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**The University of California  
Transportation Center**

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**Vance's Commuting Analysis Extended to  
The Suburban Southwest:  
Tempe, Arizona**

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Reprint, No. 67

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The University of California Transportation Center  
University of California at Berkeley

## Abstract

James E. Vance, Jr., (1960) showed that a community's character evolves as metropolitan intraurban transportation and local employers' labor needs change. Commuting patterns define a community's laborshed, the area from which employees are drawn, and employment field, the area in which residents work. This Tempe, Arizona, study demonstrates the applicability of Vance's concepts to present-day inner suburbs in Southwestern metropolitan areas using two modern procedures, a geographic information system analysis and sampling from employee commuting surveys collected by the metropolitan travel reduction program. While data availability may limit comparative studies, Tempe's 1990 extensive laborshed and smaller employment field reveal that this suburb is both a bedroom community and a satellite employment center.

Vance's Commuting Analysis Extended to the Suburban Southwest:  
Tempe, Arizona

Over thirty years ago the noted urban and transportation geographer, James E. Vance, Jr., examined daily commuting patterns in his seminal article, "Labor-shed, employment field, and dynamic analysis in urban geography" (Vance, 1960). His approach linked place characteristics and intraurban transportation modes. Vance confirmed the evolving mismatch between local employers' labor needs and local residents' employment characteristics with an 1882-1951 case study of Natick, Massachusetts, a Boston suburb with a nineteenth-century factory employment base.

This mismatch of jobs and housing is an essential cause of present-day suburban traffic congestion in United States metropolitan areas. Metropolitan commuting now focuses on suburb-to-suburb flows. This commuting pattern is twice the size of the historic suburb-to-central city pattern (Pisarsky, 1987). The lack of transit alternatives and nearby affordable housing reinforces use of automobiles for commuting.

This paper demonstrates the value of reexamining and extending Vance's method of dynamic commuting analysis as a component of current urban transportation geography. This case study location, Tempe, Arizona, an inner suburb and major employment center in metropolitan Phoenix, demonstrates this approach's applicability to Southwestern metropolitan areas. Vance's concepts lead to insights about the appropriate way to treat commuting information in a

geographic information system. Finally, conclusions about the character of inner suburbs confirm the importance of expanded procedures for suburban commuting analysis, especially as part of local travel reduction programs.

### I. Current Commuting Analysis

Geographic inferences about changing urban structure have long been rooted in knowledge of urban transportation. Hodge notes that this knowledge is commonly presented in "a model of technological determinism" which links evolving transportation modes to changes in urban form (Hodge, 1990). In this way, increased mobility from automobile availability is credited with expanding the extent of the modern metropolis. The new realities of metropolitan structure require increased emphasis on urban social and political relations, however. The spatial mismatch between jobs and workers is growing. The suburbanization of employment, the relative loss of importance of the central business district as a work destination, and typical commuting trips from suburb-to-suburb rather than from suburb-to-central city reflect this broad shift from a single-centered area to a multi-centered metropolis (Pisarsky, 1987).

In this context, the journey-to-work emerges as a mediating link between workplace and residence, areas of production and consumption, for workers with diverse characteristics and dispersed employers with specific labor needs. Disaggregate research on the employee's access to employment focuses on worker gender, racial, socioeconomic, automobile accessibility, and household characteristics (Rutherford and Wekerle, 1988). If a particular

labor force is not available, however, the urban transportation issue is one of an employer's access to labor. For example, suburban employers may provide private transit for their unskilled, central city workers (Hodge, 1990). When this situation is extended to multiple employers in the same region of a metropolitan area, suburban jurisdictions can find that their local employers expect increased public transit as a local service provided in return for employer taxes. Local employer transportation needs are yet another example of the existing intra-metropolitan competition between places for social groups, tax ratables and economic advantage.

## II. Vance's Approach

These complementary aspects of the current journey-to-work are explicitly examined in the historical urban transportation research of James E. Vance. While his writings are part of the technological tradition, his work focuses on how people interact as transportation technology is altered (Newman and Hogan, 1981). Rather than a narrow preoccupation with travel mode, time, or distance, he shows how a single town near Boston, Natick, Massachusetts, evolves from a self-contained housing and labor market to function as a metropolitan suburb (Vance, 1960). His later studies of nineteenth century American mill towns and 1851 industrial Birmingham, England, identify the varying association of residence and workplace for specific employers and their workers as well as the emergence of a generalized housing market in industrial cities (Vance, 1966; Vance, 1967).



Vance's Natick article established his view of urban geography as a field that should move beyond idiographic studies and identify the dynamic forces that shape city growth and organization over time (Vance, 1960). While he states that "...commuting is essential to the function of an urban complex" (1960, 196), he focuses on the characteristic separation of production and residence in the modern metropolis that requires daily commuting. Moreover, he emphasizes that internal urban circulation involves not only a pattern of daily movement but depends on the historical state of intraurban transportation technology. These broad concepts are the basis for explaining the growth of United States urban areas as a cumulative process within an evolving, industrialized society.

Vance starts his analysis of urban structure by identifying three general components. The essential elements are zones of conflux, which are the focus of movement by large numbers of people for employment, shopping, and recreation. The initial industrial or commercial zone of conflux is the original site where historic economic conditions fostered the city's formation. Dependent areas, zones of dispersion, are the expanding residential areas of the central city and its surrounding communities. They are located as near or far from zones of conflux as the prevailing means of intraurban transportation allows. The third and final element, internal urban circulation, connects these zone of conflux and zones of dispersion. Vance conveys an active image of daily commuting, "... this tide-like movement to and from work," (196)

of all regular movements of large groups of people within urban areas.

Historically, satellite cities within the outlying zones of dispersion provided dispersed employment. While the initial zone of conflux contains the original business and industrial centers, the expansion of employment proceeded in one of two ways. Commercial uses competed with nearby residential areas for land and expanded by accretion, while manufacturing users expanded on multiple, dispersed sites. These early, separate sites became self-contained centers with employees drawn from nearby areas. Suburbs emerged whose population served several satellite and central city zones of conflux; multiple lines of circulation linked these zones.

Vance viewed the city "as a product of forces working to align zones of dispersion in predictable relationship to zones of conflux ..." (200). The well-known term, "laborshed," identifies the area from which a zone of conflux, whether a single factory or an employment district, draws its workers. However, Vance contributed his own term, "employment field," to identify "the area in which residents from a particular zone of dispersion work" (200). The employment field includes worksites inside and outside any specific city with changing transportation modes and metropolitan employment opportunities. Similarly, a laborshed includes areas inside and outside the city from which employees are drawn to specific local worksites and evolves with changes in local employment.

The case study of Natick, Massachusetts, demonstrates the

interdependent evolution of a community's laborshed and employment field under the impact of changes in intraurban transportation technology. Natick was an early shoe-manufacturing center seventeen miles west of Boston that remained a separate satellite community until the 1880s. Employees were drawn from the town and immediate farming areas. Data from city directories and 1951 fieldwork allowed mapping of 1882, 1897, 1915, 1931, and 1951 residents' occupations and place of employment. By 1882, a decrease in local factory employment and an increase in commuting to Boston occurred. The employment field extended east to Boston and slightly west along the Boston and Albany Railroad line established in 1834. By 1915, a more extensive employment field based on trolley lines connected Natick to three southern towns with industrial employment. By 1931, the trolley lines had been abandoned and automobile commuting widely expanded Natick's employment field.

By 1951, the local laborshed covered an area approximately half the 1,189 square miles of Natick's extensive employment field which included the urbanized area of metropolitan Boston. This comparison confirms Natick's evolution from a self-contained satellite to suburban status. Local population increases after World War II did not support local employment. Rather, employment declined locally and required automobile commuting to the existing employment centers of Boston and emerging suburban employment centers.

Vance's later writings expand the findings on increased

intraurban mobility shown by this early analysis. In general, "... the automotive era has witnessed the creation of a functional unit tied together by intimate daily contacts of one part of the periphery with another as well as the perpetuation of old ties between the periphery and the core" (218). This spatially extensive framework historically provided significant private benefits (Vance, 1971). Employers sought the most advantageous sites for their activities without concern for an adjacent labor force. Residents placed highest priority on their location in metropolitan social space and adjusted their worksite locations through not-too-onerous daily commuting. As metropolitan areas grew beyond the reach of daily interaction for all residents, urban realms emerged, where everyday living needs are met (Vance, 1990). Few workers other than administrative-support workers needed to commute to the central business district or other office locations outside their urban realm.

### III. Travel Reduction and Commuting in the Suburban Southwest

Southwestern metropolitan areas provide a dramatic contrast with the historic conditions that shaped suburban Natick. Their rapid metropolitan population growth reflects the population and employment decentralization occurring in all regions of the United States (Frey and Speare, 1988). West-Young metropolitan areas, defined as Sacramento, San Diego, San Jose, Phoenix, Riverside and Anaheim, showed a 35.7% population increase, 1970-1980. This same grouping had a 1970-1980 4.4% increase in suburban workers, an increase greater than the 2.8% suburban population increase (Frey

and Speare, p. 383). In 1980, 54.7% of the workers and 61.9% of the population in West-Young cities were in the suburbs.

Population densities declined in a number of these West-Young metropolitan areas since 1940 (Burns and Hawley, 1989); aggregate commuting patterns confirm their automobile dependence and limited transit availability. In 1980, their largest commuting flow was suburb-suburb (72.4%), a value slightly larger than the central city-central city flow (72.2%) and considerably larger than the traditional suburb-central city flow (27.6%) and the reverse commute, central city-suburb (27.6%) (Frey and Speare, 418). Only 1.5% of 1980 suburb-suburb commutes were by public transit in West-Young metropolitan areas. This percentage is similar to the 2.3% of suburb-suburb commutes by transit in North-Declining areas, a grouping that includes New York, Philadelphia, Boston, Cincinnati, St. Louis, Buffalo, Chicago, Newark, Cleveland, Detroit, Milwaukee, Pittsburgh, and Peterson. However, 42.7% of all central city-central city commutes in these older areas were by transit, while the same commute flow in West-Young areas was only 3.6% by transit. Suburb-central city commutes show the same disparity in transit use, with 25.3% using transit in North-Declining areas compared with 2.8% in West-Young areas (Frey and Speare, 419).

While these trends are generally understood, their interpretation is subject to considerable debate. Declining commuting times in the nation's twenty largest metropolitan areas may be the result of many individual adjustments of home, workplace, and commuting mode and route that collectively mitigate

congestion and aggregate travel time (Gordon, Richardson, and Jun 1991). This viewpoint suggests that these long-term aggregate trends in metropolitan decentralization largely resolve themselves through multiple individual behavior and location choices.

An alternative viewpoint finds the present growth in urban trips of all types, air pollution from automobile dependence, and localized congestion unacceptable. Major southwestern metropolitan areas recently instituted commuting travel reduction programs in an effort to limit the growth of motor vehicle travel and to improve urban air quality. Metropolitan travel reduction programs for employers with 100 or more employees are mandated in Los Angeles (1987), Phoenix (1988), and Tucson (1988). Their purposes include reducing single occupant vehicle commuting and peak-hour congestion and increasing the use of alternate transportation modes, work at home, and flexible work schedules.

Current travel reduction programs attempt to provide short-term solutions to long-standing urban conditions. Vance noted that the present metropolitan mismatch between housing and employment location is likely to persist. "... So long as housing for workers rests on the initiative of private developers, it can hardly be expected that the location of that housing will result from causes other than minimum development costs" (Vance, 1960, 207). Interestingly, travel reduction programs expand employer responsibility for their employees non-work lives, a reversal of the historic trend that creates separate urban housing and employment markets. If employee commute mode choice becomes an

employer's concern, potentially, employer responsibility can be extended to employee residential choices and even an obligation to house workers. Over time, a city's employment field could decrease in size as more local residents have local employment.

#### IV. Improved Suburban Commuting Analysis

Travel reduction programs provide an unexpected source of commuting data appropriate for identification of present-day suburban laborsheds and employment fields. Programs that mandate baseline commuting data from individual employees are most useful for this purpose. Ideally, these programs use a common survey instrument, keep the data in unaggregated form, and develop large data sets with extensive employee information, including residential origin and worksite destination.

While these employee surveys do not constitute a census or a true random sample, they are a very large sample of a major portion of the commuting population. They provide a baseline level of commuting information collected before employers implement travel reduction measures such as preferential fees for carpools and subsidized bus passes. Yearly surveys allow future monitoring of aggregate change in commuting modes for individual employers and for the metropolitan region.

Geographic information system analysis procedures strengthen commuting analysis using this data. Additional information can be added to each employee's data records, such as local transit availability at the residential origin and worksite destination. A geographic information system can display the intrametropolitan

distribution of residential and workplace locations and links each employee's survey data with that individual's origin and destination. Laborsheds and employment fields can then be aggregated for particular jurisdictions or metropolitan subregions and for single or multiple employers.

The complex commuting situation found in inner suburbs in Southwestern metropolitan areas illustrates this approach. These suburbs have substantial residential populations, increasing employment, and congestion from local and regional travel. Metropolitan Phoenix shares the characteristics of other West-Young metropolitan areas, but its large central city, Phoenix, results in higher than average travel times for all four types of commuter flow (Frey and Speare, 1988, 423). Although automobile travel times increased slightly from 1980 to 1985, this change is not statistically significant (Gordon, Richardson, and Jun, 1991). Tempe abuts Phoenix on the southeast. This inner suburb has a 1990 141,900 population and approximately 28,700 employees working for firms with over 100 employees.

Tempe residents and employers were identified through sampling of the Maricopa County Travel Reduction Program 1989-1990 employee surveys. Approximately 290,000 employees completed the survey, a high 82% response rate (Maricopa County Travel Reduction Program, 1990). Respondents identified their residential origin and worksite destination by major cross street locations. Survey questions included commute distance and time, job scheduling, gender, occupation, and current travel mode, but did not include



commuting route information.

Research use of the employee surveys at the time of this study was subject to employer approval; the Travel Reduction Program had not completed its first year of operation. A metropolitan sample of 2,715 employee surveys was collected after a cluster sample approach identified twenty-five participating employers. Seven of the largest employers (over 10,000 employees) agreed to participate. Eighteen smaller employers were identified by sampling proportionate to employer size.

When the employee data was entered into the IBM Geographic Facilities Information System (GFIS), 20% of the surveys could not be used. The most common errors involved inaccurate or missing cross street information. Local transit availability within a half mile of the employee residence and worksite was added to each employee's record to show the possibility of commuting by bus. The commute mode split is calculated as the sum of one-way trip miles times the number of days worked by each employee. As a result, the variety of commute modes used on a weekly basis is accurately reported, for example, for employees who drive alone three times a week and carpool two working days.

This study uses a spatially-extensive definition of laborshed and employment field. Each area is defined by connecting the most distant points that define the area. In the case of the city's laborshed, this area includes all residential locations of an employee outside Tempe who works in Tempe. In the case of the city's employment field, this area includes all worksites outside

Tempe where a Tempe resident works. This approach shows the fullest extent of the suburb's laborshed or employment field, while not reflecting the internal density or the distribution of residents and workplaces. While this density is apparent from the mapped concentrations of individual residence and workplace locations, an alternative approach could show isolines of residential or workplace density.

These procedures result in defining Tempe's laborshed and employment field as follows: Tempe's laborshed contains nine worksites for six employers with 318 employees. The employment field includes 44 worksites for 22 employers serving 233 sampled Tempe residents.

#### V. Tempe, Arizona

The extensive laborshed of 431.35 square miles from which Tempe draws its workers is nearly twice as large as the more limited employment field of 230.73 square miles to which Tempe residents commute (Table 1). This suburb's ability to attract employees widely from the metropolitan area is reflected in differing average commute distances in the laborshed and employment field. Employees traveling to Tempe have a longer average commute (one way) in the laborshed (10.29 miles) than commuters in the employment field (8.82 miles).

The high percentage of single occupant drivers in both the laborshed and employment field (83.1% and 83.9%) shows the limited commuting mode alternatives available in this low-density metropolitan area (Table 2). Differences emerge, however, in the

mode choice of non-single occupant drivers. Carpooling predominates over bus use. Employees working at Tempe sites carpool at a higher rate (12.7%) than the 9.5% rate of Tempe residents in the employment field. The higher percentage of bus use in the employment field (3.6%), however, contrasts strongly with the low bus use (0.5%) in the laborshed. Metropolitan Phoenix bus service has a traditional route and service frequency structure that emphasizes express and local routes from the suburbs, including Tempe, to employment in and west of downtown Phoenix and the State Capitol office complex, eight miles west of Tempe. The number of routes and service frequency to suburban employment and other major activity sites are limited.

#### Laborshed

Tempe's laborshed clarifies its regional role as a suburban employment center with an inner metropolitan work location (Figure 1). This pattern reflects the city's present distribution of worksites. Major employment is located near the city's northern historic core and accessible sites north (Salt River Project) and south (Arizona State University) of the Salt River channel. Other employers locate near the north-south Interstate 10 freeway corridor on the city's western border. Low bus availability confirms the difficulties of reaching Tempe's employment sites from dispersed residential locations.

The laborshed shows sectoral bias in employee residential patterns toward the East Valley portion of the larger metropolitan region. This urban realm includes the suburbs of Tempe, Meas,

Chandler, Gilbert and Apache Junction that linked along the east-west Superstition Freeway. Rapid population growth since the 1960s increased their combined 1990 population to over 568,700. Limited commuting occurs from nearby residential areas to the north in east Phoenix and Scottsdale.

The laborsheds of specific Tempe employers vary. The main campus of Arizona State University is an attraction for many employees who live in Tempe and strengthen the city's "college town" character (Figure 2A). Only 66% of the employees commute by single occupant vehicle; others use carpools, bicycles, and walking to reach campus. Campus commuters are also drawn from east Phoenix and Scottsdale to the north and nearby East Valley suburbs. A contrasting General Semiconductor site in west Tempe draws employees more widely from the metropolitan area (Figure 2B). Commuting mode choices are single occupant driver (86.0%) and carpool (9.5%). As this site has no transit access, employees have limited commuting options.

#### Employment Field

Tempe's employment field identifies this city's role as a suburban bedroom community with multi-modal access to local worksites and central metropolitan destinations (Figure 3). While Tempe residents work at sites within the city and immediately to the south and east, strong flows occur between Tempe and more distant locations. These worksites include offices of the City of Phoenix and Maricopa County located in Phoenix's central business district and the State of Arizona governmental complex. Employee

bus use and carpooling reflects express bus service and the efforts of these large public employers to reduce single occupant vehicle travel.

Other distant worksites are concentrated near Interstate 17 that runs north-to-south through metropolitan Phoenix. These destinations show the regional importance of freeway access for suburban commuting trips taken into more congested metropolitan locations. Worksites in the total employee sample at greater distances and without transit service or freeway access are not regular destinations for Tempe commuters.

#### VI. Implications for Commuting and Inner Suburbs

Laborshed and employment field components of commuting flows reveal two urban roles that an inner suburb can serve in a metropolitan area. Tempe is a residential community with multi-modal access to local worksites and to more distant locations in congested central Phoenix. This suburb is also an employment center providing an inner metropolitan work location for local residents and residents of nearby but outer suburbs traveling, on the average, longer distances. This employment field clearly locates Tempe as part of an East Valley urban realm in metropolitan Phoenix.

In Tempe, differences in commute mode and average commute miles traveled reflect asymmetrical laborshed and employment field areas. Moreover, these patterns reflect spatial differences in metropolitan transit availability. Travel to more congested, inner metropolitan worksites involves shorter worktrips that are more

likely to involve public transit. Longer worktrips from distant residential locations without transit access are more dependent on ridesharing as an alternative to single occupant commuting.

Tempe's large laborshed and small employment field show the influence of unique suburban employers such as Arizona State University. Specialized employment opportunities in inner suburbs attract commuters from throughout the metropolitan area, expand a suburb's laborshed, and lengthen the average commute distance. Conversely, the limited employment field is spatially concentrated, but provides access to a large number of worksites with a smaller average commute distance. Inner suburbs in other Southwestern metropolitan areas are likely to provide similar commuting choices.

#### VII. A Recommendation for Place-based Commuting Analysis

As more metropolitan employment locates in suburban worksites, commuting behavior within and across jurisdictional boundaries becomes increasingly complex. Vance's concepts of laborshed, employment field, and urban realm allow geographers to focus on the character of individual communities and to examine community types, such as inner suburbs.

The Tempe study extends these concepts to demonstrate the value of this type of suburban commuting analysis in present-day metropolitan areas. These disaggregate commuting analysis methods can explore additional implications of commuting patterns with relatively little difficulty. The full range of commuting analysis possible using a geographic information system is only suggested here. Specifically, commuting mode preferences can be mapped to

identify clusters of potential carpool and bus users and assist in travel reduction planning. Inner suburbs often experience high levels of through travel on their local streets and freeways. Their travel reduction concerns include maintaining the accessibility of local employers through improved transit access, limiting congestion at specific worksites, and retaining the present range of commuting choices that residents now experience.

Finally, the similarity of these findings to the situation of other inner suburbs bears investigating. Not all urban areas have appropriate data sets available, however. Comparative studies analyzing commuting for inner suburbs in other Southwestern metropolitan areas are more likely to be limited by difficulties in data gathering than issues of technical method.

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Table 1. 1990 Laborshed and employment field

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	Laborshed	Employment Field
Area (square miles)	431.35	230.73
Average commute distance in miles (one way)	10.29	8.82

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Table 2. Commute mode split

	Laborshed		Employment Field	
	Number	Percent	Number	Percent
Single Occupant Driver	13594	83.1	8540	83.9
Bus	76	00.5	361	03.6
Carpool	2071	12.7	969	09.5
Bicycle	164	01.0	73	00.7
Walk	30	00.2	30	00.3
Motorcycle	186	01.1	166	01.6
Vanpool	0	00.0	0	00.0
Other	233	01.4	40	00.4
Total	16354	100.0	10179	100.0

Figure 1. 1990 Laborshed

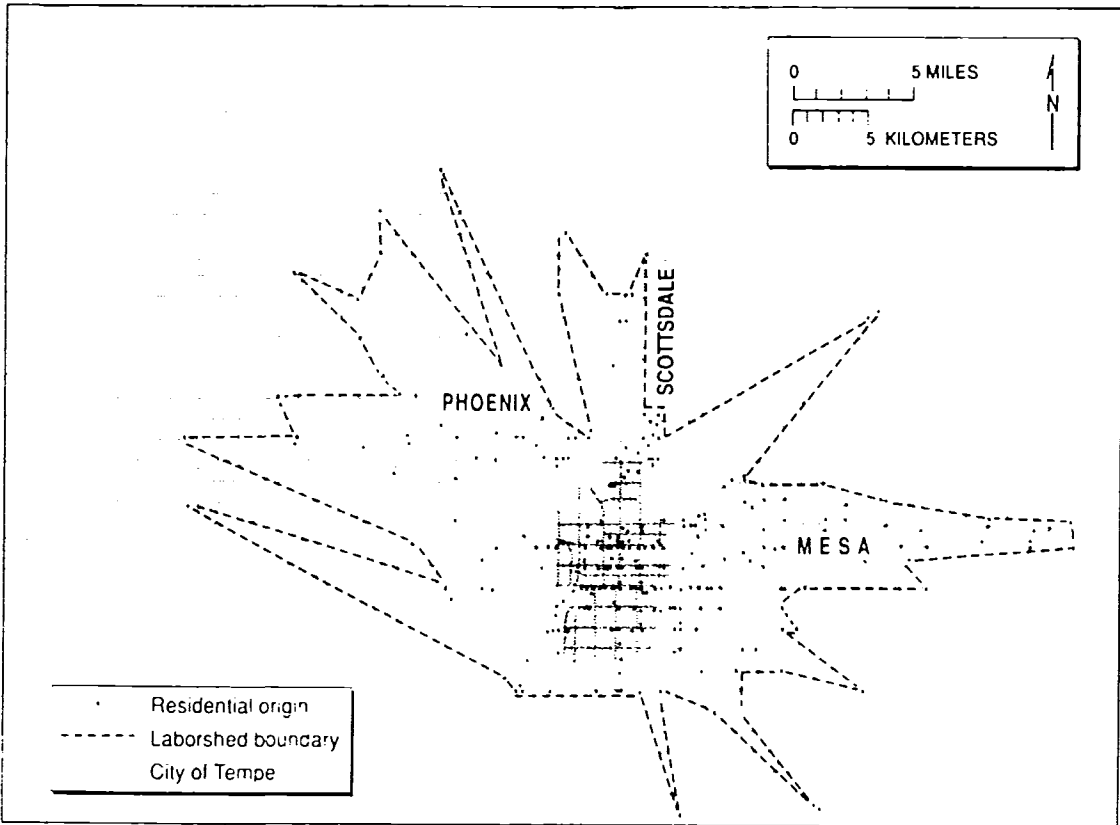


FIGURE 1

Figure 2. Employer Laborsheds

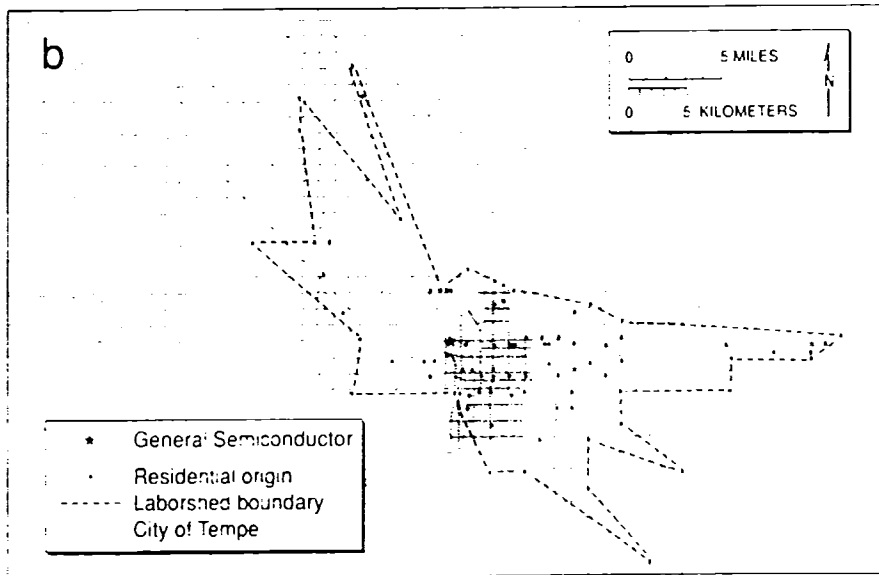
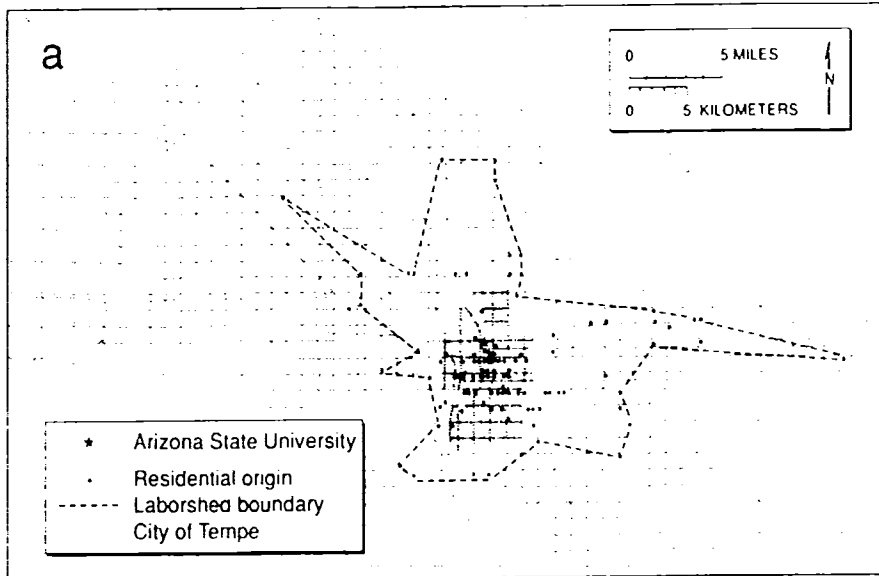


Figure 2

Figure 3. 1990 Employment Field



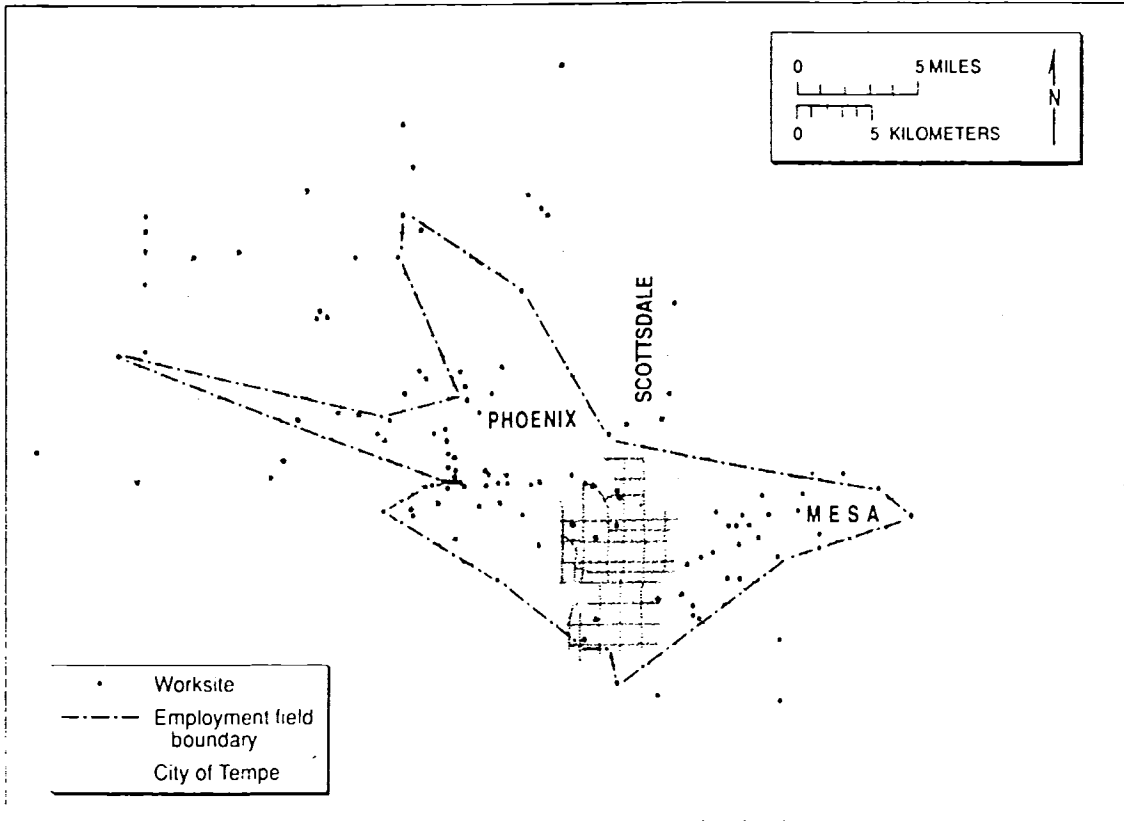


Figure 3

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