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NATIONAL COOPERATIVE
HIGHWAY RESEARCH PROGRAM REPORT

323

**TRAVEL CHARACTERISTICS AT
LARGE-SCALE SUBURBAN ACTIVITY
CENTERS**

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SUBJECT: National Cooperative Highway Research Program Report 323
Travel Characteristics at Large-Scale
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Final Report on Project 3-38(2) of the FY '87 Program.

I am enclosing one copy of the final report resulting from research conducted by JHK & Associates, Alexandria, Virginia. In accordance with the selective distribution system of the Transportation Research Board, all persons who have selected the transportation mode and subject areas listed below will receive copies of this document.

The NCHRP staff has provided a foreword that succinctly summarizes the scope of the work and indicates the personnel who will find the results of particular interest. This will aid in the distribution of the report within your department and in practical application of the research findings. These findings add substantially to the body of knowledge concerning trip generation and travel characteristics as they relate to suburban activity centers.

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
REPORT

323

TRAVEL CHARACTERISTICS AT LARGE-SCALE SUBURBAN ACTIVITY CENTERS

KEVIN G. HOOPER
JHK & Associates
Alexandria, Virginia

RESEARCH SPONSORED BY THE AMERICAN
ASSOCIATION OF STATE HIGHWAY AND
TRANSPORTATION OFFICIALS IN COOPERATION
WITH THE FEDERAL HIGHWAY ADMINISTRATION

AREAS OF INTEREST

Planning
Forecasting
Facilities Design
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(Highway Transportation)

TRANSPORTATION RESEARCH BOARD
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OCTOBER 1989

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway and Transportation Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board of the National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as: it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state, and local governmental agencies, universities, and industry; its relationship to the National Research Council is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the National Research Council and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are the responsibilities of the National Research Council and the Transportation Research Board.

The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

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NOTICE

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The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation officials, or the Federal Highway Administration, U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical committee according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

Special Notice

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FOREWORD

*By Staff
Transportation Research
Board*

The research findings of this report will be of special interest and use to transportation planners and engineers responsible for analyzing and evaluating the traffic impacts of large-scale multiuse suburban activity centers (SACs). Travel survey data-collection instruments and field traffic studies of person and vehicle counts were used at six geographically representative SAC sites. Analyses of the extensive database have led to the development of up-to-date data on trip characteristics of SACs. A series of relationships, between individual building characteristics and general SAC site characteristics, are presented in 43 tables for use by the analyst. Knowledge of these many relationships will make possible the analysis of site impact of individual buildings, the regional traffic impact of SACs, and the internal trip characteristics of SACs.

The database developed in this research has been prepared in microcomputer, IBM-compatible format to facilitate further analysis, supplementation, and on-going distribution. It has been made available to the Institute of Transportation Engineers (ITE), 525 School Street, S.W., Suite 410, Washington, DC 20024-2729. The database will be used by ITE staff and the ITE committees responsible for the ITE informational report, *Trip Generation*. Furthermore, ITE plans to make the database available to the profession for research and other uses. Readers interested in the database should contact ITE directly.

Suburban activity centers (SACs), consisting of a multiplicity of elements such as office buildings, retail sites, and hotels, constitute some of the fastest growing segments of our urban areas. From modest beginnings in the period after World War II, SACs have grown to the point where they rival the central business districts in some of our major cities. The rapid development of SACs in the 1970's and 1980's has created questions in the transportation profession as to how best they may be analyzed and planned.

Although there are well-defined procedures for analyzing regional development patterns, and similarly there are basic procedures for conducting traffic impact studies, the magnitude and nature of the SAC is such that it does not lend itself to either of these traditional approaches. The regional transportation study process is geared to a large area with the goal of establishing regional or areawide needs such as freeways, major arterials or transit system needs. At the opposite end of the spectrum, traffic impact studies usually focus on the individual building site and concern themselves largely with operational matters such as location of entrances and exits, need for signalization, or upgrading of intersections. Suburban activity centers, because of their location, size, components, and supporting transportation elements, require a well-defined and accepted analysis procedure distinct from one required for either a region or specific building site.

The lack of a defined analytical process and the continued growth in SACs has focused the attention of both public and private sectors on how SACs impact the transportation system. Better understanding of the impacts requires an extensive

database and the development of analysis procedures based on the data. An extensive database on SACs was recognized as a high priority need at an NCHRP workshop to develop a program of research in "Traffic Management and Operations," conducted in Baltimore, Maryland, in March 1986. NCHRP Project 3-38(2), "Travel Characteristics of Large-Scale Suburban Activity Centers," was initiated in response to this need. The firm of JHK & Associates, Alexandria, Virginia, carried out the research. Representative trip generation rates and other travel characteristics were formulated for use in analyzing the traffic impacts of various types of large-scale multiuse SACs on the transportation system.

This report presents the results of a comprehensive survey conducted at a total of 60 office buildings (23 of which are larger than 300,000 gross square feet), at 24 retail sites (including seven regional malls), at 15 hotels, and at 18 residential complexes. Person and vehicle counts were obtained at each building. Workplace surveys were distributed to more than 38,000 employees within the six SACs surveyed. Intercept surveys were conducted at the retail and hotel sites. Daily trip diaries were distributed to the residential complexes. The collected data were used to develop 43 tables, which depict important relationships in site impact evaluation.

The database resulting from this project has been analyzed, and the results presented in this report should substantially advance the state of the art in determining SAC travel characteristics, in our procedures for analyzing traffic impacts of new SACs, and in our planning of traffic control measures for existing SACs.

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ACKNOWLEDGMENTS

The research reported herein was performed under NCHRP Project 3-38(2) by JHK & Associates and Urban Mobility Corporation. JHK & Associates was the contractor for this study. The work undertaken at Urban Mobility Corporation was under a subcontract with JHK & Associates.

Mr. Kevin G. Hooper, Senior Associate, JHK & Associates, was the Principal Investigator and primary author of this report. The research was conducted under the general supervision of Mr. Hooper with the considerable assistance of Mr. Kenneth Orski, President of Urban Mobility Corporation, and of the following JHK employees: Ms. Sandra M. Woods, Transportation Engineer (now with the Puget Sound Council of Governments); Mr. Paul L. Gettel, Programmer; Mr. Aris G. Drakopoulos, Transportation Engineer (now with the Maryland-National Capital Park and Planning Commission); Mr. Jose D. Ojeda, Trans-

portation Engineer; Ms. Joan A. Jenkins, Transportation Planner Assistant; and Mr. Sergio E. Denegri, Transportation Technician. Special recognition should be given to Mr. David B. Bowman, Word Processor, for his tireless efforts to complete the text and the dozens of tables contained in this report.

During the course of the research effort, several individuals employed with local agencies at the survey sites provided considerable assistance in facilitating the field data collection effort. These individuals also merit recognition: Mr. Donald Samdahl, City of Bellevue; Ms. Diane Pritchett, South Coast Metro Alliance; Mr. Douglas Wiersig, City of Dallas; Mr. Brian Bochner, Barton-Aschman Associates; Mr. David Kirk, Atlanta Regional Commission; and Mr. Clarence Shallbetter, Improve-494.

TRAVEL CHARACTERISTICS AT LARGE-SCALE SUBURBAN ACTIVITY CENTERS

SUMMARY

In the 1950s and 1960s extensive trip-characteristics data were collected for metropolitan activity centers, primarily the central business district (CBD). Currently, there is a lack of up-to-date information on travel characteristics of activity centers, particularly the large-scale, multi-use suburban centers that have been developed recently. To effectively analyze the traffic impacts of these activity centers and to take rational congestion-reducing actions, new trip data are required. These data include trip generation rates, travel modes, trip purpose, trip length, parking characteristics, pedestrian activity, capture rate (i.e., proportion of trips attracted to the development from traffic normally passing by the site), vehicle movements within the activity center, hourly variations, and vehicle occupancy.

The objective of NCHRP Project 3-38(2) was to develop a comprehensive data base on travel characteristics for various types of large-scale, multi-use suburban activity centers. In fulfillment of this objective, representative trip generation rates and other travel characteristics were determined for use in analyzing the traffic impacts of such activity centers on the transportation system.

Travel characteristics data were collected at six large-scale suburban activity centers (SAC): Bellevue, located 10 miles east of the Seattle CBD; South Coast Metro, located in Orange County 45 miles south of the Los Angeles, California, CBD; Parkway Center, located 10 miles north of the Dallas CBD; Perimeter Center, located 12 miles north of the Atlanta CBD; Tysons Corner, located 12 miles west of the Washington, D.C., CBD; and Southdale, located 10 miles south of the Minneapolis CBD.

The following table provides a description of their sizes in terms of the magnitude and mix of office and retail space.

<i>SAC</i>	<i>Office Space (million sq ft)</i>	<i>Retail Space (million sq ft)</i>
Bellevue	4.7	3
South Coast Metro	3.5	4
Parkway Center	17	7
Perimeter Center	13	2
Tysons Corner	13	3
Southdale	4	3

Bellevue, South Coast Metro, and Southdale are all roughly the same size and have a relatively even split of office and retail space. These three SACs are termed "small" SACs in subsequent analyses. Perimeter Center and Tysons Corner are much larger and dominated by office space. Parkway Center is even larger and, with its three regional malls, has by far the greatest amount of retail space of the SACs surveyed. The latter three SACs are referred to, in subsequent text, as the "large" SACs.

Data were collected at a total of 60 office buildings (23 of which are larger than 300,000 gross square feet), at 24 retail sites (including 7 regional malls), at 15 hotels,

and at 18 residential complexes. Person and vehicle counts were conducted at each building. Workplace surveys were distributed to more than 38,000 employees within the six SACs. Intercept surveys were conducted at the retail and hotel sites. Daily trip diaries were distributed to the residential complexes. The results of the research are summarized in the following sections.

Office Analysis

The measured vehicle trip generation rates at the surveyed office buildings are lower, on a building square footage basis, than the ITE *Trip Generation* report (1) rates. However, on a per building employee basis, the measured trip generation rates tend to be higher than the ITE rates.

These relationships hold true for large complexes as well as for small office buildings. The relationships also hold whether the office building is located in a sprawling SAC like Parkway Center or in a dense SAC like Bellevue.

Median commute distances across the six surveyed SACs range between 11 and 14 miles. Commute travel times are much less consistent with the median values ranging between 17 and 30 min.

The Bellevue SAC has extensive, radial bus transit service and roughly 7 percent of the office employees use transit for their commute trip. In contrast, the other five SACs have limited transit service and none have a work trip transit mode share as high as 1 percent.

These low transit mode shares are a function not only of the limited transit service to the SAC but also of the inexpensive (and in most cases, free) parking provided office employees. The average automobile occupancy for work trips is 1.08 across the six surveyed SACs.

A significant proportion of SAC office employees make intermediate stops on their way to or from work. On average 22 percent of all office employees make an intermediate stop on their way to work. More than one-third of these stops are to drop a person at a day-care facility or at school. Another 21 percent stop for work-related purposes.

On average 42 percent of the office employees make an intermediate stop on their way home from work. The primary purpose is for shopping, followed by social or recreational trips and picking up passengers at day-care or school.

One-half of all office employees leave their building during the midday and half of these midday trips are internal to the SAC. These trips are primarily for a meal or for a work-related purpose.

The mode of midday trips is predominantly by automobile. The dense development pattern and continuous pedestrian facilities in Bellevue results in one-fourth of the midday trips being made by foot. However, at the other five SACs the midday walk mode share averages 6 percent.

Retail Analysis

Trip generation counts were taken and intercept surveys conducted at 26 retail sites including 7 regional malls. The majority of the surveyed regional malls have lower trip generation rates than estimated using ITE data.

A substantial proportion of the trips to and from the regional mall are internal to the SAC. In the large SACs like Parkway Center, Perimeter Center, and Tysons Corner, nearly half of the midday trips and one-third of the evening peak-period trips are internal to the SAC. In the smaller SACs such as Bellevue, South Coast Metro,

and Southdale, these internal proportions decrease (one-fourth of the midday trips and one-seventh of the evening peak trips).

For SACs with more than one regional mall, there is a small, but measurable, interaction between the malls. During the midday, roughly 2 percent of a mall's trips are linked to another mall. During the evening peak period, the interaction between malls is also roughly 2 percent.

The data suggest ranges in the mode shares that could be expected at regional malls. The Galleria complex in Parkway Center is a mixed-use development which consists of a 1 million square foot regional mall, 1 million square feet of office space, and a 440-room hotel. This density and magnitude of development results in 17 percent of the midday regional mall trips arriving or departing by foot. The overall density of the Bellevue SAC results in 10 percent of the mall trips not arriving by automobile but rather by foot or transit. The more typical regional mall locations and SAC configurations produce average walk mode shares of 4 percent.

Residential Analysis

A total of 19 multifamily residential complexes were surveyed. An average of 1.6 residents and 1.5 automobiles were found at the surveyed sites.

Of all the SAC residents who are employed, 30 percent reported their work site to be located within the SAC. For residential complexes in the larger SACs (e.g., Parkway Center, Tysons Corner), the internal work proportion increases to 33 percent. In the smaller SACs the proportion decreases to 27 percent.

The impact of this relatively high intra-SAC employment for SAC residents on overall SAC travel patterns is minimal, for two reasons. First, the number of dwelling units (and, therefore, the number of potential employees) is relatively small compared to the total number of jobs in the SAC. For example, Tysons Corner has roughly 2,000 dwelling units. Even if one person at each household is employed in the SAC, that adds up to only one employed SAC resident for every 20 SAC jobs. The second factor is that not all dwelling units have an employed resident. Many SAC residential developments attract senior citizens even if they are not exclusively elderly complexes. For example, the high-rise Rotonda complex located in Tysons Corner has a total of 1,200 dwelling units, but only 60 percent of the units house an employed resident.

The dominant mode of trips internal to the SAC made by SAC residents is the automobile. In dense activity centers like Bellevue and South Coast Metro, roughly one-sixth of these trips are made as pedestrians. In the sprawling activity centers, the walk proportion drops to only 3 percent of the total internal trips made by SAC residents.

Hotel Analysis

Fifteen hotels were surveyed. The hotels ranged in size from a 160-room business hotel to a 575-room hotel with extensive conference/meeting facilities. The majority of the surveyed hotels have lower peak-hour trip-generation rates than reported by ITE. In addition, the trip generation data presented in this research will quadruple the ITE hotel trip generation data set.

There is a great deal of interaction between the SAC hotels and the remainder of the SAC. For hotels located within the large SACs (Parkway Center, Perimeter Center, and Tysons Corner), over one-third of the morning and evening peak-period trips entering or exiting the hotel are internal to the SAC. For hotels located within the smaller SACs (Bellevue, South Coast Metro, and Southdale), the intra-SAC proportions drop to 19 percent in the AM and 27 percent in the PM peak periods.

Implications of Research Results

Key Findings. One of the more enlightening findings of the research effort is the extent of trip-making made by employees that is not between home and work. This finding has serious implications on the effectiveness of efforts, for example, to promote ridesharing and transit. The data suggest that commuters prefer their single-occupant automobile not only for the arbitrary reasons of comfort and privacy, but also for the real needs of intermediate stops either along the way to work, from work, or during the middle of the day.

Even though the surveyed SACs are perceived as being dense by typical suburban standards, they are still highly automobile-oriented. Except for Bellevue, transit ridership is virtually nonexistent. In the other five SACs, fixed-route transit service is not structured to serve the SAC as an end-of-the-line destination. Work-trip automobile occupancies at the surveyed large-scale SACs are not much different from isolated suburban building sites. In order to increase the number of commuters who rideshare or use transit, it will be necessary to also increase the following: (1) the supply of transit service, (2) the price of parking that is passed through to the motorist, and (3) the level of encouragement and incentives for ridesharing and transit use.

The research found that there is, indeed, a significant amount of interaction among the office, retail, residential, and hotel buildings located within large-scale suburban activity centers. The amount of internal capture of the interaction between SAC land uses tends to increase with the magnitude of SAC development.

Recommendations for Land Use/Transportation Principles. In order to maintain mobility and economic vitality within suburban activity centers (and indeed within any activity center, including CBDs), the elements of the transportation and land use system must be compatible. These elements include site design (e.g., the orientation of the site and its on-site facilities), land use (e.g., mix, composition, size, density, proximity), and the transportation system and its management (both of the supply and demand). Unfortunately, many individual building sites or complexes are focused inward with little provision for pedestrian interaction with adjacent sites. Transit service is virtually nonexistent in all but the Bellevue SAC, thereby necessitating the use of the automobile for commute trips and for midday trips. Despite the large number of midday trips to the regional malls from adjacent office complexes, only limited pedestrian facilities are typically provided. In order to address this problem, the following actions are suggested:

- Cluster buildings in order to increase their proximity and, thereby, pedestrian access. Mixed-use centers like the Galleria in Parkway Center generate a tremendous amount of intra-site trips, which both serve the needs of the employees/shoppers and do not add to traffic volumes in the SAC.
- Directly serve the SAC with radial bus transit service. This service should be focused on a centralized transit center. Although the practical limit may be a transit mode share of roughly 6 percent overall, traffic congestion would be noticeably reduced in the majority of SACs in which transit patronage is currently nil.
- Connect building sites with pathways, even in the less dense sectors of the SAC. These can include pedestrian overpasses or underpasses across major highways or just simply sidewalks or striped pathways in parking lots.
- Promote community support—public and private. Some of the dense and clustered suburban development described above is occurring, especially in redeveloping suburban business districts with transit stations. However, this type of development cannot realistically be expected to occur in newer areas without substantial policy influence.

Recommendations for Additional Research. With the wealth of new travel characteristics data collected for this NCHRP project, it is expected that numerous research efforts will be undertaken to extract findings from the data base. The report provides suggested topics for additional research which could use the NCHRP Project 3-38(2) data as a base. The reader is encouraged to first become familiar with the scope of the entire research effort in order to understand both the applicability of and limitations to the reported travel characteristics data. Chapters One through Five provide this overview. The details of a particular travel characteristic can be further investigated by reviewing the appropriate sections in Chapters Six through Nine. Concluding remarks and recommendations are included in Chapter Ten.

CHAPTER ONE

INTRODUCTION AND RESEARCH APPROACH

■ **This chapter presents the objectives of this research effort, discusses the more specific issues addressed with the data collected and analyzed during the course of the research, and summarizes the travel characteristics necessary for accomplishment of the research objectives.**

INTRODUCTION

Suburban activity centers (SAC) are one of the fastest growing segments of urban areas. From very modest beginnings in the 1950s, suburban activity centers have grown to the point where they rival the central business districts (CBD) in some of the major cities. Even where their individual size is modest compared to the center city, their economic competition is great and, in essence, provides a socially and economically acceptable alternative to the once dominant "downtown." Unlike the singular "CBD," activity centers are springing up in droves around the major cities. This phenomenon of suburban growth has recently become a focus in the transportation profession and is aptly described by Cervero (2) in his recent book, "Suburban Gridlock." In the book and in earlier articles, Cervero (3) points out that over 80 percent of all office space in this country's suburbs has been built since 1970 as compared to a figure of 36 percent for the downtown. Orski has also been in the forefront of those transportation planners who have recognized the growing problem in the suburbs. Using the term "megacenter," Orski (4) points out that many of these centers are "veritable minicities with daytime populations of 20,000 people, and densities far above those of the typical suburban center."

NCHRP Project 3-38(2) was initiated in response to a need for up-to-date information on the travel characteristics of these activity centers, particularly trip generation rates, travel modes, trip purpose, trip length, parking characteristics, pedestrian activity, capture rate (i.e., proportion of trips attracted to the development from traffic normally passing by the site), intra-site vehicle movements, hourly variations, and vehicle occupancy.

The principal objective of this project is to develop a comprehensive data base on travel characteristics for various types of large-scale, multi-use suburban activity centers that have been developed recently. Representative trip generation rates and other travel characteristics will be determined for use by others in analyzing the traffic impacts of such activity centers on the transportation system. The research will be limited to activity centers with over 5 million square feet of existing floor space and that lie outside of the CBD.

RESEARCH APPROACH

The two basic issues that current data on suburban activity centers fail to adequately address are: First, what are the travel characteristics (internal and external) of trips generated by large-scale suburban activity centers? And second, what is the effect of placing a new land use within an existing suburban activity center on current internal and external SAC travel characteristics? As subsets of these two questions, there are numerous other questions (as will be represented below) that must be addressed and hypotheses put forth. However, the foregoing two questions provide the essence of the utility of the data collection and analysis results of this research.

Figure 1 lists a number of questions that apply to the area of transportation and land use planning for suburban activity centers. These questions cover a wide range of suburban activity center issues and are not limited to just traffic and transportation concerns. However, transportation data are important in answering some of the issues posed that are not strictly transportation-related. For example, a knowledge of travel characteristics has great implications on the optimum mix and density of land uses within an activity center. Transportation and land-use decisions are heavily intertwined, and information from one area may well benefit the other. The data collection and analysis approach flows directly out of the questions to be addressed. Thus, under each question in Figure 1, an approach is suggested for collecting data to answer the question.

1. What is the relationship between trip generation rate (vehicle and person) and the multitude of factors affecting the rate (employee density, land use intensity, transit service, traffic congestion level, mix of land uses, ...)?

Application: Traffic impact analyses

Data collection and analysis approach: Trip generation and mode split surveys. Employees surveyed at the work place. Residents surveyed at the home. Patrons of retail stores, restaurants and hotels surveyed at the establishment.

2. What are the origin/destination characteristics of trips to, from and within an activity center?

Application: Subarea modelling of future traffic flows

Data collection and analysis approach: Collect O/D data in surveys of residents, employees, visitors and shoppers, and develop quantitative relationships that can be used in subarea modelling efforts.

3. How does the percentage of newly generated trips (linked trips, pass-by trips, primary trips, etc.) vary by land use type, location, surrounding land use and other factors?

Application: Refinement of traffic impact analyses to account for these trips

Data collection approach: Identify trip sequence and primacy of trip in travel surveys.

4. How does the makeup of a suburban activity center (e.g. density and mix of uses) affect the mode share for internal trips? How can activity centers be made less auto-dependent for internal circulation?

Application: Zoning for future land use to enhance pedestrian and transit travel

Data collection and analysis approach: Collection and analysis of trip length and trip purpose data (through surveys of employees, residents, visitors and shoppers) for auto vs. walk trips

5. What is the most efficient land use arrangement for an activity center, so that it takes advantage of transportation services or potential transportation services? Related questions: What are the demographic characteristics of those that live and work in activity centers in comparison with those who don't? What are the travel characteristics of each demographic group? Why do people choose to live and work there (i.e. what are the strengths of an activity center and how can they be enhanced by land use or transportation strategies?)

Application: Zoning, site planning, and control of land use; identification of preferred density and mix of uses

Data Collection and Analysis Approach: Analysis of travel surveys (workplace, resident, and patron) to identify land use combinations that optimize potential for transportation service.

6. How is the rate of internal suburban activity center trip-making affected by various factors?

Application: Zoning and control of land use; refinement of traffic impact analysis technique

7. What has been the experience with transit service to activity centers and what types of service are most appropriate under what conditions?

Application: Planning for transit service

Data collection and analysis: Investigation of transit experience and success/failure thereof. Analysis of ridership data.

8. Where are activity centers best located within an urban area from a transportation point of view? What transportation factors should be considered in emphasizing denser development in certain areas?

Application: Zoning and control of land use

Data collection and analysis approach: Examine O-D patterns of trips to, from, and within the activity center. Identify extent to which activity center interacts with regional CBD and other activity centers. Identify area characteristics where transportation is not perceived to be a problem.

9. How should future trip generation studies in activity centers be performed, documented and included in ongoing trip generation data bases?

Application: Provision of guidelines for future studies

Data collection and analysis approach: Documentation of experience in this study as it applies to ongoing traffic analysis work.

Figure 1. Questions to be answered with the aid of travel characteristics research.

This research does not answer all of the questions presented in Figure 1. However, it is important to start with a comprehensive set of issues (hypotheses) to ensure that none of the significant ones are overlooked. The data collection and analysis program has been tailored to the specific needs and priorities identified through interaction with the NCHRP Project 3-38(2) Panel and with other professionals in the field.

One of the observations from this research effort is that a primary need for suburban activity center data is in advancing the state of the art for traffic impact analyses of these higher density, multi-use settings. Thus, trip generation rates and the factors that influence trip generation rates are of major interest in the collection of data. Knowing the trip generation rates for individual building sites (or aggregate sites) is not sufficient, however, because this cannot necessarily be translated into useful information for others to use in suburban activity center settings. What is needed is a set of *relationships* between trip generation rates and the various factors that influence it. For example, a series of mathematical equations that factor in the effect of parking supply and cost of the trip generation rate, automobile occupancy, and transit use could be quite helpful for transportation planning within activity centers.

The questions provided in Figure 1 imply several key products of the data collection program for this research effort:

- A focal point of the study is on trip generation data for use in traffic impact analyses for suburban activity centers in general. Therefore, both *AM and PM peak-hour weekday trip generation rates* have been obtained. Off-peak trip generation rates are not critical, because traffic impact analyses are not typically conducted for off-peak periods.

- Although midday trip generation data are not particularly necessary, *midday travel characteristics* data are vital. The midday travel needs and origin-destination (O-D) patterns of employees, residents, and shoppers can impact peak-hour travel characteristics. If midday travel needs can be accommodated without using a vehicle, for example, individuals may be more inclined to rideshare or ride transit.

- Trip characteristics have been acquired for the major land uses typically included in an activity center (i.e., primarily *offices, multifamily residential dwellings, retail sites and hotels*). These data are the most relevant to the needs of practitioners.

- The issues of *internal/external* trips and *pass-by trips* have been addressed from several perspectives. Internal/external trips have been examined as they relate to each use type. Pass-by trips have been quantified for the various types of retail found in activity centers.

- Another major factor is related to the internal transportation issues and takes several forms. The most commonly cited is the reduction in vehicle trip generation resulting from large *mixed use developments*. Many of the walking trips made possible by the proximity of various land uses are extremely time-of-day sensitive. Midday trip-making may be reduced, but the reduction in peak-hour work trips may be much less. Peak-hour trips may not be significantly affected by the mix of land use activities. Peak-hour trip rates may, however, be less per unit for a *large development center* than for the same quantity of independent developments as is demonstrated in the latest ITE *Trip Generation* material (1). This is the result of increased carpooling and vanpooling, flexible work hours, and transit services that become more significant, more necessary, and more desirable in denser developments. The impacts of this behavior

on travel are highly dependent on programs and policies of the employers in the area. If a TSM program is not well supported, the traffic benefits will be substantially less than they might otherwise be.

Data Collection Effort

The foregoing paragraphs have raised a number of questions and issues regarding the various types of data that could be collected for this research effort. The following sections present the travel characteristics data that have been collected and analyzed. These travel characteristics serve as the "dependent" variables in subsequent analyses to determine the relationships between travel characteristics and the characteristics of the SAC and of individual buildings.

Trip Generation Characteristics

Figure 2 shows the "tree" of trip generation and mode split characteristics that were the focus of the data collection effort. Also shown are origin/destination and trip-making characteristics that are addressed later as "trip distribution" characteristics. The figure presents one "branch" of the trip generation tree. The land use type for the branch shown is office. Each of the other land use types (primarily residential, retail, and hotel) has comparable trip generation trees. For the analyst trying to forecast SAC travel, the time period is the first category for which different characteristics must be investigated. Daily, AM peak-hour, and PM peak-hour rates could all be used. For each of these time periods, the person-trip generation rate can be categorized as either inbound to the site or outbound from the site. For each of these person-trip generation rates for an office, one can classify the trip purpose as involving an employee or a visitor trip. For residential uses, the trip purposes would be by a resident, employee, visitor, or service personnel. For retail the trip purposes are by employee, customer, and service personnel.

For hotel uses the trips involve either an employee, overnight guest, conference attendee, retail customer (i.e., eat, drink), or service personnel. For both the person-trip and vehicle-trip generation rates disaggregated by trip purpose, the mode of the trip can be classified. Once the trip mode has been classified, the origin/destination of the trip can be classified. Finally, for each trip origin/destination, trip linking characteristics can be quantified. Any of the foregoing characteristics could be key to the proper forecast of traffic conditions within a suburban activity center or on the roadway network leading to a suburban activity center. Therefore, the data collection plan was structured to permit the development of usable rates for each of these key dependent variables.

Trip Time Period and Direction. Trip generation and traffic impact analysis is typically conducted on a weekday daily basis and for the weekday PM peak hour. The weekday AM peak hour is not usually analyzed for suburban activity centers because the total traffic volumes tend to be lower than for the PM peak hour. However, because of the different directional distribution on the SAC roadways during the AM and PM peak hours, it may be necessary to analyze the AM peak hour as well.

Trip Purpose. The trip purpose distribution for each land use includes employees and all other types of persons who could enter or leave the building. In the case of hotels, these could include overnight guests, conference/meeting attendees, retail customers for the hotel restaurant and lounge, and nonemployee service personnel. For retail sites, these include customers and nonemployee service personnel. For residential sites, the non-employee trip purposes include residents, visitors, and nonemployee service personnel. Trip purpose data could be collected separately by direction for both the AM and PM peak hours. It is most likely that the trip purpose distributions will be used by the planning analyst only to determine the number of office and retail employee trips, retail customer trips, and resident trips that occur during the peak hours. These trip purposes are the primary ones that could be affected significantly through the implementation of SAC TSM programs, such as flex-time

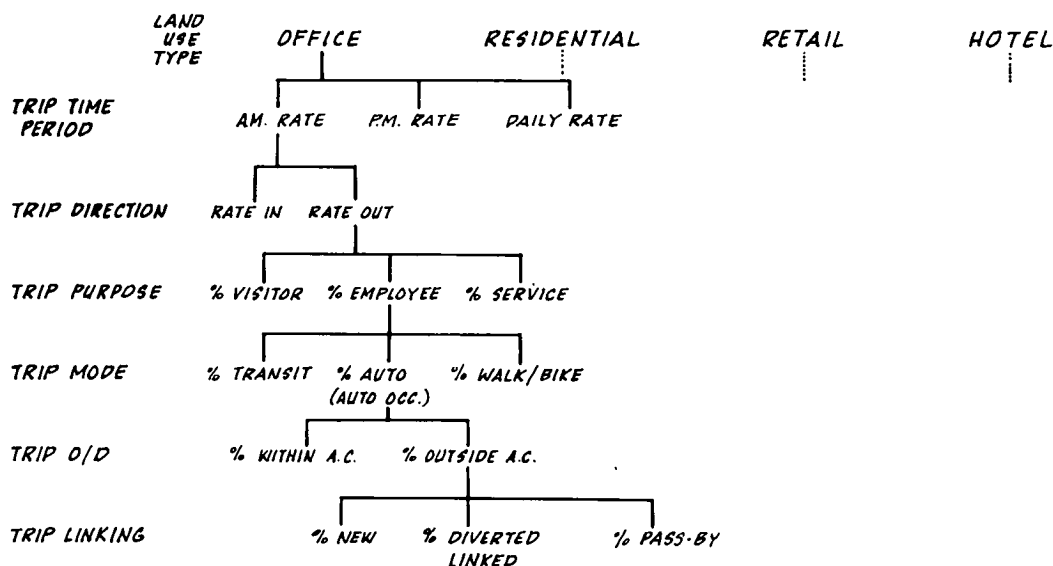


Figure 2. Trip generation tree.

work hours, local transit circulation service, and ridesharing incentive programs.

Trip Mode. The trip mode characteristics that the analyst will most likely need to know will be the number of automobile drivers, the number of automobile passengers, the net automobile occupancy, the number of transit patrons, and the number of pedestrians. Mode split data are required for the AM and PM peak hours. It is also required that these mode split data be disaggregated by trip purpose (i.e., mode split of employees vs. mode split of visitors).

Trip Distribution Characteristics

Trip Origin/Destination. For each of the trips classified by mode, by purpose, by direction to/from the building site, and by time period, it is necessary to determine the origin (or destination) of the trip. This origin/destination information will consist of the building location (within or outside the activity center and, in some cases, the jurisdiction) for each trip end and the type of building (e.g., retail, residential, hotel, and office). For purposes of measuring the relationship of trip distribution characteristics to trip generation characteristics, it may suffice to categorize the trip origin/destination as being either inside or outside the SAC. For the purpose of collecting trip distribution characteristics, additional detail regarding trip length has also been collected to produce an even more refined data set.

Trip Linking. As shown in Figure 3, there are 12 trip types that are accommodated by the SAC transportation system. However, the focus of this research effort has been on trips that include at least one trip end within the SAC (i.e., the trip origin, trip destination, or an intermediate stop within a linked trip). Therefore, for SAC analysis purposes each trip with a trip end within a SAC can be classified as one of five trip types: (1) internal trip (i.e., trip origin and destination located within the SAC), (2) trip with a pass-by stop within the SAC, (3) trip with a diverted stop within the SAC, (4) local trip (with either its origin or destination located within the SAC) with no intermediate stop within the SAC, and (5) local origin trip with an intermediate stop within the SAC.

Specific Products of Travel Characteristics Surveys

Table 1 summarizes, in tabular form, the trip generation characteristics that need to be collected. The trip distribution characteristics, which the data address, are shown in Figure 4.

Referring to Table 1, it can be seen that for a sample of the person-trips and vehicle-trips entering or exiting a building that is being surveyed, the trips have been categorized by their time period, direction, purpose, mode, origin and destination, and trip type.

Although the characteristics shown in Table 1 constitute a significant improvement over current data bases, they do not provide the complete picture. In order to fully understand travel both within and through a suburban activity center, it becomes necessary to combine the quantitative and proportional aspects of the travel characteristics into an inflow/outflow diagram of the SAC trip routing dynamics, as shown in Figure 4. The diagram shows the total trips from a particular land use (as an example, assume residential) and charts their path to each of

several potential destinations. The residential trips could be destined for an office land use, for a retail use, for a hotel use (not shown in the diagram), for a destination external to the SAC, or even for another residential use. The same relationships are charted from the destination land uses. If every building within the SAC was surveyed, each leg in the Figure 4 diagram could be assigned a numeric value. However, because this data collection effort represents only a sample of the SAC buildings, a scaled-back quantification of the dynamics has been achieved. As an example for individual buildings, the total number of trips categorized by their destination needs to be collected as well as information on the chaining of trips through the various land uses (as shown in the cut-out).

Another product of the analyses of the collected data is the derivation of relationships between travel characteristics and a wide range of independent variables. In terms of the diagram presented in Figure 4, the research project has found that the primary factors affecting the trip generation rate for an office

Table 1. SAC travel characteristics collected.

<u>Time period</u>	
•	weekday AM peak hour -- non-retail only
•	weekday midday peak hour -- retail only
•	weekday PM peak hour -- both retail and non-retail
•	weekday 24-hour
<u>Trip direction</u>	
•	into the building
•	out of the building
<u>Trip purpose</u>	
•	office sites (employee, visitor)
•	retail sites (employee, shopping, dining)
•	residential sites (residents, visitors)
•	hotel sites (overnight guests, conference/meeting attendees)
<u>Trip mode</u>	
•	auto driver (and number of occupants)
•	auto passenger
•	transit
•	bicycle
•	walk
<u>Trip origin and destination</u>	
•	trip end within SAC
•	residential
•	hotel
•	retail
•	office
•	trip end outside SAC
•	residential
•	hotel
•	retail
•	office
<u>Trip type</u>	
•	External trip origin and internal trip destination
•	no intermediate stop
•	pass-by stop
•	diverted stop
•	Internal trip origin and internal trip destination
•	no intermediate stop
•	pass-by stop
•	diverted stop
•	Internal trip origin and external trip destination
•	no intermediate stop
•	pass-by stop
•	diverted stop

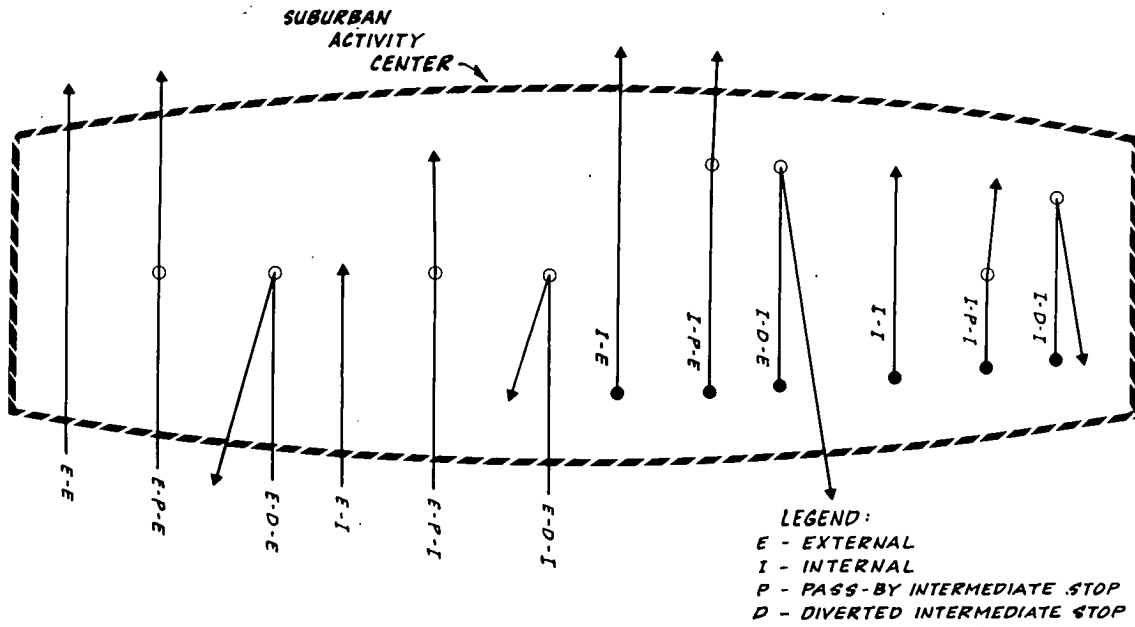


Figure 3. SAC trip types.

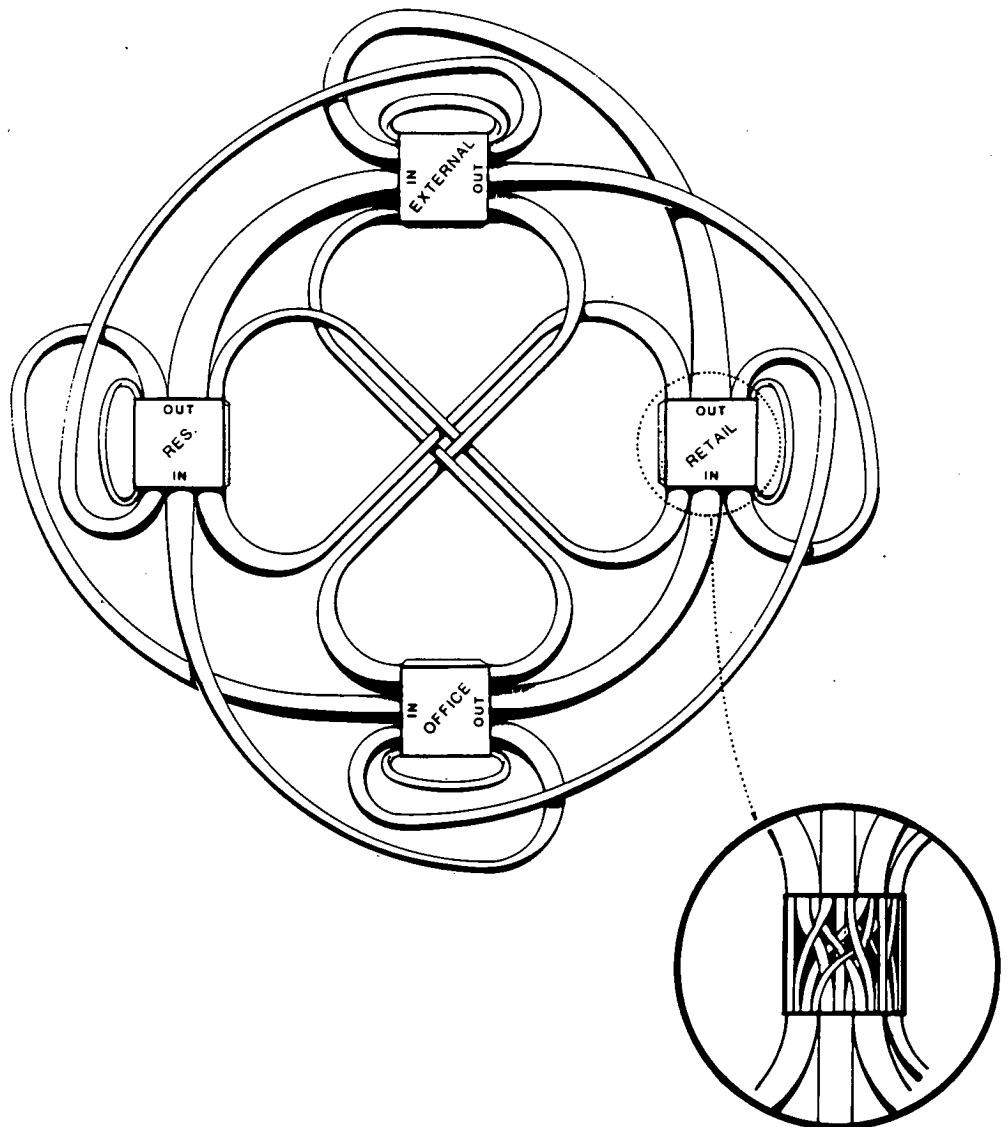


Figure 4. Routing dynamics of suburban activity centers.

building involve the characteristics of the building and of its tenants. In contrast, how these trips are apportioned among internal and external land uses is a function of the characteristics of both the individual office building and of the overall SAC.

CHAPTER TWO

FINDINGS—STUDY SITES

■ The findings with respect to the study sites are discussed under three sections. The first section defines large-scale suburban activity centers (SACs) for the purpose of this research effort. The second section of this chapter presents a preliminary listing of the current SACs in the United States, which have at least 5 million square feet of office, retail, hotel, and residential uses. This listing comprised the universe for the purpose of selecting study sites, but is not intended necessarily to be comprehensive. The third section of this chapter contains a description of the six SACs selected for detailed study.

DEFINITION OF LARGE-SCALE SUBURBAN ACTIVITY CENTER

The Research Problem Statement for NCHRP Project 3-38(2) refers to suburban activity centers as “large-scale, multi-use suburban centers.” On the basis of this definition, a wide range of activity center types could be classified as suburban activity centers. The following types of activity centers would qualify as SACs, using the nomenclature presented in the Institute of Transportation Engineers publication *Transportation and Traffic Engineering Handbook (6)*: major suburban diversified centers, regional shopping centers, older small CBD engulfed within suburbs, university campuses outside the CBD, airports, and major recreation centers.

Each of these development types could satisfy a literal interpretation of “large-scale, multi-use suburban center.” University campuses typically have residential and retail uses as well as classrooms. Airports often have office, hotel, and light industrial as adjacent land uses. Major recreation centers (e.g., theme amusement parks) may generate other uses on their perimeter, such as hotel and retail. Despite their satisfying the basic definition of large-scale, multi-use suburban centers, these latter three types of centers are excluded from this research effort.

For the purpose of this research effort, large-scale suburban activity centers are defined as development nodes, in suburban areas, which satisfy the following criteria:

- At least 5 million square feet of office and retail space.
- A mix of office and retail (and sometimes residential and hotel) space.
- At least 600,000 square feet of retail space.
- More employees than residents.
- Typically between 5 and 20 miles from regional CBD.

- Majority of development within past 10 years.

These criteria have guided the development of the SAC list in the following section.

Degree of Planning and Coordination of SAC

A number of the better known suburban activity centers are referred to as planned unit developments (PUDs), which is typically a zoning term with certain legal implications. These would include Las Colinas (near Dallas) and Oak Brook (near Chicago). Many of the SACs in the United States represent the opposite end of the spectrum with basically a dense, nodal version of strip development consisting of an assemblage of independent buildings. Several SACs (like Perimeter Center located north of Atlanta) fall somewhere in between where the original SAC layout and bulk of the original development was under a single primary developer. Within the past decade, other development has occurred which, in turn, has altered the characteristics of Perimeter Center. The issue here is the degree to which strong, conscious attempts at balancing and mixing land uses and densities result in improved mobility and accessibility.

Related to this degree of coordination and planning are the number of owners/developers responsible for the development of the SAC. Certain levels of land use planning, development scheduling, and coordination of tenant activities (e.g., work-start times) can be achieved under a single owner which would not be as feasible under multiple owners. If the quality of this coordination is high and considers transportation impacts (perhaps through a transportation management association (TMA)), resulting travel characteristics may be different.

For SAC selection purposes, each candidate SAC has been assessed qualitatively for its relative degree of coordinated development and for the relative effectiveness of the TMA (or comparable), if applicable. The full range of coordination and numbers of owners and developers are included in the selected study sites.

Level of Transit Service

The very presence of transit service presents the opportunity for some nonautomobile trips. This variable will need to reflect, however, more than the simple presence or absence of bus service. Whether the suburban activity center is merely a stop on

radial routes to the CBD or if it is, indeed, a suburban transit hub (such as in Bellevue, near Seattle, Washington) strongly influences travel characteristics on the transit system.

The presence of rail transit service can have a significant effect on SAC travel characteristics. In the San Francisco (Pleasanton), Washington (Bethesda), and Atlanta (Lenox Square) metropolitan areas, for example, major suburban activity centers are served by rail transit. In the case of Bethesda, work trip transit mode shares for office buildings near the rail transit station have been found to exceed 15 percent.

The presence (or absence) of transit service has been considered in the SAC selection process. SACs with the full range of bus transit services have been surveyed. However, SACs served by rail transit have been excluded in order to maximize the focus on the more prevalent type of SAC found throughout the nation (i.e., with, at most, extensive bus transit service).

Parking Supply

Both the supply and price of parking are factors that influence trip-making at a suburban activity center. Indeed, there is a school of thought which argues that control of parking is perhaps the largest single factor that can be used to reduce suburban congestion. A range of parking characteristics has been considered in the SAC selection process, including: parking supply vs. parking demand, pay parking vs. free parking, and off-site public parking vs. on-site private parking.

Geographic Diversity

A final characteristic that is widely used in transportation research is geographic diversity. The premise behind this characteristic is that driver attitudes and behavior (degree of aggressiveness, tolerance for delay and so on) are not uniform across the country. Consequently, geography should be used to create a set of diverse locations. All of the sites, however, are by definition suburban locations. Thus, one geographic dimension that is present in some research (i.e., the difference between urban, suburban, exurban, and rural driver attitudes and behavior) will be missing. In the selection of SACs for survey, the sites have been spread across the country with an eye for geographic diversity.

LISTING OF MAJOR SUBURBAN ACTIVITY CENTERS

One of the initial efforts of NCHRP Project 3-38(2) was a review of the literature to produce a listing of major suburban activity centers throughout the U.S. Table 2 presents these activity centers, grouped by metropolitan area and ranked in order of metropolitan area population. As shown in Table 2, it is possible to identify suburban activity centers with at least roughly 5 million square feet of office and retail in most of the 30 largest metropolitan areas in the country. For a more complete description of the activity centers in Table 2, the reader is referred to the U.S. DOT report, *America's Suburban Centers: A Study of the Land Use—Transportation Link (5)*.

Table 2. Major suburban activity centers in the United States. Rank based on 1980 MSA population. (Source: Bureau of Census)

Metropolitan Area	Suburban Activity Center
New York - Newark	Boston
Central Stamford (CT)	Cambridge Center
Meadowlands (NJ)	New England Executive Park
	Route 9 Corridor
	Route 128 Corridor
	Route 495 Corridor
Los Angeles - Long Beach	Nassau - Suffolk
Century City	E. Farmingdale
Warner Center	E. Garden City
Chicago	St. Louis
Oak Brook	Pittsburgh
Schaumburg Village	Baltimore
Naperville	Columbia
	BWI Area
Philadelphia	Central Towson
Barry's Creek Center	Hunt Valley
Harbourside	
King of Prussia	Minneapolis - St. Paul
Chesterbrook Center	Southdale
	3M Center
Detroit	Atlanta
Southfield	Perimeter Center
Fairlane Town Center	Cumberland/Galleria
Oakland Mall	Gwinnett Place
	Northlake
San Francisco - Oakland	Buckhead/Lenox Square
Bishop Ranch	
Hacienda Business Park	Anaheim - Santa Ana -
Pleasanton	Garden Grove
Central Walnut Creek	South Coast Metro
	Irvine
Washington, D.C.	Cleveland
(Tysons Corner	Chagrin Blvd. Corridor
Rock Springs Park	1-77/Rockside Corridor
Bethesda	
Friendship Heights	San Diego
	Rancho Bernardo
Dallas - Fort Worth	Miami
Las Colinas	Central Ft. Lauderdale
Parkway Center	Plantation
Park Central	Avida's Park of Commerce
	Cypress Creek
Houston	
Uptown Houston (City Post Oak)	
Greenway Plaza	
Greenspoint/Greens Crossing	
Denver	
Denver Technological Center	
Greenwood Plaza	
Inverness Business Park	
Seattle - Everett	
Bellevue	
Bel-Red Corridor	
Tampa - St. Petersburg	
Riverside - San Bernardino - Ontario	
Phoenix	
Central Avenue Corridor	
Camelback Corridor	
Cincinnati	
Tri-County	
Milwaukee	
Kansas City	
Country Club Plaza	
Overland Park	
Corporate Woods	
San Jose	
Santa Clara Golden Triangle	
Portland	
I-5 Corridor	
Trenton - Princeton	
Route 1 "Zip Strip"	
Orlando	
Maitland Center	

SELECTION OF LARGE-SCALE SUBURBAN ACTIVITY CENTERS FOR STUDY

This section briefly describes the criteria used to select the final study sites. The basic options for mix of land uses within a SAC (with examples) are as follows:

- *Office and regional shopping center:* Tysons Corner (Washington, D.C.), Perimeter Center (Atlanta), South Coast Metro (Los Angeles), Uptown Houston (Houston), and Parkway Center (Dallas).
- *Office and specialty or support retail:* Denver Technological Center, Greenway Plaza (Houston), and Bethesda, Maryland.
- *Office, support retail, and residential:* Oak Brook (Chicago), Park Central (Dallas), CentrePoint (Denver) and Schaumburg (Chicago).

Hotel uses are not included explicitly in the foregoing classifications, but they can encompass a significant portion of the square footage in a SAC. However, in relative terms to the office, retail, and residential uses, the effect of hotel space on the overall character of a SAC is minor. Also all SACs in which the research is interested have a significant office space component; therefore, the "university" and "recreation center" employment areas have been excluded.

The above three categories for land use mixes within the SACs have a great deal of overlap. But they also provide a basic framework on which initial characterizations of SACs can rely. For example, a SAC either has or does not have a regional shopping center. Those SACs with no regional retail component have at least support retail (or specialty retail) as a prominent portion of the overall land use mix. Whether or not the SAC has a significant residential population is also considered as a criterion for categorizing the type of SAC. In terms of land use mix, these will be the three basic categories.

DESCRIPTION OF SAC STUDY SITES

This section presents a description of the six large-scale suburban activity centers selected for study. The six SACs are: (1) Bellevue, Washington (located outside Seattle); (2) South Coast Metro (located in Orange County outside Los Angeles, California); (3) Parkway Center (located in north suburban Dallas, Texas); (4) Perimeter Center (located outside Atlanta, Georgia); (5) Tysons Corner (located in northern Virginia outside Washington, D.C.); and (6) Southdale (located outside Minneapolis-St. Paul, Minnesota). A brief description of each individual SAC and its characteristics and of the reasons for its selection are cited below.

Bellevue, Washington

The City of Bellevue is located on the eastern shore of Lake Washington, roughly 10 miles east of downtown Seattle (see Figure 5). The Bellevue central business district (hereinafter referred to as the Bellevue SAC) encompasses an area of approximately 440 acres and employs 19,000 workers. The SAC has over 4.7 million gross square feet of office space, 3 million square feet of retail commercial space, and roughly 1,000 hotel rooms. The majority of this development has occurred during the past 7 years. In fact during the 4-year period from 1983

through 1986, five major office buildings were opened. These five buildings range in size between 344,000 and 456,000 gross square feet, and all are at least 16 stories in height. Their total square footage exceeds 2 million.

The Bellevue SAC has a transportation management association (TMA) that has actively begun to address the parking and other transportation issues facing the area. The Bellevue TMA Board consists of representatives of private interests as well as of the City of Bellevue and Seattle Metro, the regional transit provider. One of the objectives of the Bellevue TMA is to improve upon the current levels of ridesharing (estimated by the TMA to be 16 percent of all workers) and of transit patronage (estimated by the TMA to be 7 percent of all workers). On the basis of these figures it is clear that the Bellevue SAC has excellent transit service and an effective, on-going marketing and information program.

Highway access to the Bellevue SAC is provided via several freeway facilities and numerous surface street arterials. Immediately adjacent to the SAC is I-405, a north-south limited-access facility. This roadway interchanges with the two major east-west freeways (I-90 and State Route 520) which cross Lake Washington and feed directly into downtown Seattle. These interchanges are only a couple miles to the north and south of the Bellevue SAC. All three freeways interchange with surface-street arterials that also lead to the Bellevue SAC.

The Bellevue SAC was included as a site for survey and analysis for several reasons. The SAC has over 7.5 million square feet of development and has a relatively balanced mix of office and retail land uses. It also represents the greatest density of the SACs studied. Most of the SAC development has occurred during the past 7 years and the development is purported to have successfully accommodated pedestrian needs. The City of Bellevue reports that the Bellevue SAC has high transit ridership compared to other SACs.

South Coast Metro, California

South Coast Metro is located in Orange County, roughly 45 miles from the Los Angeles CBD (see Figure 6). Its area straddles the border between the Cities of Santa Ana and Costa Mesa and encompasses roughly 580 acres. The SAC has a total of 3.47 million gross square feet of office space; four million square feet of retail space; 2,300 dwelling units; and 1,800 hotel rooms in eight hotels. In addition, South Coast Metro is unique in its quantity and quality of entertainment facilities. The SAC has 18 movie theaters, the South Coast Repertory and the "world-renowned" Performing Arts Center.

The cornerstone of South Coast Metro is the regional mall, South Coast Plaza, which contains six anchor stores and a total of 2.2 million square feet. South Coast Metro is reported to generate the greatest retail sales volume for a regional mall in the U.S. It is located within the block bordered by Sunflower Avenue, Bristol Street, the San Diego Freeway, and Bear Street. Affiliated with South Coast Plaza and located directly across the street from the mall are two other retail centers, Crystal Court (a fashion mall with two anchors) and South Coast Plaza Village (a retail center with primarily restaurant tenants).

Immediately to the east of South Coast Plaza (across Bristol Street) bounded by Sunflower Avenue to the north, the San Diego Freeway to the south, and Main Street to the east is the area known as the Town Center Zone. This area contains the

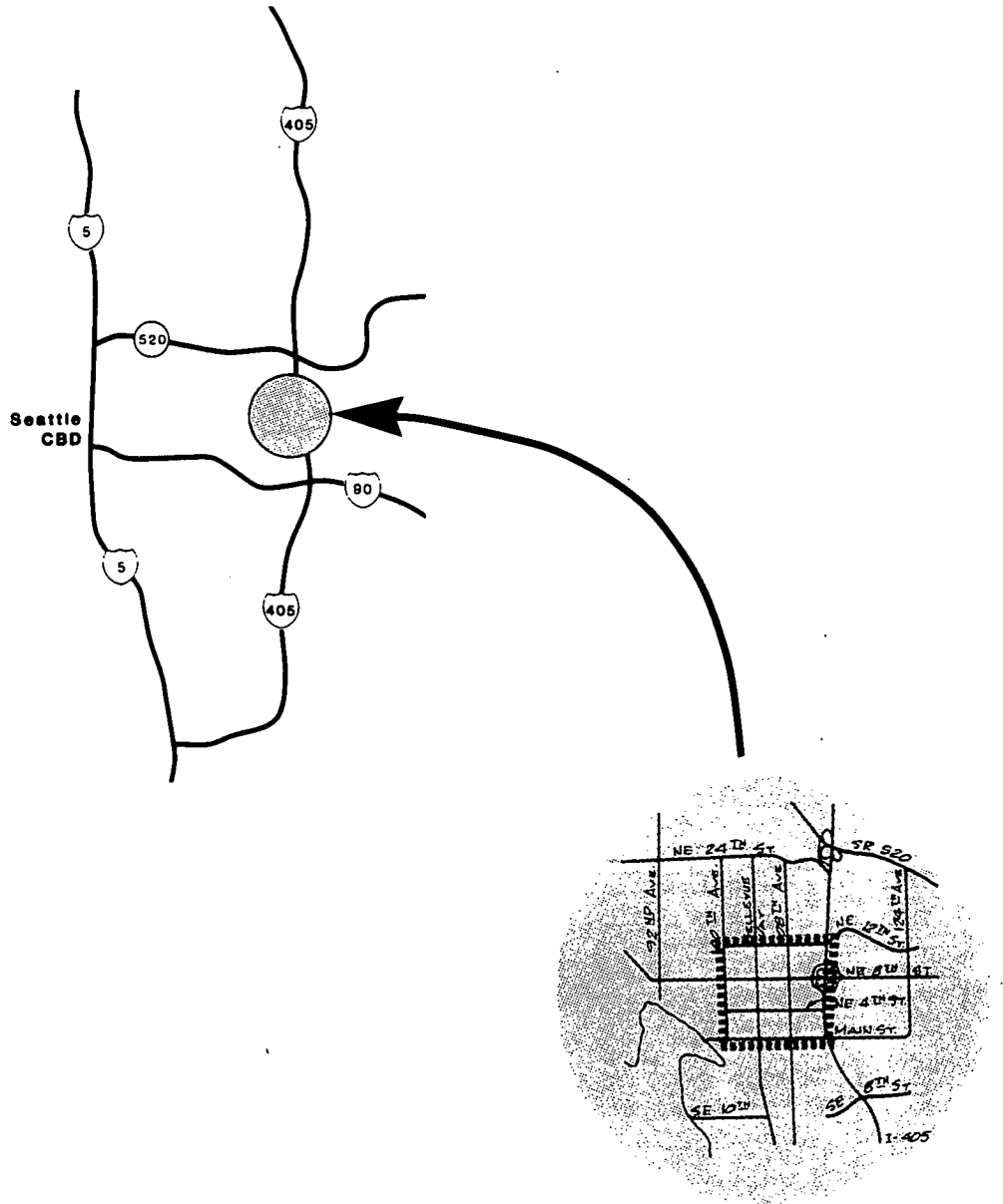


Figure 5. Bellevue SAC.

majority of the office and entertainment developments. Further to the northeast is the development area known as Hutton Center. Much of the remaining area within the SAC boundary is predominantly residential.

Parkway Center, Texas

The Parkway Center suburban activity center is located roughly 10 miles north of the Dallas, Texas, central business district. The SAC limits, as defined for this research effort, are shown in Figure 7. In general terms, they are as follows: Preston Road on the east, LBJ Freeway on the south (although the Lincoln Center complex south of LBJ Freeway is also included), the railroad tracks that run north-south to the immediate west

of the Dallas Parkway, and Keller Springs Road on the north.

Parkway Center straddles three local jurisdictions: Dallas, Addison, and Farmers Branch. The SAC contains roughly 17 million gross square feet of office space, more than for any other surveyed SAC. There are also approximately 7 million square feet of retail space within the Parkway Center SAC. Three regional malls comprise just less than one-half of the total retail space—the Galleria, Valley View Mall, and Prestonwood Town Center. The area is home to the largest concentration of restaurants in the Dallas area. The SAC contains eight hotels with a total of over 3,100 rooms. Finally, there are an estimated 15,000 dwelling units within the Parkway Center area. Most of the residential complexes are low-rise townhouses, condominiums, or apartments. There is only a single high-rise residential complex.

Perimeter Center, Georgia

As shown in Figure 8, Perimeter Center is located roughly 12 miles north of the Atlanta CBD along I-285 (Perimeter Highway). The SAC straddles the boundary between DeKalb and Fulton Counties.

The primary retail facility in the SAC is Perimeter Mall, a 1.4 million square foot mall with three anchors. It is located in the block bounded by Ashford-Dunwoody Road, Hammond Drive, Perimeter Center Drive West, and Perimeter Center Parkway. The remaining retail space in the SAC is very limited. In fact, Perimeter Center is the only one of the surveyed SACs with no free-standing fast-food restaurants. The Perimeter Mall Food Court is the site of 23 eating establishments and is the focus of many midday lunch trips by SAC employees.

The original office development at Perimeter Center was low-rise, campus style, and it concentrated along Perimeter Center Drive West and Perimeter Center Drive East. In recent years the style of office development has changed to primarily consist

of high-rise buildings with structured parking. There now is a total of roughly 14 million square feet of office space in the SAC.

The number of residential units within Perimeter Center is very limited and is estimated at less than 200 dwelling units. There are five hotels located within Perimeter Center with a total of 1,800 rooms.

Tysons Corner, Virginia

Tysons Corner is an office/retail suburban activity center located approximately 12 miles west of downtown Washington, D.C., in Fairfax County, Virginia (see Figure 9). The Tysons Corner SAC encompasses roughly 1,230 acres. The area development employs approximately 60,000 workers. The SAC has more than 13 million gross square feet of office space, a regional shopping mall, numerous specialty shopping plazas, several hotels, and a high-rise residential building. The initial "activity

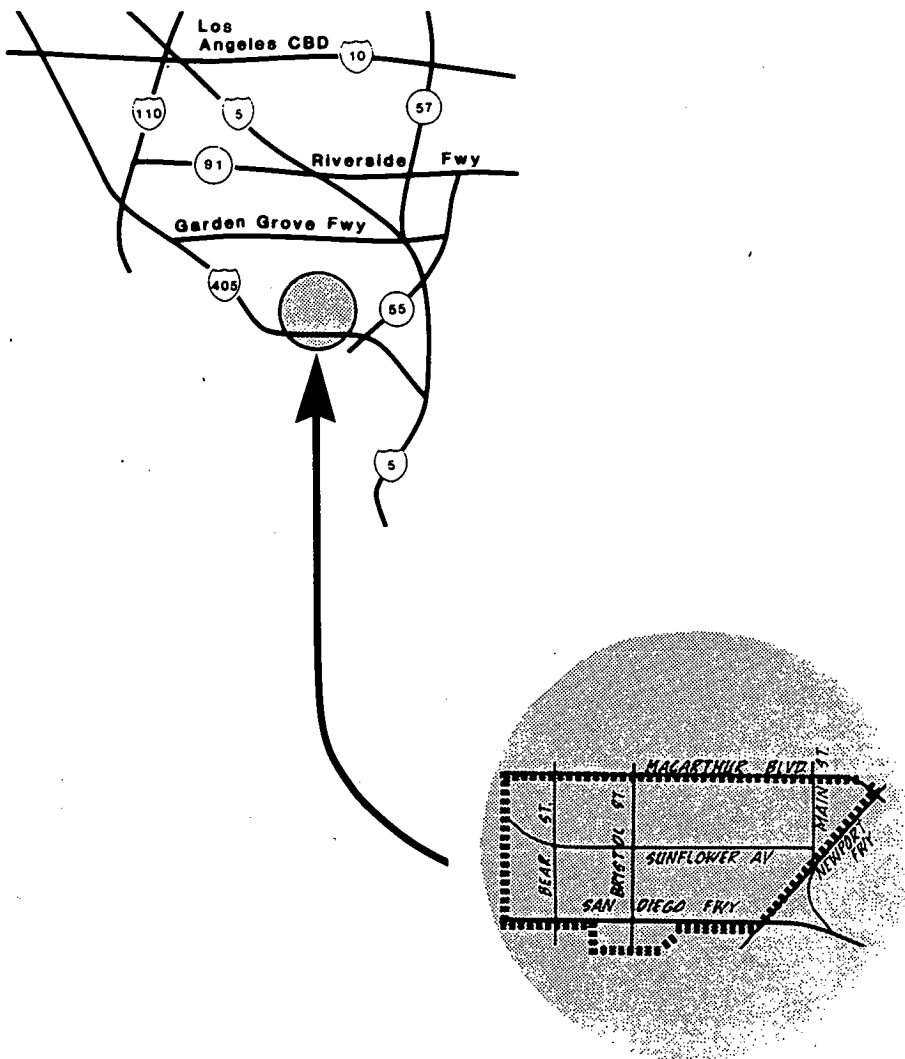


Figure 6. South Coast Metro SAC.

center scale” development opened in 1968 as Tysons Corner Shopping Center. However, the most rapid and intense development (in particular for office uses) has occurred during the past decade.

The Tysons Corner SAC has a transportation management association that is actively promoting ridesharing and transit use. Tysons Transportation Association, Inc. (TYTRAN) includes representatives of both the private community and the public sector. Despite the early efforts of TYTRAN, of the local government (Fairfax County), of the regional transit provider (WMATA), and of the regional MPO (Metropolitan Washington Council of Governments), the proportions of Tysons Corner employees which rideshare or take transit remain quite low.

Highway access to the Tysons Corner SAC is provided by several limited-access freeways (as shown in Figure 9). The

Capital Beltway (I-495) has two interchanges that feed directly into Tysons Corner from the east. The Dulles Airport Access and Toll Roads also interchange with two roadways that lead into Tysons Corner from the north and west. All three of the foregoing freeways interchange with I-66 within a few miles of the Tysons Corner SAC. The I-66 facility is the direct freeway connection from this area to downtown Washington, D.C.

The Tysons Corner SAC has been used as a study site for the following reasons. Tysons Corner has well over the minimum required square footage. In many respects it is the prototypical first-generation SAC. It began as a regional shopping mall located on a circumferential freeway which provided access from throughout the Northern Virginia suburbs. The success of the regional shopping mall caused spin-off development like specialty shopping plazas, fast-food restaurants, “fern bar” restau-

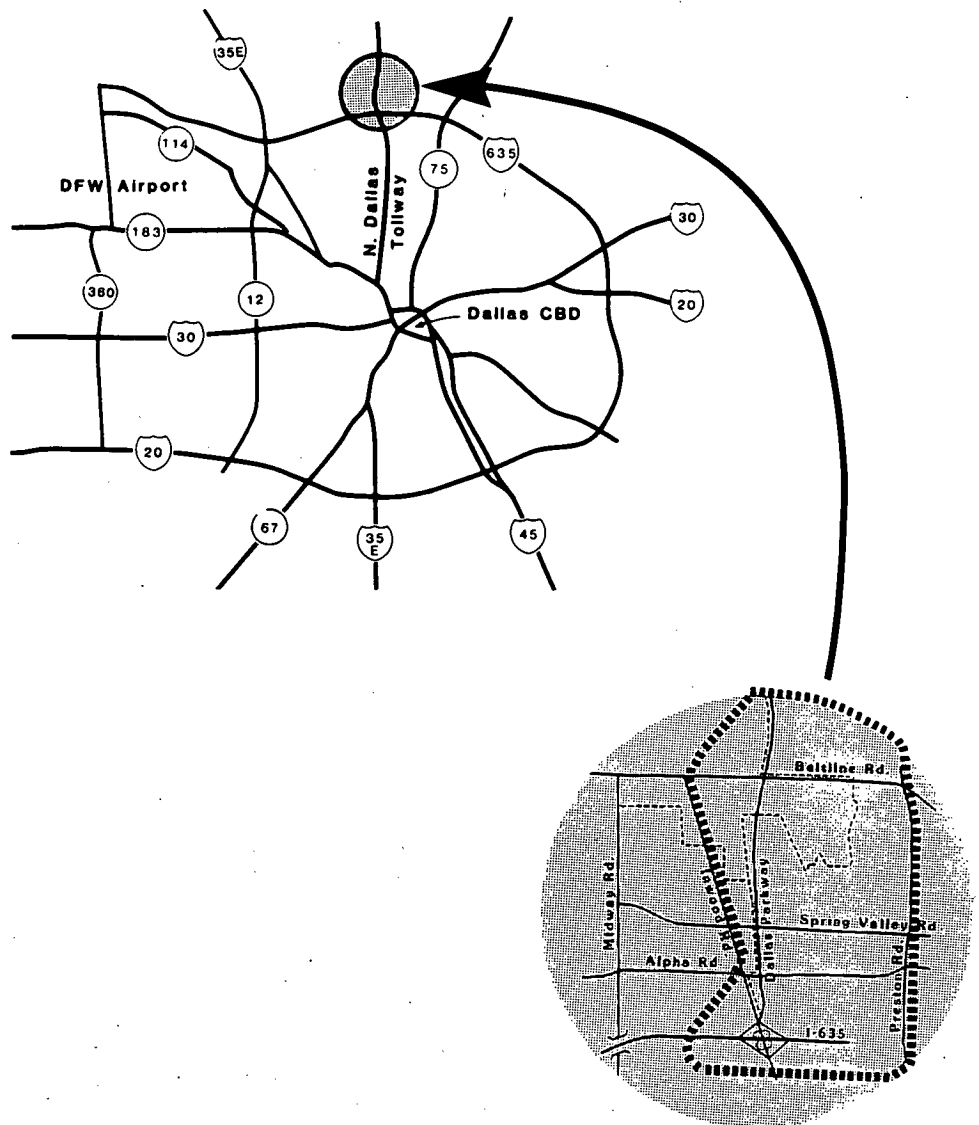


Figure 7. Parkway Center SAC.

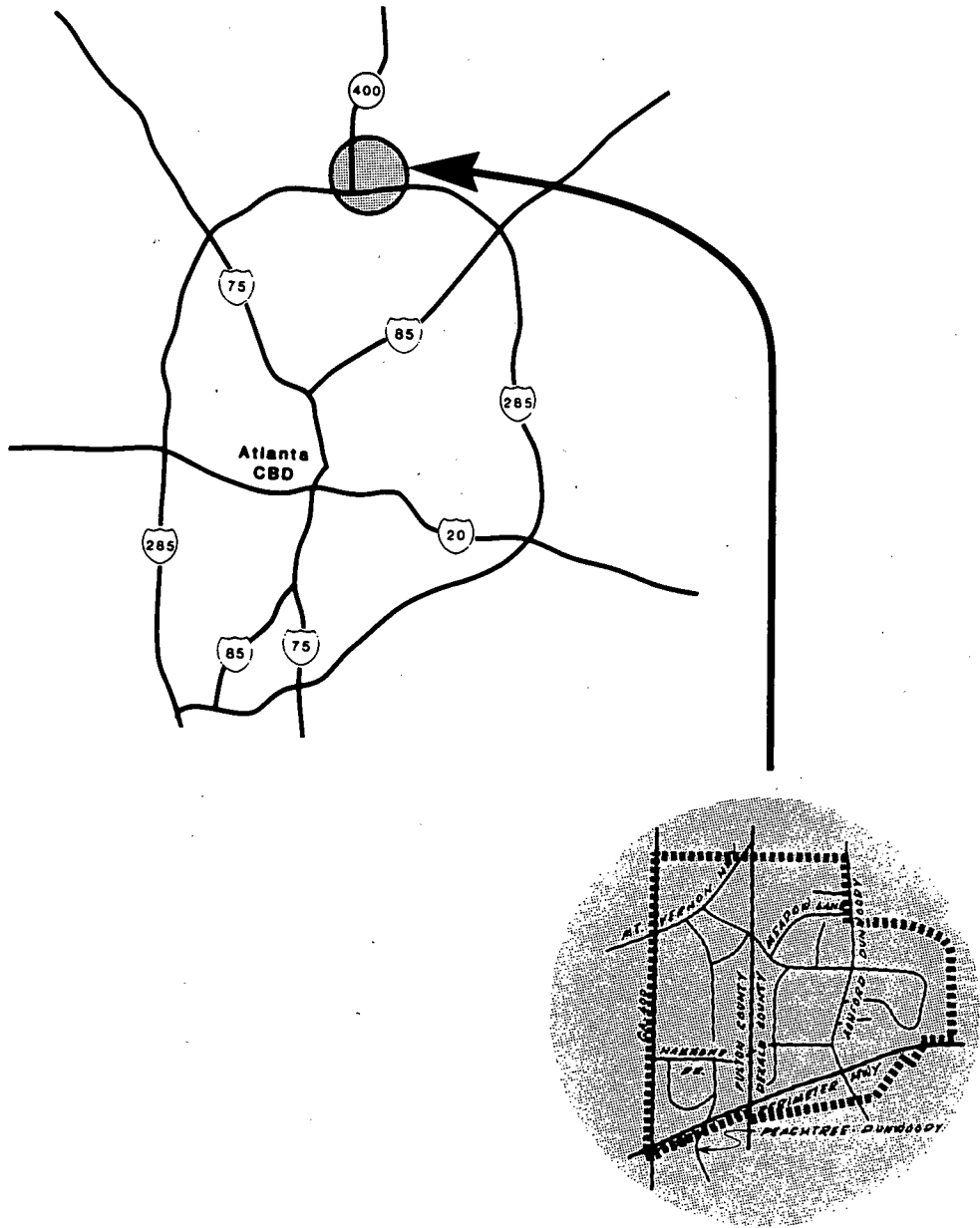


Figure 8. Perimeter Center SAC.

rants, automobile dealerships, and low-rise office parks. In recent years, there has been significant in-filling of vacant parcels with high-rise office, hotel, and residential buildings.

Southdale, Minnesota

The Southdale SAC is located roughly 10 miles south of the Minneapolis CBD within the Cities of Bloomington and Edina (see Figure 10). The SAC encompasses an area of approximately 960 acres. The total office space within the SAC is roughly 4 million gross square feet with over half of the office space being

older than 7 years old. Southdale has the oldest average building ages of the SACs surveyed.

Southdale Mall (with the reported distinction of being the oldest enclosed suburban retail mall in the U.S.) is located in the block bordered by France Avenue, York Avenue, 69th Street, and 66th Street. Southdale Mall has roughly 1.2 million square feet of space, which is nearly half of the total retail space in the SAC. In addition, there are several shopping plazas and numerous free-standing restaurants.

Southdale has a significant residential component. The SAC includes six residential high-rise complexes as well as numerous low-rise apartment and condominium complexes. Southdale has

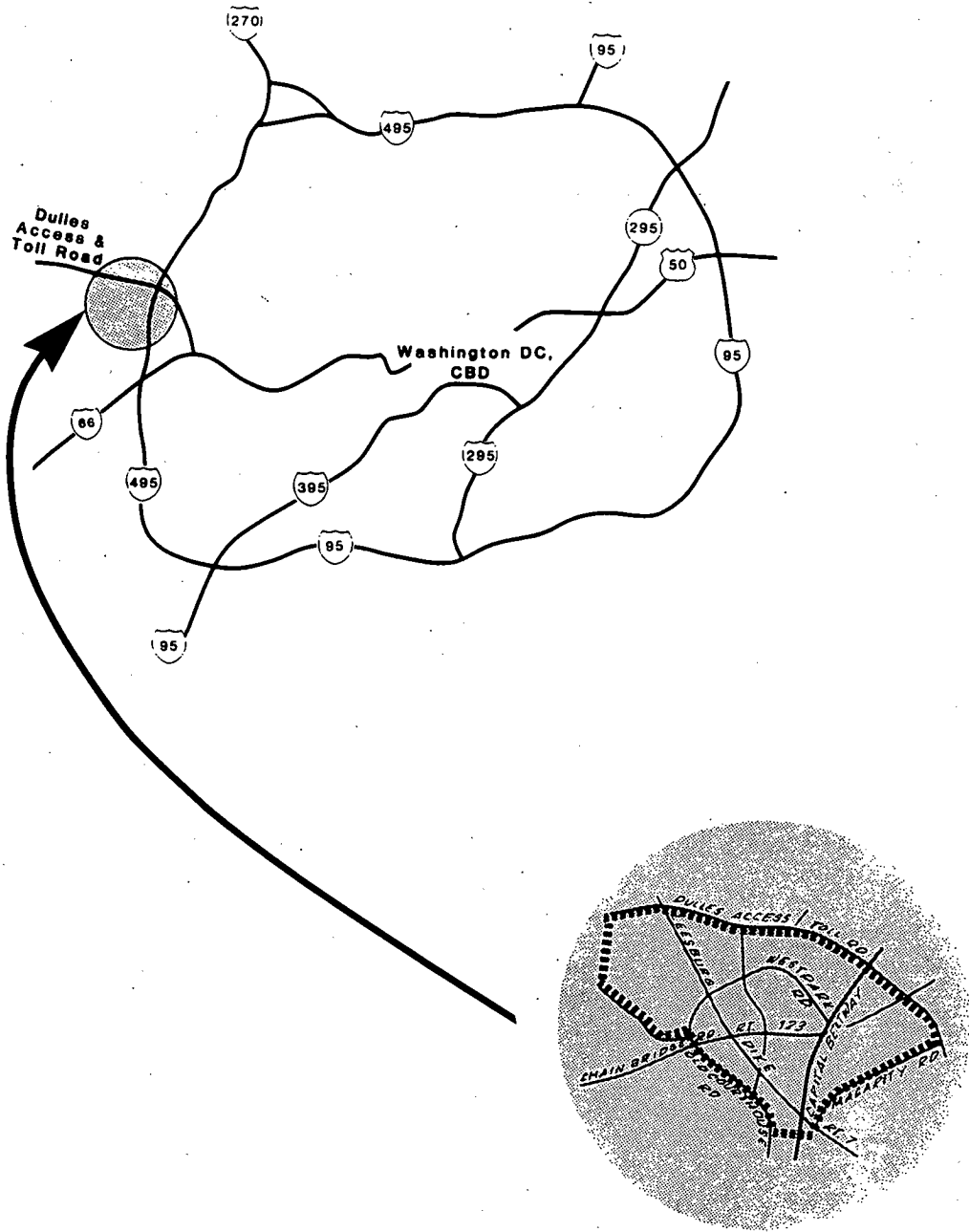


Figure 9. Tysons Corner SAC.

a total of roughly 3,000 dwelling units. The SAC has a total of 2,200 hotel rooms in nine hotels.

A summary descriptive listing of the six SACs selected for study is presented in Table 3. Shown in the table are the approximate square footages of office and retail space in the SAC, the estimated number of office and retail employees in the SAC, the approximate size of the SAC, and the SAC employee densities for each of the surveyed SACs. The most dense of the surveyed SACs is Bellevue (43 employees per acre) with its downtown-style grid network and development pattern. Tysons Corner, South Coast Metro, and Perimeter Center are each at the roughly 30 employees per acre level, followed by Parkway

Center (largest in both acreage and developed square footage) at the 26 employees per acre level. Finally, Southdale settles at roughly 21 employees per acre.

For subsequent analyses of the SACs and their travel characteristics, the term "larger SAC" refers to the three surveyed SACs with at least 15 million total square feet of office and retail space. The three larger SACs are Parkway Center, Tysons Corner, and Perimeter Center. The term "smaller SAC" refers to the three surveyed SACs with less than 8 million total square feet of office and retail space (Bellevue, South Coast Metro, and Southdale).

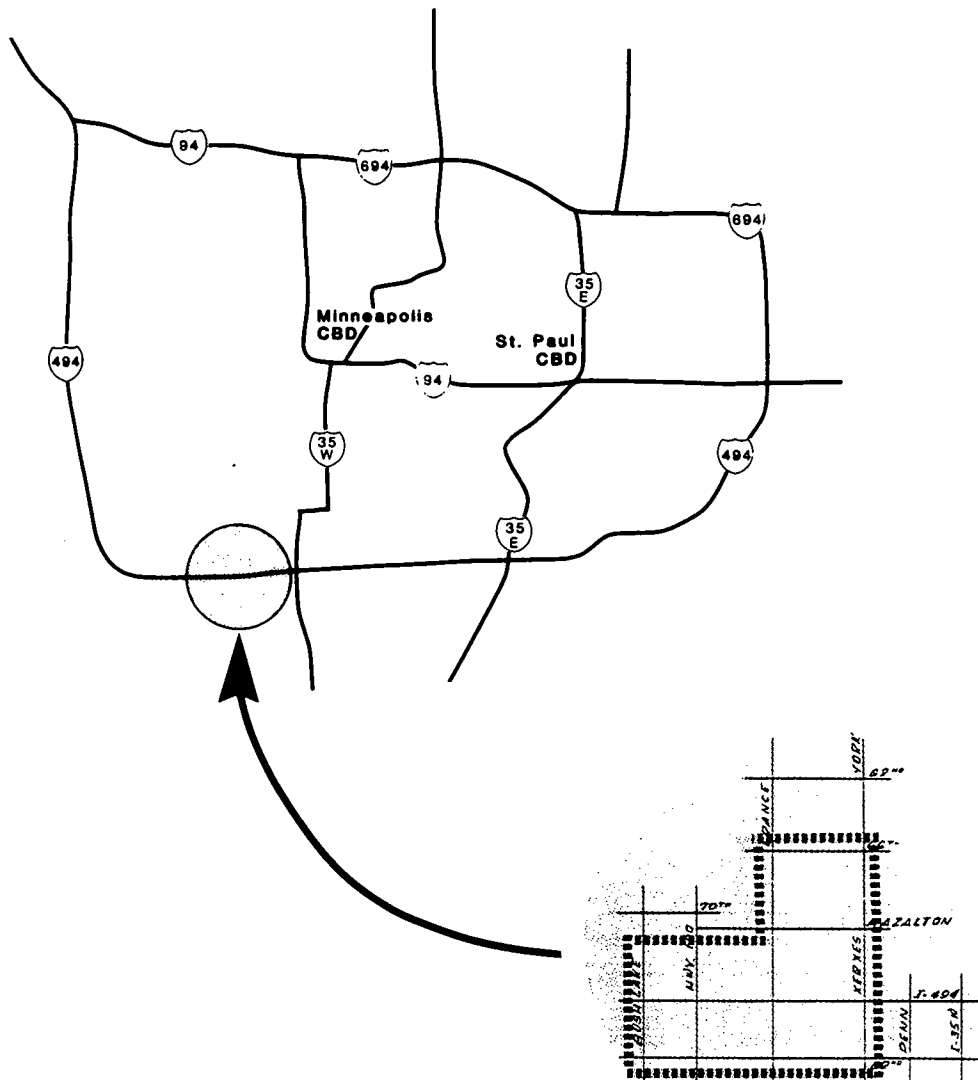


Figure 10. Southdale SAC.

Table 3. Employee densities in suburban activity centers.

<u>Suburban Activity Center</u>	<u>Office¹ GSF (million sf.)</u>	<u>Retail¹ GLA (million sf.)</u>	<u>Number of Employees</u>			<u>Acreage</u>	<u>Employees² Per Acre</u>
			<u>Office</u>	<u>Retail</u>	<u>Total</u>		
Bellevue	4.7	3	12,880	6,150	19,030	440	43.2
South Coast Metro	3.5	4	10,465	6,865	17,330	580	29.9
Parkway Center	17	7	35,020	13,355	48,375	1,870	25.9
Perimeter Center	13	2	39,000	3,430	42,430	1,450	29.3
Tysons Corner	13	3	32,500	5,150	37,650	1,230	30.6
Southdale	4	3	13,700	6,155	19,855	960	20.7

Notes:

1. The square footages of office and retail space listed above are estimated current totals. They therefore include unoccupied space which in some SAC's (e.g., Parkway Center) are significant.
2. The "employees per acre" values are shown only for comparative purposes. Much of the land in these SAC's is still undeveloped or underdeveloped. A more descriptive measure, although not available for this research, would be the average for the "build-out" sectors of the SAC.

FINDINGS—POTENTIAL VARIABLES AFFECTING SAC TRAVEL CHARACTERISTICS

■ There are any number of factors which affect the generation and distribution of trips to and from buildings located within large-scale suburban activity centers. This chapter presents a discussion of potential factors (i.e., independent variables) which are analyzed in subsequent sections of this report.

POTENTIAL INDEPENDENT VARIABLES

The factors affecting travel characteristics at buildings within suburban activity centers can be classified as the characteristics of either the metropolitan area, the SAC as a whole, the building and its immediate environs, the building tenants, the building parking, or the transit service in the area. Following this brief summary of potential independent variables, a comprehensive list of the specific data needs for deriving these independent variables is presented.

Metropolitan Area Characteristics. The characteristics of the overall metropolitan area which could affect travel within a suburban activity center are those which influence external trip-making at the SAC. The size of the metropolitan area (population and employment) and, in particular, the size of the downtown core could affect SAC travel characteristics. Another factor could be the household population, office employment, and retail square footage within close proximity of the SAC.

Suburban Activity Center Characteristics. The characteristics of the SAC which could affect SAC travel characteristics include its geography, its internal development, and other external forces. In terms of geography its proximity to the downtown core and to other primary trip generators (e.g., major residential subdivisions) could have an effect. The size of the SAC (land area and developed square footage) and its shape (linear, concentric, grid, or nodal) also could affect SAC travel characteristics. The makeup of the SAC development in terms of office, retail, residential, and hotel square footage should have a direct impact on SAC travel characteristics. Mean parking costs throughout the SAC, the age of the SAC development, and the extent of background traffic congestion are all factors influencing SAC travel characteristics.

For this set of characteristics, the most effective independent variables may in fact be combinations of several factors. For example, the proportion of PM peak-hour trips generated by an office building which are destined for an intermediate stop at a retail land use may not correlate to the total office or retail square footage. Instead, good correlation may be found with another factor (derived from the original factors), the ratio of the total SAC retail square footage to the total square footage for office use. As this ratio increases, it would be expected that an increasing proportion of the office trips will make intermediate retail stops.

Building Characteristics. The size of the building (gross square footage, gross leasable square footage, number of dwelling units, and number of hotel rooms) should have a major bearing on at least the number of person-trips and vehicle-trips generated by a building. The age of the building, its location within the SAC, its height, and its average leasing rate are all potential independent variables for use in determining SAC travel characteristics. The proximity of other buildings (especially retail uses near an office building) could affect trip distribution.

Building Tenant Characteristics. Knowledge of the number of employees in an office building produces significant improved estimates of the number of vehicle-trips generated by the building. The proportions of different types of tenants within an office building should have an effect on both trip generation and distribution. These tenants could include nonoffice uses such as retail or banking and could include medical-office space as well as general office space. Building vacancy rates, for all building types, are expected to play a significant role in trip generation rates. Hotel characteristics, such as the amount of conference and meeting room space, and residential characteristics, such as number of employed residents, age distribution, and automobile ownership, are all potential independent variables.

Building Parking Characteristics. The location, cost, and availability of parking on-site can have a substantial effect on travel characteristics at an individual building. Short-term versus long-term rates would affect different trip purposes. The presence of "incentive" parking spaces (and their particular characteristics) should have an effect on SAC travel characteristics.

Building Transit Service Characteristics. The presence of fixed-route transit service within close proximity of a building (and, in particular, the number of buses during the peak period and their number of seats) affects travel characteristics for building-generated trips. Transit travel time to the urban core and its associated round-trip fare would certainly affect the travel characteristics of a residential development. Another transit-related factor, especially for the SAC hotels, would be the typical cab fares within the SAC and to/from the downtown core.

INDEPENDENT VARIABLE DATA NEEDS

The data items in order to support the independent variables described earlier are given in Table 4. These data needs are separated into six categories: metropolitan area characteristics, suburban activity center characteristics, building characteristics, building tenant characteristics, building parking characteristics, and building transit service characteristics. For most categories a listing of "general" data needs is included. These are needed for whichever building type is being surveyed. Under "office, retail, hotel, and residential," only those data items appropriate to the denoted land use type are shown.

Table 4. Independent variable data needs.

METROPOLITAN AREA CHARACTERISTICS

- *CBD employment
- *CBD office square footage
- *CBD office employment
- *Regional employment
- *Regional office square footage
- *Regional office employment
- *Regional retail square footage
- *Regional retail employment
- *Regional population

SUBURBAN ACTIVITY CENTER CHARACTERISTICSGeographical

- *Distance to downtown core
- *Distance to other primary trip generators
- *Total SAC land area
- *Shape of SAC (linear, concentric, grid, nodal)

Other Characteristics

- *Pedestrian facilities
- *Public/private cooperative agreements
- *Current TSM actions (e.g. rideshare brokerage)
- *SAC socio-economics (e.g. white-collar, professional)
- *Overall traffic congestion
- *Overall transit availability and patronage

SAC Development

- *Age of SAC and rate of SAC development
- *Total SAC square footage (including residential)
- *Overall FAR in SAC
- *Total office square footage in SAC
- *Total retail square footage in SAC
- *Total residential units in SAC
- *Total number of hotel rooms in SAC
- *Mean daily office (8-hour) parking cost
- *Mean short-term (2-hour) retail parking cost
- *Peak hour traffic volume -- SAC cordon
 - radial facilities
 - crosstown facilities

BUILDING CHARACTERISTICSGeneral

- *Building size
 - gross square footage
 - number of stories
- *Building site FAR
- *Age of building
- *Location within SAC (central vs. periphery)

Office

- *Average leasing rate
- *Number of residential units within 2,500 feet
- *Retail square footage within 2,000 feet
- *Number of restaurants within 2,000 feet
- *Number of hotel rooms within 1,000 feet

Retail

- *Building size -- gross leasable square footage
- *Office square footage within 2,000 feet
- *Number of residential units within 2,000 feet
- *Retail square footage within 2,000 feet
- *Number of hotel rooms within 2,000 feet

Hotel

- *Building size
 - number of rooms
 - gross square footage for conference rooms
- *Office square footage within 1,000 feet
- *Retail square footage within 2,000 feet

Residential

- *Building size (number of dwelling units)
 - owner-occupied
 - rental
- *Size of complex -- # of bldgs, total # of units, GSF
- *Average number of bedrooms per dwelling unit
- *Average sales price for non-rental units
- *Office square footage within 2,500 feet
- *Retail square footage within 2,000 feet

BUILDING TENANT CHARACTERISTICSGeneral

- *Number of employees (full-time and part-time)

Office

- *Number of tenants
- *Building vacancy rate (pctge of GSF)
- *Proportion of building in non-office use
- *Retail square footage in building
 - type of retail (e.g. restaurant, convenience)
- *Medical-office square footage as a proportion of general office square footage

Retail

- *Number of retail tenants
- *Number of "anchor" stores
- *Building vacancy rate
- *Proportion of building in non-retail use
- *Number and square footage of restaurants
- *Types of retail use (e.g. restaurant, convenience, comparison)

Hotel

- *Number of occupied rooms (on survey data)
- *Proportion of building in retail use
- *Number and size of restaurants and lounges
- *Average one-night price for a double room

Residential

- *Number of residents (school age, 18-35, 36-54, 54+)
- *Mean age of adult residents
- *Mean number of cars owned per dwelling unit
- *Overall vacancy rate
- *Proportion of building in non-residential use (e.g. medical-office, office, retail)

BUILDING PARKING CHARACTERISTICS

- *Number of on-site parking spaces
- *Number of free on-site parking spaces
- *Mean employee on-site parking cost
- *Mean visitor on-site parking cost
- *Mean walk distance to on-site parking
- *Number of "incentive" parking spaces (e.g. carpools)
- *Mean parking cost for "incentive" spaces
- *Mean walk distance to "incentive" on-site spaces

BUILDING TRANSIT SERVICE CHARACTERISTICSGeneral

- *Number of peak hour buses stopping
 - within 500 feet
 - within 1000 feet
- *Walk distance to nearest transit stop

Hotel

- *Mean cab fare within SAC
- *Mean cab fare to downtown core

Residential

- *Transit travel time to downtown core
- *Roundtrip transit fare to downtown core
- *SAC office square footage within a 10-minute transit ride

FINDINGS—TRAVEL CHARACTERISTICS DATA COLLECTION PROCEDURES

■ This chapter presents the procedures and techniques used to collect the desired travel characteristics data. First, the data collection techniques (pedestrian survey, workplace survey, counts) are specified including the data that were collected. Second, the survey and count forms that were used are presented. The chapter closes with a brief discussion of the criteria used in selecting the building sites or complexes for purposes of collecting travel characteristics data in each of the six activity centers.

DATA COLLECTION PROCEDURES

The travel characteristics of suburban activity center components were collected at a sample of the SAC buildings using the following techniques:

<i>Land Use</i>	<i>Data Collection Technique</i>
Office	<ul style="list-style-type: none"> • Workplace survey distributed to all or a sample of workers in building • Pedestrian interview during AM/PM peak hours at entrance to determine visitor mode split; linked-vs.-unlinked trips, pass-by vs. new trips, and internal vs. external activity center trips • Vehicular (with occupancy) and pedestrian counts
Retail	<ul style="list-style-type: none"> • Pedestrian interviews within the shopping area (as above) • Vehicular counts with automobile occupancy and pedestrian counts
Hotel/Motel	<ul style="list-style-type: none"> • Pedestrian interviews within hotel (as above) • Vehicular counts with automobile occupancy and pedestrian counts
Residential	<ul style="list-style-type: none"> • Residential survey of all or a sample of residents • Vehicular and pedestrian counts

The travel characteristics data were collected in the six selected suburban activity centers during the months of October and November of 1987 and the months of February through May 1988.

Vehicle Counts

At each of the building sites, a complete vehicle count, by direction, was made. This count also included stratification of these vehicles by their occupancy. The counts were taken over two 2-hour periods—between 7 and 9 AM and between 4 and

6 PM for the office, hotel, and residential sites; between 12 and 2 PM and between 4 and 6 PM for the retail sites. Counts were principally conducted on a Tuesday, Wednesday, or Thursday to account for an average weekday. At each of the count sites, these vehicle quantity and vehicle occupancy counts were taken manually. It was hoped that 24-hour counts could be taken at sites at which pneumatic tube counters could be placed. However, most SAC office, retail, residential and hotel sites were not conducive to the placement of tube counters that could accurately record total traffic movements or that could be secured to a fixed object; therefore, only limited 24-hour vehicle count data were collected.

Workplace Survey

A workplace survey of employees was conducted at the office sites and at a sample of hotel and retail sites. The purpose of the employee workplace survey was to obtain a daily trip-log for employees in order to determine their total daily and peak-hour trip generation, trip purpose, trip mode, and trip origin/destination (within or outside the suburban activity center and, if within the suburban activity center, to which building).

The workplace survey form used in Perimeter Center is presented in Figure 11. The workplace survey form was distributed primarily to each of the individual employers within the building. The employer then assumed the responsibility of survey distribution to its employees as well as its retrieval.

As part of the workplace survey process, it was also necessary to determine the number of employees for each employer in the building. This was accomplished through a brief interview of the employer on the day of the workplace survey. An effort was made to ensure that the employees all regularly report to that site. Some businesses have branch offices located elsewhere, and off-site employees can sometimes unknowingly be added to the on-site figures. For this survey effort, these off-site employees are treated as visitors.

Residential Surveys

The objective of the residential survey is to obtain certain socioeconomic, demographic, and trip-making information from a sample of households within the suburban activity center. The selected method for conducting the survey was a self-administered mailback.

The residential survey used in Southdale is shown in Figure 12. The socioeconomic and demographic data that are collected include: number of persons in household; number of employed persons and their ages; number of licensed drivers; number of vehicles available; location of work site and mode of commute;

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM EMPLOYEE TRANSPORTATION SURVEY

The National Cooperative Highway Research Program (NCHRP) is conducting surveys, endorsed by DeKalb County Georgia Department of Transportation, MARTA DeKalb Chamber of Commerce and the Atlanta Regional Commission of travel characteristics by persons working in the Perimeter Center area.

We ask your cooperation by answering each of the questions below and returning the questionnaire to the person who gave it to you. The information obtained from this survey will be kept completely confidential and will only be used to produce statistical data. If you have any further questions, please contact Mr. David Kirk, Atlanta Regional Commission, at 656-7421.

THANK YOU FOR YOUR TIME AND COOPERATION.

SECTION A: COMMUTE CHARACTERISTICS

1. What is the name of the business where you report to work? _____
Name of business
2. How long have you worked at this location? _____ years _____ months
3. What is the total distance you commute (in miles) from your home to this work location? _____ miles
4. If you have changed residence since working at this location, what was your previous commute distance (in miles)? _____ miles
5. How long did it take you to get from home to work today and from work to home yesterday (or your last weekday at work)? Please include time from door to door, both to and from work (even if the same).
From home to work: _____ minutes
From work to home: _____ minutes
6. At what time did you start work today, even if atypical. At what time did you leave work yesterday, even if atypical. (Please fill in time and circle AM or PM).
Start work ____ : ____ AM PM
Leave work ____ : ____ AM PM
- 7a. What primary means of travel did you use to get to work today? (Circle one).

1. Drove alone	3. Rode as passenger: Car parked nearby	5. Bus
2. Drove others: How many, include yourself _____	4. Rode as passenger: Dropped off	6. Bicycle
		7. Walk (only)
		8. Taxi
- 7b. If your trip home is via a different means of travel please specify: _____

ANSWER QUESTION 8 ONLY IF YOU DROVE A CAR OR RODE TRANSIT TO WORK TODAY, OTHERWISE SKIP TO SECTION B.

8. A) **Auto Drivers:** How much does it cost you to park your car here? Do not include amount subsidized by employer (Circle one and fill in amount).

1. Nothing-free parking
2. \$ _____ per day
3. \$ _____ per month
- B) **Transit Riders:** What is your estimated round-trip cost to and from work? Please include all transit fares and parking charges, if any. (Fill in amount)

4. \$ _____ per day

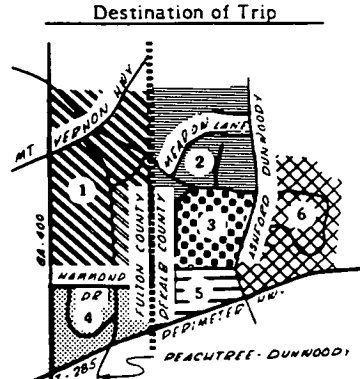
Figure 11. Workplace survey (Perimeter Center).

SECTION B: TRIP-MAKING CHARACTERISTICS

We would like to find out about all the trips you made on the way to work **TODAY**, as well as the trips you made during the day and on your way home from work **YESTERDAY** (or your last weekday at work). For the following three sections, write in the corresponding code numbers from below for Purpose of Trip and Means of Travel and Destination of Trip. For the trip destination, please use the code numbers contained on the map for the immediate Perimeter Center area or the corresponding code number for the city.

- CODE NUMBERS -

Purpose of Trip	Means of Travel
1. Work related	1. Drove a car
2. Meal or snack	Rode in a car
3. Shopping	2. -Passenger
4. Childcare/School	3. -Dropped off
5. Pick-up/drop-off a passenger	4. Walk
6. Educational	5. Bus
7. Social/Recreational	6. Taxi
8. Home	7. Other-specify in table
9. Banking	
10. Medical	
11. Health Club	
12. Dry Cleaners	
13. Gas Station	
14. Grocery Store	
15. Other-specify in table	



- 7. Cumberland
- 8. Buckhead
- 9. Downtown Atlanta
- 10. Midtown Atlanta
- 11. Elsewhere in DeKalb County
- 12. Elsewhere in Fulton County
- 13. Elsewhere in Atlanta
- 14. Marietta
- 15. Decatur
- 16. Elsewhere

PLEASE COMPLETE ALL THREE SECTIONS: I, II and III

I. TRIP TO WORK

Did you make any **STOPS** on your way **TO** work **TODAY**? (Check yes or no)

- No, I traveled directly to work: go to Section II
- Yes, I made the following stops: use code numbers from above to fill in blanks.

The example describes a stop made to drop a child off at daycare by means of driving to Area 4 within the Perimeter Center area at 7:30. This person then went to work.

	Example	1st Stop	2nd Stop	3rd Stop	4th Stop
Purpose	4				
Means of Travel	1				
Destination	4				
Time of Arrival	7:30	:	:	:	:
And then (check one)					
To Work	1 <input checked="" type="checkbox"/>	1 <input type="checkbox"/>	1 <input type="checkbox"/>	1 <input type="checkbox"/>	1 <input type="checkbox"/>
To Next Stop	2 <input type="checkbox"/>	2 <input type="checkbox"/>	2 <input type="checkbox"/>	2 <input type="checkbox"/>	2 <input type="checkbox"/>

Figure 11. Continued

and household trip patterns including trip purposes, trip lengths, and trip modes.

The travel characteristics data encompass all daily trips to or from an intra-SAC location. For each such trip, the time period, direction (leave or return), mode, origin/destination, and trip length are recorded.

The residential surveys were distributed either with the assistance of the building management or by direct mailing to the building or complex residents. At the sites at which cooperation was provided by the building management, the surveys were

distributed with an internal mailing (such as a newsletter at one of the residential sites in South Coast Metro) or by physically delivering the surveys door-to-door. At other sites, it was necessary to conduct a direct mailing of survey forms to the households.

Collection of the surveys was by means of a mailback with prepaid postage.

II. MID-DAY TRIPS

Did you make any trips during working hours YESTERDAY (or your last weekday at work)? A trip for this section is defined as the time when you leave this building to the time you return.

- No, I did not leave this building until I went home for the evening: go to Section III.
- Yes, I made the following trips: use code numbers to fill in blanks.

	<u>First Trip</u>			<u>Second Trip</u>			<u>Third Trip</u>		
Time you left this building (Circle AM or PM)	___ : ___ AM PM			___ : ___ AM PM			___ : ___ AM PM		
	<u>1st Stop</u>	<u>2nd Stop</u>	<u>3rd Stop</u>	<u>1st Stop</u>	<u>2nd Stop</u>	<u>3rd Stop</u>	<u>1st Stop</u>	<u>2nd Stop</u>	<u>3rd Stop</u>
Purpose	□	□	□	□	□	□	□	□	□
Means of Travel	□	□	□	□	□	□	□	□	□
Destination	□	□	□	□	□	□	□	□	□
And then:									
Back to work	1 □	1 □	1 □	1 □	1 □	1 □	1 □	1 □	1 □
To next stop	2 □	2 □	2 □	2 □	2 □	2 □	2 □	2 □	2 □
Time you returned to this building (Circle AM or PM)	___ : ___ AM PM			___ : ___ AM PM			___ : ___ AM PM		

III. TRIP FROM WORK

Did you make any STOPS on your way home FROM work yesterday (or your last weekday at work)?

- No, I traveled directly home: turn page over.
- Yes, I made the following stops: use code numbers to fill in blanks.

	<u>1st Stop</u>	<u>2nd Stop</u>	<u>3rd Stop</u>	<u>4th Stop</u>
Purpose	□	□	□	□
Means of Travel	□	□	□	□
Destination	□	□	□	□
Time of Arrival	:	:	:	:
And then (check one)				
To Home	1 □	1 □	1 □	1 □
To Next Stop	2 □	2 □	2 □	2 □

Please complete sections C and D on other side

Figure 11. Continued

Intercept Surveys

Pedestrian-based surveys were used to gather information on a particular trip's characteristics such as trip purpose, trip origin-destination, and whether or not it is linked with another trip (e.g., one stop in a series of stops). Pedestrian-based interviews were conducted at the office sites to record visitor trips, at retail sites to capture all trips, and at hotels to capture all

trips. The information was taken directly by the interviewer to avoid any confusion or misunderstanding by the person being interviewed.

The office and hotel intercept surveys were conducted between 7 and 9 AM and between 4 and 6 PM. The retail intercept surveys were conducted between 12 noon and 2 PM and between

SECTION C: TRIP MAKING CHARACTERISTICS WITHIN THIS BUILDING OR COMPLEX

9. Where did you eat lunch YESTERDAY (or your last weekday at work)? (Circle one)
1. Did not eat lunch
 2. In my office or company lunchroom
 3. In this building or complex
 4. Elsewhere outside this building or complex
10. WITHIN this building or complex, check all of the services that you used YESTERDAY (or your last weekday at work).
1. Restaurant
2. Bank
3. Health Club
4. Travel Services
5. Medical Office
6. Other, specify _____
7. Other, specify _____

SECTION D: RESPONDENT INFORMATION
--

11. What is the zipcode of your home address? _____ (enter zipcode)
12. What is your age? (circle one)
- | | |
|----------------------|---------------------|
| 1. 18 years or under | 5. 45 - 54 years |
| 2. 19 - 24 years | 6. 55 - 64 years |
| 3. 25 - 34 years | 7. 65 years or more |
| 4. 35 - 44 years | |
13. Your sex. (circle one) 1. Male 2. Female
14. How many autos, pickups, vans and motorcycles are available for use by members of your household? _____ (enter number)
15. What is your occupation? (circle one)
- | | |
|---------------------------|-----------------------|
| 1. Professional/technical | 5. Student/intern |
| 2. Manager/administrator | 6. Service worker |
| 3. Sales/account rep. | 7. Craftsman/mechanic |
| 4. Secretary/clerical | |
16. Including yourself, how many people live in your household?
- Total number of people _____
- Number under 16 years of age _____
- How many work full time _____
- How many work part time _____
17. Are you a full-time employee or part-time employee? (Circle one)

Figure 11. Continued

4 and 6 PM. Separate interview forms were prepared for each land use: office (Figure 13), retail (Figure 14), and hotel (Figure 15).

At the office buildings, pedestrians entering the building during the morning and afternoon peak hour were first screened to include only visitors and then asked questions regarding mode of arrival and departure, trip purpose, internal vs. external trip ends, and linked vs. unlinked trips. At the small retail sites a similar approach was taken. However, at the large retail sites (e.g., regional shopping centers) a crew of roughly six surveyors randomly interviewed patrons within the center. The interview was kept brief in order to minimize the delay to the persons interviewed and to enable the conduct of as many interviews as possible.

DATA COLLECTION SITE SELECTION

The individual building sites or complexes selected for data collection in each of the six activity centers were chosen based on several factors. Primary emphasis was placed on the need to obtain a cross section of the various land uses at each SAC and of their varying characteristics.

Each building site selected is intentionally homogeneous with only minor exceptions, most notably the presence of support retail in several of the office buildings. A mixing of uses would not enable the trip rates to be applied to other locations.

A conscious attempt was made to count and survey at least at some of the largest office buildings with sufficient occupancy and at the regional retail center. The other retail centers selected

1988 NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM RESIDENTIAL TRANSPORTATION SURVEY

This transportation survey, distributed to residents in the Southdale area, will provide the Cities of Bloomington and Edina, Metropolitan Council, Minnesota Department of Transportation, and Improve-494 with data pertaining to travel characteristics of persons living in the Southdale area.

We ask your cooperation by completing and mailing (no postage required) the following questionnaire. As the information obtained from this survey will be documented in summary form only, your name and address are not required. If you have any questions, please contact Ms. Sandra M. Woods, jhk & Associates, at (703) 370-2411.

SECTION A

One person may fill in the responses for all persons 16 years of age and older who are currently living in the household:

1. Date for reporting information -- please use a weekday.
2. Sex 1. Male 2. Female
Enter one code number for each person
3. Age - Enter age
4. Does this person work outside this residence?
1. Yes, Full-time
2. Yes, Part-time
3. No.
Enter one code number for each person
5. If yes, enter the zipcode or city of that work address.
6. Does this person have a current driver's license?
1. Yes 2. No
Enter one code number for each person
7. Did this person make any trips outside this residence on the above reported date? If yes, please go to Section B, otherwise go to Section C.
1. Yes 2. No
Enter one code number for each person

Person 1	Person 2	Person 3
/ /88	/ /88	/ /88
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Figure 12. Residential survey (Southdale).

SECTION B

We would like to find out about all the stops you and each resident made in the area designated on the map below. Please have each of the persons from Section A fill in the corresponding trip log below. It is not required that each person respond to this section.

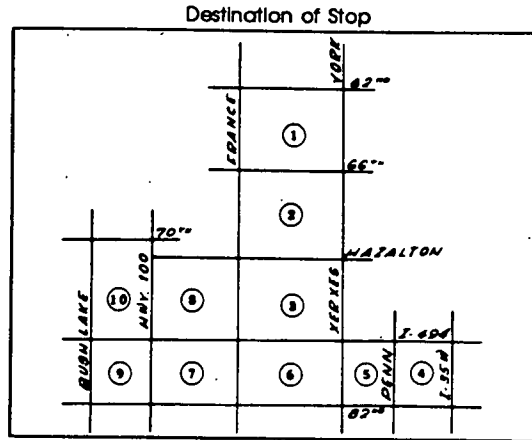
The example contained in each trip log describes a stop made at a childcare facility in area 4, at 8:15 A.M., by driving. This person then went to work.

Purpose of Stop

1. Work related
2. Meal or snack
3. Shopping
4. Childcare/School
5. Pick-up/drop-off a passenger
6. Educational
7. Social/Recreational
8. Home
9. Banking
10. Medical
11. Health Club
12. Dry Cleaners
13. Gas Station
14. Grocery Store
15. Other-specify in table

Means of Travel

1. Drove a car
2. Rode in a car as a Passenger
3. Rode in a car to be dropped off
4. Walk
5. Bus
6. Taxi
7. Other - specify in table



Person 1 Trip Log

Did you make any stops in the area contained on the above map? (Check Yes or No)

- 1 No
 2 Yes, I made the following stops

	Example	1st Stop	2nd Stop	3rd Stop	4th Stop
Purpose of Stop	<u>4</u>	—	—	—	—
Means of Travel	<u>1</u>	—	—	—	—
Destination of Stop	<u>4</u>	—	—	—	—
Time of Arrival	<u>8:15</u>	—	—	—	—
Circle AM or PM	(AM) PM	AM PM	AM PM	AM PM	AM PM
And then (check one)	<input checked="" type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1
To Work	<input checked="" type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1
To Next Stop	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 2
To Home	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 3

Figure 12. Continued

for survey tend to be multitenant strip commercial centers. Building size was an important factor because of the desire for the number of person-trips and vehicle-trips generated by the building site to be of sufficient quantity to provide some stability to the trip frequency estimates.

Hotels both isolated and within close proximity of large concentrations of office buildings were surveyed. In addition, hotels both with and without extensive conference and meeting room space were surveyed.

At several of the activity centers, the supply of residential

Person 2 Trip Log

Did you make any stops in the area contained on the above map? (Check Yes or No)

- 1 No
- 2 Yes, I made the following stops

	Example	1st Stop	2nd Stop	3rd Stop	4th Stop
Purpose of Stop	4	—	—	—	—
Means of Travel	1	—	—	—	—
Destination of Stop	4	—	—	—	—
Time of Arrival	8:15	—	—	—	—
Circle AM or PM	AM PM	AM PM	AM PM	AM PM	AM PM
And then (check one)					
To Work	<input checked="" type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1
To Next Stop	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 2
To Home	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 3

Person 3 Trip Log

Did you make any stops in the area contained on the above map? (Check Yes or No)

- 1 No
- 2 Yes, I made the following stops

	Example	1st Stop	2nd Stop	3rd Stop	4th Stop
Purpose of Stop	4	—	—	—	—
Means of Travel	1	—	—	—	—
Destination of Stop	4	—	—	—	—
Time of Arrival	8:15	—	—	—	—
Circle AM or PM	AM PM	AM PM	AM PM	AM PM	AM PM
And then (check one)					
To Work	<input checked="" type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1	<input type="checkbox"/> 1
To Next Stop	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 2
To Home	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 3	<input type="checkbox"/> 3

SECTION C

Please answer questions 8 and 9 for the entire household

8. How many persons live in your Household:

- Total number of people _____
- Number under 16 years of age _____
- How many...work full time _____
- How many...work part time _____

9. How many vehicles are owned or regularly used by members of your household (Include vans, pick-up trucks, motorcycles and company cars kept at home)

Enter number _____

Figure 12. Continued

development internal to the SAC is limited. Therefore, residential site selection often resorted to whatever was available. Where some selection was available, both high-rise and low-rise were

surveyed and both owner-occupied and rental units were surveyed.

SUMMARY OF SURVEY RESULTS AND THEIR IMPLICATIONS

■ This chapter summarizes the survey (office, retail, residential, and hotel) analysis results and their relevance to the travel characteristics data procedures described in Chapter Four. The more detailed analyses and a discussion of the research findings are presented in the subsequent Chapters Six through Nine.

OFFICE SURVEY ANALYSIS

Office Building Size

Workplace surveys were distributed, visitor intercept surveys were conducted, and trip generation counts were taken at 87 office buildings and complexes. The majority of the buildings surveyed were opened during the 1980s. This age distribution is reflective of the recent rapid growth in each of the six surveyed SACs.

The total gross square footage (gsf) of the individual office buildings ranged between a low of 21,500 gsf and a high of 597,000 gsf. The median building size surveyed was between 200,000 and 250,000 gsf. In order to measure the specific travel characteristics in large office buildings, 16 buildings larger than 400,000 gsf were surveyed.

Employee Density

The most significant finding regarding office employee density is that there is a direct correlation between employee density and building size. As shown in Listing A, the reported average employee densities decrease with increased building sizes.

Listing A

Building Size (gsf)	Average Employee Density (employees per 1,000 occupied gsf)
Over 500,000	2.22
400-500,000	2.53
300-400,000	2.77
200-300,000	2.92
100-200,000	3.02
Under 100,000	3.43

The ITE *Trip Generation* report gives average employee densities of 3.50 for office buildings larger than 200,000 gsf; 4.40 for buildings between 100,000 and 200,000 gsf; and 4.80 for buildings under 100,000 gsf. For all building size categories, the observed employee densities at the surveyed office buildings are less than the ITE rates.

Building Parking Characteristics

The number of on-site parking spaces and fees charged for their use were collected at each of the surveyed office buildings. Most of the surveyed buildings provide free parking with some having nominal daily and monthly parking fees. However, the workplace surveys found that most employees receive free or discounted parking privileges from their employers. In Bellevue, roughly 25 percent of the surveyed office employees pay a parking fee. In South Coast Metro, roughly 6 percent of the office employees pay for parking. At each of the other four surveyed SACs, less than 2 percent of the office employees pay for parking.

Office Trip Generation

In general, the observed trip generation rates per building gross square footage are lower than the reported rates in the ITE *Trip Generation* publication. Seventy-four percent of the observed AM rates are lower than the ITE rates and 69 percent of the PM rates are lower. However, the observed trip generation rates per employee are generally higher than the reported ITE rates. Sixty-seven percent of the observed AM rates per employee are higher than the ITE rates and 72 percent of the PM rates are higher. Therefore, the lower trip rates on a building square footage basis appear to be the product of lower employee densities.

The foregoing trend for observed trip generation rates to be lower than reported by ITE on a per building square foot basis and higher on a per employee basis holds true for both large and small buildings. A key observation made in this research effort is that an extensive, systematic, and statistically rigorous effort must be mounted in order to achieve a more effectual understanding of vehicle trip generation rates for office buildings. Based on the office trip generation data reported previously and discussed in detail in Chapter Six, several salient points can be made regarding the procedures currently used to measure and forecast trip generation rates: (1) The most widely used factor, among the numerous variables that affect the trip generating characteristics of an office building, is building gross square footage; however, this variable should be more accurately considered as the "occupied" gross square footage. (2) Employment generally is a more accurate independent variable for deriving trip generation estimates; but, measurement and forecasting of employment levels is even less predictable than occupied square footage. (3) Because ITE trip generation rates are supplied by private sources that have collected the data in a potentially uncontrolled environment, it cannot be stated with complete assurance that accurate estimates of building occupancies were collected and appropriately factored into the calculation. Nevertheless, even with the level of practical diligence

applied to the collection of building occupancy rates for this research effort, the researchers also cannot speak with complete assurance regarding the building occupancy rates. Thus, it appears that more research and development are required for standardizing a methodology for determining and computing building occupancy levels. (4) Transportation planners traditionally account for employee absenteeism and variable work hours in computing trip generation rates on a per employee basis. Likewise, building leases are in a continual turnover and some vacancy should be expected. The question then arises, when computing trip generation on a building square footage basis, whether or not a nominal building vacancy should be considered "typical."

Automobile Occupancy

The observed range of AM peak-hour automobile occupancies and the weighted means for each surveyed SAC are shown in Listing B.

Listing B

SAC	Observed Auto Occupancies Mean	Occupancies Range
Bellevue (total)	1.16	1.04–1.74
(w/o atypical high value)	1.10	1.04–1.20
South Coast Metro	1.07	1.04–1.10
Parkway Center	1.06	1.02–1.11
Perimeter Center	1.07	1.03–1.19
Tysons Corner	1.11	1.03–1.57
Southdale	1.07	1.02–1.11
Overall Average	1.08	1.02–1.74

The highest automobile occupancy at any surveyed office building was observed in Bellevue (1.74). The high automobile occupancy and a 12 percent transit mode share have been achieved at the single-tenant site by means of a stringent parking management program geared to encourage ridesharing and transit ridership.

As shown in Listing B, there is a great deal of consistency in the observed automobile occupancies. The highest mean automobile occupancy (1.11) at SAC office buildings were observed at Tysons Corner (if the one high rate in Bellevue is excluded). Four of the six surveyed SACs have average office work trip automobile occupancies of 1.06 or 1.07.

Workplace Survey Distribution

Workplace surveys were distributed to a total of 38,000 office employees in the six suburban activity centers. With 11,500 usable returns, an overall response rate of 30 percent was achieved.

Employee Work Trips

Work Trip Mode

The predominant mode of travel used by employees for their trip to work is the private automobile. With the exception of

Bellevue (which has a transit mode share of roughly 7 percent), none of the surveyed suburban activity centers have a transit mode share over 1 percent. In these five SACs, fixed-route transit service is either very limited or not structured to serve the SAC as an end-of-the-line destination. In contrast, the Bellevue activity center is served by 17 different Seattle Metro routes. The focus of the bus transit service is the Bellevue Transit Center which is situated at the heart of the Bellevue office building concentration.

Ridesharing (i.e., carpooling and vanpooling) is the most common form of mass transportation for the SAC office employee. The overall average across the six SACs is for 7 percent of office employees to rideshare as a passenger. There is also very little variation between the SACs.

Work Trip Arrival and Departure Time Distributions

In order to measure the spreading of peak period trips made by SAC office employees, time-of-day distributions of office employee trips to work and from work were obtained. Listing C shows, on average, across the six SACs, the proportions of office employees that arrive or depart during the peak periods. Despite the various differences between the SACs, no apparent relationship between the work trip arrival/departure time distributions and the SAC size was found.

Listing C

	Percentage of Employees which Arrive During Period (%)	Percentage of Employees which Depart During Period (%)
Peak 15-min period	23	23
Peak 30-min period	33	29
Peak 60-min period	58	46
Peak 2-hour period	84	71

Employee Commute Trip Length and Duration

There is very little difference among the six SACs in the trip length characteristics for the office employee commute trips. The median commute distances range between 11 and 14 miles (with four of the six SACs at 11 or 12 miles).

A significant proportion of SAC office employees change their place of residence upon starting work at the SAC office site. At Tysons Corner and Southdale (probably the oldest and most mature of the surveyed SACs), for example, 37 percent of the employees reported changing their residence. For employees who reported changing their residence since starting work in the SAC, roughly 43 percent moved closer to work, 46 percent moved farther from work, and 11 percent remained roughly the same distance from work.

Correlation was found between the length of employment within the SAC and the age cross section of buildings in the SAC (see Listing D). For the SAC with the oldest buildings surveyed (roughly 11 years old), the 85th percentile duration of employment is 60 months. As the average decreases from Southdale to Tysons Corner, to South Coast Metro, to Parkway

Center, and to Perimeter Center, so also do the 85th percentile lengths of employment.

Listing D

SAC	Average Age of Office Buildings Surveyed (years)	Length of Employment 85th Percentile Value (months)
Southdale	11	60
Tysons Corner	8	60
Bellevue	6	NA
South Coast Metro	5	44
Parkway Center	4	39
Perimeter Center	3	36

Travel times to and from work are less consistent than are the travel distances cited above. The mean commute time to work for SAC office employees ranges between 17 and 30 min (with four of the six surveyed SACs falling in the 25 to 30 min range). The shorter commute times are found in Bellevue and Southdale, which are located within metropolitan areas with smaller populations relative to the other four SACs. In addition, the “smaller” SACs (i.e., Bellevue, South Coast Metro, and Southdale) reported the three shortest mean commute times to work.

The commute time to home is typically longer than the “to-work” commute. In the majority of cases the median commute time values increase 3 to 5 min and the 85th percentile values increase roughly 5 min.

Another comparative measure between SACs is the “average” travel speed for the commute trip. This measure provides some indication of the degree of traffic congestion experienced by the typical commuter at each SAC. The fastest “speeds” are reported at Southdale and Bellevue. In fact, Southdale has speeds up to 50 percent greater than those reported at Tysons Corner, South Coast Metro, Parkway Center, and Perimeter Center (both for the commute to work and to home.)

Intermediate Stops Made by Office Employees

The workplace survey gathered information on intermediate stops made by office employees either along their way from home to work, along their way from work to home, or midday from work. Information was collected on the location of the intermediate stop, the purpose of the stop, the time of the stop, and whether the stop was linked with other intermediate stops.

Analysis of intermediate stop data has not revealed many definitive and quantifiable causes for the observed variations in the employee intermediate stop proportions. The following discussion highlights several of the key independent variables which appear to be functionally related to the intermediate stop characteristic. However, these observations should not be considered to be statistically derived, but rather as anecdotal interpretations.

Trips to and from Work. For the trips to work and from work, the Bellevue activity center has by far the highest proportion of employees making intermediate stops (34 percent on the trip to work and 66 percent on the trip home). For the proportion of office employee trips to and from work that make an intermediate stop, there is relative consistency between the five (non-Bellevue) SACs. On average, 22 percent of the office employees stop along their way to work and 37 percent stop

along their way home from work. The SACs with slightly higher proportions making a stop (i.e., South Coast Metro and Parkway Center) have a corresponding slightly higher proportion of secretary/clerical and female employees, both of which categories tend to have more intermediate stops to and from work than their counterparts.

The proportion of employees who make an intermediate stop within the activity center on their way to work averages at 10 percent across the six surveyed SACs (9 percent for the non-Bellevue SACs). The proportion stopping within the activity center along their way home from work averages at 11 percent across all the surveyed SACs (both with and without Bellevue).

For office employees within a SAC with relatively little retail activity immediately outside its boundaries (e.g., Bellevue, Perimeter Center), roughly 13 percent will stop within the SAC along their way to work and roughly 15 percent will stop within the SAC along their way home from work. For office employees within a SAC with relatively significant retail activity immediately outside its boundaries (e.g., South Coast Metro, Parkway Center, Tysons Corner, Southdale), roughly 8 percent will stop within the SAC along their way to work and roughly 10 percent will stop within the SAC along their way home from work.

The values presented above represent the proportions of the SAC office employees who make an intermediate stop along their way to or from work. These trips-with-stops, however, may consist of more than one stop. The average number of intermediate stops per trip on the way to work is 1.2 for all of the surveyed SACs except Bellevue where the average rate is 1.4. For trips along the way home from work, the average number of stops per trip across the six surveyed SACs is 1.3.

Midday Trips. The average proportions of employees by activity center who make a midday trip outside their office building range between 42 and 59 percent. The overall average across the six SACs of 50 percent is the best estimate of the proportion of employees making midday trips based on the current level of analysis.

With regard to the proportion of employees making midday trips internal to the activity center, a key observation is that for SACs with at least 60 percent of the office employees in professional, technical, manager, or administrator positions, the proportion of office employees making midday trips internal to the SAC ranges between 29 and 33 percent; for SACs that have lower than the above proportions of professional, technical, manager, or administrator positions, the expected proportion of office employees making midday trips internal to the SAC ranges between 20 and 23 percent.

Intermediate Stop Trip Purposes. Along the trip to work, the most common trip purposes are for child care or school (an average of 34 percent of the office employees who stop) and for work-related purposes (an average of 21 percent).

Along the trip to home from work, the primary trip purposes are for shopping (average of 21 percent), social/recreation (15 percent), child care/school (14 percent), and grocery store (13 percent). Work-related trips comprise only 6 percent of the stops on the way home from work.

Midday trip purposes are dominated by meal/snack (overall average of 35 percent of all office employee midday trips), work-related (25 percent), shopping (13 percent), and banking trips (9 percent). The proportions of midday trips by employees, which are for meals or snacks, are higher for the “larger” SACs (average of 38 percent) as compared to the “smaller” SACs (average of 31 percent). Part of the cause for this difference is

that office employees in the “smaller” SACs tend to make slightly more midday trips (52 percent versus 49 percent for the “larger” SACs). Factoring in the overall number of midday trips by activity center produces an average of 17 percent of all midday trips made by office employees that are for meal or snack (with relatively little difference observed between activity centers). An average of 9 percent of the office employee midday trips are for meal or snack within the activity center (for “larger” SACs the proportion is roughly 11 percent; for “smaller” SACs the proportion is roughly 8 percent).

There is a significant amount of interaction between the activity center office employees and other activity centers in the region. Based on the midday travel diary information compiled from the workplace survey responses, an estimate of the number of vehicle trips made by activity center office employees to other selected activity centers can be quantified as a trip rate.

For example, office employees in the Tysons Corner activity center make trips to Washington, the regional CBD, at a rate of roughly 40 trips per 1,000 Tysons Corner office employees. It should be noted that these rates could represent either one-direction or two-direction trips. They also do not account for any trips made by regional CBD office employees to the suburban activity center or any trips between the activity centers made by nonoffice employees.

Intra-site Trips. Activity center office employees, in the workplace survey, indicated whether or not they used certain on-site services: (1) restaurant, deli, or cafeteria; (2) bank; (3) health club; (4) travel services; and (5) medical offices. For office buildings with on-site restaurants, the reported use of the restaurant ranges between 6 and 65 percent of the office employees with an average of 31 percent. Based on field observations at the surveyed office buildings, it is probable that the office employees included intra-site trips to company lunch rooms or cafeterias in this category, thus inflating the reported use of the on-site, public eating establishments.

Profile of Workplace Survey Respondents

For all six activity centers, the majority of the respondents are between 25 and 44 years old with the highest percentage falling between 25 and 34 years of age. All but one of the six activity centers have relatively consistent age distributions. The atypical activity center (in terms of worker age) is Tysons Corner which has an older median age. Likewise, Tysons Corner is the only SAC with a greater proportion of male employees than female. Across all six activity centers, the office employees average 2.7 persons per household and 2.2 vehicles per household.

The occupational mix also varies between the activity centers. Tysons Corner has the highest proportion of professional, technical, manager, and administrator positions (77 percent). In contrast, Parkway Center and South Coast Metro have the highest reported proportion of secretary and clerical positions (33 and 35 percent, respectively).

Office Building Visitors

At selected office buildings, a sample of the persons entering the building were interviewed to determine whether or not they were a visitor or a regular employee based in the building. On average, 6 percent of the people entering the SAC office buildings

during the AM peak period are visitors. During the PM peak period, the visitor proportion increases to roughly 43 percent.

For the larger SACs, the proportion of visitor trips that are from within the SAC is higher (54 percent and 58 percent for the AM and PM peak periods, respectively) than for the smaller three SACs (30 and 33 percent). The higher intra-SAC proportions result from the greater proportion of SAC office space from which office visitor trips can be generated. The larger SACs have roughly three to five times as much office space as do the surveyed smaller SACs.

AM peak-hour visitors come most often from home. During the PM peak period, office-origin trips dominate the visitor trips to SAC office buildings.

The mode of visitor trips to activity center office buildings is predominantly by automobile. Although the transit mode of access proportions remains relatively constant (and low—between 0 and 5 percent) across the surveyed SACs, the walk proportions vary widely (between 0 and 15 percent) and are very much a function of building sizes and proximities.

RETAIL SURVEY ANALYSIS

Retail Survey Sites

Twenty-six retail sites were surveyed and/or counted. These included seven regional centers (ranging in size from the 970,000 square foot Galleria Mall in Parkway Center to the 2.2 million square foot South Coast Plaza); five specialty shopping centers; six community and neighborhood shopping centers; and seven high-turnover sit-down restaurants.

Peak-Hour Trip Generation

Person-counts and vehicle-counts were conducted during the midday peak period (12 noon to 2 PM) and during the evening peak period (4 PM to 6 PM). For the six surveyed regional centers, five have evening peak-hour trip-generation rates lower than the rates presented in the *ITE Trip Generation* report. Across the six surveyed regional centers, the average vehicle trip generation rate is 2.3 per 1,000 square feet gross leasable area (GLA); the ITE rates for retail centers of the surveyed sizes are 2.8 and 2.9.

For the community and neighborhood shopping centers, two of the five surveyed sites have rates lower than the ITE rates. For the specialty centers, all three of the surveyed sites have rates lower than the ITE rates.

The directional distribution of vehicle-trips at the surveyed retail sites during the evening peak hour are somewhat different from the ITE values. The regional centers have a directional distribution of 52 percent inbound to the site. The ITE inbound rate for large retail centers is 47 percent. As demonstrated earlier, the two-way peak-hour volumes for the surveyed regional centers are roughly 20 percent less than the ITE rates; however, the peak direction percentage is roughly 10 percent higher than the ITE rate. Therefore, the net effect is that peak direction retail trips at the surveyed regional centers are roughly 10 percent less than the ITE peak direction rates.

For the community and neighborhood shopping centers, the six surveyed sites have 54 percent inbound (as opposed to an ITE rate of 49 percent inbound). The difference of 5 percentage points mirrors the rate differential for regional centers.

Mode Shares

For the regional centers, the midday nonautomobile mode shares and the amount of office space within a short walk (i.e., within 2,000 ft walking distance without having to cross a limited access roadway) are given in Listing E.

Listing E

Regional Centers	Transit (%)	Walk (%)	Office GSF Within 2,000 Ft (millions)
Galleria (Parkway Center)	1	17	2.1
Bellevue Square	5	6	2.1
Perimeter Mall	0	7	2.8
Southdale Mall	1	5	0.7
South Coast Plaza	0	4	1.6
Tysons Corner	0	4	1.5
Prestonwood Town Center (Parkway Center)	0	2	0.7

There appears to be a reasonably direct relationship between the midday nonautomobile mode share and the proximity of office space. But, more importantly, these midday nonautomobile mode shares reflect the unique characteristics of the surveyed regional centers. The highest walk percentage (17 percent) is found at the Galleria that is connected by enclosed walkways with approximately 1 million square feet of office space and a 440-room high-rise hotel. In terms of persons, the 17 percent walk mode share represents roughly 500 of the mall's midday patrons. This number of midday patrons amounts to roughly 20 percent of the Galleria office tower employees, which is well within the reported number of office employees eating lunch within the complex.

Bellevue has a substantial transit mode share as a result of the area's extensive radial bus service to the activity center. The Bellevue Square walk mode share of 6 percent represents approximately 350 person-trips during the midday peak hour. The high walk mode share is testament to the existing pedestrian pathway system in the Bellevue activity center despite the relatively small amount of office space within a short walk distance.

The 2 to 5 percent walk mode share for midday trips found at South Coast Metro, Parkway Center, Perimeter Center, and Southdale are probably representative of typical regional centers with no special features such as direct connections to office buildings or an extensive pedestrian pathway system.

The smaller retail sites have virtually no transit patronage during the midday. The walk proportions tend to fall within the 4 to 9 percent range.

During the evening peak period, the regional center mode share distributions change. Bellevue Square continues to have a high walk mode share of 7 percent. The majority of the internal-to-Bellevue trips to Bellevue Square during the midday and evening peak periods originate at other retail sites (and, therefore, they are linked trips) rather than at office buildings. For that reason, apparently, the walk mode share in Bellevue Square remains relatively steady between the midday and evening peak periods.

The Galleria walk mode share drops to 4 percent during the evening peak period, significantly less than the 17 percent midday figure. During the midday, the majority of the trips originate at an office building (most notably, the Galleria office towers);

in contrast, the evening peak period trips from offices are much lower.

Trip Purposes

During the midday, the primary trip purpose for regional retail centers is for shopping, followed in order (in general) by dining, personal business, and work. At the regional centers, the widest variation is found in the dining category. The Perimeter Mall survey estimates that 44 percent of the mall patrons that enter or depart during the midday peak period are primarily there to eat. This high percentage reflects the absence of alternative inexpensive fast-food restaurants within the Perimeter Center SAC or within its close proximity. In contrast, the Bellevue Square, Southdale Mall, Prestonwood Town Center, Tysons Corner Mall, and South Coast Plaza trip purpose proportions for dining reflect the wide variety of eating alternatives in the Bellevue, Southdale, Parkway Center, Tysons Corner, and South Coast Metro SACs, respectively.

All but one of the specialty, community, and neighborhood shopping centers have restaurants. As expected, dining trip purposes for these centers are higher than for the regional centers. The seven surveyed smaller centers have an average of 43 percent dining for their trip purpose distribution (but with a range between 12 and 68 percent).

Primary trip purposes during the evening peak period are different from the midday trip purposes. In general, the dining trip purpose drops substantially from the midday (i.e., lunch) period and the work trip purpose increases in significance. At the regional centers, the work trip (i.e., trips made to or from work by employees of mall tenants) averages to be 12 percent of the evening peak period trips. At the specialty shopping centers, the work trip comprises 20 percent of the evening peak and at the community/neighborhood shopping centers the work trip comprises 14 percent of the total.

Retail Trip Origin and Destination

The surveyed retail patrons provided information on the origin of their trip to the retail center and their next destination upon leaving the retail center.

Internal Trips

The proportion of all trips generated by a retail site that are internal to the activity centers are presented in Listing F (in order of decreasing internal proportions for the midday).

Listing F

	Percentage From Within SAC	
	Midday (%)	Evening (%)
Prestonwood Town Center (Parkway Center)	68	57
Perimeter Mall	50	18
Galleria (Parkway Center)	47	41
Bellevue Square	32	21
Southdale Mall	30	15
Tysons Corner Center	22	7
South Coast Plaza	7	7
Overall Average	37	24

In general, the larger three activity centers (Parkway Center, Tysons Corner, and Perimeter Center) tend to have the higher internal percentages (47 percent during the midday and 31 percent during the evening peak period on average across the four surveyed sites). In contrast, the comparable midday and evening peak period values for the smaller activity centers (Bellevue, South Coast Metro, and Southdale) are 23 and 14 percent, respectively. In other words, the internal capture rate for the regional malls in the larger activity centers is roughly twice the magnitude for the regional malls in the smaller activity centers.

The trip origins and destinations for the regional centers provide interesting differences as well. For Bellevue Square and South Coast Plaza Mall, trips linked with other retail sites comprise over half of the internal trips generated by the regional centers during the midday and evening peak periods. In contrast, two-thirds of the internal trips generated by Tysons Corner Mall are to or from an office. For several of the regional centers with the higher proportions of internal trips, the office component also varies substantially. Over three-quarters of the internal Perimeter Mall trips go to or from an office. Prestonwood Mall in Parkway Center offers the other extreme. Roughly one-third of the internal midday trips and only one-eighth of the internal evening peak trips are to or from an office.

The Galleria retail center in Parkway Center offers an atypical pattern of internal trip distribution. During the midday, roughly one-half of the trips are to or from an office. During the evening peak period, the office trips drop to one-eighth of the total internal trips. As a result of these varied results, no definitive relationships could be established regarding the land uses that generate interactive trips with regional retail centers.

For the smaller retail centers, the proportion of trips internal to the activity center is higher than for the regional centers. An explanation can be developed for the general relationship of these internal-to-activity-center proportions for each of the smaller retail centers to the corresponding proportions for the regional centers. However, a series of predictive, independent variables with consistent, quantitative results could not be derived from the current set of travel characteristics data.

Land Use at Trip Origins and Destinations

The overall origins and destinations for trips generated at the regional centers do show some tendencies when the data are disaggregated by size of activity center, as shown in Listing G.

Listing G

	Trip Origin/Destination Distribution			
	Midday Peak		Evening Peak	
	Small SAC (%)	Large SAC (%)	Small SAC (%)	Large SAC (%)
Office	14	35	9	16
Home	55	39	58	57
Shop/Bank/Restaurant	18	13	16	13
Other	13	13	17	14

During the midday peak, the regional centers in the larger activity centers have the tendency to have a higher proportion of trips to or from an office (note that the large activity centers have roughly three times as much office space as do the small

activity centers). Likewise, the proportion of home-based trips drops to being roughly equal to the office-based trips in the larger activity centers. During the evening peak period, the regional centers in larger activity centers again have a somewhat greater proportion of office-based trips.

The Parkway Center activity center, because it contains three regional malls, provides an opportunity to measure the interaction of regional malls located within close proximity of each other. The Galleria and Prestonwood Town Center are the two regional malls that have been described previously and at which intercept surveys have been conducted. These two malls are about 2 miles apart. Also located within Parkway Center is the Valley View Mall. It is a 1.6 million square foot enclosed mall. It is situated less than 1 mile from the Galleria and about 3 miles from Prestonwood. At Prestonwood, the survey found that during the midday roughly 3 percent of its trips are linked with a stop at either Galleria or Valley View. During the evening peak period, the interaction between Prestonwood and the other two regional malls increases to 5 percent. At Galleria, nearly identical percentages were found. The midday interaction is 4 percent and the evening is 5 percent.

In terms of which malls had more interaction with the other two, the Prestonwood survey has roughly equal numbers of trips to/from Galleria and Valley View. Despite their quite different tenant list, the two are virtually equidistant from Prestonwood. The Galleria survey shows roughly a three-to-one ratio of trips to/from Valley View (less than 1 mile away) compared to those to/from Prestonwood (roughly 3 miles away).

Based on the above measured interactions between regional malls, a general relationship can be formulated. If two regional malls are located roughly 1 mile apart, roughly 2 percent of each mall's midday trips are linked to a stop at the other mall. During the evening peak period, the interaction proportion is slightly higher, but still roughly 2 percent of each mall's trips.

Trip Length

The lengths for trips to and from each individual retail site for the midday and evening peak periods were also collected. There is little difference between the trip length distributions for the larger activity centers and the smaller activity centers. Nor is there an apparent direct relationship between the trip lengths and the size of the metropolitan area. However, there are two key observations to which the data point and which could be instructive in the development of travel characteristics for a suburban site.

First, the trip length distribution for the most "up-scale" regional centers and fashion malls appears to be greater than for the other regional centers. The second observation regarding trip lengths is that for the regional centers, the distribution of evening peak trip lengths is invariably longer than the trip lengths for the midday. For the smaller retail centers, this observation is not necessarily accurate across all the surveyed sites. The reason for the longer trip lengths at the "up-scale" regional centers is that their tenants have a lower density of store coverage in their market area.

Pass-By Trip Characteristics

Automobile drivers surveyed at the retail sites provided information on whether or not the retail trip was a pass-by or a

diverted trip. There is significant uniformity of these reported pass-by rates for all of the regional centers, with the exception of Galleria. These values indicate that a range between 15 and 25 percent for the midday and between 10 and 30 percent for the evening peak should be treated as essentially the extremes that one would currently expect for a regional center located within a large-scale suburban activity center. This observation compares favorably with the ITE pass-by rate of 23 percent for a 1 million square foot mall.

For the smaller retail sites, the variation in pass-by rates is much more significant than that found for the regional centers. The midday pass-by rates range between 10 and 40 percent with an average of 26 percent. The evening peak period rates range between 19 and 51 percent with an average of 36 percent. The most significant observation regarding these pass-by rates is that they are substantially less than the ITE rate of between 42 and 45 percent for retail sites of the surveyed size. From these data, it appears that pass-by rates for retail sites in large-scale suburban activity centers are somewhat less than for comparable-sized isolated retail sites. However, it should also be noted that five of the 11 retail sites have pass-by rates at or above the ITE 42 percent rate.

RESIDENTIAL ANALYSIS

Trip generation counts were taken and a residential mailback survey was conducted at 19 multifamily residential sites.

Residential Trip Generation

In general, the measured residential trip generation rates conform to the ITE *Trip Generation* report, Fourth Edition. During both the morning and evening peak hours, the measured rates are comparable to the ITE rates on a per occupied square footage basis (16 sites have lower rates than the ITE rates and 16 sites have higher rates than ITE). However, on the basis of residents, the majority of the sites (17 of the 25 building count periods) exceed the ITE rate.

Activity Center Residents

The average number of residents (age 18 or older) per surveyed household ranges between 1.3 and 1.9. The average number of vehicles per household has approximately the same range (1.2 to 1.8).

The median age of the residents in households which responded to the survey provides a clear distinction between some of the study sites. Several of the surveyed residential complexes report median ages in the 55 to 64 range and consist predominantly of senior citizens or "empty-nesters."

Most of the surveyed households have at least one person employed. Even the two residential complexes with median ages over 55 still have between 50 and 60 percent of the households with an employed resident.

Internal Trips

Activity center residents were asked to provide information on their work location and on the trips which they made internal

to the activity center. The range of reported percentages of employed residents who also work within the activity center is between 13 and 50 percent. On average, the owner-occupied households produce a slightly higher percentage of "intra-SAC employment" (31 percent) than do the rental units (28 percent).

Another possible way of classifying the residential complexes is by size of activity center. The hypothesis would be that if the office component of the activity center gets larger, the more employment opportunities will become available, and presumably the greater proportion of employed residents will work within the activity center. The hypothesis is tested and confirmed by splitting the residential sites into those within large activity centers (Tysons Corner and Parkway Center) and those within the smaller activity centers. The "large SAC" employed resident works 33 percent of the time within the activity center. For the "smaller SAC" employed resident the internal rate is 27 percent, thus confirming the hypothesis.

The mode split of all trips taken by SAC residents within the activity center is predominantly by private automobile. For the dense activity centers (i.e., Bellevue and South Coast Metro), the walk mode shares for intra-SAC trips appear to be higher (roughly 17 percent) than the overall average of 7 percent. The shorter potential walk distances (coupled with the Bellevue pedestrian pathway system) contribute directly to an increased walk mode share. The transit mode shares for internal trips are low across most of the residential sites.

HOTEL SURVEY ANALYSIS

The hotel survey process included both a person and vehicle-trip generation count, during the morning and evening peak periods, and an intercept survey conducted within the hotel during the identical peak periods.

Hotel Survey Sites

The 15 hotels at which counts and/or surveys were conducted range in size between 160 and 575 rooms. The amount of retail space and conference/meeting room space also varied widely between sites.

Hotel Trip Generation

A comparison of the counted trip generation rates with those presented in the ITE *Trip Generation* report reveals that the majority of the activity center hotel sites have lower trip generation rates than the ITE average. This relationship holds true whether the comparison is conducted for the morning or evening peak hour or on the basis of total rooms or occupied rooms.

However, it is critical to note that the ITE rates for hotel trip generation on a per total room basis are derived from a data base of five sites for the morning peak hour and seven sites for the evening peak hour. Therefore, the data collected in this study for 15 hotel sites will in itself quadruple the size of the morning peak-hour data base and triple the size of the evening peak-hour data base.

A comparison of the range of rates observed for the 15 surveyed hotel sites and the range of rates reported by ITE indicates two conclusions: (1) the two data sets are comparable in the wide variety in trip generation rates and (2) because of this

tremendous variation in trip generation rates, additional research must be conducted on the trip-making characteristics of hotels. Results from this NCHRP study would indicate that several additional independent variables could be evaluated, including: the hotel "class" and rate structure, the amount and use of conference/meeting room space, and the amount of on-site retail and service use.

Trip Origin and Destination

There is a significant amount of interaction between the surveyed hotels and other buildings within the suburban activity center. For the hotels located in the three smaller surveyed SACs (i.e., Bellevue, South Coast Metro, and Southdale), an average of 19 percent of the hotel morning peak period trips is internal to the SAC. During the evening peak period, the average is 27 percent. In contrast, the hotels located in the three larger SACs (i.e., Parkway Center, Perimeter Center, and Tysons Corner) have a morning peak-hour internal proportion of 37 percent and an afternoon proportion of 36 percent. The differences between the proportions observed at hotels in smaller versus larger activity centers are a function of the supply of office space to generate trip attractions and productions. In this study, the larger activity centers have on the order of four times the office space of the smaller activity centers. The apparent result of quadrupling SAC office space is a doubling in the morning proportion of internal trips generated by hotels and a roughly 33 percent increase in the evening proportion of internal trips.

Trip Purpose

For most of the surveyed hotels, the majority of the morning peak period trips are made by overnight guests. Across the 14 surveyed hotels, the median proportion of morning peak period trips that are made by overnight guests is in the 70 to 80 percent range. During the afternoon peak period, the median proportion falls to the 50 to 60 percent range.

Although not as large a component as overnight guest trips, the trips by persons attending a meeting or conference in the hotel are nevertheless significant. During the morning peak period, the median proportion of meeting/conference trips is in the 30 to 40 percent range. During the evening peak period, the median proportion falls to the 20 to 30 percent range.

Trip Mode Share

Relatively few of the morning peak period trips to/from hotels are by foot. However, during the evening peak period, two sites reported walk mode shares of at least 10 percent. The two hotels are located adjacent to 700,000 square feet and to 1.4 million square feet of office space. The latter is also adjacent to a regional mall. However, there are several hotels with similar "proximity" characteristics as these, but with relatively small walk mode shares.

IMPLICATIONS OF RESEARCH RESULTS

The findings presented in this report are most frequently focused on the travel characteristics observed at the SAC-level.

These findings are not intended to supercede local interpretation of these data or local analysis of the building-level data. The primary objective of this research was to report and interpret relationships and trends of SAC-level travel characteristics.

It would perhaps be presumptuous to identify a specific list of the key findings from this research. Each data element could have direct relevance to a particular practical application. Nevertheless, the following are several important findings which confirm hypotheses put forth by others, raise questions about other hypotheses, and present new concepts not previously documented.

One of the more enlightening findings of the research effort is the *extent of trip-making made by employees which is not between home and work*. This finding has serious implications on the effectiveness of efforts, for example, to promote ride-sharing and transit. The data suggest that commuters prefer their single-occupant automobile not only for the arbitrary reasons of comfort and privacy, but also for the real needs of intermediate stops either along the way to work, from work, or during the middle of the day. These findings also infer that a successful ridesharing program must include the provision of on-site (or close-by and convenient) services which minimize the need for off-site intermediate stops. In lieu of on-site services, an option would be to provide transportation service in the SAC (e.g., at-work pool vehicles, subsidized taxi service, transit shuttle) for the employees to make their midday trips.

The above solution of providing on-site facilities for all intermediate stops, thereby reducing the need for single-occupant automobile commuting, is rather simplistic. First, the intermediate stops made by commuters may not all be transferable to the work-end of the trip. Obviously, buying perishable groceries prior to an hour commute home rather than near the residence would not be preferred. Second, the intermediate stops could be classified as either essential stops (e.g., day-care or school) or discretionary stops (e.g., dry cleaners). The transferability of essential stops to other locations may be constrained and the ability of commuters to "link trips" involving essential stops may also be limited.

Even though the surveyed SACs are perceived as being dense by typical suburban standards, they *are still highly automobile-oriented*. Except for Bellevue, *transit ridership is virtually non-existent*. In the other five SACs, fixed-route transit service is not structured to serve the SAC as an end-of-the-line destination. Work trip automobile occupancies at the surveyed large-scale SACs are not much different from isolated suburban building sites. It has been hypothesized by others that the SACs with the smallest share of work trips made by single-occupant automobiles are those SACs that are relatively dense and varied in their land use make-up. However, the data presented herein indicate that increases in development density or a greater diversity of land uses do not necessarily result in increased rates of carpooling and transit use. Three other independent variables have been determined to have a more direct bearing on commute trip mode shares: (1) the supply of transit service, (2) the price of parking that is passed through to the motorist, and (3) the level of encouragement and incentives for ridesharing and transit use. In Bellevue, where transit mode shares are by far the highest among the surveyed SACs, all three of these components are in place.

The research found that there is indeed a *significant amount of interaction among the buildings* located within large-scale suburban activity centers. Office employees make trips to other

SAC office buildings for work-related purposes. Small retail sites within a SAC are often dependent either on the secondary market spun off from the regional mall or on the office employee market. The large retail centers located in the SAC (in particular, the regional malls) also receive a substantial portion of their patronage from the nearby offices and smaller retail centers. A large portion of the market for SAC hotel conference space is filled by the SAC office employees. SAC hotel guests tend to be visiting SAC office buildings. SAC residents who are employed have a strong inclination to work within the SAC.

The *amount of internal capture* of the interaction between SAC land uses *tends to increase with the magnitude of SAC development*. Most suburban activity centers are smaller than those studied here, suggesting that the internal capture percentages reported in this research are probably the upper bounds of what would occur in smaller SACs. This internal capture, because of its relative significance in the proportions of all trips generated SAC buildings, should be reflected both in site traffic impact analyses and in subarea or regional modeling.

CHAPTER SIX

OFFICE SURVEY ANALYSIS

OFFICE SURVEY SITES

Office Building Size and Employee Density

The 87 office buildings or complexes at which workplace surveys were distributed, visitor intercept surveys were conducted, or trip generation counts were taken are given in Table 5. The actual type of data collection conducted at each individual office building is described in subsequent sections of this chapter. The multipage listing is organized by suburban activity center, with the Bellevue office buildings first followed by South Coast Metro, Parkway Center, Perimeter Center, Tysons Corner, and Southdale. For each office building Table 5 provides, where available, the following: its street address, the year in which the building was opened, the total gross square footage and net rentable gross square footage, its approximate occupancy, the estimated number of employees based in the building, and the calculated employee density expressed in terms of employees per 1,000 occupied gross square feet.

Many of the surveyed office buildings are part of a larger complex consisting of several office buildings or a mixed-use development. For example the Central Bank and Great Western Savings Towers in South Coast Metro share a common parking garage and plaza. The Signature Place and Colonnade complexes located in Parkway Center consist of a pair of high-rise office buildings connected by a common atrium. The Galleria Tower in Parkway Center is part of an enclosed complex served by common parking facilities with two office towers, a high-rise hotel, and a regional shopping mall. The proximity of other land uses is detailed in subsequent tables.

As shown in Table 5, the majority of the buildings surveyed were opened during the 1980s. This age distribution is reflective of the recent rapid growth in each of the six surveyed SACs. Selection of office buildings for the survey considered the building age in order to obtain a representative sample of the SAC buildings. Because only buildings with relatively high occupancy were surveyed, the newest buildings in the SAC may not have been surveyed. The median building opening date for all office buildings in Table 5 is 1982. For the SACs with the most rapid recent growth (i.e., South Coast Metro, Parkway Center, Pe-

rimeter Center, and Bellevue), the median opening date for surveyed office buildings is even more recent (1986, 1985, 1984, and 1983, respectively).

From the total gross square footage (gsf) column in Table 5, it can be seen that the building sizes ranged between the low of 21,500 gsf at the Wells Development in Bellevue and the high of 597,000 gsf for One Spectrum Center in Parkway Center. In addition, several of the individual surveyed buildings are part of a much larger mixed-use complex (e.g., Lincoln Center in Parkway Center, Normandale in Southdale, Tyson's International in Tyson's Corner). The median building size surveyed was between 200,000 and 250,000 gsf. In order to measure the specific travel characteristics in large office buildings, 16 buildings larger than 400,000 gsf were surveyed.

For many of the office buildings, the net rentable gross square footage was estimated at 85 percent of the total gross square footage.

The estimated occupancies of the surveyed office buildings reflect the best estimates of the researchers regarding the actual occupancy of the building. For example, leased space still to be occupied was not included in the occupancy rate. The sources of these occupancy data included the building owners, property managers, and major tenants. In addition, when workplace surveys were distributed to the building tenants, field verification of approximate building occupancies was undertaken. Because of the relative imprecision used by the data sources for quantifying building occupancy, the occupancy rates shown can not be considered precise estimates.

The estimated number of employees based in the surveyed office buildings are derived from several sources: actual counts of employees conducted during the distribution of workplace surveys, reports from individual building tenants, and building manager estimates.

The employee number estimate and the estimated building occupancy are combined in Table 5 to produce an estimated employee density. The estimated employee densities have a wide range, with a low of 1.24 at Pacific First Plaza in Bellevue and a high of 4.05 at Normandale Lake Office Park in Southdale. There is also a wide variation between the employee densities reported in each individual SAC. Parkway Center has the lowest

Table 5. Office building size characteristics.

<u>Office Building</u>	<u>Year Built</u>	<u>Total GSF¹ (x1000)</u>	<u>Net Rentable GSF(x1000)</u>	<u>Percent Occupied</u>	<u>Approx. No. of Employees</u>	<u>Employee Density (Employees per 1000 Occupied Total GSF)</u>
<u>Bellevue</u>						
PNB Plaza 450 110th Ave., NE	1983	442.0	376.0	100	1150	2.60
United Olympic Building 110 110th Ave., NE	1982	214.2	198.0	80	425	2.48
Rainier Bank Plaza 777 108th Ave., NE	1986	441.8	391.0	80	1000	2.83
Honeywell Center 600 108th Ave., NE	1980	235.8	213.0	90	650	3.06
Business Center Bldg. 777 106th Ave., NE	1969	146.0	121.0	99	450	3.11
Pacific First Plaza 155 108th Ave., NE	1986	134.0	127.0	60	100	1.24
Skyline Tower 10900 NE 4th St.	1983	420.0	390.0	82	775	2.25
Transamerica Title 308 108th Ave., NE		73.1	69.4	100	250	3.42
One Bellevue Center 411 108th Ave., NE	1983	357.0	342.0	92	900	2.75
Wells Development 10801 Main St., NE	1986	21.5	20.8	90	60	3.10
Plaza Center 10900 NE 8th St.	1983	324.7	295.1	90	950	3.25
<u>South Coast Metro</u>						
Imperial Bank Tower 659 Town Center Drive	1975	310.0	296.0	93	725	2.51
Central Bank Tower 611 Anton Boulevard	1981	289.6	266.1	89	810	3.14
Great Western Savings Tower 3200 Park Center Drive	1981	289.9	266.1	96	805	2.89
Metro Center 575 Anton Boulevard	1987	240.0	204.0 ²	80	635	3.31
Downey Plaza 3200 Bristol Street	1982	118.0	100.3 ²	100	NA	NA
Griffin Towers 5 Hutton Center Drive	1986	285.0	272.9	86	500	2.04
3 Hutton Center Drive	1981	200.0	170.0 ²	NA	NA	NA
Butterfield Tower 200 E. Sandpointe	1981	146.3	132.0	100	400	2.73
Corporate Center 3070 Bristol Street	1986	159.2	156.2	71	350	3.10
Metro Pointe 940 South Coast Drive	1987	40.0	35.0	95	120	3.16
950 South Coast Drive	1986	40.0	35.0	100	160	4.00

Table 5. Continued

<u>Office Building</u>	<u>Year Built</u>	<u>Total GSF (x1000)</u>	<u>Net Rentable GSF(x1000)</u>	<u>Percent Occupied</u>	<u>Approx. No. of Employees</u>	<u>Employee Density (Employees per 1000 Occupied Total GSF)</u>
<u>Parkway Center</u>						
Galleria Tower I 13355 Noel Rd.	1982	500.0	425.0 ²	90	1,000	2.22
Occidental Tower 5005 LBJ Freeway	1986	537.0	456.4 ²	75	750	1.86
Signature Place I 14755 N. Preston Rd.	1983	217.3 ²	184.8	60	235	1.79
II 14785 N. Preston Rd.	1985	295.4 ²	251.1	55	290	
Colonnade I Republic Bank Tower 15301 Dallas Pkwy.	1983	288.7	245.4 ²	90	600	2.31
Colonnade II Rolm Tower 15303 Dallas Pkwy.	1985	336.8	286.3 ²	90	650	2.14
Lincoln Center I 5400 LBJ Freeway	1981	403.0	342.6 ²	85	500	1.46
Stone Tower 13760 Noel Rd.	1986	265.0	247.8	42	275	2.47
Heritage Square Tower 2 5001 LBJ Freeway	1980	200.0	170.0 ²	80	400	2.50
Stanford Park 14001 Dallas Parkway	1985	295.0	266.0	95	500	1.78
Princeton 14651 Dallas Parkway	1985	370.0	314.5 ²	70	NA	NA
One Spectrum Center 5080 Spectrum Dr.	1982	597.0	507.4 ²	80	NA	NA
<u>Perimeter Center</u>						
Southern Company 58/64 Perimeter Center E.	1971/84	512.5	435.6 ²	100	NA	NA
Terraces North 400 Perimeter Center Terr.	1985	429.0	364.6 ²	99	NA	NA
Ravinia One One Ravinia Drive	1985	377.5	327.3	95	1200	3.28
Concourse II Peachtree-Dunwoody Road	1985	286.0	243.1 ²	100	NA	NA
UNISYS Ashford-Dunwoody Rd./I-285	1984	286.0	243.1 ²	NA	NA	NA
Cotton States/Goldkist 244 Perimeter Center Pkwy.	1975	264.8	225.1 ²	100	NA	NA
219/223 Perimeter Ctr. Pkwy.	1978	260.1	221.1 ²	NA	NA	NA
Travellers 211 Perimeter Center Pkwy.	1979	225.6	191.8 ²	NA	NA	NA
Ashwood 1200 1200 Ashwood Parkway	1985	218.8	186.0 ²	NA	NA	NA
Contel 245 Perimeter Center Pkwy.	1981	215.0	182.8 ²	100	NA	NA
41/47 Perimeter Center E.	1974	189.5	161.1 ²	100	NA	NA
Maryland Casualty Bldg. 1100 Ashwood Parkway	1985	146.0	124.1 ²	NA	NA	NA

Table 5. Continued

<u>Office Building</u>	<u>Year Built</u>	<u>Total GSF (x1000)</u>	<u>Net Rentable GSF(x1000)</u>	<u>Percent Occupied</u>	<u>Approx. No. of Employees</u>	<u>Employee Density (Employees per 1000 Occupied Total GSF)</u>
<u>Perimeter Center (cont.)</u>						
AT&T 40 Perimeter Center E.	1978	86.0	73.1 ²	100	400	4.65
Northpark 400 1000 Abernathy Rd.	1986	585.1	497.3 ²	70	NA	NA
Embassy Row 400 Embassy Rd.	1985	155.0	131.8	97	530	3.52
<u>Tysons Corner</u>						
The BDM Corporation						
• 7915 Jones Branch Dr.	1977	135.3	115.0	100	400	2.96
• 7923 Jones Branch Dr.	1978	88.8	75.5	100	250	2.81
• 1517 Westbranch Dr.	1980	135.3	115.0	100	400	2.96
• 1521 Westbranch Dr.	1983	64.5	54.8	100	150	2.33
Lancaster Building 7927 Jones Branch Dr.	1979	135.3	115.0	65	270	3.07
8201 Greensboro Dr.	1985	353.1	287.6 ²	100	800	2.25
SAIC 1710 Goodridge Dr.	1980	313.1	255.0	100	700	2.33
Tysons International						
1919 Gallows Rd.	1987	425.6 ²	414.3	100	675	1.38
1921 Gallows Rd.	1988	425.6 ²	414.3	20	95	0.97
Tycon Tower 8000 Tower Crescent Dr.	1987	427.3	363.2 ²	50	350	1.64
The Mitre Corporation						
• 1820 Dolley Madison Blvd.	NA	170.5	144.9 ²	100	} 2500 }	3.34
• 7525 Colshire Dr.	NA	347.0	295.0 ²	100		
• 7798 Old Springhouse Rd.	1974	67.6	57.5 ²	100		
• 7600 Old Springhouse Rd.	1970	101.6	86.4 ²	100		
• 1575 Anderson Rd.	1979	61.2	52.0 ²	100		
NADA 8400 Westpark Rd.	1975	195.9	166.5 ²	100	650	3.32
<u>Southdale</u>						
Southdale Medical Office 6545 France Ave.		198.0	160.3	85	1100	6.17
Phase I	1958					
Phase II	1965					
Phase III	1973					
Southdale Office Center 6700 France Ave.	1968	436.7	379.8	89	1250	3.22
6750	1969					
6800	1970					
6600	1974					
Southdale Place 3400 W. 66th St.	1979	73.3	68.4	92	250	3.71
Edina Office Center 7600 France Ave.	1980	125.0	106.2 ²	90	386	3.43
National Car Rental 7700 France Ave.	1980	335.0	300.0	85	1,000	3.51

Table 5. Continued

<u>Office Building</u>	<u>Year Built</u>	<u>Total GSF (x1000)</u>	<u>Net Rentable GSF(x1000)</u>	<u>Percent Occupied</u>	<u>Approx. No. of Employees</u>	<u>Employee Density (Employees per 1000 Occupied Total GSF)</u>
Southdale (cont.)						
France Place 3601 W. 77th St.	1983	225.0	190.5	80	600	3.33
Minnesota Center 7760 France Ave., S.	1987	300.0	281.0	50	550	3.67
Northland Plaza 3800 W. 80th St.	1985	328.8	297.0	84	800	2.90
Northland Center 3500 W. 80th St. 3600 W. 80th St.	1983 1981	516.1	465.2	96	1,500	3.03
Northwestern Financial Ctr. 7900 W. 80th St.	1972	480.0	432.7	89	1,500	3.51
Edinburgh 3300 Corporate Center E.	1986	100.0	85.0 ²	72	260	3.61
ADC Telecommunications 4700 W. 78th St. 4900 W. 78th St.	1964/1979* 1963	116.0 16.0	98.6 ² 13.6 ²	100 100	380 60	3.28 3.75
Pentagon Office Park ³	NA	NA	NA	NA	NA	NA
Southgate Office Tower 5001 W. 80th St.	1970	238.9 ²	203.0	80	750	3.92
Normandale Lake Office Park 8300 Normandale Lake Blvd. 8400 Normandale Lake Blvd. 8500 Normandale Lake Blvd.	1983 1985 1987	287.0 434.0 484.0	238.0 368.9 ² NA	85 95 35	850 1,300 NA	3.57 3.15 NA
ADC 5501 Green Valley Dr.	1965	115.0	97.8 ²	100	350	3.04
International Dairy Queen 5601 & 5701 Green Valley Dr.	1971	68.0	57.8 ²	100	250	3.68
Jostens 5501 Norman Center Dr.	1975 (1979)	105.0	89.2 ²	100	250	2.38
One Corporate Center I 7300 Metro Blvd.	1976	125.4	110.0	95	425	3.46
One Corporate Center III 7401 Metro Blvd.	1976	125.4	110.0	82	350	3.30

¹ Gross Square Feet² Estimated Size (GSF x .85 = Net Rentable GSF)³ Surveyed two tenants in this complex consisting of 17 buildings.

reported average (2.06), which can be explained by the relatively high vacancy rates in Parkway Center office buildings. In contrast, Southdale has an overall average employee density of 3.42.

The most significant finding regarding office employee density is that there is a direct correlation between employee density and building size. As shown in Listing H, the reported average employee densities decrease with increased building sizes.

Listing H

Building Size (gsf)	Average Employee Density (employees per 1,000 occupied gsf)
Over 500,000	2.22
400–500,000	2.53
300–400,000	2.77
200–300,000	2.92
100–200,000	3.02
Under 100,000	3.43

The ITE *Trip Generation* report presents average employee densities of 3.50 for office buildings larger than 200,000 gsf; 4.40 for buildings between 100,000 and 200,000 gsf; and 4.80 for buildings under 100,000 gsf. For all building size categories, the observed employee densities at the surveyed office buildings are less than the ITE rates.

Analysis of the employee density estimates for the individual office buildings shows little correlation between the employee density and two other key independent variables: number of tenants (in particular, single-tenant vs. multitenant buildings), and building occupancy. In Bellevue and Tysons Corner the employee densities tended to increase with increasing building occupancy. However, in Southdale and South Coast Metro the reverse trend is observed.

Tenant Characteristics

Table 6 provides a summary description of the types of tenants at each of the surveyed office buildings, again organized by suburban activity center. The table also contains additional descriptive information on the size and class of the building.

The number of stories column in Table 6 shows that the buildings range in height from two stories at several sites (e.g., Wells Development in Bellevue, Metro Pointe in South Coast Metro, and Southdale Office Center and International Dairy Queen in Southdale) to 25-stories at Ranier Bank Plaza in Bellevue and Galleria Tower in Parkway Center.

The class of the office space is also given in Table 6. Class A is typically a high-rise office building, built in the 1980s, with a major street address and adequate parking. It often has a multistory atrium and charges at or near the highest office leasing rates outside the regional CBD. Class B office buildings tend to have fewer aesthetic amenities and somewhat lower leasing rates. However, the Class B office buildings are still providing a comfortable environment for office space. Class C buildings are typical of the buildings found in traditional suburban office parks and do not provide the aesthetic or physical amenities found in Class A or Class B office space. The classifications of office space in Table 6 are arbitrary on the part of the research team and are not intended to judge the “quality”

of an office building. Rather, they are intended to convey some qualitative information to the user of the travel characteristics data.

With regard to the number of tenants, the primary focus of the building tenant inventory was to determine whether the office building had a single tenant or multiple tenants. The majority of the surveyed office buildings contained multiple tenants.

Also included in Table 6 is a brief description of the nonoffice uses of space in the office building (e.g., restaurant, cafeteria, or deli; miscellaneous retail; bank; health club). Roughly half of the surveyed office buildings have either a cafeteria, deli, or restaurant located on-site or connected via a protected walkway. About one-quarter of the office buildings have on-site banking facilities (more than ATMs). And approximately one-ninth of the office buildings either contain or are adjacent to a health or fitness club.

Parking Characteristics

The number of on-site parking spaces and fees charged for their use for each surveyed office building are presented in Table 7. The daily and monthly parking fees are the nominal charges. As will be described in a subsequent section of this chapter, many employees receive free or discounted parking privileges from their employers (despite the reported parking fee in Table 7).

In Bellevue, all but one of the surveyed buildings (Honeywell Center) charge a monthly or daily fee to park in their on-site lots or garages. The monthly rates vary widely in Bellevue with the three highest at \$60 or more. The most restrictive parking practice is employed at PNB Plaza, a single-tenant building. At PNB Plaza more than half of the on-site parking spaces are reserved for high occupancy vehicles (HOV) and these spaces are rented at a substantial discount.

In South Coast Metro, the majority of the large office buildings with garages have monthly parking fees. In addition, there is a decked public pay parking located centrally in South Coast Metro.

The Parkway Center office buildings with decked parking typically have pay parking. However, as will be shown later in this chapter, even in the “pay parking” buildings, the majority of Parkway Center office employees do not pay for parking out-of-pocket.

In Perimeter Center, most of the office building parking is free. The exceptions tend to be the newer, multitenant buildings with structured parking.

In Tysons Corner the majority of the surveyed office buildings do not charge their tenants for parking. The exceptions are the two surveyed buildings opened most recently (since 1987), which have structured parking.

The Southdale office buildings for the most part provide surface parking. Several of the buildings also have a limited number of garage spaces beneath the building and are protected from the weather. A fee is typically charged for these garage spaces.

OFFICE TRIP GENERATION

Trip generation counts were taken at 66 office buildings or complexes in the six suburban activity centers. The typical count

Table 6. Office building tenant characteristics.

<u>Office Building</u>	<u>Number of Stories</u>	<u>Class of Office Space</u>	<u>Number of Tenants</u>	<u>Comments</u>
<u>Bellevue</u>				
PNB Plaza	9	A	Single	Corp. headquarters; aggressive car-pooling program
United Olympic Plaza	10	A	Multi	
Rainier Bank Plaza	25	A	Multi	Deli, bookstore and flower store; one tenant has one-half of employees
Honeywell Center	10	B	35	Only large office building in Bellevue with free parking; has cafeteria
Business Center Building	13	B	Multi	Bank with drive-thru tellers; one tenant has one-half of building employees
Pacific First Plaza		A/B	Multi	Health club
Skyline Tower	24	A	Multi	Includes restaurant, bank and miscellaneous retail
Transamerica Title		A/B	Multi	No retail in building
One Bellevue Center	21	A	Multi	One tenant has one-half the space; Restaurant and bank
Wells Development	2	B	Multi	No retail
Plaza Center		A/B	Multi	Shared parking structure with another office building; building has a deli, computer store and several gift shops
<u>South Coast Metro</u>				
Imperial Bank Tower	17	A	20	Includes restaurants, deli, bank, travel services connected via a landscaped walkway to a Westin Hotel
Central Bank Tower	15	A	11	Within development including both Central Bank and Great Western Savings banks and two restaurants
Great Western Savings Tower	15	A	15	
Metro Center	12	A	32	Contains a deli and copy center
Downey Plaza	8	A/B	Multi	
Griffin Towers	12	A	15	Contains an art museum
3 Hutton Center Drive	11	A	Multi	
Butterfield Tower	8	A/B	16	Includes a cafe
Corporate Center	6	A	11	Adjacent to the 500 room Red Lion Inn
Metro Pointe				
940 South Coast Drive	2	B	8	Includes bank
950 South Coast Drive	2	B	9	Includes temp agency
<u>Parkway Center</u>				
Galleria Tower I	25	A	44	Part of the Galleria complex including 2 office towers, Westin Hotel and the Galleria Mall
Occidental Tower	24	A	41	Includes a deli, temp agency and travel services; largest tenant has 8 floors

Table 6. Continued

<u>Office Building</u>	<u>Number of Stories</u>	<u>Class of Office Space</u>	<u>Number of Tenants</u>	<u>Comments</u>
Signature Place I--14755 W. Preston Rd.	8	A	54	2 buildings; complex includes a bank and travel services; adjacent to a health club
II--14785 W. Preston Rd.	11	A		
Colonnade I Republic Bank Tower	12	A	20	Colonnade I and II connect via an enclosed commercial area offering banking, travel services, card shop, temp agency and deli
Colonnade II Rohm Tower	14	A	27	
Lincoln Center I	15	A	21	Part of a large complex including several office towers, a Doubletree Hotel, health club, and miscellaneous retail
Stone Tower	11	A	23	Bank in lobby; drive-thru banking also
Heritage Square Tower 2	10	A	16	Includes a coffee shop and copy center; one large tenant occupying four out of nine floors
Stanford Park	12	A	32	Includes a general store and bank; adjacent to a health club
Princeton	9	A	Multi	12,000 sf of retail including a cafe and a printer
One Spectrum Center	12	A	Multi	3 buildings; includes a restaurant and large daycare facility
<u>Perimeter Center</u>				
Southern Company	9/12	A/B	1	Two buildings connected by enclosed elevated walkway
Terraces North	11	A	Multi	Adjacent to sister building and a hotel; includes restaurant, bank and private club
Ravinia One	17	A	32	Largest tenant has 6 floors; includes cafe, bank and health club; walkway to Hyatt Ravinia
Concourse II	8	A	25	Adjacent to 2 other Concourse office buildings and Doubletree Hotel; includes cafe and bank
UNISYS		A	22	Includes cafe and bank
Cotton States/Goldkist	3	B	2	
219/223 Perimeter Center Parkway	5/6	A/B	Multi	Two adjacent buildings
Travellers	10	A	25	Two large tenants (3 floors each)
Ashwood 1200	5	A/B	34	Includes cafe, bank, health club and travel services
Contel	10	A	1	Single office tenant plus small financial services office
41/47 Perimeter Center E.	6/6	A/B	35	Two adjacent buildings; includes a deli and travel services

Table 6. Continued

<u>Office Building</u>	<u>Number of Stories</u>	<u>Class of Office Space</u>	<u>Number of Tenants</u>	<u>Comments</u>
Maryland Casualty Building	3	B	10	Includes a deli and travel services; largest tenant has 2 floors
AT&T	5	B	1	
Northpark 400	18	A	Multi	
Embassy Row	6	A	9	
<u>Tysons Corner</u>				
The BDM Corporation				Single tenant buildings offering coffee shops and lunch rooms; soon to be consolidated within a single office building in Tysons Corner
• 7915 Jones Branch Dr.	6	B	1	
• 7923 Jones Branch Dr.	6	B	1	
• 1517 Westbranch Dr.	6	B	1	
• 1521 Westbranch Dr.	6	B	1	
Lancaster Building	6	B	10	Lobby under renovation
8201 Greensboro Drive	12	A	31	Includes a restaurant
SAIC	13	B/C	1	Single tenant building offering employee lunch room
Tysons International				
1919 Gallows Road	10	A	12	Includes a coffee shop; only 20% of 1921 Gallows is occupied
1921 Gallows Road	10	A	1	
Tycon Tower	17	A	27	Includes a health club
The Mitre Corporation				Single tenant buildings; no service facilities
• 1820 Dolley Madison	3	B	1	
• 7525 Colshire	5	A/B	1	
• 7798 Old Springhouse	6	A/B	1	
• 7600 Old Springhouse	5	A/B	1	
• 1575 Anderson	3	B	1	
<u>Southdale</u>				
Southdale Medical Office	6	B	Multi	Mix of professional, technical employees
Southdale Office Center				Buildings connected by climate-controlled walkways; contains a fast-food, sit-down restaurant
6600 France Ave.	6	A/B	60 in total complex	
6700 France Ave.	2	B		
6750 France Ave.	2	B		
6800 France Ave.	7	A/B		
Southdale Place	4	B	Multi	Drive-through bank
Edina Office Center	5	A/B	20	
National Car Rental	5	A/B	1	Corporate headquarters
France Place	9	B	30	
Minnesota Center	13	A	20	Copy center, deli, temp services, bank; 50% occupied
Northland Plaza	15	A	50	Fitness center
Northland Center				
3600 W. 80th Street	7	A/B	15	Underground connection with cafe, jeweler, travel agent, health club, ATM's
3500 W. 80th Street	7	A/B	30	

Table 6. Continued

<u>Office Building</u>	<u>Number of Stories</u>	<u>Class of Office Space</u>	<u>Number of Tenants</u>	<u>Comments</u>
<u>Southdale (cont.)</u>				
Northwestern Financial Center	24	B	35	Drive-in tellers
Edinborough	7	A	30	Mixed-use development which includes residential
ADC Telecommunications 4700 W. 78th Street 4900 W. 78th Street			1	Mixed technical, service and manufacturing
Pentagon Office Park	--	B/C	Multi	17 buildings in this complex; small offices/service firms
Southgate Office Tower	10	B/C	100	Restaurant and card shop; many small tenants
Normandale Lake Ofc.Pk. 8300 Normandale Lake 8400 Normandale Lake	12 12	A A	35 60	Deli, general store, bank. Restaurant, hair salon, card shop, travel agency, jewelers, child care, gift shop.
ADC 5501 Green Valley Dr.	3	A/B	1	Corporate headquarters
International Dairy Queen	2	B	1	Corporate headquarters
Jostens	3	B	1	Corporate headquarters
One Corporate Center I	6		25	14% common area; dry cleaners, tailor, deli, insurance
One Corporate Center III	6		12	

consisted of both a person-count and a vehicle-count, separated by direction, disaggregated by 15-min period over the 2-hour AM and PM peak periods. Counts were conducted between 7 and 9 AM and between 4 and 6 PM. In cases where the mode of arrival for an individual entering the office building could not be determined visually by the counter, an intercept survey was conducted at the appropriate entrance to determine the mode of arrival distribution.

The vehicle trips and associated trip rates for the AM peak hour for the surveyed office buildings are shown in Table 8. The peak-hour values refer to the peak hour of site trip generation within the AM peak period. The corresponding PM peak-hour volumes and rates are presented in Table 9.

For each surveyed office building, Tables 8 and 9 show the total gross square footage of the building, the estimated occupancy of the building, and the approximate number of employees based in the building. The tables also give three counted values which quantify peak-hour trip characteristics: total trips during the peak hour, directional split of the peak-hour trips (percentage inbound during the AM peak hour and percentage outbound for the PM peak hour), and the peak direction automobile occupancy. With these values, various trip rates are computed (i.e., as a function of total building gsf, of occupied gsf, and per employee) and compared to the corresponding ITE rates.

In general, the observed trip generation rates per building gross square footage are lower than the reported ITE rates.

Seventy-four percent of the observed AM rates are lower than the ITE rates and 69 percent of the PM rates are lower. However, the observed trip generation rates per employee are generally higher than the reported ITE rates. Sixty-seven percent of the observed AM rates per employee are higher than the ITE rates and 72 percent of the PM rates are higher. Therefore, the lower trip rates on a building square footage basis appear to be the product of lower employee densities.

The trend for observed trip generation rates to be lower than reported by ITE on a per building square foot basis and higher on a per employee basis holds true for both large and small buildings. Buildings over 200,000 gsf have slightly higher percentages of "low" observed trip generation counts than the overall average. However, these differences are relatively insignificant.

A key observation made in this research effort is that an extensive, systematic, and statistically rigorous effort must be mounted in order to achieve a more effectual understanding of vehicle trip generation rates for office buildings. Based on the office trip generation data reported in Tables 8 and 9 and the analysis presented above, several key observations with respect to the procedures used to measure and forecast trip generation rates point out that there are numerous variables that affect the trip-generating characteristics of an office building. The most widely used factor is building gross square footage. However, this variable should more accurately be considered as the "occupied" gross square footage.

Table 7. Office building parking characteristics.

<u>Office Building</u>	<u>Number of Parking Spaces</u>	<u>Monthly Parking Fee</u>	<u>Daily Parking Fee</u>	<u>Short-Term Visitor Parking Fee</u>	<u>Number of HOV Spaces</u>
<u>Bellevue</u>					
PNB Plaza	402	\$60 - SOV \$45 - HOV2 Free - HOV3	\$3	Free	222
United Olympic Building	512	\$38	NA	NA	None
Rainier Bank Plaza	790	\$65 - Garage \$45 - Surface	\$6	\$1/hour	None
Honeywell Center	730	Free	Free	Free	None
Business Center Bldg.	NA	\$55 - Reserved \$35 - Garage \$25 - Surface	NA	Free	None
Pacific First Plaza	242	\$55	NA	\$1/hour	None
Skyline Tower	895	\$50	NA	NA	None
Transamerica Title	300	\$25	NA	Free	None
One Bellevue Center	688	\$60 - Garage \$40 - Surface	NA	\$1/hour	None
Wells Development	83	\$25 - Garage Free - Surface	Free	Free	None
<u>South Coast Metro</u>					
Imperial Bank Tower	1428	\$45	\$6	\$.75/hour	NA
Central Bank Tower	} 2,322 (shared)	\$45	NA	Free (1 hour)	NA
Great Western Savings Tower					
Metro Center	NA	Free	Free	Free	None
Downey Plaza	NA	NA	NA	Free (1 hour)	None
Griffin Towers	915	\$65 reserved \$45 unreserved	NA	Free (1 hour)	None
3 Hutton Center Drive					
Butterfield Tower	NA	Free	Free	Free	None
Corporate Center	1,200	\$45	NA	Free (1 hour)	None
Metro Pointe					
940 South Coast Drive	160	Free	Free	Free	None
950 South Coast Drive	160	Free	Free	Free	None
<u>Parkway Center</u>					
Galleria Tower I	8500 in entire complex	NA	Free	Free	None

Table 7. Continued

<u>Office Building</u>	<u>Number of Parking Spaces</u>	<u>Monthly Parking Fee</u>	<u>Daily Parking Fee</u>	<u>Short-Term Visitor Parking Fee</u>	<u>Number of HOV Spaces</u>
<u>Parkway Center (cont.)</u>					
Occidental Tower	1620	NA	\$2.50	Free	NA
Signature Place I & II 14755 W. Preston Rd. (I) 14785 W. Preston Rd. (II)	1597	basement \$100 covered \$40 uncovered \$10	\$3	Free	None
Colonnade I Republic Bank Tower	NA	NA	\$3	30 min. free 50¢/hr.	None
Colonnade II Rolm Tower	NA	NA	\$3	30 min. free 50¢/hr.	None
Lincoln Center I	NA	Free-Surface	Free	Free	None
Stone Tower	874	\$40	NA	Free	None
Heritage Square Tower 2	NA	NA	NA	Free	None
Stanford Park	1059	New leases no charge \$40	Free	Free	None
Princeton	NA	Free	Free	Free	None
One Spectrum Center	NA	\$37.50	\$2.50	Free	None
<u>Perimeter Center</u>					
Southern Company	NA	Free	Free	Free	NA
Terraces North	NA	Free	Free	Free	None
Ravinia One	NA	NA	\$3.75	50¢/hr.	None
Concourse II	800	Free	Free	Free	None
UNISYS	950	Free	Free	Free	None
Cotton States/Goldkist	770	Free	Free	Free	None
219/223 Perimeter Ctr. Pkwy.	960	Free	Free	Free	None
Travellers	890	Free	Free	Free	None
Ashwood 1200	620	Free	Free	Free	None
Contel	860	Free	Free	Free	None
41/47 Perimeter Center E.	NA	Free	Free	Free	None
Maryland Casualty Bldg.	400	Free	Free	Free	None
AT&T	340	Free	Free	Free	None
Northpark 400	NA	Free	Free	Free	None
<u>Tysons Corner</u>					
The BDM Corporation					
• 7915 Jones Branch Dr.	NA	Free	Free	Free	None
• 7923 Jones Branch Dr.	NA	Free	Free	Free	None
• 1517 Westbranch Dr.	NA	Free	Free	Free	None
• 1521 Westbranch Dr.	NA	Free	Free	Free	None

Table 7. Continued

Office Building	Number of <u>Parking Spaces</u>	Monthly <u>Parking Fee</u>	Daily <u>Parking Fee</u>	Short-Term Visitor <u>Parking Fee</u>	Number of <u>HOV Spaces</u>
<u>Tysons Corner (cont.)</u>					
Lancaster Building	NA	Free	Free	Free	None
8201 Greensboro Dr	933	Yes; Varies	Free	Free	None
SAIC	NA	Free	Free	Free	None
Tysons International	1,500	\$55	\$3.50	Free	None
Tycon Tower	1,500	\$50	\$4	Free (30 min.)	None
The Mitre Corporation					
• 1820 Dolley Madison Blvd.	NA	Free	Free	Free	None
• 7525 Colshire Dr.	NA	Free	Free	Free	None
• 7798 Old Springhouse Rd.	NA	Free	Free	Free	None
• 7600 Old Springhouse Rd.	NA	Free	Free	Free	None
• 1575 Anderson Rd.	NA	Free	Free	Free	None
<u>Southdale</u>					
Southdale Medical Office	1300	308 rentable spaces \$16	Free	Free	None
Southdale Office Center	1860	\$80 - (84 spaces)	--	Free	None
Southdale Place	365	Free	Free	Free	None
Edina Office Center	NA				
National Car Rental	NA	Free	Free	Free	NA
France Place	1030 - Surface 90 - Garage	Free - Surface \$60 - Garage	Free	Free	None
Minnesota Center	NA				
Northland Plaza	1042 - Surface 73 - Garage	Free - Surface \$100 - Garage	Free	Free	None
Northland Center	1727	\$15 - Surface \$80 - Garage		Free	2
Northwestern Financial Ctr.	1500	Free	Free	Free	None
Edinborough	NA				
ADC Telecommunications 4700 & 4900 W. 78th St.	NA	Free	Free	Free	NA
Pentagon Office Park	NA	Free	Free	Free	None
Southgate Office Tower	800 - Surface 72 - Garage	Free - Surface \$95 - Garage	Free	Free	None
Normandale Lake Office Park 8300 Normandale Lake Blvd. 8400 Normandale Lake Blvd.	950 1350				
ADC 5501 Green Valley Dr.	NA	Free	Free	Free	NA
International Dairy Queen	NA	Free	Free	Free	None
Jostens	NA				
One Corporate Center I	NA				
One Corporate Center III	NA				

Table 8. Office vehicle-trips (AM peak hour).

Office Building	Total GSF (x 1,000)	Percent Occupied	Approx. No. of Employees	AM Peak Hour (2-way vehicle trips)				% Inbound	Inbound Auto Occupancy	ITE Trips/Occupied 1,000 GSF	ITE Trips/ Employee
				Total Trips	Trips/ 1,000 GSF	Trips/ Occupied 1,000 GSF	Trips/ Employee				
Bellevue											
PNB Plaza	442.0	100	1150	203	0.46	0.46	0.20	89	1.74	1.63	0.50
United Olympic Building	214.2	80	425	242	1.13	1.41	0.57	94	1.04	1.86	0.51
Rainier Bank Plaza	441.8	80	1000	367	0.83	1.04	0.37	93	1.06	1.68	0.50
Honeywell Center	235.8	90	650	283	1.20	1.34	0.44	94	1.09	1.80	0.51
Business Center Bldg.	146.0	99	450	242	1.66	1.69	0.54	83	1.20	1.90	0.51
Pacific First Plaza	134.0	60	100	58	0.43	0.72	0.58	93	1.10	2.07	0.53
Skyline Tower	420.0	82	775	403	0.96	1.17	0.52	94	1.05	1.69	0.51
Transamerica Title	73.1	100	250	112	1.53	1.53	0.45	87	1.08	2.09	0.52
One Bellevue Center	357.0	92	900	196	0.55	0.60	0.22	89	1.06	1.70	0.50
Wells Development	21.5	90	60	29	1.35	1.50	0.48	79	1.04	2.52	0.53
South Coast Metro											
Imperial Bank Tower	310.0	93	725	411 ¹	1.33	1.43	0.57	93	NA	1.73	0.51
Central Bank Tower	289.6	89	810	663 ¹	1.14	1.24	0.41	92	NA	1.61	0.51
Great Western Savings Tower	289.9	96	805								
Metro Center	240.0	80	635	341	1.42	1.77	0.54	89	1.05	1.83	0.51
Downey Plaza	118.0	100	NA	283	2.40	2.40	NA	90	1.07	1.96	NA
Griffin Towers	285.0	86	500	319	1.12	1.30	0.64	92	1.10	1.77	0.51
3 Hutton Center Drive	200.0	NA	NA	161	0.80	NA	NA	92	1.06	NA	NA
Butterfield Tower	146.3	100	400	196	1.34	1.34	0.49	94	1.06	1.90	0.51
Corporate Center	159.2	71	350	229	1.44	2.03	0.65	75	1.08	1.97	0.51
Metro Pointe											
940 South Coast Drive	40.0	95	120	77	1.92	2.03	0.64	91	1.04	2.30	0.52
950 South Coast Drive	40.0	100	160	88	2.20	2.20	0.55	80	1.04	2.28	0.52

Table 8. Continued

Office Building	Total GSF (x 1,000)	Percent Occupied	Approx. No. of Employees	AM Peak Hour (2-way vehicle trips)				% Inbound	Inbound Auto Occupancy	ITE Trips/Occupied 1,000 GSF	ITE Trips/ Employee
				Total Trips	Trips/ 1,000 GSF	Trips/ Occupied 1,000 GSF	Trips/ Employee				
<u>Parkway Center</u>											
Galleria Tower I	500.0	90	1000	464	0.93	1.03	0.46	85	1.10	1.62	0.50
Occidental Tower	537.0	75	750	491	0.91	1.22	0.65	86	1.05	1.65	0.51
Signature Place I & II 14755 W. Preston Rd.	217.3	60	235	318	0.62	1.09	0.61	87	1.10	1.72	0.51
14785 W. Preston Rd.	295.4	55	290								
Colonnade I Republic Bank Tower	288.7	90	600	640	1.02	1.14	0.51	88	1.06	1.57	0.50
Colonnade II Rohm Tower	336.8	90	650								
Stone Tower	265.0	42	275	141	0.53	1.27	0.51	93	1.11	1.97	0.52
Heritage Square Tower 2 ²	200.0	80	400	243 ²	1.22	1.52	0.61	93	NA	1.88	0.51
Stanford Park	295.0	95	500	378	1.28	1.35	0.76	96	1.02	1.73	0.51
Princeton	370.0	70	NA	444	1.20	1.71	NA	92	1.04	1.75	NA
One Spectrum Center	597.0	80	NA	710	1.19	1.49	NA	88	1.04	1.61	NA
<u>Perimeter Center</u>											
Southern Company	512.5	100	NA	753	1.47	1.47	NA	91	1.13	1.59	NA
Terraces North	429.0	99	NA	740	1.72	1.74	NA	92	1.03	1.64	NA
Ravinia One	377.5	95	1200	824	2.18	2.30	0.69	92	1.07	1.68	0.50
Concourse II	288.0	100	NA	521	1.81	1.81	NA	93	1.06	1.73	NA
UNISYS	286.0	NA	NA	467	1.63	NA	NA	96	1.06	NA	NA
Cotton States/Goldkist	264.8	100	NA	287	1.08	1.08	NA	95	1.07	1.75	NA
219/223 Perimeter Center Pkwy.	260.1	NA	NA	247	0.95	NA	NA	90	1.06	NA	NA
Travellers	225.6	NA	NA	255	1.13	NA	NA	91	1.09	NA	NA
Ashwood 1200	218.8	NA	NA	244	1.12	NA	NA	93	1.06	NA	NA
Contel	215.0	100	NA	355	1.65	1.65	NA	94	1.06	1.80	NA

Table 8. Continued

Office Building	Total GSF (x 1,000)	Percent Occupied	Approx. No. of Employees	AM Peak Hour (2-way vehicle trips)				% Inbound	Inbound Auto Occupancy	ITE Trips/Occupied 1,000 GSF	ITE Trips/ Employee
				Total Trips	Trips/ 1,000 GSF	Trips/ Occupied 1,000 GSF	Trips/ Employee				
Perimeter Center (cont.)											
41/47 Perimeter Center East	189.5	100	NA	527	2.78	2.78	NA	85	1.10	1.83	NA
Maryland Casualty Building	146.0	NA	NA	204	1.40	NA	NA	93	1.19	NA	NA
AT&T	86.0	100	400	55	0.64	0.64	0.14	85	1.09	2.05	0.51
Northpark 400	585.1	70	NA	620	1.06	1.51	NA	99	1.06	1.65	NA
400 Embassy Row	155.0	97	530	224	1.45	1.49	0.42	98	1.07	1.89	0.51
Tysons Corner											
The BDM Corporation											
• 7915 Jones Branch Dr.	135.3	100	400	352	1.57	1.57	0.54	90	1.09	1.80	0.51
• 7923 Jones Branch Dr.	88.8	100	250								
• 1517 Westbranch Dr.	135.3	100	400	357	1.79	1.79	0.65	92	1.03	1.82	0.51
• 1521 Westbranch Dr.	64.5	100	150								
Lancaster Building	135.3	65	270	107	0.79	1.22	0.40	85	1.07	2.04	0.52
8201 Greensboro Dr.	353.1	100	800	604	1.71	1.71	0.75	85	1.07	1.68	0.50
Tysons International											
1919 Gallows Rd.	425.6	100	675	408	0.96	0.96	0.60	89	1.32	1.60	0.51
1921 Gallows Rd.	425.6	20	95								
Tycon Tower	427.3	50	350	221	0.52	1.03	0.63	88	1.04	1.80	0.51
The Mitre Corporation											
• 1820 Dolley Madison Blvd.	170.5	100	570	362	2.12	2.12	0.64	91	1.08	1.86	0.51
• 7525 Colshire Dr.	347.0	100	1160	591	1.70	1.70	0.51	82	1.05	1.68	0.50
• 1575 Anderson Rd.	61.2	100	200	172	2.81	2.81	0.86	84	1.08	2.15	0.52
NADA	195.9	100	650	348	1.78	1.78	0.54	93	1.57	1.82	0.51

Table 8. Continued

<u>Office Building</u>	<u>Total GSF (x 1,000)</u>	<u>Percent Occupied</u>	<u>Approx. No. of Employees</u>	<u>AM Peak Hour (2-way vehicle trips)</u>				<u>% Inbound</u>	<u>Inbound Auto Occupancy</u>	<u>ITE Trips/Occupied 1,000 GSF</u>	<u>ITE Trips/ Employee</u>
				<u>Total Trips</u>	<u>Trips/ 1,000 GSF</u>	<u>Trips/ Occupied 1,000 GSF</u>	<u>Trips/ Employee</u>				
Southdale											
Southdale Medical Office	198.0	85	1100	632	3.19	3.76	0.51	75	1.09	1.86	0.50
Southdale Place	73.3	92	250	197	2.69	2.92	0.79	88	1.08	2.12	0.52
National Car Rental	335.0	85	1000	486	1.47	1.71	0.49	97	1.06	1.73	0.50
Minnesota Center	300.0	50	550	320	1.07	2.13	0.58	90	1.11	1.89	0.51
Northland Plaza	328.8	84	800	436	1.33	1.58	0.55	94	1.02	1.74	0.50
Northland Exec. Center	516.1	96	1500	853	1.65	1.72	0.57	94	1.06	1.60	0.50
Northwestern Financial Ctr.	480.0	89	1500	798	1.66	1.87	0.53	96	1.08	1.64	0.50
Southgate Office Tower	238.9	80	750	368	1.54	1.93	0.49	78	1.06	1.83	0.51
Normandale Lake Office Park	700.0	78	2150	915	1.31	1.68	0.43	90	1.06	1.58	0.49
8300 Normandale Lake Blvd.	280.0	75	850	310	1.11	1.48	0.36	93	1.03	1.81	0.50
8400 Normandale Lake Blvd.	420.0	80	1300	605	1.44	1.80	0.47	88	1.07	1.69	0.50

¹ These buildings have no isolated parking. Person counts were taken at the building entrances (as reflected in Table 30). Vehicle trips are based on an assumed average auto occupancy of 1.07 (average for South Coast Metro office buildings).

² Parking garage is shared with another office building. Person counts were taken at building entrances. Vehicle trips are based on an assumed average auto occupancy of 1.06 (average for Parkway Center office buildings).

Table 9. Office vehicle-trips (PM peak hour).

Office Building	Total GSF (x 1,000)	Percent Occupied	Approx. No. of Employees	PM Peak Hour (2-way vehicle trips)				% Outbound	Outbound Auto Occupancy	ITE Trips/Occupied 1,000 GSF	ITE Trips/ Employee
				Total Trips	Trips/ 1,000 GSF	Trips/ Occupied 1,000 GSF	Trips/ Employee				
Bellevue											
PNB Plaza	442.0	100	1150	230	0.52	0.52	0.20	91	1.69	1.53	0.48
United Olympic Building	214.2	80	425	218	1.02	1.27	0.51	91	1.02	1.80	0.49
Rainier Bank Plaza	441.8	80	1000	389	0.88	1.10	0.39	87	1.08	1.59	0.48
Honeywell Center	235.8	90	650	304	1.29	1.43	0.47	97	1.06	1.73	0.48
Business Center Bldg.	146.0	99	450	380	2.60	2.63	0.84	66	1.13	1.85	0.48
Pacific First Plaza	134.0	60	100	72	0.54	0.91	0.72	87	1.13	2.04	0.50
Skyline Tower	420.0	82	775	290	0.69	0.84	0.37	92	1.07	1.60	0.48
Transamerica Title	73.1	100	250	167	2.28	2.28	0.67	81	1.03	2.08	0.49
One Bellevue Center	357.0	92	900	178	0.50	0.54	0.20	91	1.05	1.61	0.48
South Coast Metro											
Imperial Bank Tower	310.0	93	725	385 ¹	1.24	1.34	0.53	82	NA	1.64	0.48
Central Bank Tower	289.6	89	810	548 ¹	0.95	1.03	0.34	88	NA	1.46	0.47
Great Western Savings Tower	289.9	96	805								
Metro Center	240.0	80	635	216	0.90	1.13	0.34	83	1.10	1.76	0.48
Downey Plaza	118.0	100	NA	251	2.13	2.13	NA	83	1.14	1.91	NA
Griffin Towers 5 Hutton Center Dr.	285.0	86	500	336	1.18	1.37	0.67	93	1.15	1.69	0.48
3 Hutton Center Drive	200.0	NA	NA	126	0.63	NA	NA	88	1.13	NA	NA
Butterfield Tower	146.3	100	400	217	1.48	1.48	0.54	84	1.10	1.84	0.49
Corporate Center	159.2	71	350	215	1.35	1.90	0.61	79	1.09	1.93	0.49
Metro Pointe 940 South Coast Drive	40.0	95	120	80	2.00	2.10	0.67	89	1.04	2.32	0.50
950 South Coast Drive	40.0	100	160	81	2.03	2.03	0.51	84	1.19	2.30	0.50

Table 9. Continued

Office Building	Total GSF (x 1,000)	Percent Occupied	Approx. No. of Employees	PM Peak Hour (2-way vehicle trips)					Outbound Auto Occupancy	ITE Trips/Occupied 1,000 GSF	ITE Trips/ Employee
				Total Trips	Trips/ 1,000 GSF	Trips/ Occupied 1,000 GSF	Trips/ Employee	% Outbound			
Parkway Center											
Galleria Tower I	500.0	90	1000	394	0.79	0.88	0.39	81	1.12	1.52	0.48
Occidental Tower	537.0	75	750	435	0.81	1.08	0.58	87	1.09	1.55	0.48
Signature Place I & II 14755 W. Preston Rd.	217.3	60	235	348	0.68	1.19	0.66	76	1.16	1.49	0.48
14785 W. Preston Rd.	295.4	55	290								
Colonnade I Republic Bank Tower	288.7	90	600	939	1.50	1.67	0.75	87	1.07	1.47	0.48
Colonnade II Rohm Tower	336.8	90	650								
Stone Tower	265.0	42	275	169	0.64	1.52	0.61	82	1.09	1.93	0.49
Heritage Square Tower 2 ²	200.0	80	400	258 ²	1.29	1.61	0.64	93	NA	1.82	0.49
Stanford Park	295.0	95	500	321	1.08	1.15	0.64	59	1.07	1.65	0.48
Princeton	370.0	70	NA	467	1.26	1.80	NA	88	1.13	1.67	NA
One Spectrum Center	597.0	80	NA	606	1.02	1.27	NA	82	1.06	1.45	NA
Perimeter Center											
Southern Company	512.5	100	NA	697	1.36	1.36	NA	91	1.14	1.49	NA
Terraces North	429.0	99	NA	701	1.63	1.65	NA	88	1.05	1.54	NA
Ravinia One	377.5	95	1200	613	1.62	1.71	0.51	83	1.11	1.58	0.48
Concourse II	288.0	100	NA	490	1.70	1.70	NA	86	1.09	1.64	NA
UNISYS	286.0	NA	NA	417	1.46	NA	NA	89	1.10	NA	NA
Cotton States/Goldkist	264.8	100	NA	325	1.23	1.23	NA	90	1.12	1.67	NA
219/223 Perimeter Center Pkwy.	260.1	NA	NA	252	0.97	NA	NA	87	1.04	NA	NA
Travellers	225.6	NA	NA	245	1.09	NA	NA	91	1.25	NA	NA
Ashwood 1200	218.8	NA	NA	268	1.22	NA	NA	89	1.09	NA	NA
Contel	215.0	100	NA	309	1.44	1.44	NA	87	1.06	1.73	NA

Table 9. Continued

<u>Office Building</u>	<u>Total GSF</u> <u>(x 1,000)</u>	<u>Percent</u> <u>Occupied</u>	<u>Approx. No.</u> <u>of Employees</u>	<u>PM Peak Hour (2-way vehicle trips)</u>			<u>Trips/</u> <u>Employee</u>	<u>%</u> <u>Outbound</u>	<u>Outbound</u> <u>Auto</u> <u>Occupancy</u>	<u>ITE</u> <u>Trips/Occupied</u> <u>1,000 GSF</u>	<u>ITE Trips/</u> <u>Employee</u>
				<u>Total</u> <u>Trips</u>	<u>Trips/</u> <u>1,000 GSF</u>	<u>Trips/</u> <u>Occupied</u> <u>1,000 GSF</u>					
<u>Perimeter Center (cont.)</u>											
41/47 Perimeter Center East	189.5	100	NA	475	2.51	2.51	NA	70	1.14	1.77	NA
Maryland Casualty Building	146.0	NA	NA	219	1.50	NA	NA	92	1.22	NA	NA
AT&T	86.0	100	400	183	2.13	2.13	0.46	92	1.04	2.02	0.49
Northpark 400	585.1	70	NA	606	1.04	1.48	NA	86	1.06	1.55	NA
<u>Tysons Corner</u>											
The BDM Corporation											
• 7915 Jones Branch Dr.	135.3	100	400	305	1.36	1.36	0.47	86	1.10	1.72	0.48
• 7923 Jones Branch Dr.	88.8	100	250								
• 1517 Westbranch Dr.	135.3	100	400	306	1.53	1.53	0.56	90	1.05	1.75	0.48
• 1521 Westbranch Dr.	64.5	100	150								
8201 Greensboro Dr.	353.1	100	800	420	1.19	1.19	0.52	73	1.08	1.59	0.48
Tysons International											
1919 Gallows Rd.	425.6	100	675	458	0.54	0.90	0.59	93	1.26	1.38	0.48
1921 Gallows Rd.	425.6	20	95								
Tycon Tower 8000 Tower Crescent Dr.	427.3	50	350	188	0.44	0.88	0.54	76	1.09	1.73	0.49
The Mitre Corporation											
• 1820 Dolley Madison Blvd.	170.5	100	570	360	2.11	2.11	0.63	87	1.10	1.80	0.48
• 7525 Colshire Dr.	347.0	100	1160	736	2.12	2.12	0.63	82	1.10	1.59	0.48
• 1575 Anderson Rd.	61.2	100	200	125	2.04	2.04	0.62	85	1.09	2.14	0.49
NADA	195.9	100	650	384	1.96	1.96	0.59	90	1.33	1.76	0.48

Table 9. Continued

Office Building	Total GSF (x 1,000)	Percent Occupied	Approx. No. of Employees	PM Peak Hour (2-way vehicle trips)					Outbound Auto Occupancy	ITE Trips/Occupied 1,000 GSF	ITE Trips/ Employee
				Total Trips	Trips/ 1,000 GSF	Trips/ Occupied 1,000 GSF	Trips/ Employee	% Outbound			
Southdale											
Southdale Medical Office	198.0	85	1100	768	3.88	4.56	0.61	66	1.25	1.80	0.48
Southdale Place -including the drive-in banking	73.3	92	250	188 355	2.56 4.84	2.79 5.26	0.75 1.42	67	1.14	2.10	0.49
National Car Rental	335.0	85	1000	477	1.42	1.68	0.48	89	1.07	1.65	0.48
Minnesota Center	300.0	50	550	314	1.05	2.09	0.57	81	1.08	1.84	0.48
Northland Plaza	328.8	84	800	411	1.25	1.49	0.51	84	1.07	1.66	0.48
Northland Exec. Center	516.1	96	1500	777	1.51	1.57	0.52	88	1.10	1.50	0.47
Northwestern Financial Ctr.	480.0	89	1500	842	1.75	1.97	0.56	85	1.09	1.54	0.47
Southgate Office Tower	238.9	80	750	332	1.39	1.74	0.44	80	1.08	1.76	0.48
Normandale Lake Office Park											
8300 Normandale Lake Blvd.	287.0	85	NA	1075	0.89	1.29	NA	81	1.11	1.38	NA
8400 Normandale Lake Blvd.	434.0	95									
8500 Normandale Lake Blvd.	484.0	35									

¹ These buildings have no isolated parking. Person counts were taken at the building entrances (as reflected in Table 31). Vehicle trips are based on an assumed average auto occupancy of 1.11 (average for South Coast Metro office buildings).

² Parking garage is shared with another office building. Person counts were taken at building entrances. Vehicle trips are based on an assumed average auto occupancy of 1.10 (average for Parkway Center office buildings).

Generally, employment is a more accurate independent variable for deriving trip generation estimates. However, measurement and forecasting of employment levels are even less predictable than occupied square footage.

Because ITE trip generation rates are supplied by private sources that have collected the data in a potentially uncontrolled environment, it cannot be stated with complete assurance that accurate estimates of building occupancies were collected and appropriately factored into the calculation. Nevertheless, even with the level of practical diligence applied to the collection of building occupancy rates for this research effort, the researchers also cannot speak with complete assurance regarding the building occupancy rates. Therefore, it appears that more research and development are required for standardizing a methodology for determining and computing building occupancy levels.

Transportation planners traditionally account for employee absenteeism and variable work hours in computing trip generation rates on a per employee basis. Likewise, building leases are in a continual turnover and some vacancy should be expected. Therefore, when computing trip generation on a building square footage basis, the question arises whether a nominal building vacancy should be considered "typical."

Automobile Occupancy

Tables 8 and 9 give the observed peak direction automobile occupancies by building for the AM and PM peak hours, respectively. Aggregated by suburban activity center, the observed range of AM peak-hour automobile occupancies and the weighted means are shown in Listing I.

Listing I

SAC	Observed Auto Occupancies	
	Mean	Range
Bellevue (total)	1.16	1.04–1.74
(w/o PNB Plaza)	1.10	1.04–1.20
South Coast Metro	1.07	1.04–1.10
Parkway Center	1.06	1.02–1.11
Perimeter Center	1.07	1.03–1.19
Tysons Corner	1.11	1.03–1.57
Southdale	1.07	1.02–1.11
Overall Average	1.08	1.02–1.74

The highest automobile occupancy at any surveyed office building was observed at PNB Plaza, a single-tenant, 442,000 square foot building in Bellevue (1.74). Its high automobile occupancy and a 12 percent transit mode share have been achieved by means of a parking management program geared to encourage ridesharing. The office building has roughly 1,200 employees, but only 402 on-site parking spaces. More than half (222) of the spaces are reserved for carpools. A \$60 monthly parking fee is charged for a non-HOV parking space. In contrast, parking is free for three-person carpools.

As shown in the listing, there is a great deal of consistency in the observed automobile occupancies. The highest mean automobile occupancy (1.11) at SAC office buildings was observed at Tysons Corner (if PNB Plaza is excluded). In contrast, the average automobile occupancy for office trips to the Washington, D.C., CBD is 1.5. Four of the six surveyed SACs have average office work trip automobile occupancies of 1.06 or 1.07. The Perimeter Center offers an example. Its average automobile

occupancy is 1.07 in contrast to the Atlanta CBD average automobile occupancy of roughly 1.2.

Directional Distribution

The directional distribution of AM peak-hour trips at office buildings is estimated by ITE to be 87 percent entering and 13 percent exiting the site. The PM peak-hour estimate is 84 percent exiting and 16 percent entering the site. The observed average values by suburban activity center are given in Listing J.

Listing J

SAC	AM Peak Hour (%)	PM Peak Hour (%)
Bellevue	91	86
South Coast Metro	90	85
Parkway Center	89	83
Perimeter Center	93	86
Tysons Corner	85	85
Southdale	90	81
Overall Average	90	84
ITE Average	87	84

As shown in the listing, the directional split for the observed sites is greater during the AM peak hour than reported by ITE. The net effect of this difference is that for the same number of peak-hour trips generated by an office building, the observed directional split produces a 3 to 4 percent greater number of peak direction trips than does the ITE directional distribution. During the PM peak hour, the observed average directional distribution matches the reported ITE distribution.

WORKPLACE SURVEY DISTRIBUTION

The workplace survey, shown previously in Figure 11, was distributed to employees in office buildings in each of the six suburban activity centers. The buildings in which the surveys were distributed, the number of surveys distributed by building, and the number of valid survey responses by building are given in Table 10. An overall response rate of 30 percent was achieved.

EMPLOYEE WORK TRIPS

Work Trip Mode

The modes of travel used by employees for their trips to work are shown by building in Table 11. Also shown in the table are overall weighted averages for the surveyed office buildings by suburban activity center. With the exception of Bellevue, none of the suburban activity centers has a transit mode share over 1 percent. In these five SACs, fixed-route transit service is not structured to serve the SAC as an end-of-the-line destination. Rather, most of the SAC transit service passes through a portion of the SAC area along its route between the residential suburbs and the regional central business district.

The exception, as noted previously, is Bellevue. The Bellevue activity center is served by 17 different Seattle Metro routes. The focus of the bus transit service is the Bellevue Transit Center, which is situated at the heart of the Bellevue office building concentration (on N.E. 6th Street between 106th and

Table 10. Workplace survey response.

	<u>Estimated Number of Employees</u>	<u>Number of Surveys¹ Distributed</u>	<u>Number of Surveys Returned</u>
<u>Bellevue</u>			
PNB Plaza	1150	1240	522
United Olympic Building	425	410	23
Rainier Bank Plaza	1000	1040	332
Honeywell Center	650	580	247
Business Center Bldg.	450	500	215
Pacific First Plaza	100	100	22
Skyline Tower	775	900	240
Transamerica Title	250	135	41
One Bellevue Center	900	800	221
Wells Development	60	85	20
Plaza Center	950	950	267
<u>South Coast Metro</u>			
Imperial Bank Tower	725	480	206
Central Bank Tower	810	790	143
Great Western Savings Tower	805	600	134
Metro Center	635	610	261
Griffin Towers	500	490	65
Butterfield Tower	400	360	87
Corporate Center	350	310	76
Metro Pointe			
940 South Coast Drive	120	120	37
950 South Coast Drive	160	170	57
<u>Parkway Center</u>			
Galleria Tower I	1000	1000	304
Occidental Tower	750	700	306
Signature Place I & II	525	490	180
Colonnade I Republic Bank Tower	600	427	87
Colonnade II Rohm Tower	650	636	110
Lincoln Center I	500	481	76
Stone Tower	275	256	60
Heritage Square Tower 2	400	462	25
Stanford Park	500	471	211

Table 10. Continued

	<u>Estimated Number of Employees</u>	<u>Number of Surveys Distributed</u>	<u>Number of Surveys Returned</u>
<u>Perimeter Center</u>			
Ravinia One	1200	1129	301
400 Embassy Row	530	528	121
<u>Tysons Corner</u>			
The BDM Corporation	1200	1200	407
Lancaster Building	270	263	90
8201 Greensboro Dr.	800	816	261
SAIC	700	700	340
Tysons International	770	759	278
Tycon Tower	350	347	137
The Mitre Corporation	2500	2500	1103
Westwood	280	280	126
<u>Southdale</u>			
<u>Offices</u>			
Southdale Medical Office	1100	1100	132
Southdale Office Center	1250	1250	204
Southdale Place	250	250	59
Edina Office Center	386	386	138
National Car Rental	1000	1000	443
France Place	600	600	56
Minnesota Center	550	550	93
Northland Plaza	800	800	215
Northland Center	1500	1500	470
Northwestern Financial Ctr.	1500	1500	115
Edinborough	260	260	105
ADC Telecommunications 4700 & 4900 W. 78th St.	440	440	131
Pentagon Office Park	170 ²	170	86
Southgate Office Tower	750	750	305
Normandale Lake Office Park 8300 Normandale Lake Blvd. 8400 Normandale Lake Blvd.	850 1300	850 1300	132 402
ADC 5501 Green Valley Dr.	350	350	162

Table 10. Continued

	<u>Estimated Number of Employees</u>	<u>Number of Surveys Distributed</u>	<u>Number of Surveys Returned</u>
International Dairy Queen	250	250	152
Jostens	250	250	124
One Corporate Center I	425	425	118
One Corporate Center III	350	350	119
<u>Hotel</u>			
Hotel Seville	50	50	8
Ramada Inn	100	100	9
Holiday Inn	80	80	24
Radisson South	300	300	75
<u>Retail</u>			
Target	300	300	4
<u>Medical</u>			
Fairview-Southdale Hospital	1500	1500	357
OFFICE SUBTOTAL			
Bellevue	6710	6740	2150 (32%)
South Coast Metro	4505	3930	1066 (27%)
Parkway Center	5200	4923	1359 (28%)
Perimeter Center	1730	1657	422 (25%)
Tysons Corner	6870	6865	2742 (40%)
Southdale	<u>14331</u>	<u>14331</u>	<u>3761 (26%)</u>
TOTAL	39,346	38,446	11,500 (30%)

¹ The number of workplace surveys distributed may not match the estimated number of employees in a building for either of two reasons. First, not all employers in a particular building may have been willing to distribute and collect the surveys. Second, in Bellevue the employee estimate is for November 1987 when trip generation counts were taken and the survey distribution was done in May/June 1988. The number of employees in a building could have changed between the two dates.

² Consists of a portion of two buildings only.

108th Avenue, N.E.). The transit center has six bus bays, covered seating areas, and information kiosks. At the time of the Bellevue data collection effort, roughly 190 bus trips arrive or terminate at the Bellevue Transit Center during the 3-hour evening peak period.

In order to check for potential nonresponse bias in the workplace surveys, intercept surveys were conducted at Bellevue office buildings to determine the actual mode share distribution observed. These "observed" distributions were compared to the "reported" distributions derived from the workplace survey responses. Table 12 presents this comparison. The "observed" mode shares for employees are for the AM peak hour; the "reported" mode shares are for all employees. Therefore, a direct

comparison cannot be made. Nevertheless, some conclusions can still be drawn. First, in exactly half of the buildings, the "reported" transit mode share exceeds the "observed" transit mode share (and vice versa). Second, when the transit mode shares are weighted by the numbers of employees, the overall transit mode shares (for the nine buildings at which both surveys were conducted) are as follows:

*Bellevue Transit Mode Share
for Office Employees*

Based on "observed" data 6.6 percent
Based on "reported" data 8.8 percent

Table 11. Work trip mode shares for all employees.

	<u>Auto Driver</u>	<u>Auto Passenger</u>	<u>Bus</u>	<u>Bike</u>	<u>Walk</u>
<u>Bellevue</u>					
PNB Plaza	50.0%	37.0%	11.8%	0.6%	0.6%
United Olympic Building	96.2	3.8	0	0	0
Rainier Bank Plaza	78.6	4.7	14.9	0.6	1.2
Honeywell Center	84.7	7.6	6.1	0.8	0.8
Business Center Bldg.	78.9	15.8	5.3	0	0
Pacific First Plaza	86.8	8.7	4.5	0	0
Skyline Tower	89.9	4.5	5.6	0	0
Transamerica Title	85.8	6.9	4.9	0	2.4
One Bellevue Center	78.8	4.7	14.7	0	1.8
Wells Development	96.2	3.8	0	0	0
Plaza Center	86.6	6.9	5.3	0.4	0.8
<u>South Coast Metro</u>					
Imperial Bank Tower	91.1	6.4	0	0.5	2.0
Central Bank Tower	92.8	6.5	0	0	0.7
Great Western Savings Tower	93.5	6.5	0	0	0
Metro Center	94.1	4.7	0	0.4	0.8
Downey Plaza	93.5	6.5	0	0	0
Griffin Towers	89.5	9.0	1.5	0	0
Butterfield Tower	94.3	5.7	0	0	0
Metro Pointe					
940 South Coast Drive	96.2	3.8	0	0	0
950 South Coast Drive	95.2	3.8	0	0	1.0
<u>Parkway Center</u>					
Galleria Tower I	90.3	9.0	0.7	0	0
Occidental Tower	95.2	4.8	0	0	0
Signature Place I & II 14755 W. Preston Rd. 14785 W. Preston Rd.	90.9	9.1	0	0	0
Colonnade I Republic Bank Tower	94.3	5.7	0	0	0
Colonnade II Rohm Tower					
Lincoln Center I	93.9	6.1	0	0	0
Stone Tower	90.1	9.9	0	0	0
Heritage Square Tower 2	94.1	5.9	0	0	0
Stanford Park	98.0	2.0	0	0	0

Table 11. Continued

	<u>Auto Driver</u>	<u>Auto Passenger</u>	<u>Bus</u>	<u>Bike</u>	<u>Walk</u>
<u>Perimeter Center</u>					
Ravinia One	92.8	6.5	0.7	0	0
Embassy Row	92.6	7.4	0	0	0
<u>Tysons Corner</u>					
The BDM Corporation	93.5	5.8	0.5	0.2	0
Lancaster Building	93.5	6.5	0	0	0
8201 Greensboro Dr.	92.7	6.5	0.8	0	0
SAIC	90.1	7.1	1.2	0.3	0.3
Tysons International	74.9	24.0	1.1	0	0
Tycon Tower	95.5	3.8	0.7	0	0
The Mitre Corporation	91.7	7.0	0.6	0.2	0.5
Westwood	89.3	10.7	0	0	0
<u>Southdale</u>					
<u>Office</u>					
Southdale Medical Office	88.3	7.9	0.8	1.5	1.5
Southdale Office Center	89.7	8.3	1.5	0.5	0
Southdale Place	89.4	7.2	3.4	0	0
Edina Office Center	90.1	7.7	2.2	0	0
National Car Rental	92.8	5.6	0.7	0	0.9
France Place	89.9	8.3	1.8	0	0
Minnesota Center	85.2	9.4	5.4	0	0
Northland Plaza	96.7	1.9	0.9	0	0.5
Northland Center	93.8	5.6	0.2	0.2	0.2
Northwestern Financial Ctr.	91.8	7.3	0.9	0	0
Edinborough	91.4	7.6	1.0	0	0
ADC Telecommunications	92.2	7.0	0.8	0	0
Pentagon Office Park	90.7	8.1	1.2	0	0
Southgate Office Tower	94.1	5.6	0.3	0	0
Normandale Lake Office Park					
8300 Normandale Lake Blvd.	97.1	2.9	0	0	0
8400 Normandale Lake Blvd.	93.3	6.5	0.2	0	0
ADC (Corp. Headquarters)	92.0	8.0	0	0	0
International Dairy Queen	91.3	8.0	0	0.7	0
Jostens	92.7	7.3	0	0	0
One Corporate Center I	85.7	14.3	0	0	0
One Corporate Center III					

Table 11. Continued

	<u>Auto Driver</u>	<u>Auto Passenger</u>	<u>Bus</u>	<u>Bike</u>	<u>Walk</u>
Southdale (cont.)					
<u>Hotel</u>					
Composite	85.3	13.8	0.9	0	0
<u>Medical</u>					
Fairview-Southdale Hospital	87.6	8.2	1.4	1.4	1.4
<u>Overall Average</u>					
Bellevue	73.2	16.9	8.8	0.3	0.8
South Coast Metro	92.5	6.4	0.1	0.2	0.8
Parkway Center	94.2	5.6	0.2	0	0
Perimeter Center	93.0	6.5	0.5	0	0
Tysons Corner	89.2	9.8	0.7	0.1	0.2
Southdale	92.1	6.6	0.8	0.2	0.3
<u>Average for non-Bellevue Sites</u>					
	92.2	7.0	0.5	0.1	0.2

The “reported” transit mode share overstates the “observed” share. Further research is required to determine if this difference can be more accurately quantified and whether the cause for the wide variations between the “observed” and “reported” can be determined. There was no reason to collect “observed” transit mode shares in the other five SACs because the “reported” transit mode shares were already so small.

Ridesharing (i.e., carpooling and vanpooling) is the most common form of mass transportation for the suburban employee. As shown previously in Table 11, the proportion of employees which rideshare is relatively consistent among the surveyed buildings with a few isolated exceptions. The overall average across the six SACs is for 7 percent of office employees to rideshare as a passenger. For the surveyed office buildings, Bellevue has a reported average of 17 percent ridesharing. However, in PNB Plaza (described previously as a single-tenant site with stringent ridesharing inducements for employees) the overall average for Bellevue drops to 9 percent. Tysons Corner has the highest ridesharing proportion at 10 percent, with the remaining four SACs at roughly 6 percent ridesharing.

Work Trip Arrival and Departure Time Distributions

The time-of-day distribution of office employee trips to work and from work is given in Table 13, aggregated by suburban activity center. The peak 15-min, 30-min, 60-min, and 2-hour periods of commute trip arrival and departure are given. In addition, the proportion of employees arriving or departing during those periods is identified. Despite the various differences between the SACs, no apparent relationship between the work trip arrival/departure time distributions and the SAC size has been found. Listing K shows, on average, across the six surveyed activity centers, the employee proportions.

Listing K

	Percentage of Employees who Arrive during Period (%)	Percentage of Employees who Depart during Period (%)
Peak 15-min period	23	23
Peak 30-min period	33	29
Peak 60-min period	58	46
Peak 2-hour period	84	71

The proportions of office employees arriving during the overall morning peak hour for the suburban activity center are given by building in Table 14. The morning peak hour for each SAC is defined in Table 13.

Employee Commute Trip Length and Duration

The trip length characteristics of work trips reported at the six SACs are given in Table 15. For each SAC the current commute distance to work is given. Also shown in the table are the reported mean distance, median distance, and 85th percentile distance. There is very little difference among the six SACs in their reported median and 85th percentile commute distances. The median values range between 11 and 14 miles (with four of the six SACs at 11 or 12 miles). The 85th percentile values range between 20 and 26 miles (with four of the six SACs at 25 or 26 miles).

As indicated in Table 15, significant proportions of the surveyed office employees have changed their place of residence since starting work at the SAC office site. For example, at Tysons Corner and Southdale (probably the oldest and most mature of the surveyed SACs) 37 percent of the employees reported changing their residence.

Table 12. Bellevue office employee work-trip mode.

Building	AM Peak Hour ¹			All Employees ²			
	Auto	Bus	Other	Auto	Bus	Bike	Walk
PNB Plaza	NA	NA	NA	87.0%	11.8%	0.6%	0.6%
United Olympic Building	94.6%	5.4%	0%	100	0	0	0
Rainier Bank Plaza	91.9	6.3	1.8	83.3	14.9	0.6	1.2
Honeywell Center ³	95.4	4.2	0.4	92.3	6.1	0.8	0.8
Business Center Bldg.	91.2	7.0	1.8	94.7	5.3	0	0
Pacific First Plaza	98.6	0	1.4	95.5	4.5	0	0
Skyline Tower	92.6	5.8	1.6	94.4	5.6	0	0
Transamerica Title	92.6	6.2	1.2	92.7	4.9	0	2.4
One Bellevue Center	88.2	11.2	0.6	83.5	14.7	0	1.8
Wells Development	100	0	0	100	0	0	0
Plaza Center	NA	NA	NA	93.5	5.3	0.4	0.8

¹ AM peak hour mode shares for office employee work trips are based on office building intercept surveys conducted during the Fall of 1987.

² Work trip mode shares for all employees are taken directly from workplace survey responses conducted during the Spring of 1988.

³ Intercept and workplace surveys conducted in the Fall of 1987.

In general, the commute distance distribution of people who move is equivalent to the distribution for all employees. Across the six SACs, 43 percent moved closer to work, 46 percent moved farther from work, and 11 percent remained roughly the same distance from work.

Length of employment was also obtained from all survey respondents and a correlation was found between the length of employment and the age cross section of buildings in the SAC (see Listing L).

Listing L

SAC	Average Age of Office Buildings Surveyed (years)	Length of Employment 85th Percentile Value (months)
Southdale	11	60
Tysons Corner	8	60
Bellevue	6	NA
South Coast Metro	5	44
Parkway Center	4	39
Perimeter Center	3	36

For the SAC with the oldest buildings surveyed (roughly 11 years old), the 85th percentile duration of employment is 60 months. As the average age decreases from Southdale to Tysons Corner, to South Coast Metro, to Parkway Center, and to Perimeter Center, so also do the 85th percentile lengths of employment.

Travel time and speed characteristics for SAC employees are reported by SAC in Table 16. As shown in the table, the travel

times are less consistent between the surveyed SACs than were the travel distances shown previously in Table 15. The mean commute time to work ranges between 17 and 30 min (with four of the six surveyed SACs falling in the 25-min to 30-min range). The shorter commute times are found in Bellevue and Southdale, which are located within metropolitan areas with smaller populations relative to the other four SACs. In addition, the "smaller" SACs (Bellevue, South Coast Metro, and Southdale) reported the three shortest mean commute times to work.

The commute time to home (also shown in Table 16) is always reported to be longer than the "to-work" commute. In the majority of cases the median commute time values increase 3 to 5 min and the 85th percentile values increase roughly 5 min.

Another comparative measure described in the table is the "average" travel speed based on the median commute distance divided by the median commute time (also shown is the 85th percentile distance/time calculation). This measure provides some indication of the degree of traffic congestion experienced by the typical commuter at each SAC. The fastest "speeds" are reported at Southdale and Bellevue. In fact, Southdale has speeds up to 50 percent greater than those reported at Tysons Corner, South Coast Metro, Parkway Center, and Perimeter Center (both for the commute to work and to home).

INTERMEDIATE STOPS MADE BY OFFICE EMPLOYEES

The workplace survey gathered information on intermediate

Table 13. Work trip arrival/departure time.

	<u>Bellevue</u>	<u>South Coast Metro</u>	<u>Parkway Center</u>	<u>Perimeter Center</u>	<u>Tysons Corner</u>	<u>Southdale</u>
Arrival Time At Work¹						
For All Employees						
- Peak 15 minute period (% of all employees)	NA	815-830 (28%)	815-830 (23%)	745-800 (22%)	745-800 (20%)	NA
- Peak 30 minute period (% of all employees)	730-800 (35%)	800-830 (34%)	800-830 (32%)	730-800 (29%)	730-800 (39%)	730-800 (31%)
- Peak 60 minute period (% of all employees)	700-800 (58%)	730-830 (63%)	730-830 (64%)	730-830 (51%)	730-830 (59%)	730-830 (53%)
- Peak 2 hour period (% of all employees)	630-830 (86%)	700-900 (85%)	700-900 (86%)	700-900 (81%)	700-900 (83%)	630-830 (82%)
Departure Time From Work²						
For All Employees						
- Peak 15 minute period (% of all employees)	NA	1700-1715 (25%)	1700-1715 (26%)	1700-1715 (22%)	1630-1645 (18%)	NA
- Peak 30 minute period (% of all employees)	1700-1730 (34%)	1700-1730 (32%)	1645-1715 (35%)	1700-1730 (24%)	1630-1700 (23%)	1700-1730 (24%)
- Peak 60 minute period (% of all employees)	1630-1730 (54%)	1700-1800 (44%)	1630-1730 (48%)	1630-1730 (41%)	1630-1730 (45%)	1630-1730 (44%)
- Peak 2 hour period (% of all employees)	1600-1800 (80%)	1630-1830 (65%)	1630-1830 (76%)	1630-1830 (69%)	1630-1830 (73%)	1600-1800 (64%)

¹ For the "arrival time at work" values, the time period for which the trips are tabulated starts one minute into the shown period. In other words the 815-830 timeframe is from 816 through 830.

² For the "departure time" values, a time period of 1700-1730 is from 1700 through 1729.

stops made by office employees either along their way from home to work, along their way from work to home, or midday from work. Information was collected on the location of the intermediate stop, the purpose of the stop, the time of the stop, and whether the stop was linked with other intermediate stops.

Table 17 presents, aggregated by suburban activity center, the proportions of employees who make intermediate stops, the proportions of employees who make intermediate stops within the activity center, and the average number of stops made by those individuals who make an intermediate stop. For example, along their way to work 17 percent of the surveyed Tysons Corner employees and 23 percent of the surveyed South Coast Metro employees make an intermediate stop. In terms of stops made within the activity center, 9 percent of the surveyed Tysons Corner employees and 8 percent of the surveyed South Coast Metro employees make an intermediate stop within their respective activity centers. In both the Tysons Corner and South Coast Metro activity centers, the average number of intermediate stops made by those individuals who make an intermediate stop is 1.2.

Analysis of intermediate stop data has not revealed many definitive and quantifiable causes for the observed variations in the employee intermediate stop proportions. The following discussion highlights several of the key independent variables that appear to be functionally related to the intermediate stop char-

acteristic. However, these observations should be considered to be not statistically derived, but rather as anecdotal interpretations.

Trips to and from Work

For the trips to work and from work, the Bellevue activity center has by far the highest proportion of employees making intermediate stops. For both the trip to work and the trip from work, the proportion of Bellevue employees making intermediate stops is 79 percent greater than the average rates found for comparable stops at the other five surveyed activity centers. The cause for this difference is not obvious from the development pattern of the SAC or the characteristics of the office employees. The Bellevue SAC is comparable in size and mix of development to the South Coast Metro and Southdale SACs. The Bellevue office employee age mix, occupation mix, and male/female split (described in detail later in this chapter) fall within the bounds of the other five SACs. The major unique characteristic of the Bellevue SAC relative to the other surveyed SACs is its development density. The development in Bellevue is significantly more compact than in the other surveyed SACs (the Bellevue SAC has approximately 18 gsf of office and retail space per acre; this density is more than 36 percent greater than for the

Table 14. Work trip arrival time distribution.

<u>Building</u>	<u>Proportion of Employees Which Arrive During SAC Morning Peak Hour</u>	<u>Building</u>	<u>Proportion of Employees Which Arrive During SAC Morning Peak Hour</u>
<u>Bellevue</u>		<u>Parkway Center</u>	
PNB Plaza	48%	Galleria Tower I	69%
United Olympic Building	58	Occidental Tower	55
Rainier Bank Plaza	64	Signature Place I & II	73
Honeywell Center	52	Colonnade I Republic Bank Tower	54
Business Center Bldg.	68	Colonnade II Rohm Tower	62
Pacific First Plaza	58	Lincoln Center I	62
Skyline Tower	55	Stone Tower	68
Transamerica Title	82	Heritage Square Tower 2	60
One Bellevue Center	55	Stanford Park	60
Wells Development	61		
Plaza Center	67	<u>Perimeter Center</u>	
		Ravinia One	58
<u>South Coast Metro</u>		Embassy Row	34
Imperial Bank Tower	62		
Central Bank Tower	60	<u>Tysons Corner</u>	
Great Western Savings Tower	63	The BDM Corporation	64
Metro Center	66	Lancaster Building	47
Griffin Towers	58	8201 Greensboro Dr.	59
Butterfield Tower	62	SAIC	50
Corporate Center	54	Tysons International	70
Metro Pointe	69	Tycon Tower	52
		The Mitre Corporation	61
<u>Southdale</u>		Westwood	40
Southdale Medical Office	57		
Southdale Office Center	69	Normandale Lake Office Park 8300 Normandale Lake Blvd.	71
Southdale Place	61	8400 Normandale Lake Blvd.	60
Edina Office Center	69	ADC (Corp. Headquarters)	40
National Car Rental	39	International Dairy Queen	1 ¹
France Place	66	Jostens	74
Minnesota Center	50	One Corporate Center I	58
Northland Plaza	67	One Corporate Center III	58
Northland Center	69	Hotel - Composite	28
Northwestern Financial Ctr.	75	Fairview-Southdale Hospital	22
Edinburgh	70		
ADC Telecommunications	27		
Pentagon Office Park	67		
Southgate Office Tower	55		

¹ 79 percent of the employees arrive during the 30 minute period immediately prior to the activity center peak hour.

Table 15. Work trip length characteristics for automobile drivers.

	Bellevue	South Coast Metro	Parkway Center	Perimeter Center	Tysons Comer	Southdale
Current commute distance to work (in miles)						
- mean	19	14	15	17	16	13
- median	12	11	11	14	13	11
- 85th percentile	25	23	25	26	25	20
Proportion of employees who have changed residence while working at current job location (percent)	NA	30	27	26	37	37
For employees who have moved:						
Current commute (miles)						
- median	NA	10	10	14	13	10
- 85th percentile	NA	22	24	24	25	20
Previous commute						
- median	NA	10	11	12	13	10
- 85th percentile	NA	25	25	24	25	20
Proportion that moved: (percent)						
- closer to work	NA	46	45	41	43	42
- same distance	NA	14	11	6	9	13
- farther from work	NA	40	44	53	48	45
Length of time employed at current location (months)						
- mean	NA	22	21	20	32	30
- median	NA	13	13	18	24	23
- 85th percentile	NA	44	39	36	60	60

Table 16. Work trip travel time characteristics for automobile drivers.

	Bellevue	South Coast Metro	Parkway Center	Perimeter Center	Tysons Comer	Southdale
Commuter time to work for auto drivers (in minutes)						
- mean	25	31	28	32	34	20
- median	20	25	25	30	30	17
- 85th percentile	38	50	45	50	50	32
Commuter time to home for auto drivers (in minutes)						
- mean	29	34	31	37	36	23
- median	26	30	30	35	33	20
- 85th percentile	44	50	45	55	60	37
Average travel speed (mph) to work based on:						
- median distance/median time	33	26	26	28	24	39
- 85th percentile distance/85th percentile time	38	28	33	30	30	38
Average travel speed (mph) to home based on:						
- median distance/median time	25	22	22	24	22	33
- 85th percentile distance/85th percentile time	33	28	33	27	25	32

Table 17. Characteristics of trips made by suburban activity center employees.

	Bellevue	South Coast Metro	Parkway Center	Perimeter Center	Tysons Comer	Southdale
<u>Trip To Work</u>						
- Proportion of employees who stop	34%	23%	21%	17%	17%	17%
- Proportion who stop within SAC	15%	8%	9%	12%	9%	7%
- Average number of stops per trip	1.4	1.2	1.2	1.2	1.2	1.2
<u>Midday Trips</u>						
- Proportion of employees who make a midday trip	55%	59%	45%	46%	55%	42%
- Proportion who make a midday trip within the SAC	29%	22%	20%	33%	32%	23%
- Average number of stops per trip	1.7	1.9	1.6	1.6	1.6	1.6
<u>Trip From Work</u>						
- Proportion of employees who stop	66%	40%	37%	35%	36%	36%
- Proportion who stop within SAC	14%	6%	9%	16%	10%	13%
- Average number of stops per trip	1.7	1.0	1.1	1.2	1.5	1.5

next most dense SAC, South Coast Metro). However, there is no apparent logical correlation between SAC building density and office employees making intermediate stops on their way to work and from work. It should also be noted that the midday trip proportions for Bellevue are not significantly different from the characteristics found at the other SACs (a discussion of the midday trip patterns is included later in this chapter).

For the proportions of office employee trips to and from work that make an intermediate stop, there is relative consistency between the five (non-Bellevue) SACs. On average 22 percent of the office employees stop along their way to work and 37 percent stop along their way home from work. The SACs with slightly higher proportions making a stop (i.e., South Coast Metro and Parkway Center) have a corresponding slightly higher proportion of secretary/clerical and female employees, both of which categories tend to have more intermediate stops to and from work than their counterparts.

The proportion of employees who make an intermediate stop within the activity center on their way to work averages at 10 percent across the six surveyed SACs (9 percent for the non-Bellevue SACs). The proportion that stops within the activity center along the way home from work averages at 11 percent across all the surveyed SACs (both with and without Bellevue). The activity centers with the lower than average intra-SAC intermediate stop proportions for the to-work and from-work trips are South Coast Metro, Parkway Center, Southdale, and Tysons Corner. These four SACs are widely divergent in size and composition. However, the common element among the four is their proximity to external trip attractors (primarily, retail uses). All four have extensive secondary retail development immediately outside their borders. In contrast, Perimeter Center and Bellevue (both with higher than the average intra-SAC proportions) are relatively isolated and encompass the vast majority of retail activity in their subregion. Thus, the proximity of secondary retail services outside the immediate bounds of the activity center will cause a decrease in the proportion of office employees stopping within the activity center along their way to or from work. A simple relationship based on an average of the corresponding SAC characteristics would be as follows: for office employees within a SAC with relatively little retail activity immediately outside its boundaries, roughly 13 percent will stop within the SAC along their way to work and roughly 15 percent will stop within the SAC along their way home from work; for office employees within a SAC with relatively significant retail activity immediately outside its boundaries, roughly 8 percent will stop within the SAC along their way to work and roughly 10 percent will stop within the SAC along their way home from work.

The foregoing values represent the proportions of the SAC office employees that make an intermediate stop along their way to or from work. These trips-with-stops, however, may consist of more than one stop. Shown in Table 17 are the average number of intermediate stops per trip with an intermediate stop. For trips to work, the average number of stops for each trip with an intermediate stop is 1.2 for all of the surveyed SACs except Bellevue where the average rate is 1.4. For trips along the way home from work, the average across the six surveyed SACs is 1.3 (with a range between 1.0 and 1.7).

Midday Trips

Table 17 also presents information on the midday trips made

by surveyed office employees. The average proportions of employees by activity center who make a midday trip outside their office building range between 42 and 59 percent. There is no apparent reason for one activity center to have a higher or lower proportion than another. The three SACs with the higher trip proportions are South Coast Metro, Bellevue, and Tysons Corner. Of the six surveyed SACs, Tysons Corner has the highest proportion of professional/technical employees. In contrast, South Coast Metro has one of the lower proportions of professional/technical employees and one of the highest proportion of secretary/clerical employees. The overall average across the six SACs of 50 percent is the best estimate of the proportion of employees making midday trips based on the current level of analysis.

With regard to the proportion of employees making midday trips internal to the activity center, the reported values range between 20 percent at Parkway Center and 33 percent at Perimeter Center. The three activity centers with the highest midday internal proportions are Perimeter Center, Tysons Corner, and Bellevue. The former two activity centers also have the highest office-to-retail square footage ratio of the six surveyed SACs and the highest proportions of males in the workplace survey responses. Analysis of the sex of the employee relationship to intermediate stop trip-making indicates that females tend to make more intermediate stops than do males during the trips to and from work and that males tend to make more midday trips from the office than do females. However, the Bellevue SAC has one of the lower reported proportions of males in its office workforce, thereby discrediting the sex/midday trip relationship. Part of this relationship is due to occupation mix found for males and females. For example, males comprise a greater reported proportion of the professional/technical occupation than do females; likewise, females comprise a greater reported proportion of the secretary/clerical occupation than do males. As expected, the Tysons Corner, Perimeter Center, and Bellevue SACs do have the highest reported proportions of professional/technical personnel among the six surveyed SACs. Therefore, it would appear that the proportion of office employees who make midday trips internal to the SAC is a function of their occupation mix. The relationship is as follows. For SACs with at least 36 percent of the office employees in professional or technical positions (or perhaps more accurately, at least 60 percent in professional, technical, manager, or administrator positions), the proportion of office employees making midday trips internal to the SAC ranges between 29 and 33 percent. For SACs having lower than the preceding proportions of professional, technical, manager, or administrator positions, the expected proportion of office employees making midday trips internal to the SAC ranges between 20 and 23 percent.

Another factor that could affect the proportions of office employees which make midday trips internal to the activity center is the availability of luncheon establishments. In Perimeter Center, there are no free-standing fast-food restaurants; all are located within the Perimeter Mall in a Food Court. Therefore, the Perimeter Center office employee who desires to eat lunch is faced with either eating within the SAC at fast-food sit-down restaurants that are not inexpensive or at the Mall food court or outside the SAC. As noted previously, Perimeter Center is relatively isolated and has very little nonresidential use within its close proximity. Therefore, a high proportion of the Perimeter Center office employees opt for an internal lunch trip to the Perimeter Mall. The result is a high proportion of

Table 18. Intermediate stop trip purposes.

<u>Distribution of Trip Purposes by Time Period</u>			
<u>Trip Purpose</u>	<u>Along Trip To Work</u>	<u>Midday Trips</u>	<u>Along Trip Home</u>
Work Related	21%	25%	6%
Meal/Snack	10	35	4
Shopping	3	13	21
Childcare/School	34	*	14
Pick Up/Drop Off Passenger	5	1	3
Education	* ¹	*	2
Social/Recreation ²	3	3	15
Home	*	4	0 ³
Banking	7	9	6
Medical	2	2	3
Dry Cleaners	9	1	7
Gas Station	0 ⁴	1	0 ⁴
Grocery Store	2	1	13
Other	<u>3</u>	<u>3</u>	<u>6</u>
	100	100	100

Notes:

¹ * indicates less than 1 percent

² Health club trips have been included under the Social/Recreation category

³ By definition, trips to home from work cannot have an intermediate stop at home

⁴ Intermediate stops at gas stations along the way either to work or from work have been excluded in this distribution. During the trip to work, the survey indicates that roughly 11 percent of all intermediate stops are at a gas station. Along the trip home, roughly 9 percent of all intermediate stops are at gas stations.

office employees with internal midday trips and the highest midday trip generation rate for Perimeter Mall among all seven counted regional malls.

Intermediate Stop Trip Purposes

The reported purposes of the intermediate stops made by office employees along their way to work, during the midday, and along their way home from work are presented in Table 18. Shown are the average distributions across all six SACs. Along the trip to work, the most common trip purposes are for child care or school (an average of 34 percent across the surveyed SACs) and for work-related purposes (an average of 21 percent).

Along the trip to home from work the primary trip purposes are for shopping (average of 21 percent), social/recreation (15 percent), child care/school (14 percent), and grocery store (13 percent). Work-related trips comprise only 6 percent of the stops on the way home from work.

It should be noted that although the day-care/school trip would typically need to be made on the trips both to and from work, the proportions making that stop are different. The ex-

planation for this difference is that the total trip-to-home stops outnumber the trip-to-work stops and, therefore, the total number of morning and evening day-care stops are roughly equivalent.

Midday trip purposes are dominated by meal/snack (overall average of 35 percent of all office employee midday trips), work-related (25 percent), shopping (13 percent), and banking trips (9 percent). The three "smaller" surveyed SACs (Bellevue, South Coast Metro, Southdale) with roughly a 50/50 mix of office and retail square footage have the higher proportions of banking trips (10 percent versus 8 percent for the "larger" SACs) and of shopping trips (15 percent versus 11 percent). Although these trends have been observed, the underlying cause is not apparent.

The proportions of midday trips by employees, which are for meals or snacks, are higher for the "larger" SACs (average of 38 percent) as compared to the "smaller" SACs (average of 31 percent). Part of the cause for this difference is that office employees in the "smaller" SACs tend to make slightly more midday trips (52 percent versus 49 percent for the "larger" SACs). Factoring in the overall number of midday trips by activity center produces an average of 17 percent of all midday trips made by office employees that are for meal or snack (with

relatively little difference observed between activity centers). An average of 9 percent of the office employee midday trips is made for meal or snack within the activity center (for "larger" SACs the proportion is roughly 11 percent; for "smaller" SACs the proportion is roughly 8 percent).

The reported location of eating lunch by office employees is given in Table 19 by building. Overall, weighted averages for lunch locations by activity center are as shown in Listing M.

Listing M

SAC	Did Not Eat (%)	Lunch In Building (%)	Lunch Outside Building (%)
Bellevue	6	58	36
South Coast Metro	6	42	52
Parkway Center	8	55	37
Perimeter Center	6	49	45
Tysons Corner	8	56	36
Southdale	10	59	31
Overall Average	7	53	40

Virtually all surveyed office buildings and complexes have an on-site restaurant, deli, or cafeteria. Therefore, these proportions represent office complexes that include some on-site eating establishments.

The proportions of office employees that eat lunch outside their building or complex vary widely between activity centers. The size of the activity center (and its office/retail mix) do not have a direct relationship with this employee travel characteristic. The three "smaller" activity centers with roughly 50/50 office/retail mixes have the two lowest "outside building" proportions (Bellevue and Southdale) but also the highest (South Coast Metro). The occupation mix and male/female split also do not demonstrate a direct relationship to the lunch location.

Table 20 shows the amount of interaction between the activity center office employees and other activity centers in the region. Based on the midday travel diary information compiled from the workplace survey responses, an estimate of the number of vehicle-trips made by activity center office employees to other selected activity centers can be quantified as a trip rate. For example, office employees in the Tysons Corner activity center make trips to Washington, the regional CBD, at a rate of roughly 40 trips per 1,000 Tysons Corner office employees. It should be noted that these rates could represent either one-direction or two-direction trips. They also do not account for any trips made by regional CBD office employees to the suburban activity center or any trips between the activity centers made by nonoffice employees.

With the exception of South Coast Metro, all of the activity centers are located roughly 10 to 12 miles from the regional CBD. Therefore, it would be expected that analysis of the rate of interaction between the suburban activity center and the regional CBD will produce an indication of the cause. Given below in Listing N are the "interaction rates" (in descending order) as well as the approximate sizes of the metropolitan area and the regional CBD.

The data indicate that as regional CBD employment increases, the amount of interaction between the SAC employees and the CBD decreases (the only exception to this relationship is Southdale). Because this relationship is not intuitively correct, an underlying cause for the relationship was researched. Included in the tested options for the primary independent variable was

Listing N

SAC	Interaction Rate (a)	Regional CBD Employment (b)	Distance to CBD (miles)
Bellevue	80	52,000	10
Parkway Center	60	78,000	10
Perimeter Center	60	68,000	12
Tysons Corner	40	125,000	12
Southdale	30	66,000	10
South Coast Metro	30	123,000	45

^a SAC midday trips per 1,000 employees

^b 1986 employment

the proportion of the total SMSA employment in the CBD (to reflect the competition of non-CBD trip attractors for SAC-generated trips). However, neither this relationship nor any others investigated were fruitful.

Intra-Site Trips

Activity center office employees, in the workplace survey, indicated whether or not they used certain on-site services: (1) restaurant, deli, or cafeteria; (2) bank; (3) health club; (4) travel services; and (5) medical offices. These on-site services are defined as being within the office building, an adjoining building, or within an overall multiuse complex. The reported usage rates of on-site services are given in Table 21 by building.

For office buildings with on-site restaurants, the reported use of the restaurant ranges between 6 and 65 percent of the office employees with an average of 31 percent. Based on field observations at the surveyed office buildings, it is probable that the office employees included intra-site trips to company lunch rooms or cafeterias in this category, thus inflating the reported use of the on-site, public eating establishments.

The amount of banking services on-site at the surveyed office buildings ranged from full-service branch offices to limited-service mini-branches to ATM machines. There is a great deal of variation between office buildings in terms of employee use of the banking facilities even when comparable levels of banking services are provided.

For the office buildings that have internal or adjacent health clubs, the use of the club facilities is shown in Table 21. Again, the usage rates per employee vary widely and are probably a function of the size of club and its targeted membership. The Signature Place and Stanford Park office developments in Parkway Center are each located adjacent to a private, free-standing health club. At each office building, the proportion of the office employees that use the adjacent health club at some point during the survey date is 8 percent. The Ravinia complex in Perimeter Center has an on-site health club which attracts 7 percent of the Ravinia complex office employees.

With regard to the usage rates for on-site travel services and on-site medical offices, the rates vary widely for each characteristic from site to site. Although not directly relevant for the use of the decision-maker, these values do provide some indication of the magnitude of intra-site trips for the various possibilities for compatible on-site land uses. The reported use of on-site travel services ranges as high as 12 percent of the employees with an overall average of 4 percent. For office buildings with medical offices, up to 5 percent of the office employees used the medical facilities (with an overall average of 2 percent).

Table 19. Lunch location of employees.

Office Building	Did Not Eat Lunch	Ate Lunch in Their Office Building or Complex	Ate Lunch Outside Their Building
Bellevue			
PNB Plaza	6%	64%	30%
United Olympic Building	4	52	44
Rainier Bank Plaza	4	62	34
Honeywell Center	NA	NA	NA
Business Center Bldg.	6	61	33
Pacific First Plaza	10	51	39
Skyline Tower	6	54	40
Transamerica Title	2	58	40
One Bellevue Center	4	53	43
Wells Development	<u>5</u>	<u>16</u>	<u>79</u>
South Coast Metro			
Imperial Bank Tower	3	31	66
Central Bank Tower	7	45	48
Great Western Savings Tower	10	43	47
Metro Center	4	47	49
Griffin Towers	9	42	49
Butterfield Tower	8	59	33
Corporate Center	4	34	62
Metro Pointe	<u>12</u>	<u>38</u>	<u>50</u>
Parkway Center			
Galleria Tower I	8	70	22
Occidental Tower	9	57	34
Signature Place I & II	8	39	53
Colonnade I Republic Bank Tower	12	48	40
Colonnade II Rohm Tower	6	55	39
Lincoln Center I	3	55	42
Stone Tower	8	50	42
Heritage Square Tower 2	4	48	48
Stanford Park	<u>9</u>	<u>47</u>	<u>44</u>
Perimeter Center			
Ravinia One	6	56	38
Embassy Row	<u>7</u>	<u>31</u>	<u>62</u>
Tysons Corner			
The BDM Corporation	10	58	32
Lancaster Building	10	45	45
8201 Greensboro Dr.	10	64	26
SAIC	6	68	26
Tysons International	7	46	47

Table 19. Continued

Office Building	Did Not Eat Lunch	Ate Lunch in Their Office Building or Complex	Ate Lunch Outside Their Building
Tysons Corner (cont.)			
Tycon Tower	14	47	39
The Mitre Corporation	7	56	37
Westwood	6	41	53
Southdale			
Southdale Medical Office	12	58	30
Southdale Office Center	10	50	40
Southdale Place	5	43	52
Edina Office Center	7	44	49
National Car Rental	8	70	22
France Place	7	48	45
Minnesota Center	21	52	27
Northland Plaza	13	47	40
Northland Center	10	56	34
Northwestern Financial Ctr.	10	44	46
Edinborough	14	42	44
ADC Telecommunications	7	67	26
Pentagon Office Park	15	48	37
Southgate Office Tower	12	47	41
Normandale Lake Office Park 8300 Normandale Lake Blvd. 8400 Normandale Lake Blvd.	13 10	63 67	24 23
ADC (Corp. Headquarters)	4	57	39
International Dairy Queen	4	76	20
Jostens	10	45	45
One Corporate Center I	14	46	40
One Corporate Center III	9	51	40
Hotel			
Composite	10	82	8
Medical			
Fairview-Southdale Hospital	9	84	7
Overall Average			
Bellevue	6%	58%	36%
South Coast Metro	6	42	52
Parkway Center	8	55	37
Perimeter Center	6	49	45
Tysons Corner	8	56	36
Southdale	<u>10</u>	<u>52</u>	<u>31</u>
Total	7	53	40

Table 20. Interaction between activity centers.

Suburban Activity Center	CBD or Activity Center	Office Employee Midday Trips From SAC To The Listed Activity Center (Trips Per 1000 SAC Employees)
Bellevue	Seattle	80
South Coast Metro	Los Angeles Irvine SAC ¹	30 80
Parkway Center	Dallas CBD	60
Perimeter Center	Atlanta CBD Platinum Triangle SAC ²	60 10
Tyson's Corner	Washington, D.C. CBD Rosslyn SAC Crystal City/Pentagon SAC	40 10 20
Southdale	Minneapolis CBD	30

Notes:

1. The Irvine SAC is only a few miles from South Coast Metro. Despite its relatively small size compared to the Los Angeles CBD (located 45 miles away), the Irvine SAC has substantially more interaction with South Coast Metro in terms of midday employee trips.
2. The Platinum Triangle SAC is comparable in size to the Perimeter Center SAC and is located 7 miles away.

PROFILE OF WORKPLACE SURVEY RESPONDENTS

A demographic profile of the workplace survey respondents by activity center is provided in Table 22. The implications of the demographic differences between activity centers will be discussed in appropriate sections of this chapter. Some overall characteristics are described below.

For all six activity centers, the majority of the respondents are between 25 and 44 years old, with the highest percentage falling between 25 and 34 years of age. All but one of the six activity centers have relatively consistent age distributions. The different activity center is Tyson's Corner, which has an older median age with its highest, by far, proportion of 45 to 54 year old employees.

The sex distributions are quite different among the six activity centers. Tyson's Corner is the only SAC with a greater proportion of male employees than female (or at least it is the only SAC with workplace survey responses from more males than females). The three "smaller" SACs with a roughly 50/50 mix of office and retail space (i.e., Bellevue, South Coast Metro, and Southdale) also have the lowest proportion of male employees (35 percent versus 47 percent for the three "larger" SACs). The explanation for that finding is not yet clear.

The occupational mix also varies between the activity centers. Tyson's Corner has the highest proportion of professional, technical, manager, and administrator positions. In contrast, Parkway Center and South Coast Metro have the highest reported proportion of secretary and clerical positions. Implications of these sex and occupation distributions are discussed in subsequent sections of this chapter.

Also shown in Table 22 are the average numbers of persons per household and average number of vehicles per household for activity center office employees aggregated by SAC. Across all six activity centers, they average 2.7 persons per household and 2.2 vehicles per household.

Table 21. Proportion of office building employees to use intra-site land uses.

	Restaurant	Bank	Health Club	Travel Services	Medical Office
<u>South Coast Metro</u>					
Imperial Bank Tower	19%	32%	--%	4%	--%
Central Bank Tower	15	20	--	--	--
Great Western Savings Tower	11	34	--	--	--
Metro Center	45	10	--	--	--
Griffin Towers	--	2	--	--	--
Butterfield Tower	41	20	1	1	1
Corporate Center	10	4	5	5	--
Metro Pointe	--	6	--	--	--
<u>Parkway Center</u>					
Galleria Tower I	51	31	7	4	--
Occidental Tower	20	--	--	1	--
Signature Place I & II	33	39	8	3	--
Colonnade I Republic Bank Tower	34	31	--	7	--
Colonnade II Roim Tower	42	24	2	6	--
Lincoln Center I	29	41	1	1	--
Stone Tower	38	2	2	5	--
Heritage Square Tower 2	40	--	--	12	--
Stanford Park	28	20	8	4	--
<u>Perimeter Center</u>					
Ravinia One	47	43	7	5	5
Embassy Row	--	2	4	--	--
The BDM Corporation	12	4	--	3	--
Lancaster Building	--	2	1	--	--
8201 Greensboro Dr.	42	8	5	3	--
SAIC	29	6	4	4	--
Tyson's International	6	5	1	--	--
Tycon Tower	11	1	--	6	--
The Miure Corporation	32	23	5	5	3
Westwood	15	2	--	--	--
<u>Southdale</u>					
<u>Office</u>					
Southdale Medical Office	27	20	1	--	4
Southdale Office Center	26	8	--	2	--
Southdale Place	--	30	2	--	--
Edina Office Center	--	4	--	1	--
National Car Rental	63	24	1	--	--
France Place	46	4	5	--	--
Minnesota Center	36	9	8	--	--
Northland Plaza	30	2	4	1	1
Northland Center	42	14	8	2	--
Northwestern Financial Ctr.	30	31	--	3	--
Edinborough	21	--	3	--	--

Table 21. Continued

	Restaurant	Bank	Health Club	Travel Services	Medical Office
Southdale (cont.)					
ADC Telecommunications 4700 & 4900 W. 78th St.	41	4	--	--	2
Pentagon Office Park	26	35	--	--	--
Southgate Office Tower	12	2	--	--	1
Normandale Lake Office Park 8300 Normandale Lake Blvd. 8400 Normandale Lake Blvd.	46 40	17 15	2 4	2 2	-- --
ADC 5501 Green Valley Dr.	47	3	--	6	--
International Dairy Queen	40	1	--	--	--
Jostens	22	2	--	1	--
One Corporate Center I	8	0	--	--	1
One Corporate Center III	65	2	--	--	--
Medical					
Fairview-Southdale Hospital	41	1	--	--	1

OFFICE BUILDING VISITORS

At selected office buildings, a sample of the persons entering the building were intercepted and interviewed to determine whether or not they were visitors or regular employees based in the building. The visitor percentages aggregated by activity center are given in Listing O. The individual building visitor proportions are given in Table 23.

Listing O

SAC	AM Inbound % Visitors	PM Inbound % Visitors
Bellevue	6	50
South Coast Metro	7	41
Parkway Center	7	50
Perimeter Center	5	37
Tysons Corner	4	48
Southdale	8	32

The origin characteristics of visitor trips to activity center office buildings are given in Table 24. For the larger SACs, the proportion of intra-SAC visitor trips is higher (54 percent and 58 percent for the AM and PM peak periods, respectively) than for the smaller three SACs (30 and 33 percent). The higher intra-SAC proportions result from the greater proportion of SAC office space from which office visitor trips can be generated. The larger SACs have roughly three to five times as much office space as do the surveyed smaller SACs.

Also shown in Table 24 are the land use distributions at the trip origin end for visitor trips aggregated to the activity center level. These land use distributions indicate that AM peak-hour visitors come most often from home. For the large activity centers, hotel and office-based trips comprise the next most prominent and equal proportions of origins for AM peak-period visitor trips. In the smaller SACs office-based visitor trips are still prominent, but the hotel-based trips are much reduced. During the PM peak period, the office-based trips dominate for visitor trips to office buildings.

The mode of visitor trips to activity center office buildings is

Table 22. Profile of employee work-place survey respondents.

	South Coast Metro	Parkway Center	Perimeter Center	Tysons Corner	Southdale	Bellevue
Age						
18 years or under	*	*	*	*	*	*
19-24 years	11%	10%	12%	10%	14%	6%
25-34 years	43	42	40	34	41	38
35-44 years	30	29	30	27	25	38
45-54 years	12	13	13	20	13	14
55-64 years	3	4	4	8	6	4
65 years or older	*	*	*	1	*	*
Sex of Respondent						
Male	35%	41%	46%	54%	34%	35%
Female	65	59	54	46	66	65
Occupation						
Professional/Technical Manager/Administrator	35%	32%	36%	57%	34%	42%
Sales/Account Rep.	21	22	25	20	21	23
Secretary/Clerical	10	9	10	3	9	7
Other	33	35	27	18	31	26
	1	2	2	2	5	2
Number of Persons per Household (Mean)	2.66	2.62	2.69	2.84	2.77	2.70
Number of Vehicles per Household (Mean)	2.15	2.00	2.21	2.25	2.15	2.13
Number of Fulltime Workers per Household						
-1	NA	37%	32%	31%	33%	45%
-2	NA	58	59	55	56	49
-3	NA	4	8	10	8	5
-4 or more	NA	1	1	4	3	1

* Signifies value is less than one percent.

given in Table 25. These visitor trips are predominantly by automobile. Although the transit mode of access proportions remain relatively constant (and low) between activity centers, the walk proportions vary widely. No definitive explanation has yet been formulated.

Table 23. Visitor trips to office buildings.

Office Building	Inbound AM Trip Purpose		Inbound PM Trip Purpose	
	% Employee	% Visitor	% Employee	% Visitor
Bellevue				
Business Center Bldg.	91	9	52	48
Transamerica Title	92	8	52	48
Honeywell Center	94	6	40	60
United Olympic Bldg.	93	7	37	63
One Bellevue Center	94	6	65	35
Skyline Tower	94	6	53	47
Rainier Bank Plaza	97	3	53	47
Pacific First Plaza	96	4	45	55
Wells Development	100	0	17	83
Unweighted Average for Bellevue	94	6	50	50
South Coast Metro				
Imperial Bank Tower	95	5	46	54
Central Bank Tower	90	10	93	7
Great Western Savings Tower	93	7	84	16

Table 23. Continued

Office Building	Inbound AM Trip Purpose		Inbound PM Trip Purpose	
	% Employee	% Visitor	% Employee	% Visitor
Metro Center	90	10	63	37
Griffin Towers	94	6	50	50
Butterfield Tower	99	1	85	15
Corporate Center	89	11	53	47
Metro Pointe	99	1	21	79
Unweighted Average for South Coast Metro	93	7	59	41
Parkway Center				
Galleria Tower I	93	7	54	46
Occidental Tower	94	6	43	57
Signature Place I & II 14755 W. Preston Rd. 14785 W. Preston Rd.	93 85	7 15	28 34	72 66
Colonnade I Republic Bank Tower				
Colonnade II Rolm Tower	93	7	61	39
Lincoln Center I	86	14	63	37
Stone Tower	97	3	60	40
Heritage Square Tower 2	91	9	66	34
Stanford Park	95	5	*	*
Unweighted Average for Parkway Center	93	7	50	50

* Could not calculate due to adjacent health club. Total vehicles were counted for the complex, but not separated from those at the office building.

Table 23. Continued

Perimeter Center				
Ravinia One	95	5	67	33
Embassy Row	95	5	60	40
Tyson's Corner				
Lancaster Building	95	5	52	48
8201 Greensboro Dr.	--	--	50	50
Tyson's International 1919 Gallows Rd.	98	2	47	53
Tycon Tower	--	--	60	40
Unweighted Average for Tyson's Corner	96	4	52	48
Southdale				
Minnesota Center	93	7	50	50
Northland Plaza	96	4	79	21
Northland Center 3500 W. 80th St. 3600 W. 80th St.	88 88	12 12	-- --	-- --
Northwestern Financial Ctr.	96	4	76	24
Unweighted Average for Southdale	92	8	68	32

Table 24. Office building visitor trip origins.

Suburban Activity Center	AM Peak Period Office Visitor Trips					PM Peak Period Office Visitor Trips				
	Proportion from within SAC	Office	Home	Retail	Hotel	Proportion from within SAC	Office	Home	Retail	Hotel
Bellevue	47%	34%	53%	9%	4%	54%	69%	18%	10%	3%
South Coast Metro	15	26	51	7	16	15	78	8	14	0
Southdale	27	19	68	4	9	30	83	11	6	0
Average for 3 Smaller SAC's	30	26	57	7	10	33	77	12	10	1
Parkway Center	59	28	43	7	22	68	72	12	13	3
Perimeter Center	46	10	45	8	37	53	81	6	13	0
Tyson's Corner	57	42	29	0	29	52	88	6	6	0
Average for 3 Larger SAC's	54	27	39	5	29	58	80	8	11	1
Overall Average	42	26	48	6	20	45	79	10	10	1

Table 25. Office building visitor trip mode.

Suburban Activity Center	AM Peak Period Trip Mode			PM Peak Period Trip Mode		
	Auto	Transit	Walk	Auto	Transit	Walk
Bellevue	87%	5%	8%	93%	4%	3%
South Coast Metro	94	0	6	94	0	6
Parkway Center	84	3	13	97	2	1
Perimeter Center	88	2	10	100	0	0
Tysons Comer	100	0	0	85	0	15
Southdale	96	0	4	100	0	0

CHAPTER SEVEN

RETAIL SURVEY ANALYSIS

RETAIL SURVEY SITES

The 26 retail sites surveyed are given in Table 26 along with some descriptive information regarding the characteristics of the retail site. The sites are organized in the table by activity center. In subsequent tables covering the characteristics of trips to and from these retail sites, the retail sites are categorized by their type (e.g., regional center).

Shown in the table are the type of each retail site, the year of its opening, its gross leasable area, and its estimated level of occupancy. Seven regional centers were surveyed. They range in size from the 970,000 square foot Galleria Mall in Parkway Center to the 2.2 million square foot South Coast Plaza. A fashion mall, Crystal Court in South Coast Metro, was surveyed. A fashion mall is defined as an up-scale version of the regional centers that typically are mid-scale and carry a full-line cross section of goods. Five specialty shopping centers were counted and surveyed, as well as six community and neighborhood shopping centers. Counts and surveys were conducted at a promotional center (Target in Southdale). Counts were conducted at seven high-turnover sit-down restaurants and at a gourmet grocery store in Southdale.

PEAK-HOUR TRIP GENERATION

The results of peak-hour person and vehicle counts taken at SAC retail sites are presented in Table 27 for the midday peak hour and in Table 28 for the evening peak hour. The peak hours correspond to the peak hour of site-generated trips within the defined peak period (12 noon to 2 PM for the midday peak period and 4 PM to 6 PM for the evening peak period).

As shown in Table 27, the vehicle trips generated by the surveyed regional centers and fashion mall during the midday peak hour range between 1.8 and 3.5 vehicle-trips per 1,000 occupied gross leasable square feet. For the smaller community and neighborhood shopping centers, the midday trip generation rates range between 6.2 and 12.2 per 1,000 occupied GLA. For

the five specialty centers that were counted, the midday rates fall between 5.4 and 8.9. The high-turnover sit-down restaurants have rates that range from 4.2 to 30.7 trips per 1,000 occupied GLA (although all but one of the five surveyed sites fall within the 18 to 30 range).

The midday peak hour, average automobile occupancies are also shown in Table 27. For the seven surveyed regional centers and fashion mall, the average automobile occupancies range between 1.23 and 1.30, with an overall average of 1.27.

Evening peak-hour trip-generation rates for the surveyed retail sites are presented in Table 28. Also provided in the table for comparison purposes are the rates presented in the ITE *Trip Generation* report. For the six regional centers, five have peak-hour trip-generation rates lower than the ITE rates; and one, Bellevue Square, has a rate higher than the ITE rate. Across the six surveyed regional centers, the average vehicle trip generation rate is 2.3 per 1,000 square feet GLA; the ITE rates for retail centers of the surveyed sizes are 2.8 and 2.9.

For the community and neighborhood shopping centers, two of the five surveyed sites have rates lower than the ITE rates. For the specialty centers, all three of the surveyed sites have rates lower than the ITE rates.

The directional distribution of vehicle trips at the surveyed retail sites during the evening peak hour are somewhat different from the ITE values. The regional centers have a directional distribution of 52 percent inbound to the site (from a total of six survey sites ranging from 51 to 54 percent inbound). The ITE inbound rate for large retail centers is 47 percent. As demonstrated above, the two-way peak-hour volumes for the surveyed regional centers are roughly 20 percent less than the ITE rates; however, the peak direction percentage is roughly 10 percent higher than the ITE rate. Therefore, the net effect is that peak direction retail trips at the surveyed regional centers are roughly 10 percent less than the ITE peak direction rates.

For the community and neighborhood shopping centers, the six surveyed sites have 54 percent inbound (as opposed to an ITE rate of 49 percent inbound). The difference of 5 percentage points mirrors the rate differential for regional centers.

Table 26. Retail site characteristics.

<u>Retail Site</u>	<u>Year Built</u>	<u>Gross Leasable Area (GLA) (x 1000)</u>	<u>Percent Occupied</u>	<u>Description</u>
<u>Bellevue</u>				
Bellevue Square	1981 (Remodel)	1066.3	99	Super Regional Center 3 Anchors 215 Additional Tenants 5134 Parking Spaces
Bellevue North	--	47.0	77	Community Shopping Center 13 shops and restaurants 145 parking spaces
Ernst Hardware 44 Bellevue Way	1976	54.2	100	Neighborhood Shopping Center 2 tenants (hardware store and auto parts store)
Park Row	--	17.8	100	Neighborhood Shopping Center 12 tenants, including 3 restaurants 52 parking spaces
<u>South Coast Metro</u>				
South Coast Plaza Mall	1967 ¹	2,200.0	95 ²	Super Regional Center 6 Anchors 200 Additional tenants
South Coast Plaza Crystal Court	1986	600.0	77	Fashion Mall 2 Anchors 50 Additional tenants
South Coast Plaza Village	1973	130.0	60	Specialty Shopping Center 40 Shops 8 Restaurants
Sunflower - Bristol Plaza	1984	45.0	89	Community Shopping Center 20 Shops 5 Restaurants
<u>Parkway Center</u>				
Galleria 13355 Noel Road	1982	970.0	98	Super Regional Center Macy's Marshall Fields Saks Fifth Avenue 180 Additional tenants
Prestonwood Mall 5301 Beltline Rd.	1980	1112.0	95	Super Regional Center 5 anchor stores 151 additional tenants
Plaza at the Quorum I 5000 Beltline Rd.	1979	85.2	100	Specialty Shopping Center RB Furniture President's Health Club 5 Restaurants Federal Express 10 other tenants (general services)
Plaza at the Quorum II 4900 Beltline Rd.	1979	79.2	94	Specialty Shopping Center Businessland Computers Super Gap 3 Restaurants 15 other tenants (predominantly office/computer products)

Table 26. Continued

<u>Retail Site</u>	<u>Year Built</u>	<u>Gross Leasable Area (GLA) (x 1000)</u>	<u>Percent Occupied</u>	<u>Description</u>
<u>Perimeter Center</u>				
Perimeter Mall 4400-4500 Ashford- Dunwoody Rd.	1971 (1982, 1986)	1,436.0	98	Super Regional Center 3 anchor stores 157 additional stores; plus 23 food court counters
Park Place Shopping Center	1978 (1986 upgrade)	61.0	100	Specialty Shopping Center 17 stores; 5 restaurants 610 parking spaces
Chequers (Restaurant) 236 Perimeter Center Pkwy.	1984	9.4	100	High-turnover (sit down) restaurant 165 parking spaces
Fuddruckers (Restaurant) 240 Perimeter Center Pkwy.	1984	9.0	100	High-turnover (sit down) restaurant 115 parking spaces
Bay Street (Restaurant) 1015 Crown Pointe Parkway	1986	5.9	100	High-turnover (sit down) restaurant
<u>Tysons Corner</u>				
Tysons Corner Mall 1961 Chain Bridge Road	1968 (Renovated 1988)	2114.1	99	Super Regional Center Nordstrom Bloomingdale's Hecht's Woodward & Lothrop 123 other tenants
Tysons Commons 7401 Dartford Dr.	1970	70.2	95	Neighborhood Shopping Center Drug Store Grocery Store 10 other tenants
Clyde's of Tysons Corner 8332 Leesburg Pike		26.3	100	High-turnover (sit down) restaurant
<u>Southdale</u>				
Southdale Mall 6601 France Ave.	1956	1,161.3	100	Super Regional Center Dayton's Donaldson's JC Penney 140 additional tenants 6,603 parking spaces
Galleria 3510 W. 70th St.	1975	147.4	100	Specialty Shopping Center 53 tenants 3 restaurants 1,580 parking spaces
Yorktown Mall 3301-3335 Hazelton Rd.	1973	92.0	90	Community Shopping Center 30 tenants 3 restaurants (including a drive-thru)
Target 7000 France Ave.	1973	113.0	100	Promotional Center Includes 4 additional tenants
Byerlys 7171 France Ave.	1973	70.0	100	Gourmet Grocery Store
Fuddruckers 77th & France Ave.	1984	10.0	100	High-turnover (sit down) restaurant

¹ Major renovations and additions in 1973, 1978 and 1987² Estimated

Table 27. Midday peak-hour trip-generation at retail sites.

<u>Retail Site</u>	<u>Gross Leaseable Area (GLA) (x1000)</u>	<u>2-Way Person Trips</u>	<u>2-Way Vehicle Trips</u>	<u>Percentage¹ Inbound</u>	<u>Average Auto Occupancy</u>	<u>Person Trips Per Occupied GLA</u>	<u>Vehicle Trips Per Occupied GLA</u>
<u>Bellevue</u>							
Bellevue Square	1066.3	5760	3644	59	1.26	5.5	3.5
Bellevue North	47.0	517	440	53	1.15	14.3	12.2
Ernst Hardware	54.2	296	246	52	1.15	5.5	4.5
Park Row	17.8	198	110	45	1.22	11.1	6.2
<u>South Coast Metro</u>							
South Coast Plaza Mall	2,200.0	6650	4915	55	1.28	3.2	2.4
South Coast Plaza Crystal Court	600.0	1454	1047	51	1.27	3.2	2.3
South Coast Plaza Village	130.0	933	609	58	1.44	12.0	7.8
Sunflower-Bristol Plaza	45.0	1052	689	52	1.40	26.3	17.2
<u>Parkway Center</u>							
Galleria Mall	970.0	--	--	--	--	--	--
Prestonwood Mall	1112.0	3375	2627	54	1.29	3.2	2.5
Plaza at the Quorum I	85.2	686	467	44	1.43	8.1	5.5
Plaza at the Quorum II	79.2	722	473	45	1.44	9.7	6.4
<u>Perimeter Center</u>							
Perimeter Mall	1436.0	5969	4496	50	1.29	4.2	3.2
Park Place Shopping Ctr.	61.0	769	540	43 ³	1.41	12.6	8.9
Chequers (Restaurant)	9.4	282	175	49	1.58	30.0	18.6
Fuddruckers (Restaurant)	9.0	382	195	54	1.87	42.4	21.7
Bay Street (Restaurant)	5.9	207	111	45	1.82	35.1	18.8
<u>Tysons Corner</u>							
Tysons Comer Mall	2114.1	5260	3960	51	1.30	2.5	1.9
Tysons Commons	70.2	995	675	48	1.20	14.9	10.1
Clyde's of Tysons Comer	26.3	169	110	33	1.45	6.4	4.2
<u>Southdale</u>							
Southdale Mall	1161.3	4612	3648	60	1.23	4.0	3.1
Galleria	147.4	1052	796	51	1.32	7.1	5.4
Yorktown Mall	92.0	670	551	49	1.20	8.1	6.7
Target	113.0	1226	1023	54	1.19	10.8	9.1
Byerlys	70.0	1031	813	49	1.29	14.7	11.6
Fuddruckers	10.0	517	307	45	1.68	51.7	30.7

¹ Percentage inbound for vehicle trips² Includes vehicle trips and walk trips³ Park Place also had an hour period with 537 vehicle trips with 59% inbound

Table 28. PM peak-hour trip-generation at retail sites.

<u>Retail Site</u>	<u>Gross Leaseable Area (GLA) (x1000)</u>	<u>2-Way Person Trips</u>	<u>2-Way Vehicle Trips</u>	<u>Percentage Inbound</u>	<u>Average Auto Occupancy</u>	<u>Person Trips Per Occupied GLA</u>	<u>Vehicle Trips Per Occupied GLA</u>	<u>ITE Rates</u>	
								<u>Vehicles/ GLA</u>	<u>Percentage Inbound</u>
<u>Bellevue</u>									
Bellevue Square	1066.3	4753	3335	53	1.27	4.5	3.2	2.9	47
Bellevue North	47.0	637	531	48	1.19	17.6	14.7	10.2	49
Ernst Hardware	54.2	250	215	54	1.15	4.6	4.0	--	--
Park Row	17.8	132	125	52	1.05	7.4	7.0	14.3	49
<u>South Coast Metro</u>									
South Coast Plaza Mall	2,200.0	5096	3427	54	1.45	2.4	1.6	2.8	47
South Coast Plaza Crystal Court	600.0	754	613	47	1.18	1.6	1.3	3.4	47
South Coast Plaza Village	130.0	595	416	56	1.30	7.6	5.3	7.0	49
Sunflower-Bristol Plaza	45.0	604	447	53	1.23	15.1	11.2	9.7	49
<u>Parkway Center</u>									
Galleria Mall	970.0	3115	2232	55	1.34	3.3	2.3	3.0	47
Prestonwood Mall	1112.0	3300	2581	52	1.28	3.0	2.3	2.9	47
Plaza at the Quorum I	85.2	456	296	57	1.51	5.4	3.5	6.7	49
Plaza at the Quorum II	79.2	481	323	51	1.46	6.5	4.3	7.0	49
<u>Perimeter Center</u>									
Perimeter Mall	1436.0	4070	3173	53	1.26	2.9	2.3	2.9	47
Park Place Shopping Center	61.0	423	351	75	1.18	6.9	5.8	7.9	49
<u>Tysons Corner</u>									
Tysons Comer Mall	2114.1	5245	3875	51	1.33	2.5	1.8	2.8	47
Tysons Commons	70.2	1205	765	60	1.53	17.2	10.9	7.6	49
<u>Southdale</u>									
Southdale Mall	1161.3	3820	2988	52	1.27	3.3	2.6	2.9	47
Galleria	147.4	922	677	47	1.36	6.3	4.6	5.2	49
Yorktown Mall	92.0	434	347	57	1.18	5.2	4.2	6.8	49
Target	113.0	1434	1067	50	1.33	12.7	9.4	8.0	49
Byerleys	70.0	969	760	51	1.26	13.8	10.9	--	--
Fuddruckers	10.0	217	117	67	1.85	21.7	11.7	3.3	--

MODE SHARES

The arrival and departure modes of persons interviewed at the retail sites are given in Table 29. Separate sets of values are shown for the midday and evening peak survey periods. For the regional centers, the midday nonautomobile mode shares and the amount of office space within a short walk (i.e., within 2,000 ft walking distance without having to cross a limited access roadway) are given in Listing P.

Listing P

Regional Centers	Transit (%)	Walk (%)	Office GSF Within 2,000 Ft (millions)
Galleria	1	17	2.1
Bellevue Square	5	6	2.1
Perimeter Mall	0	7	2.8
Southdale Mall	1	5	0.7
South Coast Plaza	0	4	1.6
Tysons Corner	0	4	1.5
Prestonwood Town Center	0	2	0.7

There appears to be a reasonably direct relationship between the midday nonautomobile mode share and the proximity of office space. But more importantly, these midday nonautomobile mode shares reflect the unique characteristics of the surveyed regional centers. The highest walk percentage (17 percent) is found at the Galleria, which is connected by enclosed walkways with approximately 1 million square feet of office space and a 440-room high-rise hotel. In terms of persons, the 17 percent walk mode share represents roughly 500 of the mall's midday patrons. This number of midday patrons amounts to roughly 20 percent of the Galleria office tower employees, which is well within the reported number of office employees eating lunch within the complex (as reported earlier in Chapter Six).

Bellevue has a substantial transit mode share as a result of the area's extensive radial bus service to the activity center. The Bellevue Square walk mode share of 6 percent represents approximately 350 person-trips during the midday peak hour. Field counts of persons walking to the retail site confirm the magnitude of this estimate. A direct count of pedestrians at the Bellevue Square site could not be accurately conducted because of the proximity of off-site parking in relative close proximity to the site. The high walk mode share is testament to the existing pedestrian pathway system in the Bellevue activity center despite the relatively small amount of office space within a short walk distance.

The Perimeter Mall walk mode share of 7 percent was obtained, as are the other mode share estimates, from the retail intercept surveys conducted within the site. Where possible, the vehicle counts conducted at the site cordon also included tabulation of pedestrians accessing the site. At Perimeter Mall, the field-counted pedestrian mode share was approximately 5 percent, just two percentage points lower than the intercept survey result. Because the surveys and counts were not entirely conducted on the same day, no definitive conclusions should be drawn about the potential bias in the retail intercept survey process.

The 2 to 5 percent walk mode share for midday trips found at the other four regional centers are probably representative of

Table 29. Mode shares at retail sites.

Retail Site	Midday Period			PM Peak Period		
	Auto	Transit	Walk	Auto	Transit	Walk
Super Regional Center						
Bellevue Square	89%	5%	6%	91%	2%	7%
South Coast Plaza Mall	96	0	4	98	1	1
Galleria	82	1	17	95	1	4
Prestonwood Mall	98	0	2	97	0	3
Perimeter Mall	93	0	7	99	0	1
Tysons Corner Mall	96	0	4	99	0	1
Southdale Mall	94	1	5	98	1	1
Fashion Mall						
Crystal Court	97	0	3	100	0	0
Specialty Shopping Center						
South Coast Plaza Village	95	0	5	88	0	12
Plaza at Quorum I	94	0	6	98	0	2
Galleria	96	0	4	99	0	1
Community Shopping Center						
Bellevue North	92	2	6	97	0	3
Sunflower-Bristol Plaza	91	0	9	91	0	9
Yorktown Mall	94	0	6	99	0	1
Neighborhood Shopping Center						
Park Row	72	2	26	97	0	3
Tysons Commons	86	0	14	92	0	8
Other Centers						
Ernst Hardware	96	0	4	98	0	2
Target	98	0	2	98	0	2

typical regional centers with no special features, such as direct connections to office buildings or an extensive pedestrian pathway system.

The smaller retail sites have virtually no transit patronage during the midday. The walk proportions tend to fall within the 4 to 9 percentage range with one principal exception. Park Row located in Bellevue contains two fast-food sit-down eating establishments and is within 2,000 ft of 1.5 million gsf of office space. Its high walk percentage (26 percent), nevertheless, represents only approximately 50 two-way person-trips during the midday peak hour.

During the evening peak period, the regional center mode share distributions change. Bellevue Square continues to have a high walk mode share of 7 percent. As will be shown in a subsequent section of this chapter, the majority of the internal-to-Bellevue trips to Bellevue Square during the midday and evening peak periods originate at other retail sites (therefore, they are linked trips) rather than at office buildings. For that reason, apparently, the walk mode share in Bellevue Square remains relatively steady between the midday and evening peak periods.

The Galleria walk mode share drops to 4 percent during the evening peak period, significantly less than the 17 percent midday figure. During the midday, the majority of the trips originate at an office building (most notably, the Galleria office towers); in contrast, the evening peak period trips from offices are much lower.

TRIP PURPOSES

The primary purposes of trips to be surveyed sites are given in Table 30 for the midday peak period and in Table 31 for the

Table 30. Midday trip purpose for retail sites.

Retail Site	SAC	Primary Purpose of Midday Trip ¹			
		Work	Shopping	Dining	Personal Business
Super Regional Center					
Bellevue Square	Bellevue	9%	84%	2%	5%
South Coast Plaza Mall	SCM	4	80	13	3
Galleria	Parkway	4	65	19	12 ²
Prestonwood Mall	Parkway	4	83	9	4
Perimeter Mall	Perimeter	4	46	44	6
Tysons Corner Mall	Tysons Corner	8	72	10	10
Southdale Mall	Southdale	4	83	8	5
Fashion Mall					
Crystal Court	SCM	2	77	19	2
Specialty Shopping Center					
South Coast Plaza Village	SCM	7	27	54	12
Plaza at Quorum I	Parkway	5	36	47	12
Galleria	Southdale	6	80	12	2
Community Shopping Center					
Bellevue North	Bellevue	2	72	21	5
Sunflower-Bristol Plaza	SCM	3	27	64	6
Yorktown Mall	Southdale	6	54	32	8
Neighborhood Shopping Center					
Park Row	Bellevue	5	19	68	8
Tysons Commons	Tysons Corner	6	56	21	17
Other Centers					
Ernst Hardware	Bellevue	3	95	0	2
Target	Southdale	0	97	1	2

Notes:

1. Midday trips are defined as those either entering or exiting the site between 12 noon and 2 PM.
2. The high proportion of personal business trips at Galleria could constitute some "pass-through" trips to the office buildings.

evening peak period. During the midday, the primary trip purpose is for shopping, followed in order (in general) by dining, personal business, and work. At the regional centers, the widest variation is found in the dining category. The Perimeter Mall survey estimates that 44 percent of the mall patrons that enter or depart during the midday peak period are primarily there to eat. This high percentage reflects the absence of alternative inexpensive fast-food restaurants within the Perimeter Center SAC or within its close proximity. In contrast, the Bellevue Square, Southdale Mall, Prestonwood Mall, Tysons Corner Mall, and South Coast Plaza trip purpose proportions for dining reflect the wide variety of eating alternatives in the Bellevue, Southdale, Parkway Center, Tysons Corner, and South Coast Metro SACs, respectively.

All but one of the specialty, community, and neighborhood shopping centers have restaurants. As expected, dining trip purposes for these centers are higher than for the regional centers. The seven surveyed smaller centers have an average of 43 percent dining for their trip purpose distribution (but with a range between 12 and 68 percent).

Primary trip purposes during the evening peak period are given in Table 31. In general, the dining trip purpose drops substantially from the midday (i.e., lunch) period and the work trip purpose increases in significance. At the regional centers, the work trip (i.e., trips made to or from work by employees of mall tenants) averages to be 12 percent of the evening peak period trips. At the specialty shopping centers, the work trip comprises 20 percent of the evening peak and at the community/neighborhood shopping centers the work trip comprises 14 percent of the total.

Table 31. PM peak trip purpose for retail sites.

Retail Site	SAC	Primary Purpose of PM Peak Period Trip ¹			
		Work	Shopping	Dining	Personal Business
Super Regional Center					
Bellevue Square	Bellevue	8%	87%	1%	4%
South Coast Plaza Mall	SCM	10	74	7	9
Galleria	Parkway	8	76	5	11
Prestonwood Mall	Parkway	12	83	3	2
Perimeter Mall	Perimeter	13	72	8	7
Tysons Corner Mall	Tysons Corner	18	69	2	11
Southdale Mall	Southdale	11	81	4	4
Fashion Mall					
Crystal Court	SCM	12	78	1	9
Specialty Shopping Center					
South Coast Plaza Village	SCM	19	21	30	30
Plaza at Quorum I	Parkway	19	32	11	38
Galleria	Southdale	22	58	6	14
Community Shopping Center					
Bellevue North	Bellevue	14	79	1	6
Sunflower-Bristol Plaza	SCM	7	51	28	14
Yorktown Mall	Southdale	30	38	10	22
Neighborhood Shopping Center					
Park Row	Bellevue	14	46	14	26
Tysons Commons	Tysons Corner	4	86	2	8
Other Centers					
Ernst Hardware	Bellevue	2	96	0	2
Target	Southdale	4	94	1	1

¹ PM peak period trips are defined as those entering or exiting the site between 4 and 6 PM.

RETAIL TRIP ORIGIN AND DESTINATION

The surveyed retail patrons provided information on the origin of their trip to the retail center and their next destination upon leaving the retail center. Table 32 summarizes some of the characteristics derived from that information for midday peak period trips by automobile drivers. Table 33 presents the same information but for the evening peak period.

Tables 32 and 33 give for each surveyed retail site, the following:

- The proportion of all trips entering the retail site which originated at a point located within the activity center (those internal trips which originated at an office; those internal trips which originated at a home; those internal trips which originated at another retail site, a bank, or a restaurant; and those internal trips which originated at any other land use).
- The proportion of all trips which originated at an office.
- The proportion of all trips which originated at a home.
- The proportion of all trips which originated at another retail site, a bank, or a restaurant.
- The proportion of all trips which originated at any other land use.
- The distance from the last stop to the retail site, in miles (median value and 85th percentile value).
- Whether the trip to the retail site was a pass-by trip along the way to or from home.
- The proportion of all trips exiting the retail site which are destined for a point located within the activity center (those

Table 32. Characteristics of midday peak period automobile trips to and from retail sites.

<u>Trip Characteristics</u>	<u>Bellevue Square</u>	<u>Bellevue North</u>	<u>Ernst Hardware</u>	<u>Park Row</u>
Last Stop Before Arriving at Retail Site				
• Location of and Purpose of Last Stop				
• Within SAC	37%	80%	67%	91%
• Office	(7)	(32)	(38)	(59)
• Home	(1)	(12)	(0)	(0)
• Shop/Bank/Restaurant	(25)	(27)	(23)	(24)
• Other	(4)	(9)	(6)	(8)
• Outside SAC	63%	20%	33%	9%
• Purpose of Last Stop				
• Office	14	41	44	62
• Home	45	20	21	3
• Shop/Bank/Restaurant	28	29	26	26
• Other	13	10	9	9
• Distance from Last Stop (miles)				
• Median	3.5-4	1-1.5	0.5-1	0.5-1
• 85th percentile	9-10	6-7	4.5-5	2.5-3
• Pass-by To/From Home				
• Yes	23	33	39	21
• No	77	67	61	79
Next Stop After Leaving Retail Site				
• Location of and Purpose of Next Stop				
• Within SAC	25%	89%	62%	93%
• Office	(6)	(39)	(31)	(63)
• Home	(2)	(17)	(0)	(0)
• Shop/Bank/Restaurant	(13)	(18)	(29)	(25)
• Other	(4)	(15)	(2)	(5)
• Outside SAC	75%	11%	38%	7%
• Purpose of Next Stop				
• Office	10	41	36	63
• Home	56	22	27	7
• Shop/Bank/Restaurant	22	22	31	25
• Other	12	15	6	5
• Distance to Next Stop (miles)				
• Median	4.5-5	0.5-1	0.5-1	0.5-1
• 85th Percentile	9-10	2.5-3	4.5-5	1.5-2
Trip Characteristics				
	<u>South Coast Plaza Mall</u>	<u>South Coast Plaza Crystal Ct.</u>	<u>South Coast Plaza Village</u>	<u>Sunflower Bristol Plaza</u>
Last Stop Before Arriving at Retail Site				
• Location of and Purpose of Last Stop				
• Within SAC	8%	18%	23%	24%
• Office	(2)	(2)	(3)	(5)
• Home	(1)	(1)	(6)	(1)
• Shop/Bank/Restaurant	(4)	(13)	(14)	(15)
• Other	(1)	(2)	(0)	(3)
• Outside SAC	92%	82%	77%	76%
• Purpose of Last Stop				
• Office	22	30	32	43
• Home	47	30	31	16
• Shop/Bank/Restaurant	18	25	24	27
• Other	13	15	13	14
• Distance from Last Stop (miles)				
• Median	5-6	4.5-5	2-2.5	2-2.5
• 85th percentile	10-15	9-10	9-10	6-7
• Pass-by To/From Home				
• Yes	15	33	11	17
• No	85	67	89	83
Next Stop After Leaving Retail Site				
• Location of and Purpose of Next Stop				
• Within SAC	5%	19%	24%	18%
• Office	(2)	(3)	(4)	(6)
• Home	(0)	(1)	(6)	(1)
• Shop/Bank/Restaurant	(3)	(15)	(14)	(11)
• Other	(0)	(0)	(0)	(0)
• Outside SAC	95%	81%	76%	82%
• Purpose of Next Stop				
• Office	21%	25%	39%	9%
• Home	55	43	36	68
• Shop/Bank/Restaurant	12	22	21	16
• Other	12	10	4	7
• Distance to Next Stop (miles)				
• Median	4.5-5	5-6	1.5-2	2.5-3
• 85th Percentile	15-20	15-20	8-9	5-6

Table 32. Continued

Trip Characteristics	Galleria	Prestonwood	Quorum	Perimeter
		Mall		Mall
Last Stop Before Arriving at Retail Site				
• Location of and Purpose of Last Stop				
• Within SAC	44%	72%	80%	50%
• Office	(23)	(20)	(31)	(38)
• Home	(8)	(17)	(12)	(0)
• Shop/Bank/Restaurant	(7)	(23)	(26)	(6)
• Other	(6)	(12)	(11)	(6)
• Outside SAC	56%	28%	20%	50%
• Purpose of Last Stop				
• Office	32	26	40	55
• Home	38	30	17	23
• Shop/Bank/Restaurant	12	28	29	10
• Other	18	16	14	12
• Distance from Last Stop (miles)				
• Median	7-8	3.5-4	1.5-2	0.5-1
• 85th percentile	15-20	9-10	6-7	9-10
• Pass-by To/From Home				
• Yes	7	20	40	47
• No	93	80	60	53
Next Stop After Leaving Retail Site				
• Location of and Purpose of Next Stop				
• Within SAC	49%	64%	78%	49%
• Office	(12)	(21)	(32)	(46)
• Home	(15)	(16)	(22)	(0)
• Shop/Bank/Restaurant	(14)	(18)	(15)	(0)
• Other	(8)	(9)	(9)	(3)
• Outside SAC	51%	36%	22%	51%
• Purpose of Next Stop				
• Office	18	26	43	61
• Home	46	40	23	26
• Shop/Bank/Restaurant	17	20	23	3
• Other	19	14	11	10
• Distance to Next Stop (miles)				
• Median	5-6	3.5-4	1.5-2	0.5-1
• 85th Percentile	15-20	10-15	6-7	9-10
Trip Characteristics				
		Tysons	Tysons	
		Mall	Commons	
Last Stop Before Arriving at Retail Site				
• Location of and Purpose of Last Stop				
• Within SAC		21%	14%	
• Office		(14)	(11)	
• Home		(1)	(0)	
• Shop/Bank/Restaurant		(2)	(3)	
• Other		(4)	(0)	
• Outside SAC		79%	86%	
• Purpose of Last Stop				
• Office		32	46	
• Home		52	26	
• Shop/Bank/Restaurant		5	14	
• Other		11	14	
• Distance from Last Stop (miles)				
• Median		4.5-5	0.5-1	
• 85th percentile		10-15	10-15	
• Pass-by To/From Home				
• Yes		19	10	
• No		81	90	
Next Stop After Leaving Retail Site				
• Location of and Purpose of Next Stop				
• Within SAC		23%	11%	
• Office		(16)	(9)	
• Home		(3)	(1)	
• Shop/Bank/Restaurant		(2)	(1)	
• Other		(2)	(0)	
• Outside SAC		77%	89%	
• Purpose of Next Stop				
• Office		31	52	
• Home		55	35	
• Shop/Bank/Restaurant		7	11	
• Other		7	2	
• Distance to Next Stop (miles)				
• Median		4.5-5	0.5-1	
• 85th Percentile		10-15	3.5-4	

Table 32. Continued

Trip Characteristics	Southdale Mall	Galleria	Yorktown Mall	Target
Last Stop Before Arriving at Retail Site				
• Location of and Purpose of Last Stop				
• Within SAC	32%	23%	43%	50%
• Office	(11)	(2)	(14)	(10)
• Home	(0)	(0)	(0)	(1)
• Shop/Bank/Restaurant	(16)	(19)	(29)	(35)
• Other	(5)	(2)	(0)	(4)
• Outside SAC	68%	77%	57%	50%
• Purpose of Last Stop				
• Office	11	14	17	28
• Home	59	48	45	24
• Shop/Bank/Restaurant	19	26	30	37
• Other	11	12	8	11
• Distance from Last Stop (miles)				
• Median	2.5-3	4.5-5	1.5-2	1-1.5
• 85th percentile	9-10	10-15	9-10	4.5-5
• Pass-by To/From Home				
• Yes	20	27	18	36
• No	80	73	82	64
Next Stop After Leaving Retail Site				
• Location of and Purpose of Next Stop				
• Within SAC	28%	33%	33%	40%
• Office	(4)	(8)	(7)	(12)
• Home	(2)	(0)	(0)	(0)
• Shop/Bank/Restaurant	(17)	(21)	(26)	(25)
• Other	(5)	(4)	(0)	(3)
• Outside SAC	72%	67%	67%	60%
• Purpose of Next Stop				
• Office	5	1	7	14
• Home	69	62	58	54
• Shop/Bank/Restaurant	17	23	28	26
• Other	9	14	7	6
• Distance to Next Stop (miles)				
• Median	3.5-4	4.5-5	2.5-3	1.5-2
• 85th Percentile	10-15	10-15	9-10	6-7

internal trips with an office destination; those internal trips with a home destination; those internal trips with a destination at another retail site, a bank, or a restaurant; those internal trips with a destination at any other land use).

- The proportion of all trips with an office destination.
- The proportion of all trips with a home destination.
- The proportion of all trips with a destination at another retail site, a bank, or a restaurant.
- The proportion of all trips with a destination at any other land use.
- The distance from the retail site, in miles, to the next stop (median value and 85th percentile value).

Internal Trips

By taking the internal origin and destination proportions given in Tables 21 and 22 and factoring these values with the inbound/outbound distributions presented earlier, it is possible to derive a single value for the proportion of all trips generated by a retail site that are internal to the activity center. These proportions are presented in Listing Q (in order of decreasing internal proportions for the midday).

In general, the larger three activity centers (Parkway Center, Tysons Corner, and Perimeter Center) tend to have the higher internal percentages (47 percent during the midday and 31 percent during the evening peak period on average across the four surveyed sites). In contrast, the comparable midday and evening

Listing Q

	Percentage from within SAC Midday (%)	Evening (%)
Prestonwood Town Center	68	57
Perimeter Mall	50	18
Galleria	47	41
Bellevue Square	32	21
Southdale Mall	30	15
Tysons Corner Center	22	7
South Coast Plaza	7	7
Overall Average	37	24

peak period values for the smaller activity centers (Bellevue, South Coast Metro, and Southdale) are 23 and 14 percent, respectively. In other words, the internal capture rate for the regional malls in the larger activity centers is roughly twice the magnitude for the regional malls in the smaller activity centers.

The trip origins and destinations for the regional centers provide interesting differences as well. For Bellevue Square and South Coast Plaza Mall, trips linked with other retail sites comprise more than half of the internal trips generated by the regional centers during the midday and evening peak periods. In contrast, two-thirds of the internal trips generated by Tysons Corner Mall are to or from an office. For several of the regional

Table 33. Characteristics of PM peak period automobile trips to and from retail sites.

<u>Trip Characteristics</u>	<u>Bellevue Square</u>	<u>Bellevue North</u>	<u>Ernst Hardware</u>	<u>Park Row</u>
Last Stop Before Arriving at Retail Site				
• Location of and Purpose of Last Stop				
• Within SAC	21%	69%	81%	76%
• Office	(3)	(21)	(32)	(35)
• Home	(0)	(9)	(0)	(0)
• Shop/Bank/Restaurant	(13)	(31)	(42)	(28)
• Other	(5)	(8)	(7)	(13)
• Outside SAC	79	31	19	24
• Purpose of Last Stop				
• Office	15	28	40	41
• Home	43	28	6	10
• Shop/Bank/Restaurant	25	34	43	28
• Other	17	10	11	21
• Distance from Last Stop (miles)				
• Median	4.5-5	1.5-2	1-1.5	0.5-1
• 85th percentile	10-15	9-10	4.5-5	5-6
• Pass-by To/From Home				
• Yes	26	42	51	50
• No	74	58	49	50
Next Stop After Leaving Retail Site				
• Location of and Purpose of Next Stop				
• Within SAC	20%	43%	46%	32%
• Office	(3)	(12)	(3)	(11)
• Home	(1)	(12)	(0)	(0)
• Shop/Bank/Restaurant	(13)	(13)	(38)	(14)
• Other	(3)	(6)	(5)	(7)
• Outside SAC	80	57	54	68
• Purpose of Next Stop				
• Office	4	17	3	11
• Home	64	57	54	64
• Shop/Bank/Restaurant	17	17	38	18
• Other	15	9	5	7
• Distance to Next Stop (miles)				
• Median	5-6	2.5-3	1.5-2	2.5-3
• 85th Percentile	10-15	9-10	5-6	9-10
Trip Characteristics				
	<u>South Coast Plaza Mall</u>	<u>South Coast Plaza Crystal Ct.</u>	<u>South Coast Plaza Village</u>	<u>Sunflower-Bristol Plaza</u>
Last Stop Before Arriving at Retail Site				
• Location of and Purpose of Last Stop				
• Within SAC	5%	17%	15%	30%
• Office	(0)	(0)	(3)	(9)
• Home	(1)	(0)	(8)	(3)
• Shop/Bank/Restaurant	(3)	(16)	(2)	(18)
• Other	(1)	(1)	(2)	(0)
• Outside SAC	95%	83%	85%	70%
• Purpose of Last Stop				
• Office	17	15	18	46
• Home	46	33	62	29
• Shop/Bank/Restaurant	16	32	5	22
• Other	21	20	15	3
• Distance from Last Stop (miles)				
• Median	4.5-5	5-6	4.5-5	1-1.5
• 85th percentile	15-20	20-25	10-15	7-8
• Pass-by To/From Home				
• Yes	20	43	49	36
• No	80	57	51	64
Next Stop After Leaving Retail Site				
• Location of and Purpose of Next Stop				
• Within SAC	9%	14%	18%	27%
• Office	(0)	(0)	(2)	(2)
• Home	(1)	(0)	(5)	(14)
• Shop/Bank/Restaurant	(4)	(13)	(8)	(11)
• Other	(4)	(1)	(3)	(0)
• Outside SAC	91%	86%	82%	73%
• Purpose of Next Stop				
• Office	2%	1%	5%	5%
• Home	67	65	68	72
• Shop/Bank/Restaurant	11	17	10	14
• Other	20	17	17	9
• Distance to Next Stop (miles)				
• Median	4.5-5	5-6	3.5-4	1.5-2
• 85th Percentile	15-20	30-40	10-15	7-8

Table 33. Continued

Trip Characteristics	Galleria	Prestonwood	Quorum	Perimeter
		Mall		Mall
Last Stop Before Arriving at Retail Site				
• Location of and Purpose of Last Stop				
• Within SAC	44%	61%	57%	26%
• Office	(8)	(12)	(18)	(20)
• Home	(10)	(20)	(10)	(1)
• Shop/Bank/Restaurant	(17)	(17)	(26)	(2)
• Other	(9)	(12)	(3)	(3)
• Outside SAC	56%	39%	43%	74%
• Purpose of Last Stop				
• Office	22	20	36	39
• Home	34	44	24	38
• Shop/Bank/Restaurant	23	22	35	7
• Other	21	14	5	16
• Distance from Last Stop (miles)				
• Median	5-6	4-4.5	3.5-4	5-6
• 85th percentile	20-25	10-15	10-15	15-20
• Pass-by To/From Home				
• Yes	6	14	25	26
• No	94	86	75	74
Next Stop After Leaving Retail Site				
• Location of and Purpose of Next Stop				
• Within SAC	37%	52%	51%	10%
• Office	(2)	(1)	(1)	(5)
• Home	(14)	(36)	(39)	(1)
• Shop/Bank/Restaurant	(10)	(9)	(8)	(1)
• Other	(11)	(6)	(3)	(3)
• Outside SAC	63%	48%	49%	90%
• Purpose of Next Stop				
• Office	4	1	4	9
• Home	60	80	77	72
• Shop/Bank/Restaurant	15	10	14	6
• Other	21	9	5	13
• Distance to Next Stop (miles)				
• Median	9-10	4.5-5	4.5-5	9-10
• 85th Percentile	20-25	10-15	9-10	15-20
		Tysons Comer	Tysons	
		Mall	Commons	
Trip Characteristics				
Last Stop Before Arriving at Retail Site				
• Location of and Purpose of Last Stop				
• Within SAC		9%	12%	
• Office		(6)	(8)	
• Home		(1)	(0)	
• Shop/Bank/Restaurant		(1)	(4)	
• Other		(1)	(0)	
• Outside SAC		91%	88%	
• Purpose of Last Stop				
• Office		31	48	
• Home		52	29	
• Shop/Bank/Restaurant		7	12	
• Other		10	11	
• Distance from Last Stop (miles)				
• Median		6-7	1.5-2	
• 85th percentile		15-20	9-10	
• Pass-by To/From Home				
• Yes		11	23	
• No		89	77	
Next Stop After Leaving Retail Site				
• Location of and Purpose of Next Stop				
• Within SAC		5%	5%	
• Office		(1)	(1)	
• Home		(2)	(2)	
• Shop/Bank/Restaurant		(1)	(2)	
• Other		(1)	(0)	
• Outside SAC		95%	95%	
• Purpose of Next Stop				
• Office		4	8	
• Home		82	78	
• Shop/Bank/Restaurant		4	6	
• Other		10	8	
• Distance to Next Stop (miles)				
• Median		7-8	0.5-1.0	
• 85th Percentile		15-20	10-15	

Table 33. Continued

Trip Characteristics	Southdale Mall	Galleria	Yorktown Mall	Target
Last Stop Before Arriving at Retail Site				
• Location of and Purpose of Last Stop				
• Within SAC	18%	19%	19%	40%
• Office	(4)	(0)	(4)	(9)
• Home	(6)	(0)	(0)	(1)
• Shop/Bank/Restaurant	(5)	(19)	(13)	(25)
• Other	(3)	(0)	(2)	(5)
• Outside SAC	82%	81%	81%	60%
• Purpose of Last Stop				
• Office	11	14	17	28
• Home	59	48	55	34
• Shop/Bank/Restaurant	11	26	20	27
• Other	19	12	8	11
• Distance from Last Stop (miles)				
• Median	7-8	4.5-5	3.5-4	1.5-2
• 85th percentile	10-15	10-15	10-15	9-10
• Pass-by To/From Home				
• Yes	14	19	22	34
• No	86	81	78	66
Next Stop After Leaving Retail Site				
• Location of and Purpose of Next Stop				
• Within SAC	11%	20%	26%	36%
• Office	(1)	(0)	(0)	(3)
• Home	(0)	(0)	(12)	(1)
• Shop/Bank/Restaurant	(8)	(20)	(14)	(27)
• Other	(2)	(0)	(0)	(5)
• Outside SAC	89%	80%	74%	64%
• Purpose of Next Stop				
• Office	5	1	7	4
• Home	69	62	62	56
• Shop/Bank/Restaurant	17	23	24	34
• Other	9	14	7	6
• Distance to Next Stop (miles)				
• Median	7-8	5-6	4.5-5	2-2.5
• 85th Percentile	10-15	10-15	15-20	9-10

centers with the higher proportions of internal trips, the office component also varies substantially. More than three-quarters of the internal Perimeter Mall trips go to or from an office. Prestonwood Mall offers the other extreme. Roughly one-third of the internal midday trips and only one-eighth of the internal evening peak trips are to or from an office.

The Galleria retail center in Parkway Center offers an atypical pattern of internal trip distribution. During the midday, roughly one-half of the trips are to or from an office. During the evening peak period, the office trips drop to one-eighth of the total internal trips. As a result of these varied results, no definitive relationships could be established regarding the land uses that generate interactive trips with regional retail centers.

For the smaller retail centers, the proportion of trips internal to the activity center is higher than for the regional centers. An explanation can be developed for the general relationship of these internal-to-activity-center proportions for each of the smaller retail centers to the corresponding proportions for the regional centers. However, a series of predictive, independent variables with consistent, quantitative results could not be derived from the current set of travel characteristics data. For example, Bellevue North (a community shopping center) and Park Row (a neighborhood shopping center) located in Bellevue have midday internal proportions of 85 and 92 percent, respectively, during the midday. These midday proportions are roughly three times the proportion for Bellevue Square. During the evening peak period, the Bellevue North and Park Row internal proportions are 36 and 37 percent, respectively. These "smaller retail" internal proportions are nearly twice as great

as the value determined for Bellevue Square (21 percent). Comparable relationships between the "smaller retail" and "regional center" internal proportions occur in South Coast Metro (for South Coast Plaza Village and Sunflower-Bristol Plaza). In both Bellevue and South Coast Metro, the regional center generates only a small proportion of its trips from the office development internal to the activity center. In contrast, the corresponding smaller retail centers draw a significant proportion of their trips from internal offices for lunch during the midday and for a convenience purchase during the evening peak period.

Trip Origins and Destinations

The overall origins and destinations for trips generated at the regional centers do show some tendencies when the data are disaggregated by size of activity center, as shown in Listing R.

Listing R

	Trip Origin/Destination Distribution			
	Midday Peak		Evening Peak	
	Small SAC (%)	Large SAC (%)	Small SAC (%)	Large SAC (%)
Office	14	35	9	16
Home	55	39	58	57
Shop/Bank/Restaurant	18	13	16	13
Other	13	13	17	14

During the midday peak, the regional centers in the larger activity centers have the tendency to have a higher proportion of trips to or from an office (the large activity centers have roughly three times as much office space as do the small activity centers). Likewise, the proportion of home-based trips drops to being roughly equal to the office-based trips in the larger activity centers. During the evening peak period, the regional centers in larger activity centers again have a somewhat greater proportion of office-based trips.

The Parkway Center activity center, because it contains three regional malls, provides an opportunity to measure the interaction of regional malls located within close proximity of each other. The Galleria and Prestonwood Town Center are the two regional malls, described previously, at which intercept surveys were conducted. These two malls are located about 2 miles apart. Also located within Parkway Center is the Valley View Mall. It is a 1.6 million square foot enclosed mall. It is situated less than 1 mile from the Galleria and about 3 miles from Prestonwood. At Prestonwood, the survey found that during the midday roughly 3 percent of its trips are linked with a stop at either Galleria or Valley View. During the evening peak period, the interaction between Prestonwood and the other two regional malls increases to 5 percent. At Galleria, nearly identical percentages were found. The midday interaction is 4 percent and the evening is 5 percent.

In terms of which malls had more interaction with the other two, the Prestonwood survey has roughly equal numbers of trips to/from Galleria and Valley View. Despite their quite different tenant list, the two are virtually equidistant from Prestonwood. The Galleria survey shows roughly a three-to-one ratio of trips to/from Valley View (less than 1 mile away) compared to those to/from Prestonwood (roughly 3 miles away).

Based on the above-measured interactions between regional malls, a general relationship can be formulated. If two regional malls are located roughly 1 mile apart, roughly 2 percent of each mall's midday trips are linked to a stop at the other mall. During the evening peak period, the interaction proportion is slightly higher, but still roughly 2 percent of each mall's trips.

Trip Length

Tables 32 and 33 give the median and 85th percentile trip lengths for trips to and from each individual retail site for the midday and evening peak periods, respectively. There is little difference between the trip length distributions for the larger activity centers and the smaller activity centers. There also is not an apparent direct relationship between the trip lengths and the size of the metropolitan area. There are, however, several observations to which the data point, which could be instructive in the development of travel characteristics for a suburban site.

The trip length distribution for the most "up-scale" regional centers and fashion malls appears to be greater than for the other regional centers. In particular, the median and 85th percentile trip lengths for South Coast Plaza Mall, South Coast Plaza Crystal Court, and the Galleria are, for the most part, longer than those for the other five surveyed regional centers. The reason for the longer trip lengths at the "up-scale" regional centers is that their tenants have a lower density of store coverage in their market area.

The second observation regarding trip lengths is that, for the regional centers, the distribution of evening peak trip lengths is invariably longer than the trip lengths for the midday. For the

smaller retail centers, this observation is not necessarily accurate across all the surveyed sites.

PASS-BY TRIP CHARACTERISTICS

Automobile drivers surveyed at the retail sites provided information on whether or not the retail trip was a pass-by or a diverted trip. Listing S gives the reported pass-by proportions for the regional centers.

Listing S

	Peak Period Pass-By Rates for Regional Centers	
	Midday (%)	Evening (%)
Perimeter Mall	23	26
Bellevue Square	21	27
Southdale Mall	20	14
Prestonwood Town Center	20	14
Tysons Corner Mall	19	11
South Coast Plaza Mall	15	20
Galleria	7	6

There is significant uniformity of these reported pass-by rates for all of the regional centers, with the exception of Galleria. These values indicate that a range between 15 and 25 percent for the midday and between 10 and 30 percent for the evening peak should be treated as essentially the extremes that one would currently expect for a regional center located within a large-scale suburban activity center. This observation compares favorably with the ITE pass-by rate of 23 percent for a 1 million square foot mall.

As shown in Listing T, for the smaller retail sites, the variation in pass-by rates is much more significant than that found for the regional centers.

Listing T

	Pass-by Rates for Small Retail Sites	
	Midday (%)	Evening (%)
Bellevue North	33	42
Ernst Hardware	39	51
Park Row	21	50
South Coast Crystal Court	33	43
South Coast Plaza Village	11	49
Sunflower-Bristol Plaza	17	36
Quorum	40	25
Tysons Commons	10	23
Galleria	27	19
Yorktown Mall	18	22
Target	36	34

The midday pass-by rates range between 10 and 40 percent with an average of 26 percent. The evening peak period rates range between 19 and 51 percent with an average of 36 percent. The most significant observation regarding these pass-by rates is that they are substantially less than the ITE rate of between 42 and 45 percent for retail sites of the surveyed size. From these data, it appears that pass-by rates for retail sites in large-

scale suburban activity centers are somewhat less than for comparable-sized isolated retail sites. However, it should also be noted that 5 of the 11 retail sites have pass-by rates at or above the ITE 42 percent rate.

CHAPTER EIGHT

RESIDENTIAL ANALYSIS

RESIDENTIAL SITES

The residential sites at which trip generation counts were taken, and a residential mailback survey was conducted, are given in Table 34. The table provides information on the name of each surveyed site and its address, the year of its opening, the type of dwelling units (in accordance with the ITE *Trip Generation* report), the number of units and the number of occupied units, and the average number of bedrooms per unit as a measure of the dwelling unit size.

TRIP GENERATION

Morning and evening peak-hour trip-generation counts and analyses are presented in Table 35. In general, the measured residential trip generation rates conform to the ITE *Trip Generation* report, Fourth Edition. During both the morning and evening peak hours, the measured rates are comparable to the ITE rates on a per occupied square footage basis (16 sites have lower rates than the ITE rates and 16 sites have higher rates than ITE). However, on the basis of residents, the majority of the sites (17 of the 25 building count periods) exceed the ITE rate.

ACTIVITY CENTER RESIDENTS

Table 36 summarizes the key characteristics of the residents and households at the 15 surveyed residential sites. As shown in the table, the average number of residents (age 18 or older) per household ranges between 1.3 and 1.9. The average number of vehicles per household has approximately the same range (1.2 to 1.8).

The median age of the residents in households, which responded to the survey, provides a clear distinction between some of the study sites. In particular, the Rotonda in Tysons Corner and the Durham in Southdale (with median ages in the 55 to 64 range) are predominantly senior citizens or "empty-nesters." Roughly 60 percent of all Rotonda residents are 65 years or older. In contrast, each of the Parkway Center survey sites has no senior citizens and a median age between 35 and 44.

Most of the households have at least one person employed. As shown in Table 36, the two residential complexes with median ages over 55 still have between 50 and 60 percent of the households with an employed resident. At the remaining resi-

dential complexes, the majority have at least 95 percent of the complex households that have an employed person.

The final item in the table is the average number of employed persons per household. This factor could be used in the development and refinement of trip generation rate estimates. However, a wide range was reported (between 0.6 and 1.6).

INTERNAL TRIPS

Activity center residents were asked in the survey to provide information on their work location and on the trips which they made internal to the activity center. Table 37 presents a summary of the data. The range of reported percentages of employed residents who also work within the activity center is between 13 and 50 percent. On average, the owner-occupied households produce a slightly higher percentage of "internal employment" (31 percent) than do the rental units (28 percent).

Another possible way of classifying the residential complexes is by size of activity center. The hypothesis would be that if the office component of the activity center gets larger, the more employment opportunities will become available, and presumably the greater proportion of employed residents will work within the activity center. The hypothesis is tested by splitting the residential sites into those within large activity centers (Tysons Corner and Parkway Center) and those within the smaller activity centers. The "large SAC" employed resident works 33 percent of the time within the activity center. For the "smaller SAC" employed resident the internal rate is 27 percent, thus confirming the hypothesis. Therefore, the hypothesis is confirmed.

The mode split of all trips taken by SAC residents within the activity center is also shown in Table 37. For the denser activity centers (Bellevue and South Coast Metro), the walk mode shares appear to be higher than the overall average. The shorter potential walk distances (coupled with the Bellevue pedestrian pathway system) contribute directly to an increased walk mode share. The transit mode shares for internal trips are low across most of the residential sites. One exception is the Rotonda in Tysons Corner, which has a 5 percent transit mode share for internal trips. The Rotonda provides a shuttle bus service, for its residents only, to ride to various close-by retail sites, some of which are even outside the activity center.

The purposes of the trips internal to the SAC made by the SAC residents and their proportions are as follows: work—24

Table 34. Residential site characteristics.

Residential Site	Year Built	Type of Dwelling Units	Number of Dwelling Units		Number of Occupied Dwelling Units		Average No. of Bedrooms per Unit
			Rental	Owner	Rental	Owner	
<u>Bellevue</u>							
The East Side 1264 Bellevue Way, NE	1984	Low-Rise Apartments (Townhouse)	168	--	147	--	48 -1BR 120 -2BR Avg. - 1.71
The Park 1515 Bellevue Way, NE	1985	Low-Rise Apartments (Townhouse)	184	--	168	--	48 - 1BR 136 -2BR Avg. - 1.74
12 Central Square 10290 NE 12th St.	1984	High-Rise Apartment	204	--	171	--	204 -2BR Avg. - 2.00
<u>South Coast Metro</u>							
The Lakes of South Coast 3400 Avenue of the Arts	1986	High-Rise Luxury Apt.	772	---	710	---	85-Studio 331 -1BR 332 -2BR 24 -3BR+ Avg. 1.49
The Cape at Metro Pointe 1000 South Coast Drive	1986	Low-Rise Apartment	296	---	246	---	228-1BR 68-2BR Avg. - 1.23
Village Creek	1978	Low-Rise Condominium (Townhouse)	---	133	---	133	NA
<u>Parkway Center</u>							
Spring Meadows 5636 Spring Valley Rd.	1978	Low-Rise Apartments	152	--	128	--	24 -Eff 80 - 1BR 48 - 2BR Avg. - 1.31
Carolina Chase Apts. 5351 Peterson Lane	1968	Low-Rise Apartments	334	--	280	--	40 - Eff. 106 -1BR 164 -2BR 24 - 3BR Avg. - 1.63
Preston Racquet Club 5840 Spring Valley Rd.	1982	Low-Rise Condominium	--	184	--	170	40 - 1BR 144 -2BR Avg. - 1.78
Galleria Plaza Apts. 13408 Noel Road	1975	Low-Rise Apartments	153	--	109	--	56 -1BR 93 -2BR 4 -3BR Avg. - 1.66

Table 34. Continued

Residential Site	Year Built	Type of Dwelling Units	Number of Dwelling Units		Number of Occupied Dwelling Units		Average No. of Bedrooms per Unit
			Rental	Owner	Rental	Owner	
<u>Perimeter Center</u>							
Dunwoody Chace 6135 Peachtree-Dunwoody Rd.		Low-Rise Apartments (Townhouses)	50	--	50	--	NA
Dunwoody Springs 6150 Peachtree-Dunwoody Rd.		Low-Rise Condominiums (17 Single-Family Detached)	139	17	134	16	NA
<u>Tysons Corner</u>							
The Commons of McLean 1653 Anderson Rd.		High-Rise Apt/Condo Low-Rise Condo (Townhouses)	200	349	175	349	NA
			---	28	---	28	
The Rotonda 8352 Greensboro Dr.		High-Rise Apartments	408	760	400	760	271 -1BR 672 -2BR 225 -3BR Avg. - 1.96
<u>Southdale</u>							
Edinborough York Ave.	1987	Low-Rise Condominiums (Townhouses)	---	392	---	360	NA
The Colony 6328 Barrie Rd.		High-Rise Apartment	310	---	265	---	NA
The Cedars 7340 Gallagher Dr.		Low-Rise Apartments	510 ¹	---	415	---	NA
The Durham 7201 York Ave.		Low-Rise Apartments	275	---	220	---	NA
York Plaza 7200 York Ave.		High-Rise Apartments High-Rise Condos	265	---	210	---	NA
			---	265	---	260	

Table 35. Residential vehicle trips (AM and PM peak hour).

Residential Site	# DU's	Occupied DU's	Total Trips	<u>AM Peak Hour (total vehicle trips)</u>				Outbound Auto Occupancy	ITE Trips/ Occ. DU	ITE Trips/ Resident
				Trips/ DU	Trips/ Occupied DU	Trips/ Resident ¹	% Outbound			
<u>Bellevue</u>										
The East Side	168	147	53	0.32	0.36	0.23	88.7	1.11	0.48 ²	0.28 ²
The Park	184	168	75	0.41	0.45	0.32	85.5	1.17	0.48 ²	0.28 ²
12 Central Square	204	171	77	0.38	0.45	0.22	79.2	1.26	0.35 ³	0.27 ²
<u>South Coast Metro</u>										
The Lakes at South Coast	772	710	301	0.39	0.42	0.24	85.0	1.07	0.30 ³	0.27 ²
The Cape at Metro Pointe	296	246	139	0.47	0.57	0.33	91.4	1.21	0.47 ²	0.26 ²
Village Creek	133	133	63	0.47	0.47	0.25	73.0	1.13	0.50 ⁴	0.25 ⁴
<u>Parkway Center</u>										
Spring Meadows	152	128	126	0.83	0.98	0.61	56	1.16	0.49 ²	0.28 ²
Carolina Chase Apts.	334	280	113	0.34	0.40	0.22	79	1.17	0.47 ²	0.26 ²
Preston Raquet Club	184	170	114	0.62	0.67	0.42	87	1.07	0.47 ⁴	0.24 ⁴
Galleria Plaza Apts.	153	109	55	0.36	0.50	NA	75	1.10	0.49 ²	NA

Residential Site	# DU's	Occupied DU's	Total Trips	<u>AM Peak Hour (total vehicle trips)</u>				Outbound Auto Occupancy	ITE Trips/ Occ. DU	ITE Trips/ Resident
				Trips/ DU	Trips/ Occupied DU	Trips/ Resident	% Outbound			
<u>Perimeter Center</u>										
Dunwoody Chace	50	50	35	0.70	0.70	NA	91	1.00	0.55 ²	NA
Dunwoody Springs	156	150	128	0.82	0.85	NA	90	1.10	0.49 ⁴	NA
<u>Tysons Corner</u>										
The Commons of McLean ⁵	246	235	133	0.54	0.57	0.35	78	1.13	0.45 ⁴	0.21 ⁴
The Rotonda	1168	1160	388	0.33	0.33	0.20	86	1.25	0.34 ⁴	0.14 ⁴
<u>Southdale</u>										
Edinborough	392	360	132	0.34	0.37	0.28	89	1.09	0.41 ⁴	0.19 ⁴
Cedars of Edina	510	415	219	0.43	0.53	0.41	92	1.11	0.46 ²	0.26 ²
York Plaza	530	470	120	0.23	0.26	NA	88	1.18	0.40 ⁴	NA

Table 35. Continued

Residential Site	# DU's	Occupied DU's	Total Trips	PM Peak Hour (total vehicle trips)						
				Trips/ DU	Trips/ Occupied DU	Trips/ Resident	% Inbound	Inbound Auto Occupancy	ITE Trips/ Occ. DU	ITE Trips/ Resident
<u>Bellevue</u>										
The East Side	168	147	84	0.50	0.57	0.36	70.2	1.08	0.63 ²	0.34 ²
The Park	184	168	89	0.48	0.53	0.38	67.4	1.15	0.62 ²	0.34 ²
12 Central Square	204	171	90	0.44	0.53	0.31	73.3	1.20	0.45 ³	0.34 ²
<u>South Coast Metro</u>										
The Lakes at South Coast	772	710	255	0.33	0.36	0.20	72.7	1.16	0.42 ³	0.32 ²
The Cape at Metro Pointe	296	246	145	0.49	0.59	0.35	68.3	1.15	0.58 ²	0.32 ²
Village Creek	133	133	94	0.71	0.71	0.37	64.9	1.11	0.60 ⁴	0.32 ⁴
<u>Parkway Center</u>										
Spring Meadows	152	128	158	1.04	1.23	0.77	52	1.20	0.60 ²	0.35 ²
Carolina Chase Apts.	334	280	134	0.40	0.48	0.27	55	1.25	0.57 ²	0.32 ²
Preston Raquet Club	184	170							4	4
Galleria Plaza Apts.	153	109	116	0.76	1.06	NA	54	1.48	0.66 ²	NA
<u>Perimeter Center</u>										
Dunwoody Chace	50	50	30	0.60	0.60	NA	70	1.10	0.92 ²	NA
Dunwoody Springs	156	150	124	0.79	0.83	NA	65	1.21	0.59 ⁴	NA
<u>Tysons Corner</u>										
The Commons of McLean ⁵	246	235	115	0.47	0.49	0.31	63	1.13	0.53 ⁴	0.27 ⁴
The Rotonda	1168	1160	385	0.33	0.33	0.20	71	1.28	0.38 ⁴	0.18 ⁴
<u>Southdale</u>										
Edinborough	392	360	145	0.37	0.40	0.31	67	1.09	0.49 ⁴	0.19 ⁴
Cedars of Edina	510	415	216	0.42	0.52	0.40	69	1.15	0.54 ²	0.32 ²

¹ Number of residents is based on average number of residents per household in the listed residential complex as shown in Table 36.

² Based on ITE Land Use Code 220 (Apartment); for complexes with known household size characteristics, appropriate adjustment factors have been applied.

³ Based on ITE Land Use Code 222 (High-Rise Apartment)

⁴ Based on ITE Land Use Code 230 (Residential Condominium)

⁵ Trip generation counts were taken at only a portion of the total complex.

Table 36. Characteristics of SAC residents.

Residential Site	# DU's	Average No. Residents/ Household	Average No. Vehicles/ Household	Median Age	% 65 Years Or Older	% Households With Employed Resident	Average No. Employees/ Household
Bellevue							
East Side	168	1.6	1.6	40	3	100	1.1
The Park	184	1.4	1.5	41	16	100	1.1
12 Central Square	204	1.7	1.4	55	33	77	0.8
South Coast Metro							
The Lakes	772	1.8	1.6	35-44	2	100	1.3
The Cape	296	1.7	1.6	35-44	0	95	1.3
Village Creek	133	1.9	1.8	35-44	6	98	1.2
Parkway Center							
Spring Meadows	152	1.6	1.6	25-34	0	100	1.1
Carolina Chase	334	1.8	1.3	25-34	0	100	1.3
Preston Racquet Club	184	1.6	1.7	25-34	0	100	1.6
Tyson's Corner							
Commons	577	1.6	1.6	35-44	7	85	1.1
Rotonda	1168	1.7	1.5	55-64	60	61	0.8
Southdale							
Edinborough	392	1.3	1.3	35-44	13	69	0.9
The Colony	310	1.4	1.3	45-54	8	72	0.9
The Cedars	510	1.3	1.2	25-34	2	86	0.9
The Durham	275	1.9	1.5	55-64	11	50	0.6

percent; shopping—19 percent; eat—11 percent; bank—10 percent; grocery store—8 percent; social/recreation—7 percent; gas station—8 percent; pick-up/drop-off passengers—4 percent; medical—3 percent; health/fitness club—3 percent; dry cleaners—3 percent. All other categories fall below 2 percent of the total trips.

Table 37. Intra-SAC trips made by residents.¹

Residential Site	% of Employed Residents ² Which Work Within SAC	Mode of Trips Made Within the SAC		
		Auto	Walk	Transit
Bellevue				
East Side	45%	85%	15%	0%
The Park	32	86	4	0
12 Central Square	27	72	24	4
South Coast Metro				
The Lakes	33	76	24	0
The Cape	13	96	4	0
Village Creek	27	89	11	0
Parkway Center				
Spring Meadows	33	100	0	0
Carolina Chase	50	91	0	9
Preston Racquet Club	14	98	2	0
Tyson's Corner				
Commons	40	93	6	1
Rotonda	33	94	1	5
Southdale				
Edinborough	27	98	2	0
The Colony	15	87	10	3
The Cedars	32	93	2	5
The Durham	33	94	4	2

¹ Use of these data by individual residential complex is cautioned. A more appropriate use of the data would be in total.

² Based on the trip diary provided by the survey respondents, it is estimated that on average the residents make 2.8 trips outside their complex but internal to the SAC.

HOTEL ANALYSIS

SURVEY SITES

The hotel survey process included both (1) a person and vehicle trip generation count during the morning and evening peak periods and (2) an intercept survey conducted within the hotel during the identical peak periods.

The 15 hotels at which counts and/or surveys were conducted are described in Table 38. The site description includes the total number of guest rooms, the total conference/meeting room space, the number (and size, if available) of hotel restaurants and lounges, and any additional descriptive information that could aid in the interpretation of the count and survey results. The level of use of hotel facilities and the survey/count date are also provided. Also shown are the number of rooms and the amount of conference/meeting room space occupied on the date.

TRIP GENERATION

Person and vehicle trips generated by the hotel study sites are presented in Table 39 for the morning peak hour and in Table 40 for the evening peak hour. A comparison of these trip generation rates with those presented in the ITE *Trip Generation* report reveals that the majority of the activity center hotel sites have lower trip generation rates than the ITE average. This relationship holds true whether the comparison is conducted for the morning or evening peak hour or on the basis of total rooms or occupied rooms.

However, it is critical to note that the ITE rates for hotel trip generation on a per total room basis are derived from a data base of five sites for the morning peak hour and seven sites for the evening peak hour. Therefore, the data collected in this study for 15 hotel sites will, in itself, quadruple the size of the morning peak hour data base and triple the size of the evening peak hour data base.

A comparison of the range of rates observed for the 15 surveyed hotel sites and the range of rates reported by ITE indicates two conclusions: (1) the two data sets are comparable in the wide variety in trip generation rates and (2) because of this tremendous variation in trip generation rates, additional research is required to be conducted on the trip-making characteristics of hotels. For example, the combined data sets would have a morning peak hour rate range between 0.16 and 1.42 per room. Discarding even the lowest and highest rates as outliers nets a range of 0.25 to 0.93 per room. Using the same logic of discarding potential outlying data points, the morning peak hour rate per occupied room ranges between 0.43 and 1.22. For the evening peak hour, the per room rate ranges between 0.22 and 0.95 and the per occupied room rate ranges between 0.35 and 1.07.

Results from this NCHRP study would indicate that additional research is warranted on hotel trip generation which addresses the issue of improving the classification of hotels. Several additional independent variables could be evaluated,

including: the hotel "class" and rate structure, the amount and use of conference/meeting room space, and the amount of on-site retail and service use.

TRIP ORIGIN AND DESTINATION

The amount of interaction between the surveyed hotels and other buildings within the suburban activity center is presented in Table 41. Shown for each of the surveyed hotels are (1) the proportions of vehicle trips entering the hotel during the morning or evening peak period that originate within the activity center and (2) the proportions of vehicle trips exiting the hotel during the morning or evening peak period that are destined to a location within the activity center.

For example, at the Marriott Quorum at Parkway Center, 22 percent of the morning peak period vehicle trips entering the hotel originate within Parkway Center. Likewise, 50 percent of the vehicle trips leaving the hotel during the morning peak period are destined to locations within Parkway Center. Weighting these origin and destination proportions by the site peak hour directional volumes produces a net 37 percent of all morning peak hour vehicle trips being internal to the activity center.

The trip origin/destination pattern for hotels follows a definite pattern if the hotels are grouped in accordance with the overall size of the suburban activity center. For the hotels located in the three smaller surveyed SACs (Bellevue, South Coast Metro, and Southdale), the overall average morning peak hour internal proportion is 19 percent. In the evening, the average is 27 percent. In contrast the hotels located in the three larger SACs (Parkway Center, Perimeter Center, and Tysons Corner) have a morning peak hour internal proportion of 37 percent and an afternoon proportion of 36 percent. The differences between the proportions observed at hotels in smaller versus larger activity centers are a function of the supply of office space to generate trip attractions and productions. In this study, the larger activity centers have on the order of four times the office space of the smaller activity centers. The apparent result is a doubling in the morning proportion of internal trips generated by hotels and a roughly 33 percent increase in the evening proportion of internal trips.

TRIP PURPOSE

The distribution of general purposes for individuals visiting each surveyed hotel is presented in Table 42. Each individual is categorized as one of the following: overnight guest only (e.g., on personal business, business meeting at another location); overnight guest and attending a meeting/conference in hotel; attending a meeting/conference in the hotel but not staying overnight (e.g., local resident, staying at another hotel); solely to pick up or drop off a guest of the hotel; visit restaurant or lounge; employee. Analysis of these trip purposes can provide

Table 38. Hotel survey sites.

Hotel	Number of Rooms (Occupied)	Conference/ Meeting Rooms (Occupied) (gsf)	Restaurants/Lounges	Comments
Bellevue				
Greenwood Hotel	176 (167-AM) (164-PM)	6,600 (69%-AM) (80%-PM)	1 restaurant (125 seats) 1 lounge (225 seats)	No adjacent office space; 11/3/87 survey date
Red Lion Inn	355 (320-AM) (355-PM)	17,500 (80%-AM) (80%-PM)	2 restaurants (250 seats) 1 lounge (260 seats)	No adjacent office space; 11/3/87 survey date
South Coast Metro				
Westin South Coast Plaza	394 (355)	16,010 (65%)	5 restaurants	High-rise; adjacent to 1.4 million gsf office; 3/1/88 survey date
Beverly Heritage	238 (220)	4,400 (40%)	1 restaurant/lounge	Adjacent to 500,000 gsf office; 3/9/88 survey date
Parkway Center				
Westin Galleria	440 (365)			High-rise; part of Galleria complex (1 million gsf office and 1 million gsf retail); health club; 4/6/88 survey date
Marriott Quorum	548 (514)	16,200 (60%-AM) (30%-PM)	1 restaurant (222 seats) 1 lounge (125 seats)	High-rise; adjacent to 600,000 gsf office; 4/7/88 survey date
Hampton Inn	160 (93-AM) (120-PM)	1,300 (0)	None	Low-rise business hotel; adjacent to 100,000 gsf office; 4/5/88 survey date
Perimeter Center				
Hyatt Regency Ravinia	533 (380)	12,000 (50%)	2 restaurants 2 lounges	Built in 1986; high-rise adjacent to Ravinia office complex (800,000 gsf); health club; 4/21/88 survey date
Marriott	406 (264)	8,600 (60%)	1 restaurant 2 lounges	Built in 1979; high-rise; adjacent to 480,000 gsf office; 4/19/88 survey date
Doubletree Hotel	371 (200)	8,500 (30%)	2 restaurants	Built in 1987; high-rise; adjacent to Concourse office complex (700,000 gsf); 4/20/88 survey date
Tysons Corner				
Hilton	456 (330)	22,095 (55%)	2 restaurants (274 seats) 1 lounge	Adjacent to 800,000 gsf office; 5/11/88 survey date
Sheraton	455 (407-AM) (342-PM)	34,200 (50%-AM) (40%-PM)	2 restaurants (230 seats) 3 lounges (300 seats)	High-rise; conference space includes 2,800 sf amphitheater; adjacent to 200,000 gsf office; 6/8/88 survey date
Southdale				
Radisson	575 (433-AM) (345-PM)	30,400 (60%-AM) (40%-PM)	5 restaurants 1 lounge	High-rise; no adjacent office space; 5/25/88 survey date
Ramada Inn	186 (151)	4,000 (40%)	1 restaurant	Adjacent to 300,000 gsf office; 5/24/88 survey date
Hotel Seville	254 (55-AM) (75-PM)	4,000 (10%-AM) (20%-PM)	1 restaurant 1 lounge (96 seats)	High-rise (Best Western); adjacent to 200,000 gsf office; 5/23/88 survey date

another indication of the function of the hotel in terms of its interaction with other land uses in the activity center.

For most of the hotels, the majority of morning peak hour trips are made by overnight guests. Across the 14 surveyed hotels, the median proportion of morning peak period trips that are made by overnight guests is in the 70 to 80 percent range. During the afternoon peak period, the median proportion falls to the 50 to 60 percent range.

Although not as large a component as overnight guest trips, the trips by persons attending a meeting or conference in the hotel are nevertheless significant. During the morning peak period, the median proportion of meeting/conference trips is in the 30 to 40 percent range. During the evening peak period, the median proportion falls to the 20 to 30 percent range.

TRIP MODE SHARE

The trip mode shares for peak period trips to and from the surveyed hotel sites are given in Table 43. Relatively few morning peak period trips are by foot. However, the evening peak period sees two sites with at least 10 percent walk mode shares. The Doubletree Hotel in Perimeter Center is adjacent to 700,000 square feet of office space and has a 15 percent walk mode share. The Westin Plaza in South Coast Metro (with a 10 percent walk mode share) is adjacent to 1.4 million square feet of office and is directly across the street from the regional mall. At the same time, there are several hotels with similar "proximity" characteristics as these, but with relatively small walk mode shares.

Table 39. Hotel trips generated during AM peak hour.

Hotel	Total Peak Hour Trips		Trips Per Room		Trips Per Occupied Room		Percentage Inbound	Avg. Auto Occupancy
	Person	Vehicle	Person	Vehicle	Person	Vehicle		
Bellevue								
Greenwood Hotel	327	250	1.86	1.42	1.96	1.50	70	1.31
Red Lion Inn	371	331	1.05	0.93	1.16	1.03	64	1.12
South Coast Metro								
Westin Plaza	197	151	0.50	0.38	0.55	0.43	54	1.20
Beverly Heritage	212	130	0.89	0.55	0.96	0.59	55	1.61
Parkway Center								
Westin Galleria	292	234	0.66	0.53	0.80	0.64	51	1.25 ¹
Marriott Quorum	192	138	0.35	0.25	0.37	0.27	48	1.28
Hampton Inn	92	53	0.58	0.33	0.99	0.57	37	1.35
Perimeter Center								
Hyatt Regency Ravinia	232	190	0.44	0.36	0.61	0.50	56	1.22
Marriott	426	321	1.05	0.79	1.61	1.22	56	1.32
Doubletree Hotel	137	103	0.37	0.28	0.68	0.52	60	1.33
Tysons Corner								
Hilton	395	311	0.87	0.68	1.20	0.94	35	1.22 ¹
Sheraton	311	235	0.68	0.52	0.76	0.58	60	1.25
Southdale								
Radisson	312	254	0.54	0.44	0.72	0.74	57	1.19 ¹
Ramada Inn	82	68	0.44	0.37	0.54	0.45	34	1.21
Hotel Seville	59	41	0.23	0.16	1.07	0.75	51	1.39

¹ Estimated from intercept surveys

Table 40. Hotel trips generated during PM peak hour.

Hotel	Total Peak Hour Trips		Trips Per Room		Trips Per Occupied Room		Percentage Inbound	Avg. Auto Occupancy
	Person	Vehicle	Person	Vehicle	Person	Vehicle		
Bellevue								
Greenwood Hotel	217	168	1.23	0.95	1.32	1.02	62	1.24
Red Lion Inn	324	210	0.91	0.59	0.91	0.59	50	1.53
South Coast Metro								
Westin Plaza	129	87	0.33	0.22	0.36	0.25	54	1.43
Beverly Heritage	269	148	1.13	0.62	1.22	0.67	59	1.38
Parkway Center								
Westin Galleria	300	226	0.68	0.51	0.82	0.62	49	1.30 ¹
Marriott Quorum	230	178	0.42	0.32	0.45	0.35	52	1.26
Hampton Inn	75	44	0.47	0.28	0.63	0.37	66	1.48
Perimeter Center								
Hyatt Regency Ravinia	394	315	0.74	0.59	1.04	0.83	58	1.25
Marriott	388	282	0.96	0.69	1.47	1.07	71	1.34
Doubletree Hotel	238	196	0.64	0.53	1.19	0.98	65	1.21
Tysons Corner								
Hilton	279	223	0.61	0.49	0.85	0.68	52	1.25 ¹
Sheraton	419	311	0.92	0.68	1.23	0.91	51	1.27
Southdale								
Radisson	426	333	0.74	0.58	1.23	0.97	57	1.21 ¹
Ramada Inn	155	120	0.83	0.64	1.03	0.79	73	1.22
Hotel Seville	68	50	0.27	0.20	0.91	0.67	50	1.32

¹ Estimated from intercept surveys

Table 41. Hotel trips to and from the activity center.

Hotel	Proportion of AM Peak Period Trips to/from within Activity Center			Proportion of PM Peak Period Trips to/from within Activity Center		
	Origin	Destination	Total	Origin	Destination	Total
Bellevue						
Greenwood Hotel	23%	49%	31%	35%	30%	33%
Red Lion Inn	9	31	17	39	33	36%
South Coast Metro						
Westin Plaza	10	17	13	21	8	15
Beverly Heritage	15	27	20	30	12	23
Parkway Center						
Westin Galleria	43	41	42	44	47	46
Marriott Quorum	22	50	37	47	32	40
Hampton Inn	33	64	53	43	29	38
Perimeter Center						
Marriott	4	45	22	19	28	22
Doubletree Hotel	50	49	50	47	32	42
Tysons Corner						
Hilton	36	36	36	25	43	34
Sheraton	14	21	17	18	40	29
Southdale						
Radisson	10	25	16	32	14	24
Ramada Inn	13	20	18	37	14	31
Hotel Seville	17	23	20	34	16	25
Hotels located in small SAC's	14	27	19	33	18	27
Hotels located in large SAC's	29	44	37	35	36	36

Table 42. Trip purpose at hotel sites.

Hotel	AM Peak Period Trip Purpose						PM Peak Period Trip Purpose					
	Overnight Guest Only	Overnight Guest	Local Resident	Pick Up/ Drop Off Guest	Restaurant/ Lounge	Employee	Overnight Guest Only	Overnight Guest	Local Resident	Pick Up/ Drop Off Guest	Restaurant/ Lounge	Employee
Bellevue												
Greenwood Hotel	33%	0%	62%	0%	5%	0%	9%	12%	35%	0%	41%	3%
Red Lion Inn	34	3	32	14	17	1	31	14	23	8	21	3
South Coast Metro												
Westin Plaza	13	7	74	0	0	6	33	0	23	7	17	20
Beverly Heritage	100	0	0	0	0	0	100	0	0	0	0	0
Parkway Center												
Westin Galleria	50	11	28	6	1	4	36	8	20	7	16	13
Marriott Quorum	38	34	8	12	2	6	46	5	15	20	7	7
Hampton Inn	92	0	0	8	0	0	68	0	0	29	0	3
Perimeter Center												
Hyatt Regency Ravinia												
Marriott	61	12	11	8	5	3	37	15	29	5	10	4
Doubletree Hotel	26	55	14	2	3	0	35	20	20	3	19	3
Tysons Corner												
Hilton	43	17	20	1	15	4	21	38	12	0	21	8
Sheraton	46	14	30	2	4	4	74	22	4	0	0	0
Southdale												
Radisson	40	36	17	2	3	2	16	11	48	8	13	4
Ramada Inn	74	17	0	6	0	3	49	0	12	0	33	6
Hotel Seville	72	0	9	13	0	6	50	0	8	0	23	19

Table 43. Hotel trip mode shares.

Hotel	Mode of AM Peak Period Trips				Mode of PM Peak Period Trips			
	Personal ¹ Auto	Rental Car	Taxi/Limo Shuttle	Walk	Personal ¹ Auto	Rental Car	Taxi/Limo Shuttle	Walk
Bellevue								
Greenwood Hotel	70%	16%	14%	0%	80%	14%	3%	3%
Red Lion Inn	79	16	5	0	73	23	4	0
South Coast Metro								
Westin Plaza	84	10	3	3	62	28	0	10
Beverly Heritage	100	0	0	0	100	0	0	0
Parkway Center								
Westin Galleria	91	5	4	0	85	5	8	2
Marriott Quorum	82	6	6	6	63	24	10	3
Hampton Inn	100	0	0	0	80	14	3	3
Perimeter Center								
Marriott	78	11	11	0	64	30	4	2
Doubletree Hotel	89	2	7	2	65	14	6	15
Tysons Corner								
Hilton	75	20	1	4	67	33	0	0
Sheraton	80	17	2	1	29	65	6	0
Southdale								
Radisson	88	6	3	3	81	14	2	3
Ramada Inn	92	5	3	1	69	17	11	3
Hotel Seville	100	0	0	0	69	23	4	4

¹ Includes being picked up or dropped off in a personal auto

CHAPTER TEN

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

NCHRP Project 3-38(2) has produced a vast amount of useful information on travel characteristics at large-scale suburban activity centers (SAC). The product of the research is a series of relationships between selected independent variables and the desired travel characteristics. The independent variables include individual building characteristics (such as building size, proximity to complementary land uses, and parking availability and cost) and SAC characteristics (such as overall mix of office/retail, development density, and location within the urban area).

The key qualitative findings can be summarized as follows. First, there is a great deal of internalization (i.e., within the SAC) of trips generated by the retail development. The extent of this internalization is a function of the type of retail and the overall SAC office/retail mix. Second, there is significant interaction between the office buildings located within the SAC.

Third, although the foregoing two points portray similarities to central business districts, there still is a major difference in their modes of travel. The vast majority of internal SAC trips are by automobile, even in SACs where parking supply is limited and parking costs are paid by employees. Fourth, intermediate stops on the way to and from work and midday are made by a majority of office employees. Fifth, a significant proportion of the employed SAC residents also work within the SAC. Sixth, peak period vehicle trips generated by hotels with conference facilities are dominated by non-guest, local trips and a significant proportion of the trips are internal to the SAC. And seventh, in order to maintain mobility and economic vitality within suburban activity centers (and indeed within any activity center, including CBDs), the elements of the transportation and land use system must be compatible. These elements include site design (e.g., the orientation of the site and its on-site facilities),

land use (e.g., mix composition, size, density, proximity), and the transportation system and its management (both of the supply and demand). The research found cases where each of these elements was "deficient" and had an adverse effect on the mobility of the SAC employees, residents, or visitors. For example, many individual building sites or complexes are focused inward with little provision for pedestrian interaction with adjacent sites. Transit service is virtually nonexistent in all but the Bellevue SAC, thereby necessitating the use of the automobile for commute trips and for midday trips. Despite the large number of midday trips to the regional malls from adjacent office complexes, only limited pedestrian facilities are typically provided.

Based on the research results presented in this report, it is clear that there is a great deal of interaction between buildings located within large-scale suburban activity centers. Despite this high level of interaction, traffic congestion within the SAC and on its access routes is perceived to be a significant problem by virtually all tenants of the SAC (employers, workers, shoppers, visitors, and residents). A key factor in this perceived congestion problem is the dominating reliance in the SAC on the private automobile. In order to address this problem, the following actions are suggested:

- Cluster buildings in order to increase their proximity and, thereby, pedestrian access. Mixed-use centers like the Galleria in Parkway Center generate a tremendous amount of intra-site trips which both serve the needs of the employees/shoppers and do not add to traffic volumes in the SAC.
- Directly serve the SAC with radial bus transit service. Focus this service on a centralized transit center. Although the practical limit may be a transit mode share of roughly 6 percent overall, this mode share nevertheless represents a significant number of employees in these large-scale SACs. Traffic congestion would be noticeably reduced in the majority of SACs in which transit patronage is currently nil.
- Connect building sites with pathways, even in the less dense sectors of the SAC. These can include pedestrian overpasses or underpasses across major highways or just simply sidewalks or striped pathways in parking lots. In order to minimize the reliance on the automobile for the midday trip by office employees, it will be necessary to provide continuous and direct pedestrian systems.
- Promote community support—public and private. Some of the dense and clustered suburban development described above is occurring, especially in redeveloping suburban business districts with transit stations. However, this type of development cannot realistically be expected to occur in newer areas without substantial policy influence.

RECOMMENDATIONS FOR ADDITIONAL RESEARCH

With the wealth of new travel characteristics data collected for this NCHRP project, it is expected that numerous research efforts will be undertaken to extract findings from the data base. The following are suggested topics for additional research which could use the NCHRP Project 3-38(2) data as a base. The first suggested research topics require no, or very little, additional data collection or compilation. The latter topic suggestions require significant field data collection to supplement the NCHRP data base.

The NCHRP research analysis, to this point, has focused at the SAC level. In order to derive more complete explanations for the observed variations in travel characteristics between SACs and between buildings, it will be necessary to conduct analyses at the individual building level. For some travel characteristics, it may be necessary to conduct the analyses at the individual employer level. It would be expected that variations in the building-level characteristics will be a function of both the building itself and its tenants as well as of the land uses and their intensities within close proximity of the building being analyzed. Because each workplace survey data record corresponds to a single individual survey respondent, the analyses can be aggregated to the employer or building or sector level or retained as a disaggregated data set.

The topics of employee densities and of building occupancies, as demonstrated in the report, require additional research. Despite the concerted efforts of the researchers, building occupancy rates and the number of on-site employees proved to be elusive figures. It was therefore necessary to use potentially imprecise values in the analyses. It is recommended that more research and development be undertaken for standardizing a methodology for determining and computing building occupancy levels.

It has been postulated by others that there is a direct relationship between employee density and building age, given a constant building occupancy. With the available data, it would be possible to determine for the surveyed office buildings whether employee densities do indeed change with the building age.

This report presents some comparisons between the SAC travel characteristics and those found in other sectors of the region, most notably the CBD. It is recommended that some effort be expended in comparing the SAC travel characteristics (e.g., commute trip length and travel time) to regional or CBD or non-SAC/CBD averages.

The research effort determined the travel characteristics at individual buildings within six large-scale suburban activity centers across the country. An important issue to the practitioner is whether the observed travel characteristics at the building level are the same whether the building is located within a large SAC, moderate SAC, or small SAC. Field data collection comparable to that described in this report, but perhaps to a more limited degree, would need to be undertaken. It also is recommended that travel characteristics data be collected at SACs (1) with either on-site shuttle operations or bus transit service focused on the SAC, like Bellevue, and (2) at suburban business districts with rail transit stations, like Bethesda, Maryland. These data could further demonstrate and quantify the effect of a multimodal transportation system on SAC travel characteristics.

The research analysis suggests that as pedestrian accessibility is improved between buildings, the number of pedestrian trips likewise increases. However, it is unknown whether the total number of person-trips between SAC buildings increases with pedestrian accessibility or whether only the mode changes. In other words, does the walk trip simply replace an automobile trip? Additional manipulation of the existing data will be necessary.

Another issue regarding internal trip-making is whether there is a relationship between the number of internal trips made by office employees and the diversity of land uses. The research found that the proportion of internal trips is a function of the

mix of land uses outside the SAC. Further analysis of the data may confirm the above relationship.

The data collected and analyzed on hotel trip generation rates point to the need for an expanded hotel trip generation data set and for a concerted review of the potential independent variables affecting hotel trip generation. This will involve additional data collection and further analysis of existing data.

As part of the research effort, information was collected and reported on pass-by trip characteristics at retail centers and for office building visitors. It became clear during analysis of the intercept surveys that the definition of a "pass-by trip" varies from individual to individual. To one person, a shift in travel

path of a single block produces a "diverted" trip. In contrast, another person traveling on the adjacent freeway along his way home, exits to shop at a regional mall and considers the trip "pass-by." Further analysis and refinement of the pass-by trip percentages and their definitions are recommended.

The analysis of travel characteristics at SAC retail centers was primarily focused on the large regional malls. It is recommended that more detailed analyses be conducted of the varying travel characteristics at the smaller retail centers. It may be necessary to supplement the NCHRP data base with additional field surveys.

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