



Pre-Census Travel Behavior Report
Analysis of the 2000 SACOG Household Travel Survey

prepared for
Sacramento Area
Council of Governments

prepared by
DKS Associates
Mark Bradley Research & Consulting

July 25, 2001

TABLE OF CONTENTS

<u>1</u>	<u>EXECUTIVE SUMMARY</u>	1
1.1	<u>Background</u>	1
1.2	<u>What is “Travel Behavior”?</u>	2
1.3	<u>Frequency of Travel</u>	2
1.4	<u>Purpose of Travel</u>	4
1.5	<u>Mode of Travel</u>	5
1.6	<u>Time of Travel</u>	6
1.7	<u>Duration of Travel</u>	7
<u>2</u>	<u>BACKGROUND</u>	8
<u>3</u>	<u>DEMOGRAPHICS OF THE SURVEY SAMPLE</u>	10
3.1	<u>Background on the Sampling Approach</u>	10
3.2	<u>Key Demographic Variables</u>	12
3.2.1	<u>Population</u>	12
3.2.2	<u>Household Structure</u>	13
3.2.3	<u>Employment and Income</u>	14
3.2.4	<u>Vehicle Ownership</u>	14
<u>4</u>	<u>WHAT IS TRAVEL BEHAVIOR?</u>	15
4.1	<u>Trips</u>	15
4.1.1	<u>Trip Purpose</u>	15
4.1.2	<u>Trip Mode</u>	16
4.1.3	<u>Time of Travel</u>	17
4.1.4	<u>Duration of Travel</u>	18
4.2	<u>Tours and Day Patterns</u>	18
<u>5</u>	<u>FREQUENCY OF TRAVEL</u>	21
5.1	<u>Analysis of Trips</u>	21
5.1.1	<u>Variation in Trip Frequency by Purpose of Travel</u>	21
5.1.2	<u>Variation in Trip Frequency by Household Structure</u>	22
5.1.3	<u>Variation in Trip Frequency by Income and Auto Ownership</u>	23
5.1.4	<u>Trip Summary</u>	24
5.2	<u>Analysis of Tours</u>	26
5.2.1	<u>Variation of Tour Frequency by Purpose of Travel</u>	26
5.2.2	<u>Variation in Tour Frequency by Household Structure and Person Type</u> ..	27
5.2.3	<u>Tour Complexity</u>	27
5.2.4	<u>Tour Summary</u>	28

<u>6</u>	<u>MODE OF TRAVEL</u>	29
<u>6.1</u>	<u>Analysis of Trips</u>	29
<u>6.1.1</u>	<u>Variation in Trip Mode by Purpose of Travel</u>	29
<u>6.1.2</u>	<u>Variation in Trip Mode by Household Structure</u>	30
<u>6.1.3</u>	<u>Variation in Trip Mode by Vehicle Ownership</u>	30
<u>6.1.4</u>	<u>Variation in Trip Mode by Area Type</u>	31
<u>6.1.5</u>	<u>Trip Summary</u>	32
<u>6.2</u>	<u>Analysis of Tours</u>	36
<u>6.2.1</u>	<u>Variation in Mode of Travel by Purpose</u>	36
<u>6.2.2</u>	<u>Variation in Mode of Travel by Person Type</u>	36
<u>7</u>	<u>TIME OF TRAVEL</u>	37
<u>7.1</u>	<u>Analysis of Trips</u>	37
<u>7.2</u>	<u>Analysis of Tours</u>	39
<u>8</u>	<u>DURATION OF TRAVEL</u>	41
<u>9</u>	<u>WORKPLACE AMENITIES</u>	43

APPENDIX

LIST OF TABLES

<u>Table 1 Demographics of the Sample</u>	13
<u>Table 2 Distribution of Households, Person, and Trips by Household Size</u>	21
<u>Table 3 Distribution of Trips by Purpose</u>	22
<u>Table 4 Distribution of Households, Persons and Trips by Household Class</u>	23
<u>Table 5 Distribution of Households, Persons and Trips by Income Category</u>	24
<u>Table 6 Frequency of Tours</u>	26
<u>Table 7 Tour Frequency by Purpose</u>	27
<u>Table 8 Number of Stops on Work Tours by Gender and Presence of School Age Children in Household</u>	28
<u>Table 9 Trips by Mode and Purpose</u>	29
<u>Table 10 All Trips by Mode and Vehicle/Worker Household Class</u>	31
<u>Table 11 Work Trips Mode Share by Employment Area Type</u>	32
<u>Table 12 Non-Work Trips by Mode and “Attraction” Area Type</u>	32
<u>Table 13 Reported Time of Travel by Trip Purpose (Survey Results)</u>	38
<u>Table 14 Times of Travel for Work Tours</u>	40
<u>Table 15 Trip Duration by Purpose of Travel</u>	42
<u>Table 16 Travel Time Budgets by Person Type</u>	42

1 Executive Summary

1.1 Background

A detailed survey of travel behavior of 9,130 people in 3,941 households in the Sacramento region was made in Spring 2000. The region included all of Sacramento, Yolo, Yuba and Sutter Counties, and the western portions of Placer and El Dorado Counties. The survey was undertaken for three major reasons:

- The survey will be used to develop SACOG's next generation of travel and land use forecasting models. The models will be used for preparation of the regional transportation plan, air quality conformity analyses, and other regional planning activities. Other agencies will use the models for planning studies, such as ridership estimates for light rail projects, and environmental analyses for transportation projects and general plans. Development of the new models will begin in the coming year, with the first versions ready for use in two to three years.
- The survey will be used to update SACOG's current travel forecasting model for use in the 2002 Metropolitan Transportation Plan. The last comprehensive update of the current model was completed in 1994. The survey provides a rich source of data for fine-tuning the current model.
- The survey is intended to provide a resource for others in the region. The survey report provides a limited number of tabulations. A more detailed set of tabulations is provided in the Appendix. Additionally, the survey datasets will be made available to researchers and other organizations for their own projects.

This report is titled the "Pre-Census", because it was prepared prior to the release of detailed results from the 2000 U.S. Census. Information from the Census will be used to *weight* or *expand* the survey sample to represent aggregate travel behavior in the region. SACOG tracks housing and population growth between Census years, and estimates regional population, employment and household characteristics. These estimates were used to prepare *interim weighting factors* used for the analysis presented in this report. A "Post-Census" survey report will be published in about two years, which will have somewhat different numbers.

Each of the results of the survey cited in this report is provided in *unweighted* and *weighted* form. The weighting factors expand the responses of the survey sample to the population of the entire region, and also correct for any bias in the survey response. For example, proportionally more small households, and especially households with retired adults, participated and provided complete responses in the survey. Proportionally fewer larger families and families with children responded. The interim weighting factors correct for these biases.

1.2 What is “Travel Behavior”?

For the purposes of this report, travel behavior is defined as ***the movement of a person from one place to another to participate in a necessary or desired activity.*** The characteristics of travel examined in this report include the frequency, purpose, mode, timing and duration of travel. Because the survey only included residents of the region, it does not include any other type of travel, such as freight or goods movement.

The report uses two different units of travel to analyze travel behavior.

- A ***trip*** is the most common unit of analysis, and this is literally the movement of a person from one place to another. The survey questionnaires, travel diaries, and forms were all designed to record information about all of the places a person visited during the course of the day.
- A ***tour*** is the other unit used, and it focuses on a ***series of linked trips*** that a person makes over the course of the day, and the pattern of activities included in that series of trips. In short, a tour is defined by all of the travel a person does from the time they leave their home until the next time they return home. The concept of the tour was developed because of the inherent interdependencies of a given trip with the prior trip made, and the next trip a person will make.

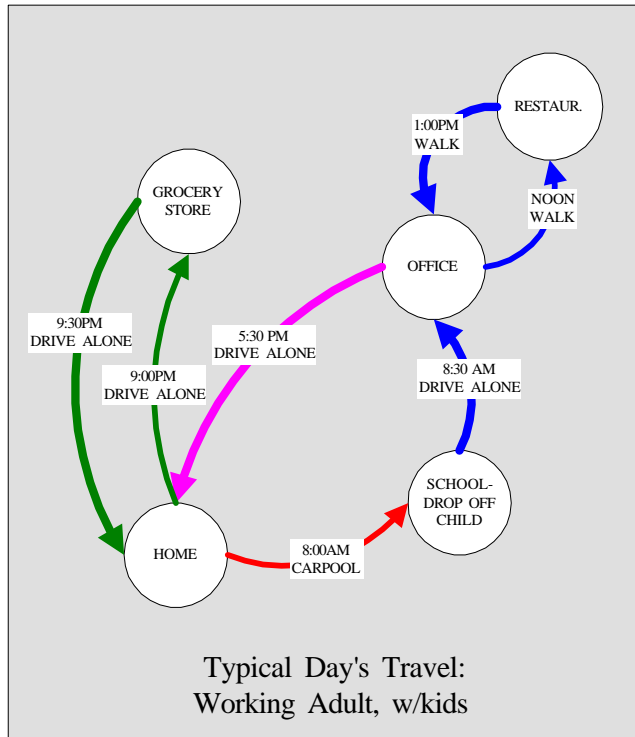
A comparison of trips and tours for a typical person-day of travel is shown in Figure ES-1.

The survey includes a record of all of the travel each of the 9,130 persons in 3,941 households in the sample made over the course of a weekday. The survey also includes the characteristics of the person (age, gender, education level, employment status, etc.), the other persons in the household and the household itself (numbers of persons, numbers of vehicles, income, etc.), and some characteristics of the places each person visited during the course of the day. This provides a rich source of data for analyzing travel behavior. The focus of the analysis was to identify key characteristics of persons, households, and places which influenced travel behavior significantly.

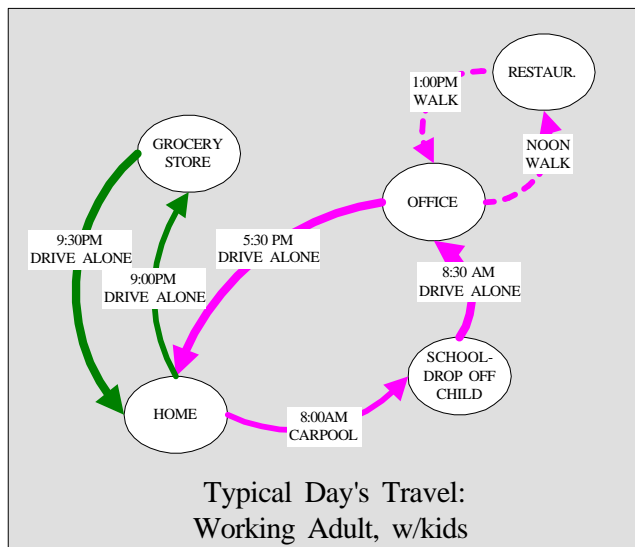
1.3 Frequency of Travel

The average number of daily trips per person in the survey was 3.6 (3.7 weighted). The minimum number of trips was zero, and 5 percent of the persons in the survey made 9 or more trips on the survey day. Trips-per-person varies strongly by household income level, and by type of person.

- About 11 percent (9 percent weighted) of the households in the survey made no trips on the survey day. These households tended to be smaller households, and just over one-half were senior households.



TRIP PURPOSE	Vehicle Trips Made	Transit Trips Made	Non-Motorized Trips Made	All Modes
Work	1			1
Shop	2			2
Home-Other	1			1
Work-Other	1		2	3
Other-Other				
School				
ALL PURPOSES	5		2	7



Tour Type	Number of Tours	Mode	Intermediate Stops	Tour Segments
Work	1	Auto	1	3
Work Sub Tour	1	Walk	0	2
Shop	1	Auto	0	2
Totals	3	n/a	n/a	7

Figure ES-1: Comparison of Trips and Tours for a Typical Person Day of Travel

- Household size had a significant effect on the number of trips generated by a household. One-person household generated about 3.6 trips per day, increasing to over 21.4 trips-per-day for households with 6-or-more persons.
- Trips-per-person averaged 2.7 per day (2.9 weighted) for persons in households with income less than \$15,000, increasing to 4.2 for persons in over-\$75,000-income households. Trips-per-person did not vary strongly by number of persons in the household.
- Daily trips-per-person for adults with children in the household (4.5) were higher than for adults without children (3.4). However, daily trips were significantly higher for females with children (4.9) than for males with children (4.1).

The average number of daily person trips-per-household in the survey was 8.4 (9.6 weighted). However, the range of trips-per-household was very wide. Some households made no trips, and 5 percent of the sample made 23 or more trips-per-day. Household size and structure affected the number of trips a household makes.

- Daily trips-per-household averaged 3.6 for households with one person, increasing to 21.4 (21.0 weighted) for households with 6-or-more persons.
- Daily trips-per-household ranged from 12.5 to 16.2 (13.6 to 16.6 weighted) for various types of households with children, and 5.4 to 8.7 (5.7 to 9.0 weighted) for households without children present.

1.4 Purpose of Travel

Travel characteristics varied widely according to the activity which caused the person to travel. Many different types of trips were analyzed, but the difference between work travel and non-work travel were the most striking. Two different definitions of work travel were used: for *trips* work travel focused on “commute trips”, or trips made from a person’s home to their workplace, or vice versa. For this report, only these commute trips were counted as “work” trips.

For *tours* work travel included not only commute trips, but also stops made going to and from the workplace. Tours are intended to capture the way that people chain together trips for different purposes. The purpose of a tour is determined by the most important activity which is undertaken from when a person leaves home, to when they return home. Work is considered to be the primary activity on any tour which includes work, but work tours can include trips for dropping-off or picking-up a passenger, shopping, going to a gym, or eating a meal out of the home.

- Only about 18 percent of all *trips* made were work trips (i.e., home-to-work or work-to-home). The vast majority of trips are home-based trips made for reasons other than work

(i.e. to drop a child off at school, do shopping, visit the doctor, etc.), or non-home-based trips (i.e. trips made from the workplace to a non-home location, or from a shopping center to a school to pick up a child, etc.).

- Because *work tours* include all trips made in the process of going to work and returning home, a much greater percentage of tours were work or work-based (about 28 percent).
- Only about 56 percent of all work tours were traditional home-to-work and work-to-home commutes. The remaining 44 percent included one or more stops along the way.

1.5 Mode of Travel

Travel modes analyzed in the survey were single-occupant vehicle (SOV), high-occupancy vehicle (HOV split into 2-person vehicles and 3-or-more persons per vehicle), public transit (split into walk-access and drive-access modes), walk, and bicycle. Mode of travel was strongly influenced by the purpose of the trip, the ratio of vehicles to workers at the household, and by the origin and destination areas of the trip.

- The SOV share for work trips (81 percent, 82 percent weighted) was much higher than for non-work trips (44 percent, 40 percent weighted). Because non-work trips include social and recreational trips, as well as trips to drop-off or pick-up passengers, they were far more likely to be HOV trips.
- Transit share was also much higher for work trips (3 percent) than for non-work trips (less than one percent). Work trips were more likely to occur in areas where transit service was good, and work travelers were far more likely to face parking charges and other disincentives to drive. Also, transit service was best during peak hours, when work trips tend to occur.
- In households with no automobiles, transit share of all trips (21 percent, 15 percent weighted) and walk and bike share (43 percent, 39 percent weighted) were very high. However, zero-auto households only account for about 4 percent of the households (3 percent weighted) and 1 percent of the trips in the survey.
- In households where workers outnumber automobiles, transit share of all trips was 4 percent (3 percent weighted), compared to less than one percent for households in which each worker had access to at least one vehicle.
- Work trips made to Downtown Sacramento, where transit access was the best, and where parking charges were the highest, had a transit share of 14 percent, compared to most other areas where transit share of work trips was three percent or less.
- Davis was a unique area in terms of mode of travel. Bike share of work trips was 31 percent (35 percent weighted), and 12 percent (13 percent weighted) of non-work trips. Of the bicycle trips captured in the survey, 56 percent (53 percent weighted) occurred in Davis.

- Non-work trips made in Downtown Sacramento had a walk share of 17 percent, and 10 percent in Davis. For other area types, the maximum walk share was 7 percent. This relates in part to the populations within these areas. The daytime population of Downtown Sacramento includes workers, who are likely to make walk trips for lunch or other incidentals during work. The population in Davis includes university students, who are slightly less likely to own cars, and more likely to face charges for parking on-campus. Also, the areas include relatively dense residential and commercial areas, where walking and biking is more feasible.

1.6 Time of Travel

The time that travel occurs is determined by a number of different factors. Timing of certain types of travel is discretionary (e.g. shopping trips). For other types, such as work, timing of travel is relatively fixed. The analysis of the survey focused on the likelihood of travel to occur during ***peak periods***, when travel demand is the highest, versus ***off-peak periods***. The off-peak periods were split into the midday period, and the evening period.

- On the average, about 20 percent (21 percent weighted) of all travel occurred during the morning peak period, and 27 percent during the afternoon/evening peak period. The peak periods were defined as 7:00AM to 10:00AM, and 3:00PM to 6:00PM, respectively.
- About 57 percent (56 percent weighted) of work travel occurred during the AM and PM peak periods.
- About 33 percent (34 percent weighted) of non-work travel occurred during the midday period (10:00AM to 3:00PM).

Since ***tours*** take place over the course of the day, and include a number of trips and stops, the tabulation of the timing of tours takes into account the time a person left home to start a tour, and the time they left the primary destination on the tour to return home. The tabulation is for a pair of time periods. For a work tour, the time pair includes the departure time from home, and the departure time from work.

- About 36 percent of all work tours (34 percent weighted) were “***AM peak/PM peak***” tours. The departure from home occurred during the AM peak period, and the departure from work, during the PM peak period.
- Another 21 percent (23 percent weighted) of work trips were “***pre-AM peak/PM peak***” tours, in which the departure from home occurred before 7:00AM, but the departure from work occurred during the PM peak period.

1.7 Duration of Travel

The duration of travel refers to how long each unit of travel lasts, or the length of the trips. For this report, duration means the time between when a survey respondent reported leaving one activity location, and when they reported arriving at the next activity location. This is not a perfectly accurate or consistent measure, since people may have different ideas about when they left (Is it when they walked out the door of their office? Is it when they left the parking lot in their vehicle? Etc.). Also, people tend to round their times to the nearest quarter- or half- hour. However, it is assumed that these judgments and biases average out over the sample.

Duration of travel varies by purpose of travel, the mode of travel, and by the areas the travel occurs.

- Work trips were the longest of all trip purposes, averaging 24 minutes (25 weighted). However, variation in work trip times is high. Five percent of trips are over 60 minutes.
- Non-work trips ranged from 13 to 18 minutes in average length, depending on the specific purpose of the trip.
- Trips made by transit were the longest of all modes, averaging 40 minutes for walk-access and 45 minutes for drive-access trips.
- Walk trips were the shortest of all modes, averaging 12 minutes.
- Trip lengths for households located in rural areas were the longest of all area types, averaging 20 minutes (19 weighted). Average trip lengths for households located in ex-urban, suburban, and urban areas were 17, 16 and 16 respectively (17, 17, 16 weighted).

Another measure of travel duration is the total time a person devoted to travel during the course of a day, often called a “*travel time budget*”.

- The average travel time budget for the survey respondents was 62 minutes per person, or 143 minutes per household (163 weighted).
- Work travel accounted for 16 minutes or 25 percent of the average travel time budget. (Note that for this measure, work travel time was averaged over all people in the survey, not just workers. For this reason, it is lower than the average work trip length.)
- Working adults had higher travel time budgets than non-working adults. Working males spent 79 minutes traveling, and females, 72 minutes, compared to 61 and 56 minutes for non-working males and females, respectively.
- Seniors and children had the lowest travel time budgets, with 47 and 46 minutes, respectively.

2 Background

The 2000 SACOG Household Travel Survey was undertaken for three major reasons. First, the survey will be used to develop the next generation of regional travel forecasting models. The models will be used by SACOG for development and analysis of the regional transportation plan, air quality conformity analyses, and other regional planning activities. The models will be used by other agencies within the region, too. For example, the models have been used for ridership estimates for light rail projects, and by local agencies for general planning, environmental analyses, and traffic studies. The survey provides the data for estimating statistical models to predict travel behavior, and in validating those models before they are used for forecasting.

Historically, SACOG has, like virtually all other regional agencies around the country, utilized modeling tools which were based on a system of traffic analysis zones (TAZ's). The SACOG modeling area is divided into about 1250 TAZ's. Because of limitations in the software used for travel forecasting, this was about the maximum level of detail which could be handled. New software and modeling approaches have been developed, using more powerful computers commonly available today. These approaches do not rely on a system of TAZ's, but simulate travel at the household or even person level. All aspects of the household survey (questionnaires, sampling approach, recruiting strategy, data retrieval, and data coding) were carefully designed to allow for the development of the new modeling approaches for the Sacramento region.

The second major use of the survey is to update the current travel forecasting tools, and to calibrate the models to reflect current travel behavior. Because new forecasting tools will not be developed and ready for use for at least two years, the current model will be used for important regional planning projects, such as the 2002 Metropolitan Transportation Plan. However, the current tools have not had a comprehensive update since 1994. The 2000 Household Survey, plus other data such as the 1999 On-Board Transit survey, provided a rich source of information for fine-tuning the current regional travel demand model.

Third, the survey is intended to provide a resource for others in the region interested in travel behavior. For this reason, an Appendix with many detailed data tabulations and breakdowns from the survey is provided.

The survey area included the entire SACOG region: Sacramento, Yolo, Yuba, and Sutter Counties in their entirety, and the western portions of El Dorado and Placer Counties. The survey area had an estimated population of 1,849,000 in the year 2000, with approximately 701,000 households. A total of 3,941 households completed the survey, well above the target of 3,500 households. The group of households which responded to the survey is referred to as the survey *sample*.

The recruitment process was designed to maximize participation in the survey, and started with an invitation letter from SACOG explaining the importance of the survey for transportation planning. Households were contacted by telephone for the actual recruitment. Once recruited, travel diaries to record travel from each resident in the household were mailed out, and survey responses were retrieved via telephone.

The survey was administered during the months of March, April and May of 2000. These months were selected because no major holidays occur during that time, most schools are in session, and the likelihood of major inclement weather which may affect survey results is minimal. Respondents were asked to record travel during the weekdays only, and not on weekends. The survey attempted to capture *typical weekday travel* during the springtime months.

During the entire process, care was taken to get accurate, complete information from each respondent. The entire recruitment and data retrieval process was beta-tested prior to the actual survey, to work out any kinks in the process and refine the survey questionnaires and travel diary forms. Finally, the survey respondents were tracked through the course of the survey, to ensure that sample targets were met.

More detail on the survey process can be found in the “2000 Household Travel Survey Report” by NuStats Research and Consulting, the firm that implemented the survey.

This report is organized into sections, according to key characteristics of travel behavior. Section 3 presents information on the demographics of the survey sample, and on weighting and expansion factors applied to the sample. Section 4 presents some definitions of travel behavior and terminology used in the report. The following four sections present information on frequency of travel (Section 5), mode of travel (Section 6), time of travel (Section 7) and duration of travel (Section 8). For Sections 5 through 8, the first part presents *trip* summaries from the survey, and the second part present *tour* summaries. Section 9 includes a discussion of workplace amenities which have some influence on travel behavior.

3 Demographics of the Survey Sample

3.1 Background on the Sampling Approach.

For the purposes of the survey, the region was split into four different area types: rural, ex-urban, suburban, and urban:

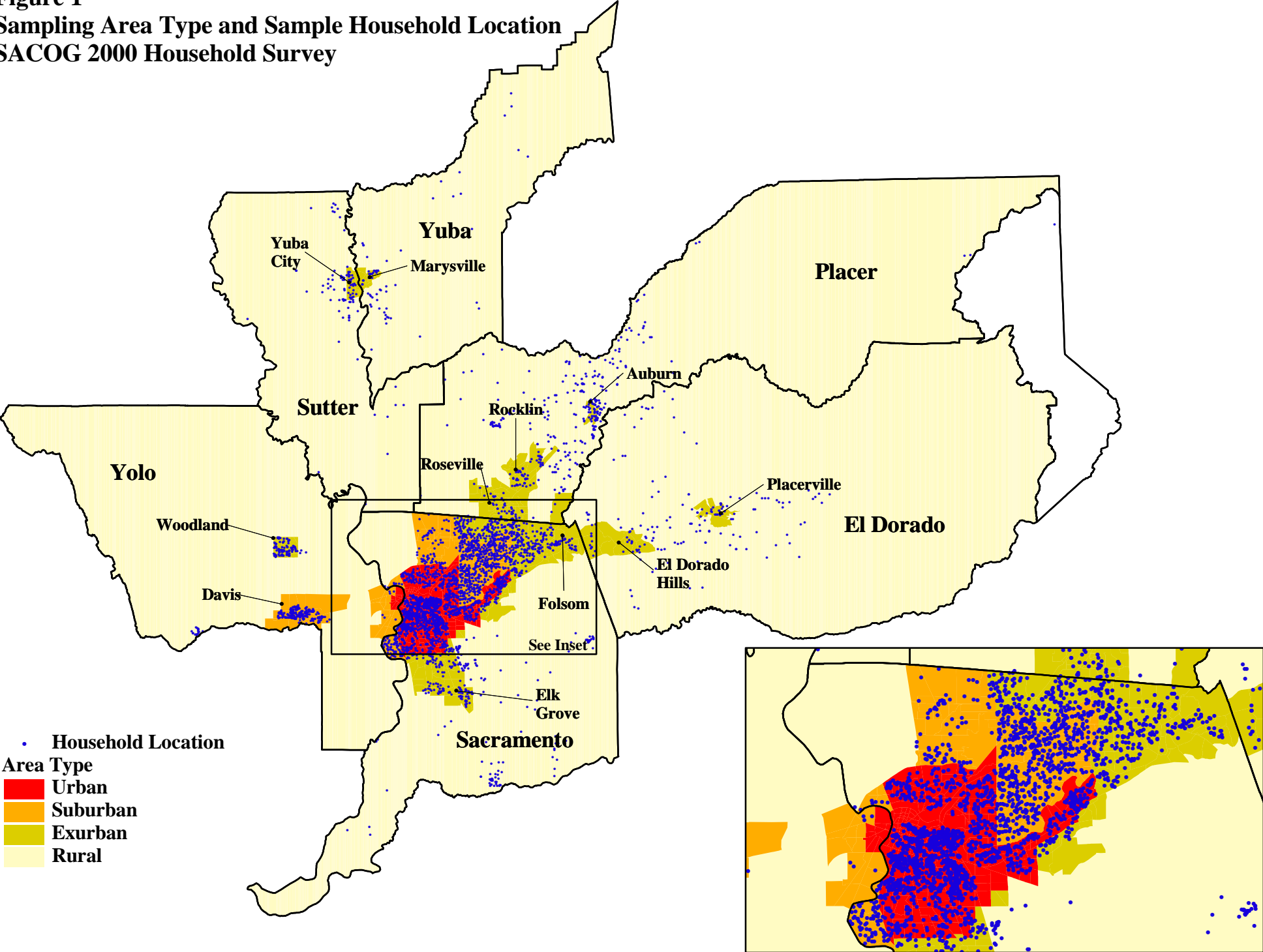
- Rural areas have relatively low-density development, have very little non-agricultural employment, and are served by no fixed route transit service.
- Ex-urban areas are also relatively low density, but have slightly more non-agricultural employment and some, limited fixed route transit service. Transit service is limited to the peak hours.
- Suburban areas are moderate in overall density, with some concentrations of employment, and are served by some fixed route transit. At least some transit service is provided during off-peak hours.
- Urban areas are relatively high in density, with significant concentrations of employment. A full range of transit service is provided during both peak and off-peak hours.

Figure 1 shows the area types, and also shows the locations of each household in the survey sample. The sample was randomly drawn from within each area type, but the sample was more heavily drawn in the urban areas. This was done for two reasons: First, household structure and travel behavior tends to be more complex in the urban areas, and a higher sampling rate was needed to capture this complexity.

The second reason was pragmatic. The 1991 household travel survey (the last such survey taken in the Sacramento region) was randomly drawn throughout the region. The overall transit mode share in the region is about one percent, and the number of transit trips captured in the 1991 survey reflected this (less than 150 transit trips in total). For developing mode choice models, which are a key component of forecasting models used for evaluation of projects like light rail or bus systems, this provides barely enough trips to work with. By drawing relatively more cases from the urban areas of the region, a much higher number of transit trips were captured in the 2000 survey sample (just over 400), which will provide a better basis for developing the next set of forecasting models.

Drawing the sample in this way does present one issue, related to the use of the sample results to generalize about the region as a whole. The process of *expanding* or *weighting* the sample results to reflect the region is an issue for any survey, but because the sample was drawn more heavily from urban areas, it is a bit more complicated for this survey. In general, weighting of a sample is done by comparing the demographic characteristics of the sample to known

Figure 1
Sampling Area Type and Sample Household Location
SACOG 2000 Household Survey



characteristics of the region, and using the ratio between the region and the sample to weight the sample results. These ratios are known as *weighting factors*.

For example, this survey sample included 3,941 households. From other sources, it is known that the region from which it was drawn includes about 701,000 households. One way of weighting the survey would be to apply the ratio (701,000 / 3,941, or 177.8) to each case in the sample. Because the sample was drawn more heavily from urban areas, and less from the other areas, this would not be a good way to weight the sample. Weighting factors which correspond to the area types used for drawing the sample are needed.

Ideally, census data would be used to develop weighting factors. In addition to providing current information on numbers of households and people in each of the sampling areas, the census provides valuable information on household structure, employment, vehicle ownership, and other variables which influence travel behavior. Detailed census breakdowns will not be available until later this year. As an interim measure, SACOG's estimates of households, population, and employment were used to develop weighting factors. The final weighting factors were broken down by the sampling area types, numbers of persons in the household, and number of workers in the household. Each tabulation of data is presented in both *weighted* and *unweighted* forms.

Because the weighted results of the survey are being reported prior to the availability of detailed tabulations from the US Census, this survey report is titled the "*Pre-Census* Travel Behavior Report", and should be considered as an interim report. Several checks were made to ensure that the weighting and expansion of the survey was reasonable. However, a final report on the travel survey will be produced after information is available from the US Census, and will be somewhat different from the numbers reported here.

3.2 Key Demographic Variables

This section of the report provides a portrait of the survey sample group (i.e. the 3,941 households which provided complete responses to the survey), and some points of comparison to reliable regional data.

3.2.1 Population

- The sample included 9,130 persons. The weighted population was 1,824,000. The best available estimate of the region's household population in 2000 was 1,848,000. The weighted sample was within 1.3 percent of the independent estimate of regional household population (Table 1).
- The sample included 3,941 households. The weighted number of households was 696,000. The best independent estimate of 2000 households in the region was 701,000. The weighted sample was within 0.6 percent of the independent estimate of regional households (Table 1).

- The sample average household size was 2.32. The weighted average household size was 2.62. Based on the best available estimates, the regional average household size in 2000 was 2.64. The average household size in the weighted sample was within 0.7 percent of the independent estimate of regional household size (Table 1).

Variable	Survey Results	Weighted Results	Regional Comparison Total	% Difference
Households	3,941	696,200	700,636 ¹	-0.6%
Persons	9,130	1,824,300	1,848,529 ¹	-1.3%
Workers	4,500	853,300	850,147 ²	0.4%
Vehicles	7,732	1,439,000	n/a	n/a
Persons/HH	2.32	2.62	2.64	-0.7%
Workers/HH	1.14	1.23	1.21	1.0%
Vehicles/HH	1.96	2.07	n/a	n/a

Source: DKS Associates
 Notes: ¹ SACOG 1999 Projections
² SACOG estimates

3.2.2 Household Structure

Household structure means the number of persons in a household, their age and employment status, and their relationships to the other people in the household. Below are some highlights from the sample. Unfortunately, until the detailed information from the U.S. Census is available, very limited data on household structure, other than aggregate persons per household and workers per household, are available. (More detailed information on the survey sample is provided in Table A2 in the Appendix).

- The *modal* (i.e. most common) household size was 2 persons, with 43 percent of the sample in that category. The modal household size for the weighted sample was also 2, but the percentage in that category decreased to 34.
- About 25 percent of the sample households included school-age children. After weighting, the percentage increased to 35.
- Just over 30 percent had no workers present. After weighting, the “no-workers” percentage dropped to 25.
- Just over 24 percent of the sample households were composed of adults 65 years and older. After weighting, the percentage decreased to 18.

No independent estimates of these variables were available for comparison. Based on a comparison of the sample to the weighted totals, the sample probably drew too heavily from smaller households, with older household members. The weighting factors applied to the

sample appear to have corrected for this bias in the sample. This issue will be revisited when detailed tabulations from the US Census are available.

3.2.3 Employment and Income

As will be discussed throughout this report, employment status and income have significant effects on travel behavior. Until detailed information is available from the US Census, no independent estimates of household income are available for the entire region. (More detailed information on the survey sample is provided in Table A3 the Appendix).

- The total number of workers in the sample was 4,500. The weighted sample included 853,000 workers. The best estimate of total workers in the region was 850,000. The weighted sample was within 0.4 percent of the regional comparison total (Table 1).
- The average number of workers per sample household was 1.14. The weighted average number was 1.23. The best estimate of total workers per household in the region was about 1.21. The weighted sample was within 1 percent of the regional comparison total.
- The modal number of workers per household was one, with 32 percent of the sample in that category. Weighting of the sample did not alter the modal category, but increased the percentage with one worker to 36.
- The median household income category was \$45,000-49,999. Weighting the sample did not change the median income.

Based on a comparison of the sample to weighted totals, the sample drew somewhat more heavily from households with no workers. The weighting factors applied to the sample appear to have corrected this bias. Again, this issue will be revisited when detailed tabulations from the US Census are available.

3.2.4 Vehicle Ownership

Vehicle ownership, or the number of private vehicles available for use within a household, has a significant effect on the mode of travel and other travel characteristics. (More detailed information from the survey is provided in Table A4 in the Appendix).

- The total number of vehicles held by households in the sample was 7,732. The weighted sample included 1,439,000 (Table 1).
- The average number of vehicles held in the sample households was 1.96. After weighting, the average number increased to 2.07 vehicles per household.
- The modal number of vehicles held by households was two, with 42 percent of the sample in that category. This result was unchanged by the weighting (More detailed information on vehicle ownership is reported in Table A4 in the Appendix).
- Only 4 percent of the sample households had no vehicles. After weighting, this number decreased to 3 percent.

4 What is travel behavior?

Most people would define “travel” as the movement from one place to another. Travel is considered to be a *derived demand*. That is, people seldom travel without purpose, or for pure recreational value. Aside from an occasional drive in the country for relaxation, the demand for all travel is derived from participation in other activities: going to work, shopping, visiting a friend or relative, visiting a doctor, etc. In fact, most people seek to minimize the amount of travel through their choices of where to live or work, by consolidating trips, or by scheduling trips to occur at times when traffic is light. However, some activities do not allow a traveler much flexibility. For example, most people have a wide range of options for when to shop, but work start times for many people are not flexible or negotiable.

Because this report focuses on travel by persons living in households, all travel described in this report is by residents of the region (i.e. not equipment or goods). For the purposes of this report, then, “travel” is defined as *a person’s movement from one place to another to participate in a necessary or desired activity*. “Travel behavior” encompasses all aspects of travel by people. Specifically, this includes:

- The frequency of travel
- The purpose of travel, or the types of activities which generate the demand for travel
- The modes of travel used
- The time of travel
- The combination of all of the above into pattern of activity for a person throughout the course of the day.

Listed below are some terms which are used throughout the document.

4.1 Trips

Trips have historically been the basic unit of travel behavior. For this report, a trip means a *person trip*, or the travel by a person between one physical location and another. A person trip can be made in a vehicle (automobile, bus, train, etc.), or by some non-motorized means (bike or walk). Several person trips can be made in one vehicle trip (e.g. in a carpool). Trips have a definite beginning point or origin, and ending point or destination. Trips also have a beginning and ending time.

4.1.1 Trip Purpose

By the definition of travel used here, all travel (and all trips) have some *purpose*, related to the activity or activities engaged in at the ends of the trip. The range of possible purposes is

practically infinite, and literally as varied as the population of the region. However, for purposes of this report, a much more simplified set of definitions will be used for defining trip purposes.

- **Home-Work** trips have one end at home, and one at work. Home-work trips are made for the purposes of working (i.e. not for dropping-off or picking up a passenger at work), and must have at least one end of the trip at home (i.e. not another workplace, or a store stopped at on the way to or from work). These are “typical” commute trips. For this report, only these trips will be counted as “work” trips.
- **Home-Shop** trips have one end at home, and the other at a retail establishment, and are made to shop for any good needed or desired to sustain a household. These trips must have at least one end at home.
- **Home-Other** trips have one end at home, and the other at some non-home location. Home-other trips are made to participate in any activity other than working, shopping, or school. Examples are trips made to drop-off a student at school, to the doctor, to visit a friend, or to eat a meal at a restaurant.
- **Work-Other** trips have one end at the workplace, and the other at a non-home location. The “other” end can be a restaurant (to eat lunch), a shopping center (to pick up groceries on the way home), or to pick-up or drop-off a passenger.
- **Other-Other** trips have both trips ends at non-home and non-work locations. Examples of other-other trips include a trip between a shopping center and a dry cleaner.
- **Home-School** trips are made by school-age children to get to a K-12 school, or to return home. No trip made by an adult or by a student to a school other than K-12 is a home-school trip. If an adult drives a student to school, the adult trip is classified as “home-other”, and the child trip is “home-school”.

Home-shop and home-other trips are collectively referred to as **home-non-work** trips. Work-other and other-other are referred to as **non-home-based** trips. Commercial and freight trips are not treated in this report.

4.1.2 Trip Mode

Trips can be made by a huge number of modes. The most prevalent are by driving or riding in a vehicle. However, the range of vehicles people use to make a trip is extremely wide, and includes everything from an automobile to a unicycle. For the purposes of this report, trip modes will be limited to the following seven:

- **Single-Occupant Vehicle (SOV)** mode includes trips made in a car, van, or truck, with the driver as the sole vehicle occupant.
- **High-Occupancy Vehicle (HOV)** mode includes trips made in vehicles, but with the driver and at least one passenger. No differentiation is made between the driver and passenger in this definition (i.e. both the driver and passenger in a two-person carpool

would be traveling in an HOV mode). For some purposes the number of persons in the vehicle is of interest, so the HOV mode is split into 2-person and 3+ person modes.

- **Public Transit** mode includes all trips made by publicly provided buses or trains. The mode is subdivided by mode of access (walk versus drive).
- **Walk.** This mode seems the most self-explanatory of all, but there are nuances which should be understood. For example, only trips which are made wholly by walking are included. The walk from a parking space to a store, or a transit stop to an office, are not counted as walk trips. A certain amount of walking is presumed to be a part of trips by all other modes, and is not counted as separate walk mode trips.
- **Bike.** As with walk trips, only trips made in their entirety (other than short walks from to get to or from an activity to the bike) by bicycle are counted as bike trips.

4.1.3 Time of Travel

In general, time of travel simply means the time a particular trip begins and ends. All other things being equal, most persons would chose to schedule a trip at a time when traffic is likely to be the lightest, or when a particular preferred mode of travel (transit or carpool, for example) is available to them. In fact, because travel is derived from the activities people participate in, the time of travel is constrained by the times those activities can occur. From a regional or system perspective, this results in travel clustering or **peaking** during certain time periods. For this report, four time periods will be used and referred to:

- **Morning Peak Period** is the highest three hours of travel activity in the morning hours, falling roughly between 7:00AM and 10:00AM, which includes the morning rush hour in most areas.
- **Midday Period** is the five-hour period between 10:00AM and 3:00PM. This includes a minor peak around noon or 1:00PM, when lunch-related travel mixes with retail and commercial travel.
- **Afternoon Peak Period** is the highest three hours of travel activity in the afternoon and early evening hours, falling roughly between 3:00PM and 6:00PM. In general, this is the highest period of travel demand, because the afternoon commute travel mixes with other peaks for retail- and school- related travel.
- **Evening Period** is the remaining thirteen hours of the day, after 6:00PM and before 7:00AM. This includes a declining volume of travel activity during the early evening hours, very low activity levels during the late evening and early morning hours, and an increase leading into the morning peak period.

4.1.4 Duration of Travel

While time of travel refers to the time of day which travel occurs, duration of travel refers to the amount of time spent in travel. Duration of travel is affected by the purpose of the trip. People are willing to travel further to work, or to purchase an automobile or washing machine, for example, than they are to purchase a bag of groceries.

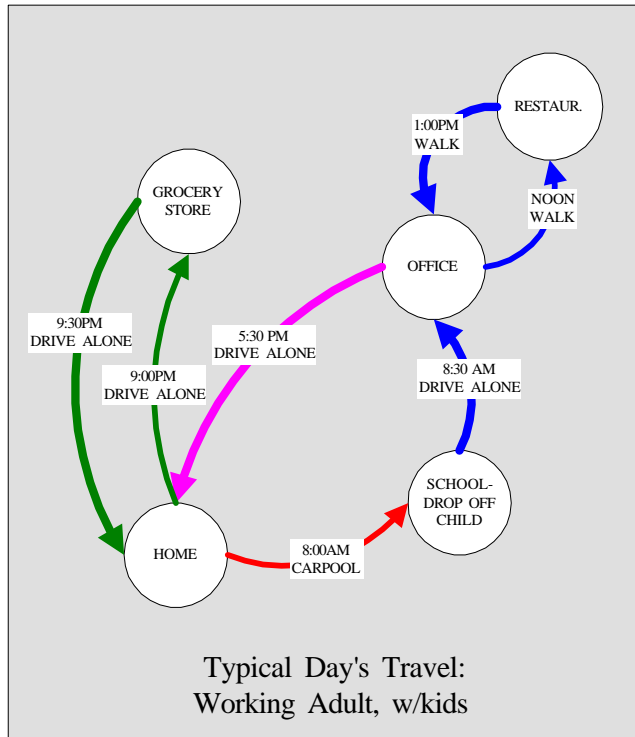
4.2 Tours and Day Patterns

Increasingly over time, the trip is being replaced as the fundamental unit of travel behavior with more complex units called “*tours*” or a “*day patterns*”. A *tour* is defined as a sequence of trips by a person beginning and ending at home. For example, the simplest sort of tour includes two trips (e.g. a tour from home, to a shopping center to pick up groceries, and returning home). A tour, though, can be very complex (e.g. from home to school, dropping of a child, then to work, and returning home with a stop at the dry cleaners). Figure 2 illustrates a typical set of tours for a worker, and compares it to the same pattern of activity broken down into trips.

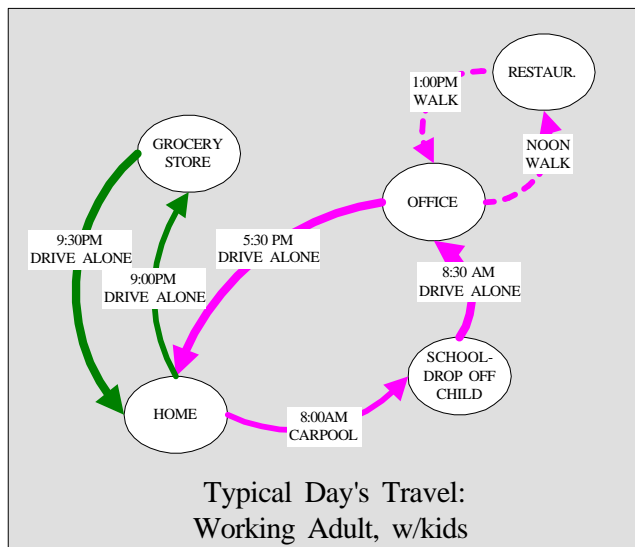
Within a given tour can be one or more *sub-tours*. While a tour is defined by a series of trips beginning and ending at home, a sub-tour is a similar series of trips beginning and ending at a non-home location, such as the workplace or school. An example of a simple sub-tour is a trip by a worker from his/her workplace to a restaurant for lunch, and returning to the workplace. A *day pattern* is a sequence of tours and sub-tours over the course of an entire day for one person.

With a tour as the fundamental unit of travel behavior, none of the variables described above (purpose, mode, time of travel) apply in the same way as they do for trips. For example, while a trip can be thought of as having a single definable purpose, a tour can combine many different purposes and activities. Likewise with mode of travel, a trip is defined as having a single mode of travel, while a tour can mix modes together. Finally, with time of travel, because a tour involves a linked series of trips, the time of travel can be spread out over the course of an entire day, rather than contained within a predefined time period.

If looking at tours is so complicated, why bother? The main answer to this question is that many important aspects of travel behavior cannot be explained (or predicted) without looking at the overall pattern of activity a person is involved in over the course of an entire day. A simple example of this is a working parent with children. The need to drop a child off at school on the way to work makes travel by a mode such as transit very difficult, even if transit service exists for each leg of the trip.



TRIP PURPOSE	Vehicle Trips Made	Transit Trips Made	Non-Motorized Trips Made	All Modes
Work	1			1
Shop	2			2
Home-Other	1			1
Work-Other	1		2	3
Other-Other				
School				
ALL PURPOSES	5		2	7



Tour Type	Number of Tours	Mode	Intermediate Stops	Tour Segments
Work	1	Auto	1	3
Work Sub Tour	1	Walk	0	2
Shop	1	Auto	0	2
Totals	3	n/a	n/a	7

Figure 2: Comparison of Trips and Tours for a Typical Person Day of Travel

- Another example of the dependency of mode choice to a tour or day pattern is the unlikelihood of choosing a mode of travel different than that chosen for the trip (or trips) from home to work, for example. Again using the working parent with children as an example, even if the other parent was picking the child up, and direct transit service existing from the workplace to home, the person in the example is unlikely to choose transit given that other trips on the tour require an automobile.

Using tours as the fundamental unit of analysis, purpose, mode, and time of travel have different meanings than those applied to trips.

- **Tour purpose** is defined according to the main activity undertaken in the course of the tour. There is a hierarchy of eight activities, and the tour is classified by the highest-ranking activity occurring within the tour. For example, a tour which includes both out-of-home-work and school would be classified as a “work tour”, with work as the **primary destination** of the tour.
- **Tour mode** is also defined according to a hierarchy of travel modes. The tour mode is defined by the highest mode used in the course of the tour.
- **Time of travel** is defined according to two time periods: the time period which the first trip of a tour (or sub-tour) begins, and the time period in which the departure from the primary destination occurs.

Several new concepts apply to tours, which are not relevant to trips:

- **Tour Hierarchy** is defined to distinguish multiple tours made by one person in the course of a day. The same hierarchy of activities used to define the purpose of the tour is applied to define the hierarchy of tours within a day. For example, if a person made two tours (one a work tour, the second a shop tour) the work tour would be considered the **primary tour** and the shop tour would be the **secondary tour**.
- **Intermediate stops** are made on trips to and trips from the primary destination of the tour. The number of stops to the defining destination of the tour (i.e. from home to work on a work tour) and from the defining destination and home are tabulated separately.

5 Frequency of Travel

Frequency of travel is the number of trips or tours made by a person over the course of a day. The frequency of travel varies strongly by the purpose of the trip, the characteristics of the person making the trip, and by the structure of the household to which a person belongs.

5.1 Analysis of Trips

- A total of 33,014 trips were recorded in the survey sample (Table 2). (The weighted sample included 6,687,000 trips. See Table A5 in the Appendix for weighted results).
- Average trips-per-household and per person in the survey sample were 8.4 and 3.6, respectively (Table 2). (The weighted sample averages for households and persons were 9.6 and 3.7, respectively).
- The range of trips-per-household was quite wide. One-person households averaged 3.6 trips-per-day, increasing to 21.4 trips-per-day for households with six-or-more persons. However, the average daily trips-per-person only ranged from 3.3 to 4.1, and did not vary strongly by household size (Table 2).
- The range of trips-per-household in the sample was very wide. The minimum was 0 (11 of the sample, 9 percent weighted). About 7 percent of the sample (and 10 percent of the weighted sample) had 20 or more trips-per-household. (See Table A6 in the Appendix for more information).

No. Persons Per Household	# HH's	# Persons	# Trips	Trips/ HH	Trips/ Person
1	1,008	1,008	3,585	3.6	3.6
2	1,693	3,386	11,713	6.9	3.5
3	580	1,740	6,231	10.7	3.6
4	436	1,744	7,113	16.3	4.1
5	138	690	2,528	18.3	3.7
6+	86	562	1,844	21.4	3.3
Total	3,941	9,130	33,014	8.4	3.6

Source: DKS Associates

5.1.1 Variation in Trip Frequency by Purpose of Travel

Trip purpose has a huge influence on the frequency of travel. Work, or commute, trips accounted for about one-in-six trips in the survey, with shop, school and other home-based trips (home-shop, home-other, and home-school) accounting for nearly one-half of all trips

made. Other non-home-based trips (work-other and other-other) accounted from the remaining third of trips made in the sample (Table 3).

- Home-work trips accounted for 18 percent of the sample trips (17 percent weighted) and averaged 1.5 per household (1.7 weighted). (Weighted results are reported in Table A7 in the Appendix).
- Home-shop and home-other trips accounted for 43 percent of the sample trips (44 percent weighted), and averaged 3.7 per household (4.1 weighted).
- Non-home-based trips (work-other and other-other) accounted for 33 percent of the sample trips (32 percent of the sample), and averaged 2.7 per household (3.1 weighted).
- Home-school trips accounted for 6 percent of the sample trips (8 percent weighted), and averaged 0.5 per household (0.7 weighted).

Trip Purpose	# Trips	%	Trips/ HH	Trips/ Person
Home-Work	6,086	18%	1.5	0.7
Home-Shop	3,393	10%	0.9	0.4
Home-Other	10,908	33%	2.8	1.2
Work-Other	3,947	12%	1.0	0.4
Other-Other	6,780	21%	1.7	0.7
Home-School	1,923	6%	0.5	0.2
Total	33,037	100%	8.4	3.6

Source: DKS Associates

5.1.2 Variation in Trip Frequency by Household Structure

Key variables related to household structure also have a large effect on the number of trips made. A household class variable was created, which relates the presence (or absence) of workers, and the presence (or absence) of school age children in the household. (See Table 4).

- Households with school age children ranged from 12.5 to 16.2 person trips-per-day compared to 5.4 to 8.7 trips-per-day for households without school age children. Ranges for the same classes in the weighted sample were 13.6 to 16.6, and 5.7 to 9.0, respectively. (Weighted results are reported in Table A8 in the Appendix).
- “Retired” households (i.e. with all adults over 65, none working, and no school age children present) had the lowest trip rate: 4.3 per day (4.2 weighted).

- Most of the variation appears to be accounted for in household sizes corresponding to these classes. Average trips-per-person range from 3.2 to 4.0 for non-retired households (3.0 to 4.0 in the weighted sample).
- Persons in retired households averaged the lowest per-person trip rate: 2.9 trips-per-person.

Household Class	# HH	# Persons	# Trips	Trips/ HH	Trips/Person	Person/HH
No Workers + School Age Kids	49	179	612	12.5	3.4	3.7
1 Worker + School Age Kids	335	1,215	4,571	13.6	3.8	3.6
2+ Workers + School Age Kids	591	2,385	9,598	16.2	4.0	4.0
No Workers, No Kids	334	567	1,804	5.4	3.2	1.7
1 Worker, No Kids	937	1,477	5,227	5.6	3.5	1.6
2+ Workers, No Kids	877	2,076	7,653	8.7	3.7	2.4
Retired	818	1,231	3,549	4.3	2.9	1.5
Total	3,941	9,130	33,014	8.4	3.6	2.3

Source: DKS Associates

5.1.3 Variation in Trip Frequency by Income and Auto Ownership

In general, per-person trip rates increase with household income. This pattern has been observed in many household travel surveys. Households with higher incomes have greater opportunity and desire for non-work travel (e.g. shopping and recreation), and also are more likely to have workers within the household (Table 5).

- Per-person trip rates averaged the lowest for households with less than \$15,000 per year in income: 2.7 trips per person (2.9 weighted). (Weighted results are reported in Table A9 in the Appendix).
- Per-person trip rates increased consistently with household income to 4.2 trips-per-person from households with income greater than \$75,000.
- Per-person trip rates also increase with vehicle ownership. Zero-auto household average the lowest per-person trip rates: 2.0 daily trips-per-person (2.1 weighted).
- Per-person trip rates increased to over 4 trips-per-person for households with 4 vehicles. However, households holding 5 or more vehicles have slightly lower per-person trip rates: 3.7 daily trips-per-person (3.6 weighted). (More detailed information on auto ownership and travel frequency is reported in Table A4 in the Appendix).

Income Category	# HH	# Persons	# Trips	Trips/HH	Trips/Person	Person/HH
<\$15,000	356	671	1,842	5.2	2.7	1.9
\$15,000-24,999	399	760	2,161	5.4	2.8	1.9
\$25,000-44,999	775	1,734	5,905	7.6	3.4	2.2
\$45,000-74,999	1,105	2,666	10,040	9.1	3.8	2.4
>\$75,000	928	2,536	10,579	11.4	4.2	2.7
Declined/Didn't Know	378	763	2,487	6.6	3.3	2.0
Total	3,941	9,130	33,014	8.4	3.6	2.3

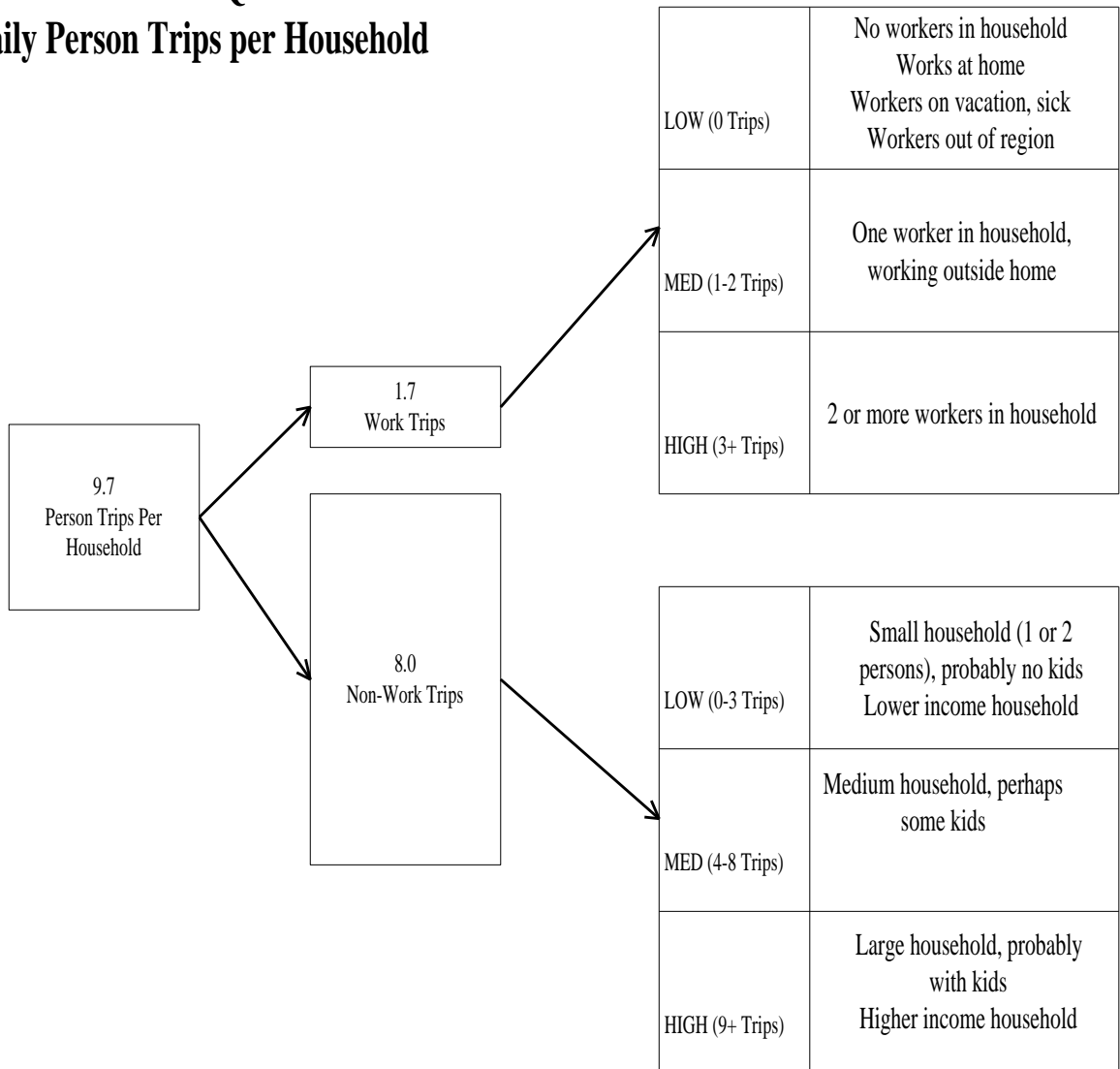
Source: DKS Associates

While there does appear to be a strong connection of trip frequency with income and auto ownership, other factors are also important. Higher household income is also related to more persons and vehicles in the household. When the number of persons is taken into account the variation in trip frequency by income and auto ownership is much less pronounced (see Figures A1 and A2 in the Appendix).

5.1.4 Trip Summary

Trip frequency is affected by household size, income, household structure, and trip purpose. Figure 3 provides an illustration of some of this variation. Specifically, trip frequency is higher for larger households, households with higher income, and households with workers or children. Trip frequency is lower for smaller households, lower income households, and households without workers or children. Work travel (i.e. home-to-work and work-to-home trips) account for less than one-in-five trips. Other tabulations related to travel frequency are provided in Tables A17 to A19 in the Appendix.

Figure 3
VARIATION FREQUENCY OF TRAVEL:
Daily Person Trips per Household



5.2 Analysis of Tours

As with trips, the frequency of tours varies widely by person and household. The total number of tours reported in the survey was 11,896. The average number of tours-per-person was 1.4. The average number of tours-per-household was 3.1.

- About 8 percent of the persons in the sample (and 6 percent in the weighted sample) made no tours at all (Table 6). (Weighted results are reported in Table A10 in the Appendix).
- About 13 percent (17 percent weighted) made 8 or more tours.
- The modal number of tours-per-day was two, but only 17 percent of the sample (15 percent weighted) made two tours. This means that the number of tours-per-person varies widely in the sample.

Number of Tours Made	# Persons	%
0	703	8%
1	1,111	13%
2	1,518	17%
3	1,264	14%
4	1,067	12%
5	823	9%
6	619	7%
7	486	6%
8 or More	1,146	13%
Total	8,737	100%

Source: DKS Associates

5.2.1 Variation of Tour Frequency by Purpose of Travel

Patterns of variation in travel frequency seen in the trip analysis are also seen in the analysis of tours, with some significant exceptions.

- Work tours were much more prevalent than home-work trips: 28 percent (26 percent weighted) of all tours had work as a primary destination (Table 7), compared to only 18 percent of all trips (Table 3).

Work tours are, in fact, the most prevalent tour type, accounting for more than one-in-four tours. Work tours capture many trip segments made to and from work, which in the trip analysis were typed as “home-other” or “work-other” trips (e.g. passenger serving trips or shopping trips on the way to and from work). By putting these trip segments into a context of a pattern of travel related to work, the overall amount of work-related travel is higher.

Type of Tour	# Tours	%	Tours/ HH	Tours/ Person
Work	3,333	28%	0.9	0.4
Education	1,478	12%	0.4	0.2
Personal business/other	2,420	20%	0.6	0.3
Shopping	1,326	11%	0.3	0.2
Visit/recreation	586	5%	0.2	0.1
Meal	886	7%	0.2	0.1
Serve passenger	811	7%	0.2	0.1
Work/school-based	1,056	9%	0.3	0.1
Total	11,896	100%	3.1	1.4

Source: DKS Associates

5.2.2 Variation in Tour Frequency by Household Structure and Person Type

Frequency of tours roughly mirrors frequency of trips, when household structure was taken into account. Households with school age children, greater numbers of workers, and more people had more tours per household. However, except from retired households, per-person tour frequency did not vary as strongly.

Per-person tour frequency was higher for workers than for non-workers. Per-person tour frequency also increased with age of the traveler. Children under 5 averaged just less than one tour per day, while persons 25-64 years of age average more than 1.5 tours per day. The average rate of tours per day for persons 65 years and older dropped again to just over one per day. (See Tables A12, A13, and A14 in the Appendix for more detailed information).

5.2.3 Tour Complexity

Because tours may include many trip segments spread over the course of a day, tours can be very complex, with many intermediate stops. The prevalence of complex tours (i.e. with intermediate stops on the way to or from the main destination of the tour) varied by type of person.

- Slightly more than one-half (56.1 percent) of all work tours had no stops going to or coming from work. Men were more likely than women to have no stops either way (Table 8). (Weighted results and more detailed information are reported in Tables A15 and A16 in the Appendix).
- Women with children were twice as likely to have stops on the way to and from work than men with children. About one-quarter of all women with children made stops going to and from work.

Table 8 Number of Stops on Work Tours by Gender and Presence of School Age Children in Household						
Sequencing of Stops on Tour	Gender/Children in Household Class					
	Male		Female		School Age Kids	All
	No Kids in HH	Kids in HH	No Kids in HH	Kids in HH		
No stops	61.8%	56.5%	55.9%	45.0%	50.0%	56.1%
Stops On Way to Primary Destination	7.7%	13.2%	8.6%	13.5%	25.0%	10.1%
Stops on Way from Primary Destination	21.6%	18.0%	25.8%	17.3%	25.0%	21.4%
Stops Both Ways	9.0%	12.3%	9.8%	24.1%	0.0%	12.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: DKS Associates

5.2.4 Tour Summary

Tour frequency corresponds to many of the same variables as trip frequency: number of persons in a household, income, and household structure. Many work tours include intermediate stops and “sub-tours” from the workplace. Work tours account for more than one-quarter of all tours.

6 Mode of Travel

Mode of travel is affected by many factors. Choosing transit is difficult in areas where transit service is limited. Home-non-work trips (e.g. trips to go shopping, drop off or pick up a student or worker, or trips to visit a friend or relative) are much more likely to be made by carpool, simply because these trips are more social in nature. Personal characteristics of the traveler make a difference, too.

6.1 Analysis of Trips.

6.1.1 Variation in Trip Mode by Purpose of Travel

Mode choice was influenced strongly by trip purpose.

- Over 80 percent (82 percent weighted) of home-work trips were made in single-occupant vehicles, compared to only 44 percent (40 percent weighted) of non-work trips (Table 9). (Weighted results are reported in Table A20 in the Appendix).
- The total carpool share for non-work trips was 47 percent (51 percent weighted), compared to about 10 percent for work trips.
- Transit share of non-work trips was less than one percent, compared to over 3 percent for work trips.

Travel Mode	Mode Share		
	Purpose		
	Non-Work	Work	All
SOV	44.2%	80.9%	51.0%
HOV-2 Persons	29.2%	7.9%	25.3%
HOV-3 or More Persons	17.7%	1.8%	14.8%
Transit (Walk Access)	0.5%	2.3%	0.9%
Transit (Drive Access)	0.3%	1.1%	0.4%
Walk	5.6%	2.6%	5.1%
Bike	1.2%	3.3%	1.6%
Other	1.2%	0.2%	1.0%
Total	100.0%	100.0%	100.0%

Source: DKS Associates

6.1.2 Variation in Trip Mode by Household Structure

Presence of children in the household affected mode choice for both work and non-work trips.

- For work trips, 3+ person carpool shares were nearly 4 percent for households with children, compared to less than one percent for households with no school-age children. (Detailed information is reported in Table A21 in the Appendix).
- Conversely, work trip transit, bike, and walk share for households without children was 11 percent (10 percent weighted), compared to 7 percent for households with children (less than six percent weighted).
- Perhaps most strikingly, nearly 60 percent of non-work trips were made by single occupant vehicle for households without children, compared to less than 30 percent by households with children.
- About two-thirds of all carpools for work trips, and over 70 percent for non-work trips, were composed entirely of household members. (For more detailed information see Table A22 in the Appendix).

6.1.3 Variation in Trip Mode by Vehicle Ownership

For the purposes of this analysis, household classifications based on the relationship between the numbers of workers and numbers of vehicles owned in the household were used to create household classes.

- Not surprisingly, households not owning vehicles made very few trips by single occupant vehicle (about 3 percent). In fact, the most common mode for these households was walking, with a 27 percent mode share (Table 10). However, only about one percent of the trips were made by households in this category. (Weighted results and more detailed information is reported in Tables A23, A24 and A25 in the Appendix).
- In households which own vehicles, but where workers outnumber vehicles, single occupant vehicle share was also quite low (31 percent), and transit share (4 percent) and walk and bike share (about 13.2 percent) were quite high. This household class accounted for about 5 percent of the trips in the survey.
- Where workers in a household are likely to have access to a vehicle, or where no workers were present, single-occupant vehicle shares were the highest, at nearly 50 percent. Transit shares were less than one percent for these classes, and bike-and-walk shares average about 5 percent or less. Combined, these households accounted for about 93 percent of the sample.

Table 10					
All Trips by Mode and Vehicle/Worker Household Class					
Travel Mode	Mode Share				
	Vehicles-to-Workers In HH				
	Vehicle=0	Workers>0, Vehicles<Workers	Workers>0, Vehicle=>Workers	Workers=0	All
SOV	3.2%	31.0%	53.0%	52.3%	51.0%
HOV-2 Persons	13.4%	29.6%	22.9%	35.3%	25.3%
HOV-3 or More Persons	20.9%	21.1%	16.0%	7.1%	14.8%
Transit (Walk Access)	17.2%	3.2%	0.5%	0.2%	0.9%
Transit (Drive Access)	3.8%	0.8%	0.4%	0.1%	0.4%
Walk	27.5%	9.0%	4.7%	3.6%	5.1%
Bike	12.6%	4.2%	1.4%	0.8%	1.6%
Other	1.4%	1.3%	1.1%	0.5%	1.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%
Percent of Trips in Category	1%	5%	76%	17%	100%

Source: DKS Associates

6.1.4 Variation in Trip Mode by Area Type

The types of destinations for both work and non-work trips also affects the mode of travel. Two employment areas stand out in the region: Davis and Downtown Sacramento.

- 89 percent of work trips to jobs in rural and ex-urban areas were made by single-occupant vehicles. Less than one percent of work trips to these areas were made by transit (Table 11). (Weighted results and more detailed information is reported in Table A26 in the Appendix).
- The single-occupant vehicle shares to jobs in Davis were the smallest of any area analyzed (less than 50 percent). Also, about one-third of all work trips were made by bicycle. This includes reported work trips made by students to the University.
- Transit share of work trips was highest to Downtown Sacramento, with nearly 14 percent.

Mode shares for non-work trips also varied by area, but differently than they did for work trips. Again, Davis and Downtown Sacramento are unique.

- The bike share of non-work trips to Davis was about 12 percent (Table 12), compared to less than 3 percent for all other areas. (See Table A27 in the Appendix).
- The walk share of non-work trips to Downtown Sacramento was about 17 percent, compared to about 10 percent for trips to Davis, and less than 7 percent for other areas.

Table 11					
Work Trips Mode Share by Employment Area Type					
Travel Mode	Mode Share				
	Employment Area Type				
	Rural/Ex-Urban	Suburban (less Davis)	Urban (Less Sacramento Downtown)	Davis	Sacramento Downtown
SOV	88.7%	86.4%	81.0%	48.0%	70.4%
HOV-2 Persons	7.5%	7.4%	8.0%	8.0%	9.3%
HOV-3 or More Persons	1.4%	2.2%	1.9%	3.0%	0.9%
Transit (Walk Access)	0.4%	1.2%	2.0%	5.5%	8.0%
Transit (Drive Access)	0.2%	0.1%	0.8%	0.0%	5.9%
Walk	1.2%	1.6%	4.5%	4.5%	2.6%
Bike	0.5%	1.0%	1.5%	30.7%	2.6%
Other	0.1%	0.0%	0.3%	0.5%	0.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: DKS Associates

Table 12					
Non-Work Trips by Mode and "Attraction" Area Type					
Travel Mode	Mode Share				
	"Attraction" Area Type				
	Rural/Ex-Urban	Suburban (less Davis)	Urban (Less Sacramento Downtown)	Davis	Sacramento Downtown
SOV	44.8%	44.4%	44.7%	39.5%	42.6%
HOV-2 Persons	30.2%	30.3%	29.3%	23.6%	23.7%
HOV-3 or More Persons	19.2%	18.9%	16.9%	14.3%	11.0%
Transit (Walk Access)	0.1%	0.4%	0.8%	0.5%	2.0%
Transit (Drive Access)	0.0%	0.3%	0.3%	0.1%	1.2%
Walk	3.5%	3.8%	6.5%	9.5%	17.1%
Bike	0.3%	0.8%	0.6%	12.4%	2.4%
Other	1.8%	1.1%	0.8%	0.2%	0.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: DKS Associates

6.1.5 Trip Summary

Trip purpose, vehicle ownership, and the area in which a trip is made all affect the mode of travel chosen. Figures 4, 5, and 6 illustrate some of these effects. Work trips and trips to areas with good transit service are more likely to be made by transit. Non-work trips are more likely to be made by carpools. Davis and Downtown Sacramento are unique in the region, because of high transit, bike, and non-motorized trip shares.

Figure 4
MODE OF TRAVEL:
Transit Share of Daily Person Trips

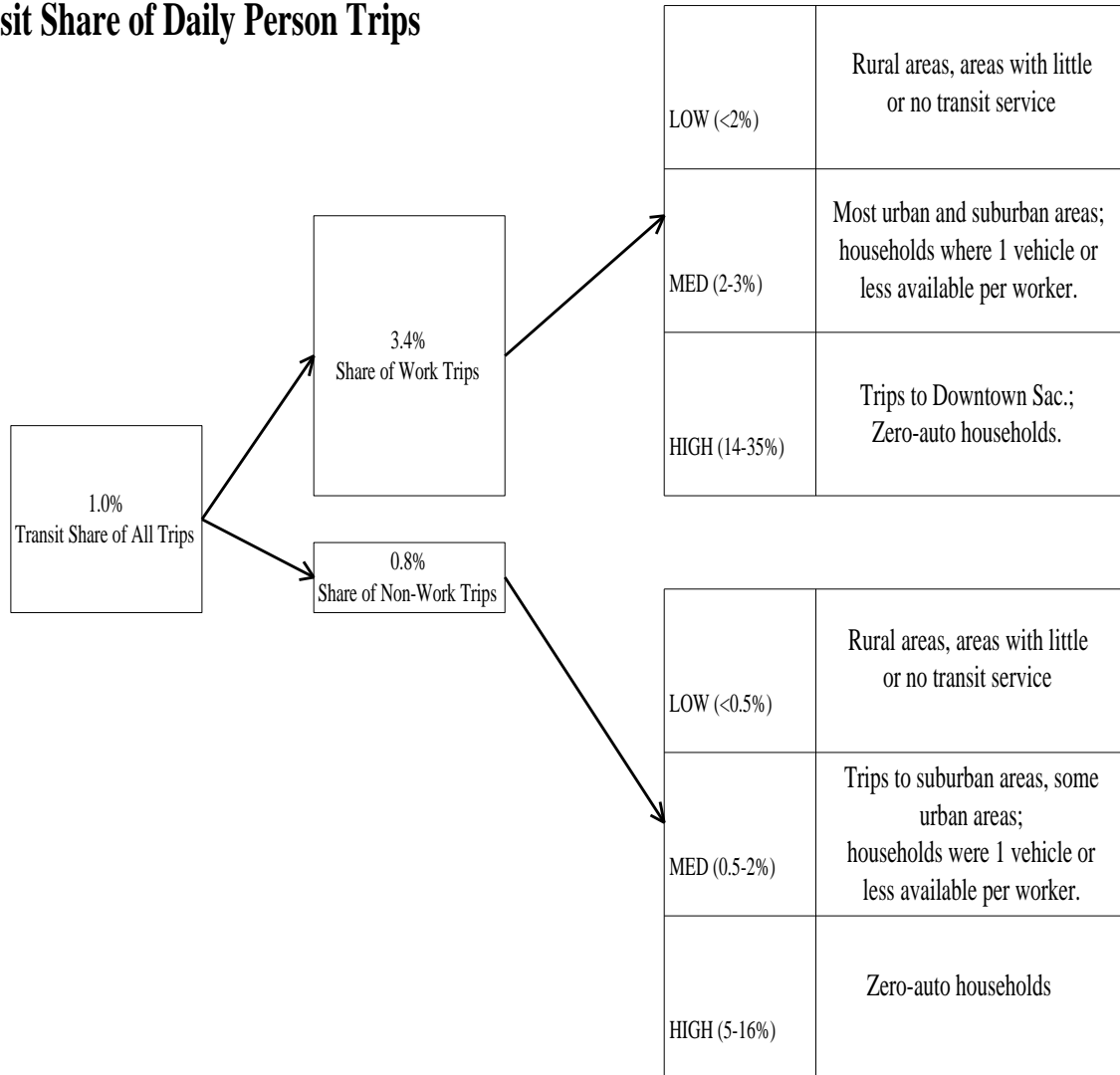


Figure 5
MODE OF TRAVEL:
Bike Share of Daily Person Trips

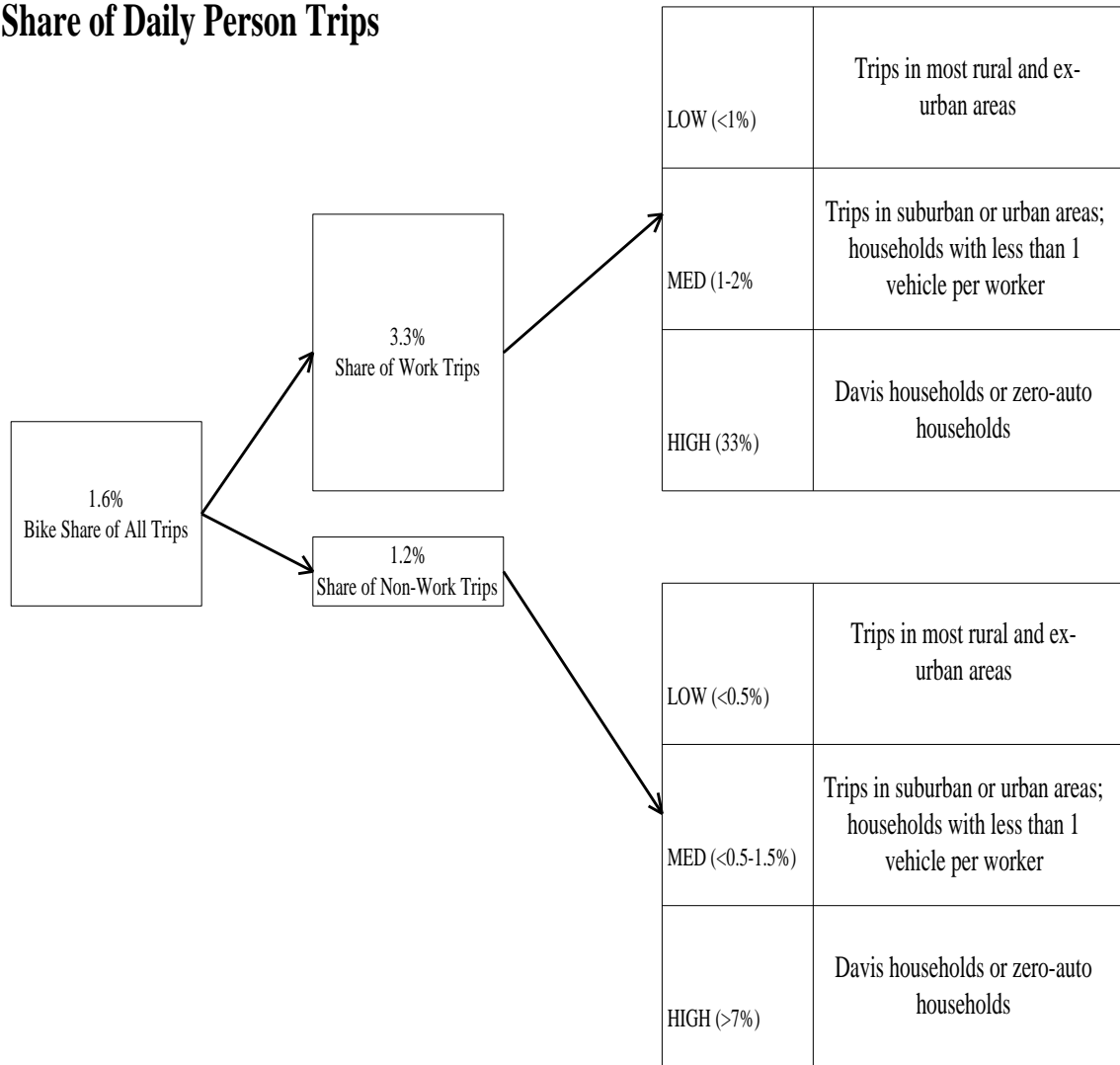
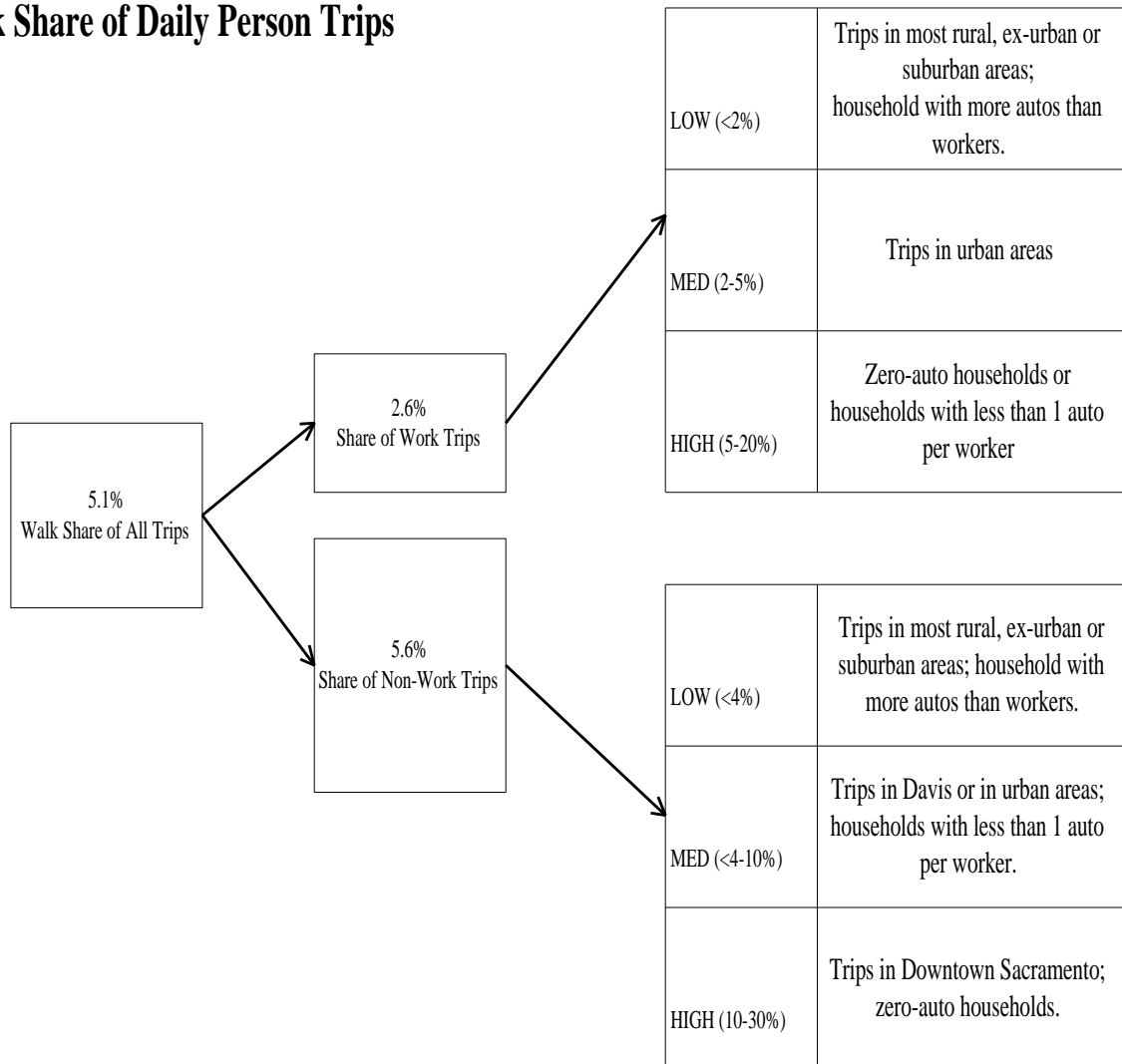


Figure 6
MODE OF TRAVEL:
Walk Share of Daily Person Trips



6.2 Analysis of Tours

As mentioned above, because tours include multiple trip segments, the mode of travel can vary within the tour. However, most tours (over 90 percent) are made using only one mode of travel for the entire tour.

6.2.1 Variation in Mode of Travel by Purpose

As with the analysis of trips, the main mode of travel for a tour varies significantly by tour purpose. (See Table A28 in the Appendix for more information).

- Work tours had the highest auto driver mode shares (88 percent).
- Tours made for education and school had the lowest auto-driver share by far (17 percent, and 14 percent weighted).
- Work- or school- based sub-tours had relatively high walk shares at about 12 percent.
- Tours made for social/recreational purposes, or to eat a meal out of the home, had the highest auto-passenger shares, at about 30 to 50 percent.

6.2.2 Variation in Mode of Travel by Person Type

Tour mode varied somewhat by gender and by the presence/absence of school age children in the household in the survey sample. (See Tables A29 and A30 in the Appendix for more information).

- For work trips, transit mode share was highest for males with no children in the household. These persons were nearly three times as likely to take public transit (nearly four percent compared to less than two percent, weighted). For female workers, no pronounced difference in mode choice by presence or absence of children was observed.
- For non-work trips, females with children had the highest auto-passenger share (over 22 percent with children, and 11 percent without). This was significantly higher than the comparable groups for males.

7 Time of Travel

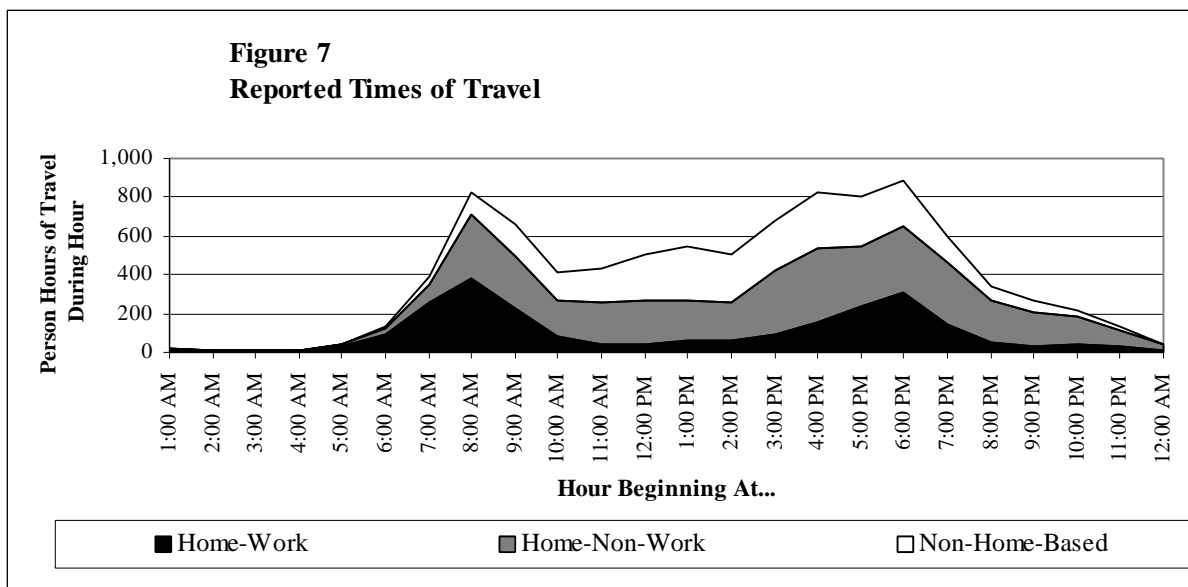
Time of travel refers to the time periods in which survey respondents chose travel. Time of travel varies significantly by trip or tour purpose. The reported travel times in the survey were used to tabulate the number of person hours of travel which occurred during each hour of the day. Some caveats need to be stated regarding reported times of travel. First, reported times of travel are often times rounded to the nearest 5, 10, or 15-minute increment by respondents, rather than the exact times. Second, different persons judge the beginning or ending time of a trip by different milestones (e.g. the time at which a person parked the car may be used as the trip end point by one person, and the time at which the person arrived at his or her desk may be used by another person).

7.1 Analysis of Trips

The distribution of travel over the hours of the day is shown in Figure 7. Time of travel is shown for three generalized trip purposes: home-work, home-non-work, and non-home based. Home-work trips are typical commute trips. Home non-work includes home-shop and home-other trips. Non-home-based trips include trips with both ends at non-home locations (e.g. a trip from work to a restaurant for lunch, a trip from work to another workplace for a business meeting, or a trip from school to a shopping center).

- Home-work travel showed the expected double-peak pattern. About 16 percent of all work travel occurred during the hour from 7:00 to 8:00 AM. About 13 percent occurred between 5:00 and 6:00PM. (Table 13). (More detailed information and weighted results are reported in Tables A32 and A33 in the Appendix).
- Home non-work travel also showed two peaks, but much less pronounced than home-work travel. About 9 percent of home-non-work travel occurred during the hour from 7:00 to 8:00 AM, and about 10 percent during the hour from 3:00 to 4:00 PM.
- Non-home-based travel showed only one true peak, which occurred between 3:00 and 4:00 PM. However, this type of travel exceeded 8 percent during each hour from 11:00AM to 6:00PM.
- Nearly one-half of all travel occurred during the three hour AM and PM peak periods (six hours total, or 25 percent of the day).
- Almost 29 percent of all travel occurred during the five-hour midday period, between the AM and PM peak periods.

Hour Starting At...	% of Total By Purpose				Time Period Groupings	
	Home-Work	All Home-Non-Work	Non-Home-Based	All	Period Name	% Travel During Period
12:00 AM	0.3%	0.3%	0.1%	0.2%	Late Evening/ Early Morning Period (Part 1)	23.9%
1:00 AM	0.2%	0.2%	0.1%	0.2%		
2:00 AM	0.1%	0.1%	0.1%	0.1%		
3:00 AM	0.3%	0.0%	0.0%	0.1%		
4:00 AM	1.4%	0.2%	0.1%	0.5%		
5:00 AM	4.0%	0.8%	0.4%	1.5%		
6:00 AM	10.6%	2.3%	1.4%	4.2%	AM Peak Period	20.3%
7:00 AM	15.7%	8.0%	4.3%	8.9%		
8:00 AM	9.5%	6.5%	5.7%	7.0%		
9:00 AM	3.5%	4.6%	5.1%	4.4%	Mid-Day Period	28.7%
10:00 AM	1.8%	5.3%	6.2%	4.7%		
11:00 AM	1.7%	5.5%	8.6%	5.4%		
12:00 PM	2.6%	4.9%	10.1%	5.9%		
1:00 PM	2.6%	4.8%	8.9%	5.5%		
2:00 PM	3.9%	7.9%	9.2%	7.3%	PM Peak Period	27.0%
3:00 PM	6.3%	9.4%	10.4%	8.9%		
4:00 PM	9.6%	7.7%	9.0%	8.6%		
5:00 PM	13.0%	8.2%	8.5%	9.5%	Late Evening/ Early Morning Period (Part 2)	Included in Part 1
6:00 PM	6.0%	7.8%	4.7%	6.4%		
7:00 PM	2.1%	5.3%	2.8%	3.7%		
8:00 PM	1.4%	4.3%	1.9%	2.8%		
9:00 PM	1.7%	3.4%	1.3%	2.3%		
10:00 PM	1.4%	1.9%	0.8%	1.4%	Daily	100.0%
11:00 PM	0.6%	0.6%	0.3%	0.5%		
Total Daily	100.0%	100.0%	100.0%	100.0%		



Source: DKS Associates.

7.2 Analysis of Tours

As mentioned above, because tours take place over the course of the day, the analysis of time of travel must take into account more than just the beginning and ending points. Tours were cross-tabulated by the time of departure from home (or from work or school for sub-tours), and by departure from main destination of the tour. For example, this would be the time a person left home for work, and the time he or she left work to return home. This cross tabulation does not account for timing of intermediate stops, if any.

- For work tours, the most times of travel were an AM peak (7:00-9:59 AM) departure from home, and a PM peak (3:00-5:59 PM) departure from work. Just over one-third of all work tours fit this pattern (Table 14). (More detailed information and weighted results are reported in Table A34 in the Appendix).
- Another 20-plus percent of work tours departed home in the early AM peak (i.e. before 7:00AM), and returned home in the PM peak period.
- The timing of non-work tours was more dispersed. Just over 20 percent of all non-work tours departed the tour origin during the AM peak period, and departed the main tour destination during either the midday (10:00 AM to 2:59 PM) or PM peak period (See Table A35 in the Appendix).
- Just over 16 percent of all non-work tours began and ended within the midday period.

Table 14							
Times of Travel for Work Tours							
	% of Total Tours						
	Time Leaving Tour Destination (Work)						
Time Leaving Tour Origin (Home)	Early	AM Peak	Midday	PM Peak	Eve.	Late Eve.	All
Early AM (4:00-6:59AM)	0.1%	0.2%	6.0%	21.3%	2.8%	0.2%	30.6%
AM Peak Period (7:00AM -9:59AM)	0.0%	0.5%	8.8%	35.8%	10.9%	0.7%	56.6%
Midday Period (10:00AM-2:59PM)	0.0%	0.0%	1.8%	2.6%	2.8%	1.8%	9.0%
PM Peak Period (3:00PM-5:59PM)	0.0%	0.0%	0.0%	0.3%	1.6%	0.9%	2.8%
Evening (6:00PM-9:59PM)	0.0%	0.0%	0.0%	0.0%	0.2%	0.2%	0.5%
Late Evening (10:00PM-3:59AM)	0.0%	0.0%	0.3%	0.1%	0.1%	0.0%	0.5%
All	0.1%	0.8%	17.0%	60.1%	18.3%	3.8%	100.0%

Source: DKS Associates

8 Duration of Travel

The duration of travel refers to how long each unit of travel lasts, or the length of the trips. For this report, duration means the time between a survey respondent reported leaving one activity location, and when they reported arriving at the next activity location. This is not a perfectly accurate measure, since people may have different ideas about when they left (Is it when they walked out the door of their office? Is it when they left the parking lot in their vehicle? Etc.). Also, people tend to round their times to the nearest 5, 10 or 15-minute time increment. However, it is assumed that these judgments and biases average out over the sample.

Duration of travel varies by purpose of travel, the mode of travel, and by the areas the travel occurs.

- Home-work trips were the longest of all trip purposes, averaging 24 minutes (25 weighted). However, variation in work trip times is high. Five percent of trips are over 60 minutes (Table 15). (More detailed information and weighted results are reported in Table A37 in the Appendix).
- Non-work trips ranged from 13 to 18 minutes in average length, depending on the specific purpose of the trip.

Duration of travel also varied by mode of travel, household structure, and person type. (See Tables A38 and A39 in the Appendix for detailed information).

- Trips made by transit were the longest of all modes, averaging 40 minutes for walk-access and 45 minutes for drive access trips.
- Walk trips were the shortest of all modes, averaging 12 minutes.
- Trip lengths for households located in rural areas were the longest of all area types, averaging 20 minutes (19 weighted). Average trip lengths for households located in ex-urban, suburban, and urban areas were 17, 16 and 16 respectively (17, 17, 16 weighted).

Another measure of travel duration is the total time a person devoted to travel during the course of a day, often called a “*travel time budget*”.

- The average travel time budget for the survey respondents was 62 minutes per person (Table 16), or 143 minutes per household (163 weighted). (For weighted results and more detailed information, see Tables A40 and A41 in the Appendix).

Table 15
Trip Duration by Purpose of Travel

Trip Purpose	Cumulative Trip Results					
	# Trips	%	Reported Travel Duration (Hours)	%	Average Trip Length (Minutes)	Standard Deviation (Minutes)
Home-Work	6,086	18%	2,438	26%	24	19
Home-Shop	3,393	10%	751	8%	13	11
Home-Other	10,908	33%	2,932	31%	16	20
Work-Other	3,947	12%	1,174	12%	18	18
Other-Other	6,780	21%	1,646	17%	15	17
Home-School	1,923	6%	493	5%	15	13
Total	33,037	100%	9,434	100%	17	18

Source: DKS Associates

- Work travel accounted for 16 minutes or 25 percent of the average travel time budget.
- Working adults spent had higher travel time budgets than non-working adults. Working males spent 79 minutes traveling, and females, 72 minutes, compared to 61 and 56 minutes for non-working males and females, respectively.
- Seniors and children had the lowest travel time budgets, with 47 and 46 minutes, respectively.

Table 16
Travel Time Budgets by Person Type

Person Type	Survey Results							
	# Persons	%	Total Travel Duration (Hours)			Travel Duration Per Person (Minutes)		
			Home-Work	Non-Work	Total	Home-Work	Non-Work	Total
Kid	1,737	19%	21	1,301	1,322	1	45	46
Male Worker	2,361	26%	1,377	1,722	3,098	35	44	79
Female Worker	2,063	23%	920	1,550	2,471	27	45	72
Male Non-Worker	459	5%	56	409	465	7	53	61
Female Non-Worker	797	9%	50	690	740	4	52	56
Senior	1,698	19%	11	1,310	1,321	0	46	47
Uncodable	15	0%	2	12	14	6	49	55
Total	9,130	100%	2,437	6,994	9,431	16	46	62

Source: DKS Associates

9 Workplace Amenities

Workplace amenities considered in the analysis included the ability to flex-time, presence of facilities such as on-site cafeterias or eating establishments, presence of bike lockers, availability of transit subsidies, etc. In general, it was difficult to parse out the specific effects of these amenities, because of strong correlations and patterns in where specific amenities were provided, and what type of employee had access to them. However, travel behavior was significantly different for those workers which had access to some workplace amenities. (See Tables A42 to A47 in the Appendix for more detailed information).

- One of the most significant effects seemed to be presence of on-site childcare. For workers with on-site childcare, SOV mode split was 12 percent less, and carpool, transit, bike and walk mode splits were higher. However, on-site childcare was far more likely to be provided at worksites in urban areas, and the area type of the worksite may explain part of the variation.
- For workers facing parking charges at the worksite had 20 percent less SOV share for work trips, and significantly higher carpool, transit and bike shares. Again, though, worksites with worker-paid parking were far more likely to be located in urban areas, where transit service is the best.

Appendix
