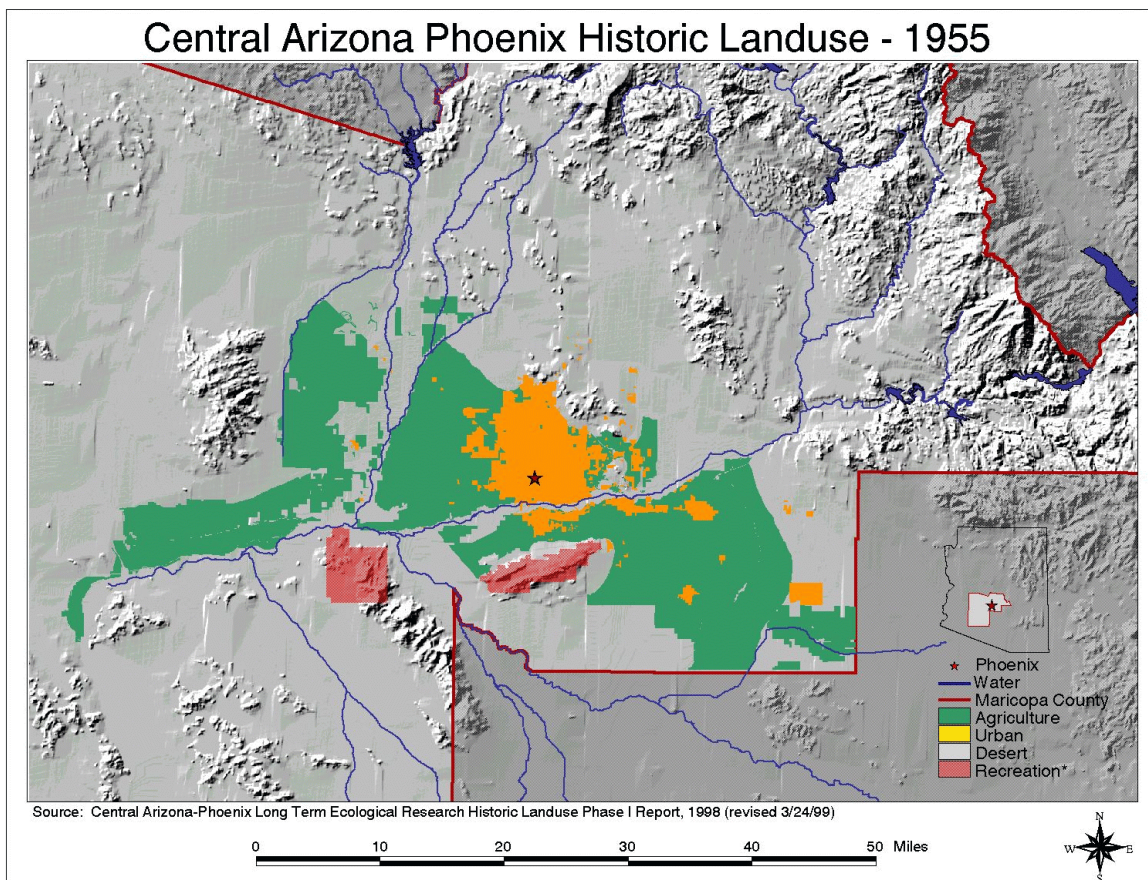
The Charter Government similarly launched an aggressive campaign to attract high-tech industry to the Valley by touting the healthful climate, natural beauty, right-to-work employee status, skilled labor pool,



and plentiful energy provided by Arizona Public Service (APS) and SRP for industry. Also, because of the national migration trends to the West and, in particular, the Southwest, no sign of let-up was seen and it was deemed a good market for consumer products. A steadily increasing per capita income produced a populace that sought technical products for a cosmopolitan lifestyle. Again, the Charter Government was successful, recruiting high-tech giants such as Motorola, General Electric, Goodyear Aircraft Corporation, Kaiser Aircraft Electric, and Sperry Corporation. The Charter Government was dissolved in 1975 because it was not thought to represent the diverse residents of the huge city it had created (Konig 1983, Preisler 1992).

### Settlement Pattern

The rapid population growth leading up to this year was paralleled by an expansion of the area of Phoenix and the other valley cities. Phoenix grew in all directions, establishing a substantial population south of the Salt River and a very large push to the northwest. Tempe, Mesa, and Scottsdale expanded until settlement was virtually continuous in the core of the Valley. Almost all land becoming urbanized was former farmland, but for the first time a significant portion (over one-sixth) of the new urbanization was on formerly desert landscape. This is particularly true in the north and northeast direction where the land being settled was higher terrain, inaccessible to irrigation water. This probably reflects that for a growing proportion of the population farming was no longer the major industry. Hence, proximity to fields was less important than an attractive geographic setting. By this time Estrella Mountain Park was established, the first piece of what was to become the very extensive Maricopa County park system.



## Data Sources

Lands belonging to the agricultural class for this period were again identified from the SRP Kent Decree and SRVWUA irrigation data (see 1912 section for details). SRP classes A, B, and C were all used to designate agricultural lands. SRVWUA districts in production in 1934 were used, as well as those coming into production between 1934 and 1955.

Urban lands for 1955 were obtained from multiple sources. The eastern portion of the Valley was obtained from 1:24,000 USGS topographic maps from ASU's Noble Map Library. The best available maps were dated from 1952 to 1964. We identified urban areas as those in which a regular street grid was established with a density of six or more streets per quarter section. Qualifying areas were then digitized onscreen over a Township-Range-Section background. Topographic maps for a large portion of the metropolitan area were unavailable for this period. Maps from the Glendale Historical Society were used to estimate northwest Valley urban areas. These areas were digitized onscreen over a street background layer. The main Phoenix urban area was taken from the 1958 *City of Phoenix Generalized Existing Landuse* map, created by the Advanced Planning Task Force of the City of Phoenix and Maricopa County, again using a street background for digitizing.

Due to multiple data sources, we again found spatial overlap between agricultural and urban classified lands. This overlap was processed in the same way as previously described for the other periods. The urban category was given priority over the agricultural category and areas initially classified as both were assigned to urban only. We then added the regional parks that existed at this time from the MAG Existing Land Use spatial dataset for 1995. Estimated establishment dates were obtained from the Maricopa County Parks and Recreation Department. Finally, we subtracted the agricultural, urban, and recreation lands from a polygon representing Maricopa County, and classified the remaining county area as desert.

## 1975

### History

The growth spurt that began in the 1940s in the Valley continued through the 1970s in an intense period of urbanization. Although growth in the 1950s spread in all directions from the central Phoenix area, by the 1960s growth had begun favoring the northwest, northeast, and southeastern portions of the Valley. Growth was largely influenced by land economics rather than planned growth policy. By 1960 over 75% of the population resided in urban areas, as opposed to just over a third of the population in 1870. This reflected a national trend towards urbanization with migration occurring westward and from rural areas and smaller cities to larger urban areas. From 1950 to 1960 the only two states that had higher net migration than Arizona were Nevada and Florida. People move, in general, to better their economic status, for health, or for retirement. Economic and climatic factors appear to be behind the mass exodus from the east to the west. Conversely, while the urban area continued to grow, agricultural areas decreased due to urban expansion (Maricopa County Planning and Zoning Department 1964, Maricopa County Planning Department 1975).

Agriculture was the leading source of income for the last time in 1953. However, in 1973 it still played a large role and was only second in importance to manufacturing. In 1984 agriculture as an occupation was not dominant in any Maricopa County census tract. The highest employment for the same time period could be found in the central business district of Phoenix, the Scottsdale Central Business District, Arizona State University, Sky Harbor, and Metrocenter and Christown Malls (Maricopa County Planning and Zoning Department 1964, Maricopa County Planning Department 1975).

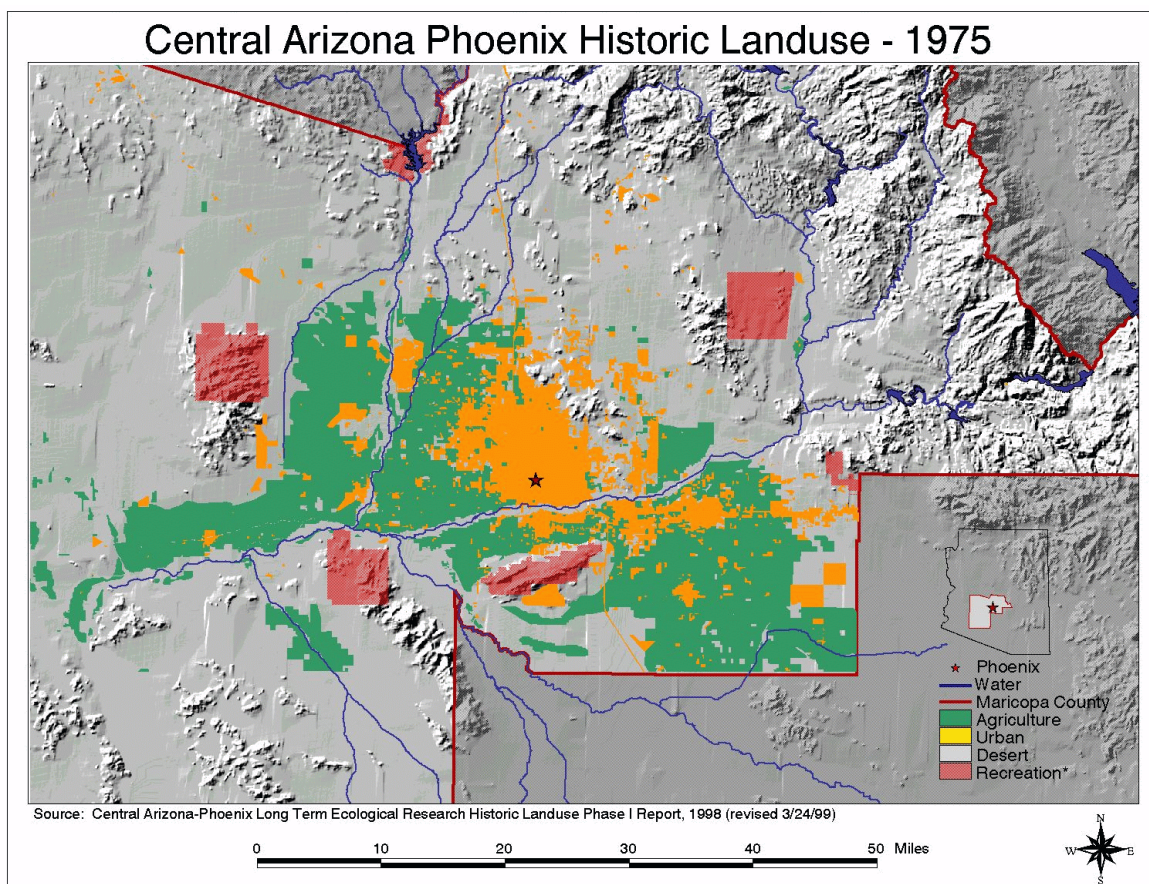
Few physical limitations, availability of low cost land, and tax policies that promoted expansion have all been responsible for growth in the Valley. Also the Salt River Phoenix Agricultural Improvement and



Power District, formed in 1937 and which evolved into SRP provided a stable entity to oversee water issues in the Valley. Plans for large-scale interstate projects such as the Central Arizona Project and the Palo Verde Nuclear Generation Plan continued to guarantee an abundant energy and water supply well into the future (Maricopa County Planning and Zoning Department 1964, Maricopa County Planning Department 1975).

### Settlement Pattern

The area of urban development in Maricopa County continued to grow rapidly, more than doubling between 1955 and 1975. Contiguous expansion continued toward the southeast and northwest, but two new patterns emerged. First, of the new urban development, 60% was on former desert landscapes, whereas in the previous period only 17% was from desert. This marked a new direction in urban development probably related to perceived high real estate value of desert landscapes and the availability of transferable water rights for desert development. This shift in preference for new housing development was not forced by the lack of available farmland, quite to the contrary, our data shows this period had the greatest extent of farmland under cultivation of any period during our study. The boundaries of agricultural land had expanded, new areas were opened to irrigation, and other parcels within districts became active. The second settlement pattern that first became apparent on the 1975 map was that a large portion of the new urban development was not contiguous with former development, but appeared to “leap frog” over open space to more distant locales. This was particularly true of desert lands that were developed, but it also was seen in distant parcels of farmland that were converted. One possible explanation for this new pattern was a change in the nature of land speculation



and its relation to real estate development. With the real estate development of desert areas also came the expansion of the county park system to preserve selected desert locations.

### **Data Sources**

For the urban, agricultural and desert land-use categories in this period, we used a single 1:250,000 spatial dataset, the 1974 Land Use Land Cover (LULC) data from the USGS Geographic Information Retrieval Analysis System (GIRAS). This data set is available through the web site <http://edcwww.cr.usgs.gov/webglis>, and its categories are given in Table 2. Our reclassification of the LULC categories is noted at the bottom of the table.

We then added the regional parks that existed at this time from the MAG Existing Land Use spatial data set for 1995. Estimated establishment dates were obtained from the Maricopa County Parks and Recreation Department. The area covered by these parks was subtracted from the GIRAS LULC data to avoid multiple classes for the same place.

## **1995**

### **History**

The greater Phoenix metropolitan area experienced a growth rate three times greater than that of the average U.S. rate between 1982 and 1992. Maricopa County was the third-fastest growing of the nation's top 50 counties by number of people from 1980 to 1994. Between 1954 and 1994, Maricopa County experienced a 564% growth rate, as compared to a 72% rate in the U.S. Most of the draws to the Valley have been economic in nature. A large skilled-labor supply and markets for products strengthens population growth. The population remained relatively young and well-educated, while the number in the labor force in the County doubled between 1980 and 1995. Between 1984 and 1993, the County experienced a 1.5% lower unemployment rate than the rest of the nation. Retirement communities also have a positive impact on the economy in the Valley (Maricopa County Department of Planning and Development 1984, Maricopa County 1994).

An economy built on "copper, cattle, cotton and citrus," shifted into a more diversified one based on real estate, construction, electronics, aerospace, retirement, service, and tourism. Growth continued in the information, communications, health, services, aerospace, transportation/distribution, agribusiness, and tourism industries. Future growth in the area will depend on access to a quality work force, capital availability, competitive tax and regulation environment, accessible technology, advanced infrastructure, housing affordability, cost of living, educational opportunity, and quality of life (Maricopa County Department of Planning and Development 1984, Maricopa County 1994).

In 1994, the population growth was forecast to hit 2.7 million by the year 2000, over 3 million by 2005, and 4.1 million by 2020. However, by January 1999 Maricopa County was estimated to already have 2.8 million residents, showing these projections to be too conservative. Personal income, retail sales, average housing prices, and salary and wage employment are all expected to steadily increase (Maricopa County Department of Planning and Development 1984, Maricopa County 1994).

TABLE 2. LULC Land-use Categories

| Level 1/Level 2                             | Level 1/Level 2                       |
|---|---------------------------------------|
| 1 Urban or built-up land                    | 6 Wetland                             |
| 11 Residential                              | 61 Forested wetland                   |
| 12 Commercial and services                  | 62 Nonforested wetland                |
| 13 Industrial                               |                                       |
| 14 Transportation, communication, utilities | 7 Barren land                         |
| 15 Industrial and commercial complexes      | 71 Dry salt flats                     |
| 16 Mixed urban or built-up land             | 72 Beaches                            |
| 17 Other urban or built-up land             | 73 Sandy areas not beaches            |
|   | 74 Bare exposed rock                  |
| 2 Agricultural land                         | 75 Strip mines, quarries, gravel pits |
| 21 Cropland and pasture                     | 76 Transitional areas                 |
| 22 Orchards, groves, vineyards, nurseries   |                                       |
| 23 Confined feeding operations              | 8 Tundra                              |
| 24 Other agricultural land                  | 81 Shrub and brush tundra             |
|   | 82 Herbaceous tundra                  |
| 3 Rangeland                                 | 83 Bare ground                        |
| 31 Herbaceous rangeland                     | 84 Wet tundra                         |
| 32 Shrub and brush rangeland                | 85 Mixed tundra                       |
| 33 Mixed rangeland                          |                                       |
|   | 9 Perennial snow or ice               |
| 4 Forest land                               | 91 Perennial snowfields               |
| 41 Deciduous forest land                    | 92 Glaciers                           |
| 42 Evergreen forest land                    |                                       |
| 43 Mixed forest land                        |                                       |
|   |                                       |
| 5 Water                                     |                                       |
| 51 Streams and canals                       |                                       |
| 52 Lakes                                    |                                       |
| 53 Reservoirs                               |                                       |
| 54 Bays and estuaries                       |                                       |

We reclassified the LULC landuse categories as follows:

Urban = 11, 12, 13, 14, 15, 16, 17

Agricultural = 21, 22, 23, 24

Desert = 31, 32, 33, 41, 42, 43, 73, 74, 75, 76, 0, 77

Water = 51, 52, 53, 54, 61, 62

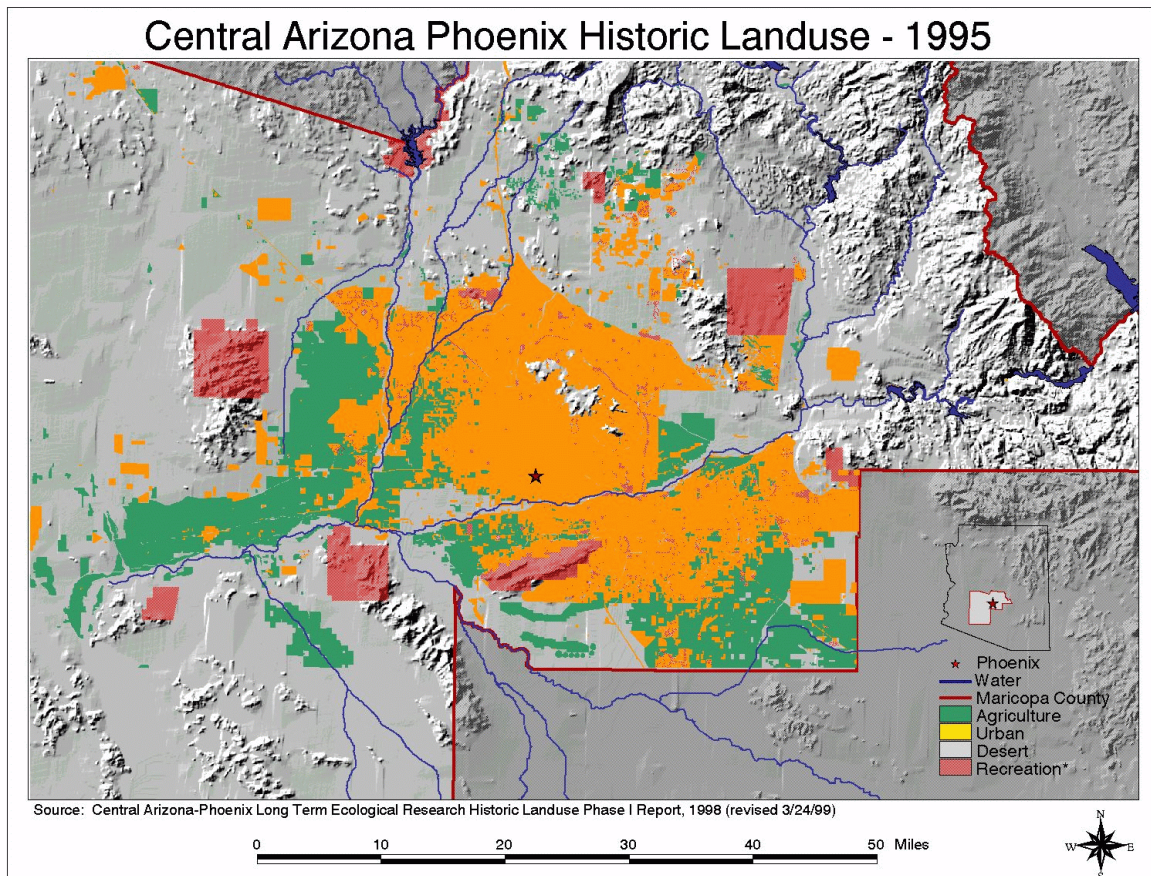


### Settlement Pattern

The period from 1975 to 1995 witnessed what might be considered the most dramatic spread of urban development in Maricopa County. According to our study, the amount of land devoted to urban development almost tripled during these 20 years! Huge tracts of farmland in the southeast and northwest Valley were converted to housing and commercial purposes, filling-in much of the open space leapfrogged over in the previous period. This expansion was not matched by new land being put under cultivation and there was a 30% drop in the land devoted to agriculture. Once again, however, the majority of new development (58%) was on previously desert landscapes. The northeast was the major contributor to this pattern, but there were desert developments in virtually every direction, some of them at a great distance from the current urban boundaries. Although there continues to be broad tracks of available land for urban development, in some directions growth is restricted by land devoted to Indian reservations, county parks, and state trust lands. Travel distance is somewhat of a limiting factor in this outward expansion, but even that is mitigated by the increased rate of freeway construction and the establishment of industrial and commercial centers along what is the urban periphery, allowing future employees to locate even further from the urban center.

### Data Sources

A single spatial dataset, the MAG Existing Land Use for 1995, was used for this period. Our reclassification of their land-use categories is given in Table 3. To maintain consistency with the other data layers, we continued to use the ALRIS water data and did not include the MAG “water” classification in our





data. Urban “core” was loosely defined by inspection of the overall MAG land-use map and drawing a perimeter around those areas where the land-use polygons were relatively small and dense. This polygon was then used to separate rural residential and vacant lots into their appropriate categories. Vacant land within this polygon was classified as urban. Rural residential was classified as agricultural. Rural residential was the most problematic land-use category, because we were unable to ground truth to determine which specific parcels were or were not agricultural.

Two of the recreation areas that first appear on the 1995 map may have uncertain development dates. Buckeye Hills, is not yet a formally developed park, according to the Maricopa County Parks and Recreation Department. Adobe Mountain Recreation Area is not a uniformly managed park but rather a gathering of individual concessionaires with no single, known establishment date.

## LAND-USE TRANSITION

Our land-use transition analysis focused on the expansion of urban land use. While analyzing the data, we were met with the challenge of dealing with a few illogical year-to-year land-use sequences that were sometimes found in the data. To deal with this problem, we devised a set of data validation criteria that allowed us to reclassify problematic transitions. The following criteria also reflect our primary interest in the urban land-use classification:

- If a previous year was identified as urban land use, then subsequent years were changed to urban land use
- If the land use before and after a middle land use was the same, the middle land use was changed to match the pre- and post-land uses. If before and after land uses were different, then the pre-land use was used. In the case of agricultural/desert transitions, no change was made.
- If 1955 land use was urban, but 1934 and 1975 land use were not urban, 1955 land use was changed to equal 1934 land use.
- If land use was recreational in 1975, it remained recreational in 1995.

TABLE 3. Reclassification of MAG Land-Use Categories

| Our Classification | MAG Classification                |
|--------------------|-----------------------------------|
| Urban              | Large Lot Residential             |
|                    | Small Lot Residential             |
|                    | Medium Density Residential        |
|                    | High Density Residential          |
|                    | Rural Residential                 |
|                    | Neighborhood Retail Centers       |
|                    | Community Retail Centers          |
|                    | Regional Retail Centers           |
|                    | Hotels, Motels, and Resorts       |
|                    | Warehouse/Distribution Centers    |
|                    | Industrial                        |
|                    | Business Park                     |
|                    | Office                            |
|                    | Educational                       |
|                    | Institutional                     |
|                    | Public Facilities                 |
|                    | Large Assembly Areas              |
|                    | Transportation                    |
| Desert             | Airports                          |
|                    | Vacant                            |
| Space              | Vacant                            |
|                    | Dedicated or Non-Developable Open |
| Agricultural       | Rural Residential                 |
|                    | Agriculture                       |
| Recreation         | Recreational Open Space           |

Table 4 shows the amount of land affected each year by application of the above criteria. Table 5 displays the amount of land per land use and year and explains which land uses gave way to urban land use for each year studied. Figures 1 and 2 follow the tables and are visualizations of the data in Table 5, demonstrating changes in urban land sources.

| TABLE 4. Percent of study area affected by application of data validation criteria. |                |              |               |  |
|---|----------------|--------------|---------------|--|
| Year  | Land-Use Class | Pre-Criteria | Post-Criteria | Percent Change Due to Data Validation Criteria |
| 1912  | Agricultural   | 9.0%         | 9.0%          | 0.0%   |
|   | Desert         | 90.9%        | 90.9%         | 0.0%   |
|   | Recreation     | 0.0%         | 0.0%          | na   |
|   | Urban          | 0.2%         | 0.2%          | 0.0%   |
|   | Total          | 100.0%       | 100.0%        |  |
| 1934  | Agricultural   | 15.7%        | 15.7%         | 0.0%   |
|   | Desert         | 83.4%        | 83.4%         | 0.0%   |
|   | Recreation     | 0.5%         | 0.5%          | 0.0%   |
|   | Urban          | 0.4%         | 0.4%          | 2.4%   |
|   | Total          | 100.0%       | 100.0%        |  |
| 1955  | Agricultural   | 13.5%        | 13.8%         | 2.6%   |
|   | Desert         | 81.9%        | 82.3%         | 0.5%   |
|   | Recreation     | 1.2%         | 1.2%          | 0.0%   |
|   | Urban          | 3.4%         | 2.7%          | -21.5%   |
|   | Total          | 100.0%       | 100.0%        |  |
| 1975  | Agricultural   | 16.0%        | 16.0%         | 0.0%   |
|   | Desert         | 74.2%        | 74.1%         | -0.1%  |
|   | Recreation     | 3.3%         | 3.3%          | 0.1%   |
|   | Urban          | 6.5%         | 6.6%          | 1.5%   |
|   | Total          | 100.0%       | 100.0%        |  |
| 1995  | Agricultural   | 11.4%        | 11.3%         | -1.2%  |
|   | Desert         | 66.7%        | 66.4%         | -0.5%  |
|   | Recreation     | 4.7%         | 4.4%          | -6.1%  |
|   | Urban          | 17.2%        | 18.0%         | 4.2%   |
|   | Total          | 100.0%       | 100.0%        |  |

TABLE 5. Land Use per Year (km<sup>2</sup>)

|                         | 1912   | 1934   | 1955   | 1975   | 1995   |
|-------------------------|--------|--------|--------|--------|--------|
| Total Land Area         | 11,452 | 11,452 | 11,452 | 11,452 | 11,452 |
| Total Agricultural Area | 1,026  | 1,792  | 1,583  | 1,837  | 1,293  |
| Total Desert Area       | 10,406 | 9,551  | 9,424  | 8,486  | 7,599  |
| Total Recreational Area | 0      | 61     | 139    | 378    | 502    |
| Total Urban Area        | 20     | 47     | 306    | 751    | 2,058  |
| Urban from Agricultural | 0      | 27     | 213    | 178    | 547    |
| Urban from Desert       | 20     | 0      | 45     | 268    | 760    |
| Urban from Recreational | 0      | 0      | 0      | 0      | 0      |
| Urban from Urban        | 0      | 20     | 48     | 305    | 751    |
| Total New Urban Area    | 0      | 27     | 259    | 445    | 1,307  |

### Change in Urban Land Sources New Urban Areas Only

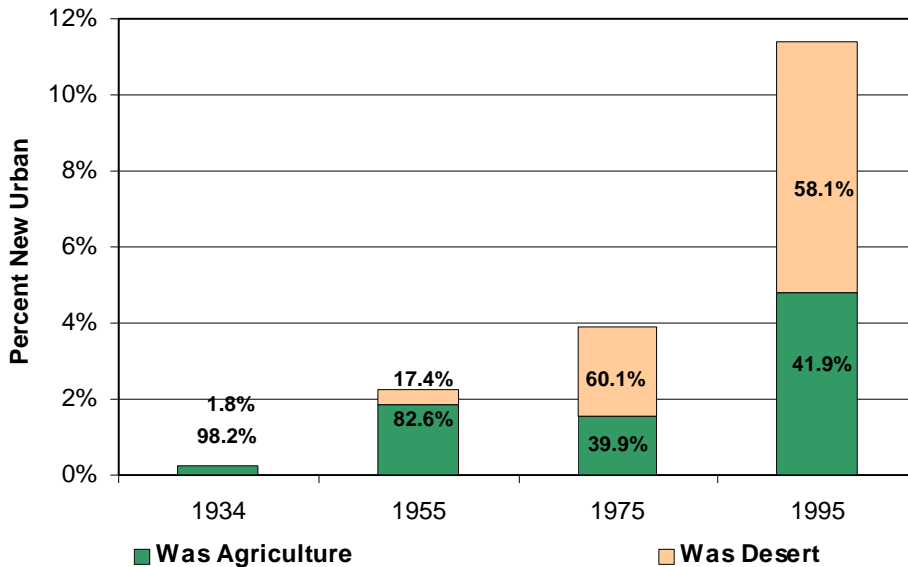


FIG. 1. Change in urban land sources; new urban areas only.

## Change in Urban Land Sources

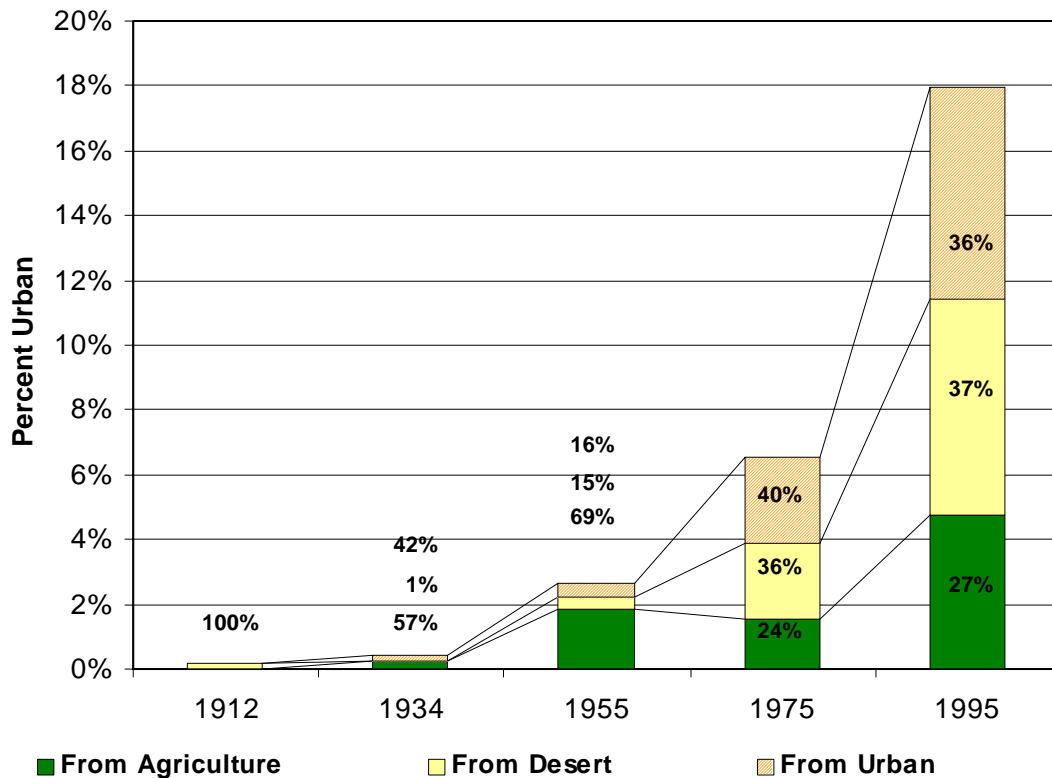


FIG. 2. Change in urban land sources.

## PHASE II PLANNING

Work has begun on Phase II of the Historic Land Use Project. Phase II involves a more in-depth analysis of land use for specific sites, times, and scales; indeed our time frame for completion of this project is open. In Phase I we produced a land-use classification system specific to the needs of CAP LTER and are meeting with other CAP LTER researchers to determine their requirements. In Phase II we will expand the number of land-use categories (see Table 6), monitor changing use of every land parcel for 1 km<sup>2</sup> according to the overall LTER extensive sampling strategy.

TABLE 6. Land-Use Classes for Phase II (Modified from Anderson et al. 1976, American Planning Association Research Department 1998, Maricopa Association of Governments 1995).

|  |                            |
|--|----------------------------|
| 1. Urban or Built-Up Land                                      | C. Orchards                |
| A. Residential   | D. Feeding Operations      |
| 1. Small Lot (>5 and <=15 dwelling units per acre)             | E. Horse Ranches           |
| 2. Medium Lot (>2 and <=5 dwelling units per acre)             | F. Other Agricultural      |
| 3. Large Lot (>1 and <=2 dwelling units per acre)              | 4. Water                   |
| 4. Rural (<= 1 dwelling unit per acre)                         | A. Streams, Rivers, Canals |
| 5. High Density (>15 dwelling units per acre)                  | B. Lakes                   |
| B. Non-Residential   | C. Reservoirs              |
| 1. Institutional (schools, churches, public facilities, etc.)  | 5. Riparian Zone           |
| 2. Commercial (malls, office buildings, etc.)                  | A. Vegetated               |
| 3. Industrial (landfill, utility power stations, etc.)         | B. Un-vegetated            |
| 4. Mining  | 6. Transportation          |
| 5. Large Assembly Areas (includes stadiums, fairgrounds, etc.) | A. Highway                 |
| C. Graded, under construction                                  | B. Major Roads             |
| 2. Open  | C. Streets                 |
| A. Golf Course   | D. Airport                 |
| B. Parks   | E. Railroad                |
| C. Vacant  |                            |
| D. Dedicated   |                            |
| E. Natural   |                            |
| 1. Forest  |                            |
| 2. Desert  |                            |
| 3. Agricultural Land   |                            |
| A. Cropland  |                            |
| 1. Active Cropland   |                            |
| 2. Fallow Cropland   |                            |
| B. Pasture   |                            |
| 1. Active Pasture  |                            |
| 2. Fallow Pasture  |                            |

Note: Ambiguous uses default to more general level category

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## LIST OF CONTRIBUTIONS

- No. 1. Historic Land Use: Phase I Report on Generalized Land Use. *Authors:* Kim Knowles-Yáñez, Cherie Moritz, Jana Fry, Charles L. Redman, Matt Buccchin, and Peter H. McCartney. August 1999.