TEXAS DEPARTMENT OF TRANSPORTATION

EXECUTIVE SUMMARY

Jim Lyle/TTI

2005 • 2006 • 2007

Austin Area Travel Surveys

Bastrop, Caldwell, Hays, Travis and Williamson Counties

DISCLAIMER
The contents of this report reflect the views of the authors who are responsible for the data, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration or the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation.

ACKNOWLEDGEMENTS
This report provides a summary of the travel surveys conducted in Austin 5-County Area, Texas in 2005, 2006 and 2007. Details of these surveys are provided in the following separate technical reports which are available for viewing through the Capital Area Metropolitan Planning Organization (CAMPO) and the TxDOT Transportation Planning and Programming Division.

- 2006 Capital Area Metropolitan Planning Organization Household Travel Survey Technical Summary, authored by George B. Dresser and David Pearson, Texas Transportation Institute, April 2008
- 2005 Austin External Survey Technical Summary, authored by Stephen P. Farnsworth, Texas Transportation Institute, February 2008
- 2006 Austin Commercial Vehicle Survey Technical Summary, authored by Stella Amor F. Nepal, Stephen P. Farnsworth and David Pearson, Texas Transportation Institute, December 2007 (Revised February 2008)
- 2006/2007 Austin Area Work Place Travel Survey Technical Summary, authored by Stella Amor F. Nepal and David F. Pearson, Texas Transportation Institute, March 2009.

The factual contents of this report were taken from the above summary reports and the contributions of the authors of these reports are acknowledged. Other factual sources are referenced in the report. The authors are responsible for the opinions, findings, and conclusions.

There were a number of individuals who extended technical support and assistance during the preparation of this report. Special thanks are due to Gary Lobaugh, Dr. Dennis Perkinson, Mark Ojah, and John Henry of the Texas Transportation Institute; and Greg Goldman of CAMPO.

The authors would like to thank Charlie Hall, TxDOT Travel Survey Program Manager, for his advisement and guidance and the Department for its continuing program to collect and analyze urban travel data to support travel demand modeling.

Cover Photo – Austin, Texas : Jim Lyle/TTI

2005 • 2006 • 2007

Austin Area Travel Surveys

Bastrop, Caldwell, Hays, Travis and Williamson Counties

EXECUTIVE SUMMARY

Sponsored by Capital Area Metropolitan Planning Organization (CAMPO) in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA)

Prepared by

Stella Amor F. Nepal
Associate Transportation Researcher

Edwin Hard
Research Scientist

and

David F. Pearson Ph.D., P.E.
Research Engineer

Texas Transportation Institute
The Texas A&M University System
College Station, Tx 77843

August 2009

TABLE OF CONTENTS

INTRODUCTION 1
Population Gowth 4
Mobility and Congestion 4
HOUSEHOLD SURVEY 7
Household Characteristics 7
Household Size And Income 8
Vehicles Available 9
Age Cohort 10
Employment Status 10
Employment Type 11
Household Travel Characteristics 12
Trip Productions 12
Trip Production Rates 13
Trip Distance 13
Time-of-Day Travel 14
Trip Purpose 15
WORK PLACE SURVEY 18
Work Place Travel Characteristics 19
Special Generators 21
EXTERNAL SURVEY 26
COMMERCIAL VEHICLE SURVEY 27
TRAVEL TIME AND DELAY SURVEY 29
SUMMARY OF FINDINGS 32
Growth In Travel 32
Household Characteristics and Travel Behavior 33
Travel Purpose 33
External-Local and External-Through Travel 33
Commercial Vehicle Travel 33
Travel Speed and Delay 33
Expansion of Campo Modeling Area 34
1997/1998 and 2006 Travel Surveys 34
GLOSSARY AND TERMINOLOGY 36
REFERENCES 37

LIST OF FIGURES

Figure 1. Key Elements of the Planning Process. 2
Figure 2. Austin Five-County Travel Survey Area. 3
Figure 3. Annual Delay per Peak Period Traveler. 5
Figure 4. Distribution of Households by Household Size 8
Figure 5. Distribution of Households by Household Income 8
Figure 6. Distribution of Households by Vehicles Available 9
Figure 7. Distribution of Employed Households....9
Figure 8. Distribution of Persons by Age Cohort....10
Figure 9. Distribution of Persons by Employment Status. 11
Figure 10. Distribution of Persons by Employment Type....11
Figure 11. Distribution of Employed Persons by Basic, Retail, Service and Education Employment....12
Figure 12. Distribution of Trip Productions by Trip Purpose. 13
Figure 13. Distribution of Person Trips by Travel Distance 14
Figure 14. Distribution of Person Trips by Travel Time 14
Figure 15. Distribution of Person Trips by Time-of-Day....15
Figure 16. Distribution of Person Trips by Destination Purpose 15
Figure 17. Sub-Areas within Travis County....17
Figure 18. Person-Trips that Remain withing Each County....17
Figure 19. Austin Five-County Work Place Survey Locations 19
Figure 20. Distribution of Reported Trips by Trip Purpose....20
Figure 21. Distribution of Person Trips by Travel Distance 20
Figure 22. Distribution of Person Trips by Time-of-Day 21
Figure 23. Surveyed Trips by Trip Purpose at ABIA....22
Figure 24. Visitor Trips by Travel Mode at ABIA 22
Figure 25. Surveyed Trips by Trip Purpose at SWU 23
Figure 26. Surveyed Trips by Travel Mode at SWU 24
Figure 27. Austin Five-County External Station Survey Locations....25
Figure 28. External-Local Trip and External–Through Movements by Location Group....26
Figure 29. Example of a Commercial Vehicle Survey Station 27

LIST OF TABLES

Table 1. Population Estmates, Projections, and Annual Growth Rate: 1960–2030....4
Table 2. City of Austin Mobility Data: 1982–2005....5
Table 3. Commuting to Work in 1990 and 2000. 6
Table 4. Austin Five-County Population, Daily VMT and Daily VMT per Person. 6
Table 5. Person Trip Rates by Household Size and Household Income 13
Table 6. Average Trip Lengths for Surveyed Trips to ABIA....23
Table 7. Average Trip Lengths for Surveyed Trips to SWU 24
Table 8. Estimated VMT for Commercial Vehicles by Roadway Functional Classification 28
Table 9. Peak Period Average Speeds (mph) 30
Table 10. Off-Peak Period Average Speeds (mph) 31
Table 11. Posted Speed Limits (mph) 31
Table 12. Household Survey Data Comparison (1998 and 2006) 35
Table 13. Commercial Vehicle Survey Data Comparison (1997 and 2006)....35

View of downtown Austin, Texas

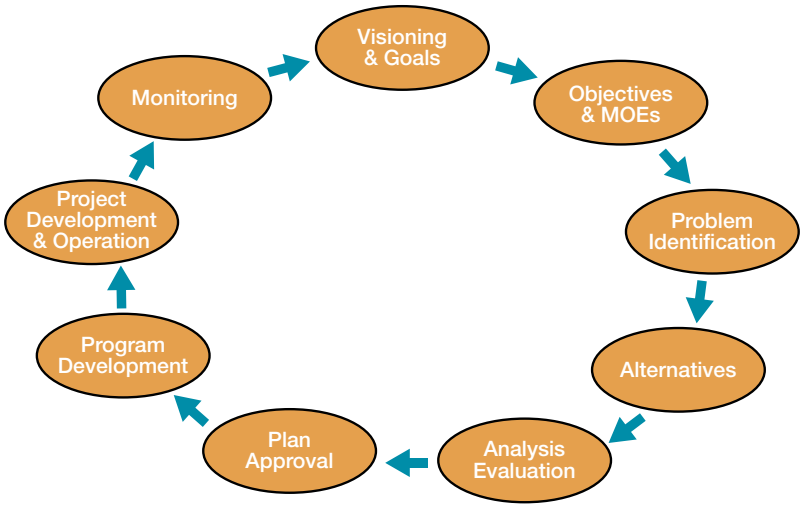
INTRODUCTION

Metropolitan transportation planning is the process of examining travel and transportation issues and needs in metropolitan areas. The process is governed by federal legislation passed in the early 1970s, which required the establishment of a Metropolitan Planning Organization (MPO) for any urbanized area with a population greater than 50,000. The legislation ensures that metropolitan area transportation plans and programs throughout the U.S. were developed based on a continuing, cooperative, and comprehensive (3-C) planning process. An MPO is a transportation policy-making body made up of representatives from local government and transportation agencies with authority and responsibility in metropolitan planning areas. Federal funding for transportation projects and programs is channeled through the MPO. Figure 1 shows the key elements of the metropolitan transportation planning process.

Metropolitan transportation planning is the process of examining travel and transportation issues and needs in metropolitan areas.

Where do travel surveys fit in this process? Data collected from travel surveys serve as vital input to travel demand models. Most MPOs use a travel demand model to forecast the demand for transportation and capacity needs and to evaluate how proposed alternative transportation systems will perform. This analysis is used to support the development of a long-range transportation plan and short-range transportation improvement program that are adopted by an MPO's policy board. These plans are approved at a minimum of once every five years for metropolitan areas that are in attainment of National Ambient Air Quality Standards (NAAQS) and once every four years for metropolitan areas that are not in attainment of the NAAQS.

Figure 1. Key Elements of the Planning Process.



Source: National Highway Institute (Course No. 152069. Metropolitan Transportation Planning).

Travel surveys are essential for the development of a travel demand model to support the metropolitan transportation planning process.

The State Capitol – Austin, Texas

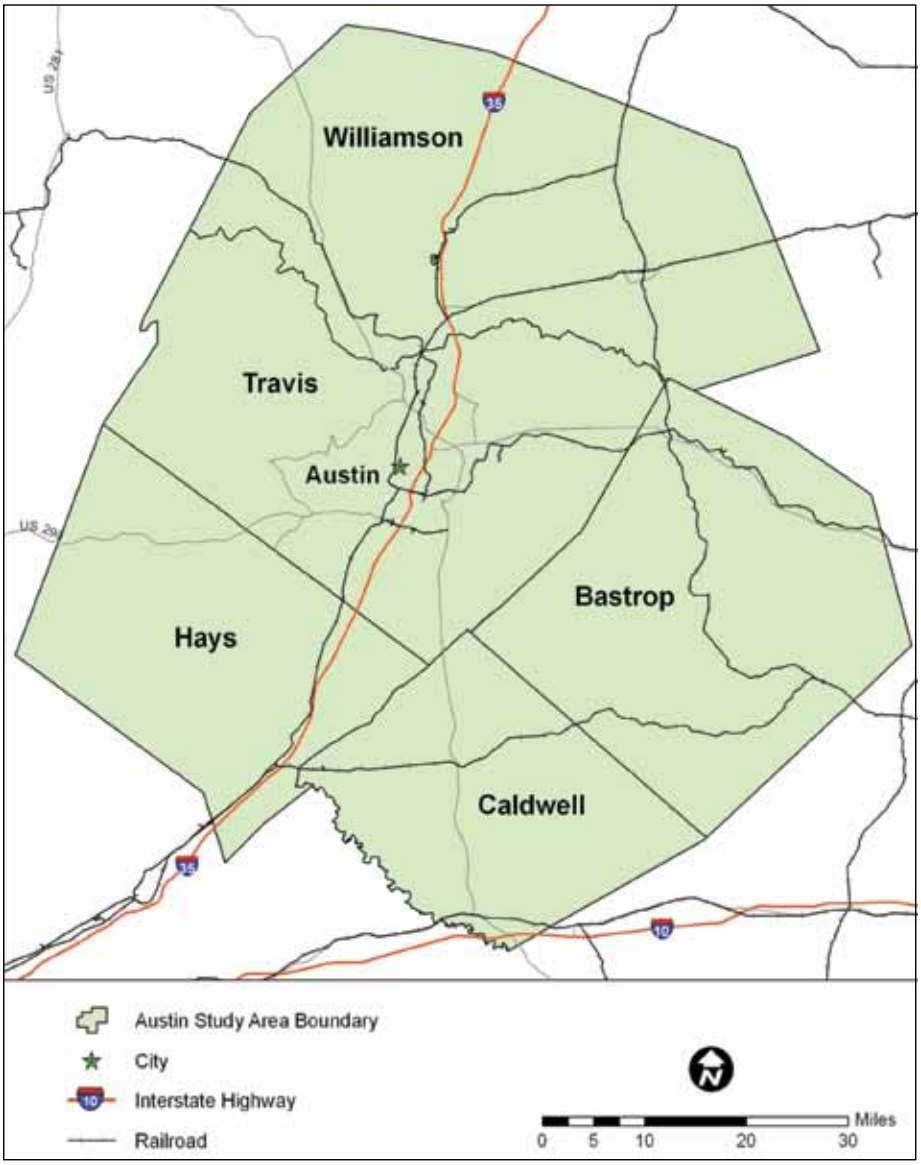
Travel surveys are required to support travel demand model estimation, calibration, and validation for the model's base year. The Texas Department of Transportation (TxDOT) has supported, and continues to support, the timely conduct of urban travel surveys that are essential for the development of travel demand models to support the metropolitan transportation planning process. During the period between 2005 and 2007, the Transportation Planning and Programming Division (TPP) of TxDOT funded a comprehensive set of travel surveys in the Austin region. Five types of travel surveys were conducted to collect information on different aspects of travel and trip-making in the Austin area. These included the following:

- a household travel survey to collect information on amounts, origins and destinations of resident travel within the area;
- a work place survey to collect information on the number and types of trips attracted to basic, retail, service, and education establishments, including special generators such as airports and universities;
- an external survey to collect information on travel coming into, going out of, or passing through the study area;
- a commercial vehicle survey to collect information on travel made by commercial vehicles operating within the study area; and
- a travel time and delay survey to collect travel time data during peak and off-peak time periods for roadways within the area.

The Capital Area Metropolitan Planning Organization (CAMPO) is the organization responsible for transportation planning for the Austin metropolitan area. The data obtained from the travel surveys will be used in the development and update of the travel demand model for the CAMPO planning area.

This report presents a summary of the travel surveys conducted in the Austin region. The study area included the three counties in the CAMPO planning area - Hays, Travis and Williamson, and two additional counties, Bastrop and Caldwell, which were included in the study area due to the large volume of travel that occur between these two counties and the CAMPO planning area. Figure 2 shows the location map for the Austin five-county study area.

Figure 2. Austin Five-County Travel Survey Area.



Between 2005 and 2007, a comprehensive set of travel surveys were conducted in the Austin area to collect data needed to update the travel demand model for the CAMPO planning area.

This section details selected demographic and transportation statistics to provide a frame of reference for the Austin five-county study area as compared to the state of Texas.

POPULATION GROWTH

The Austin five-county study area is forecast to grow at a faster rate than the rate of growth for all of Texas. The area's population is estimated to grow by 867,000 people or about 62 percent between 2005 and 2030. Significant growth rates for the study area occurred during the period between 1960 and 2000. The Austin area's population is forecast to account for around 7 percent of the total Texas population estimate by 2030 (Table 1).

The Austin five-county area is forecast to grow at a faster rate than the rate of growth for Texas as a whole.

Table 1. Population Estimates, Projections, and Annual Growth Rate: 1960-2030.

Year	Austin Five-County Study Area Population	Percent Annual Growth Rate	Texas Population	Percent Annual Growth Rate
1960	301,261	-	9,579,677	-
1970	398,938	2.85	11,196,730	1.57
1980	585,051	3.90	14,229,191	2.43
1990	846,227	3.76	16,986,510	1.79
2000	1,249,763	3.98	20,851,820	2.07
2005	1,405,087	2.37	22,556,027	1.58
Population Projections				
2010	1,565,051	2.18	24,330,643	1.53
2020	1,901,433	1.97	28,005,740	1.42
2030	2,272,224	1.80	31,830,575	1.29

Source: U.S. Census Bureau and Texas State Data Center, Scenario 0.5.

Improved transportation planning and analysis tools are needed to plan for and to provide the additional transportation facilities that will be needed to accommodate this growth and maintain the good level of personal mobility that residents currently enjoy. The travel surveys, summarized in this report, provide the travel-related data needed to continue to improve these analysis tools.

MOBILITY AND CONGESTION

According to the 2007 Annual Urban Mobility Report developed by the Texas Transportation Institute (TTI), travel in the City of Austin, as measured by vehicle miles of travel (VMT), increased by 63 percent from 1982 to 2005 (Table 2). The amount of travel has increased faster than the amount of capacity (lane-miles) being added to the roadway system, and, as a result, annual delay per peak period traveler has also increased. Compared to the average annual delay, 28 hours per year per peak period traveler in medium urban areas (urban areas with 500,000 to 1 million population), the delay in the City of Austin is about 49 hours per year per peak period traveler, 21 hours more than the other medium urban areas (Figure 3).

Based on key mobility performance measures such as delay per traveler, travel time index, and total delay, Austin showed much higher congestion ratings in comparison with other medium urban areas. The trends during the period 1982 to 2005 also showed much faster growth rates in terms of delay per traveler and total delay.

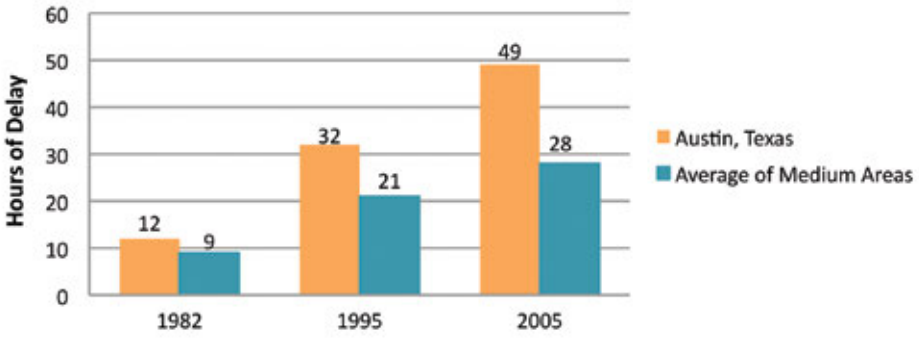
Table 2. City of Austin Mobility Data: 1982 – 2005.

Year	Population (1,000)	Daily Vehicle Miles of Travel (1,000)	Daily Vehicle Miles of Travel per Person	Peak Period Travelers (1,000)	Annual Delay per Peak Traveler (Person Hours)
1982	410	6,000	15	175	12
1983	430	6,815	16	186	17
1984	455	7,130	16	198	18
1985	465	7,700	17	204	19
1986	470	8,200	17	208	19
1987	480	8,175	17	214	18
1988	525	8,505	16	236	16
1989	520	9,000	17	235	20
1990	550	9,570	17	251	22
1991	575	10,230	18	266	24
1992	590	10,600	18	276	21
1993	600	11,100	19	284	23
1994	610	11,400	19	293	27
1995	635	11,875	19	309	32
1996	665	12,575	19	327	36
1997	705	12,950	18	351	40
1998	725	13,530	19	366	37
1999	745	14,050	19	381	41
2000	770	15,000	19	398	41
2001	800	15,650	20	419	45
2002	825	15,810	19	438	43
2003	840	16,000	19	451	43
2004	850	16,175	19	459	44
2005	855	16,505	19	464	49

Source: TTI, 2007 Urban Mobility Report. Available at http://mobility.tamu.edu.

Travel in the City of Austin, as measured by vehicle miles of travel (VMT), increased by 63 percent from 1982 to 2005.

Figure 3. Annual Delay per Peak Period Traveler.



Source: TTI, 2007 Urban Mobility Report.

Persons commuting to work in the Austin five-county study area (and Texas in general) primarily drive alone or use carpools (Table 3). There is limited use of public transportation, which can be mainly attributed to the majority of the households having one or more vehicles available.

Table 3. Commuting to Work in 1990 and 2000.

Mode of Commuting to Work	Austin Five-County Study Area		Texas	
	1990	2000	1990	2000
Drive Alone	74.9%	76.5%	76.5%	77.7%
Carpool	14.5%	13.7%	14.9%	14.5%
Public Transportation	3.2%	2.6%	2.2%	1.9%
Walk	2.9%	2.1%	2.7%	1.9%
Other	1.5%	1.6%	1.3%	1.3%
Work at Home	3.0%	3.6%	2.4%	2.8%

Source: U.S. Census Bureau.

The daily VMT per person for the Austin five-county study area has been remarkably stable over time. However, with population forecast to increase by 62 percent from 2005 to 2030, and with daily VMT projected to increase by around 80 percent, the daily VMT per person is estimated to be 29.5 by 2030 (Table 4).

Persons commuting to work in the Austin five-county study area (and Texas in general) primarily drive alone or use carpools.

Table 4. Austin Five-County Population, Daily VMT and Daily VMT per Person.

Year	Population	Daily Vehicle Miles of Travel	Daily Vehicle Miles of Travel per Person
1990	846,227	21,433,225	25.3
1995	1,031,557	25,886,437	25.1
2000	1,249,763	33,341,041	26.7
2001	1,325,305	35,444,966	26.7
2002	1,355,241	35,858,436	26.5
2003	1,385,723	36,330,440	26.2
2004	1,423,161	36,850,576	25.9
2005	1,405,087	37,235,719	26.5
Projections			
2010	1,565,051	44,949,122	28.7
2020	1,901,433	55,767,521	29.3
2030	2,272,224	67,118,753	29.5

Sources: U.S. Census Bureau, TxDOT, and TTI.

To estimate future travel, trips are divided between trips made within the study area (internal trips), trips made into or out of the study area (external-local trips), and trips made through the study area (external-through trips). The household survey collected information and data on internal trips.

MoPac Expressway Town Lake Bridge – Austin, Texas

HOUSEHOLD SURVEY

The primary purpose of the household survey is to understand the trip-making patterns of households relative to their characteristics such as household size, number of persons employed, income, vehicles available, and trip purpose. The data obtained from the survey are used in the trip generation step of the travel demand model to estimate trip production rates by trip purpose. The average travel distances and trip length frequency distributions for each trip purpose are then estimated, and along with the number of productions and attractions are used in the trip distribution step of the travel demand model to estimate the attraction end for each trip produced. (See the Glossary and Terminology section of this report for an explanation of terms.)

The data obtained from the household survey are used in the trip generation step of the travel demand model to estimate trip production rates by trip purpose.

HOUSEHOLD CHARACTERISTICS

Households that participated in the survey were randomly selected and were asked to record in a diary the travel made by each person in the household during a 24-hour period. For each trip, participants were asked to record the time, place the trip began and ended, mode of travel, number of passengers, purpose of the trip, and other descriptive information. In addition to the trip diary, households were asked to provide information on household characteristics that are closely correlated with the household trip-making such as the number and age of persons in the household, number of members employed, income, and the number of vehicles available to the household.

The 2005/2006 Austin five-county study area household survey included 1,499 randomly selected households from within the study area. The joint distribution of household size and income characteristics from the 2000 US Census and the Texas State Data Center (TSDC) population projections for the study area, with the estimated distribution of persons by age cohort and gender, were used to expand the household survey data. The results presented in this section are based on expanded survey data.

Household Size and Income

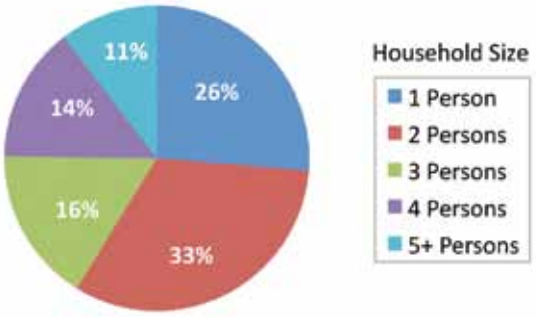
Household size and income are used in the travel demand model for estimating and forecasting travel. In general, as household size increases, daily household travel increases. In the same manner, when household income increases, daily household travel increases. By monitoring these two household characteristics, future travel demand can be estimated with greater accuracy.

Figures 4 and 5 show the distribution of households by household size and household income, respectively. Approximately 26 percent of the households in the Austin five-county study area have a household size of one, and 33 percent have household size of two. More than 50 percent of the households have annual household income greater than $50,000.

Households that participated in the survey were randomly selected and were asked to record in a diary the travel made by each person in the household during a 24-hour period.

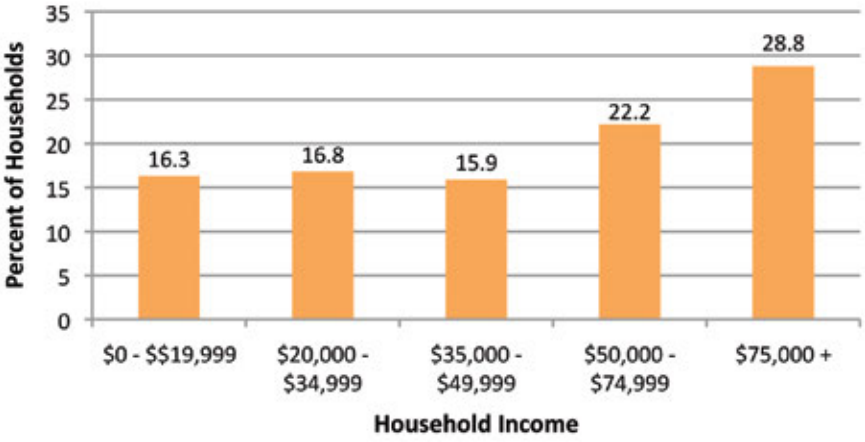
MoPac Expressway – Austin, Texas

Figure 4. Distribution of Households by Household Size.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

Figure 5. Distribution of Households by Household Income.



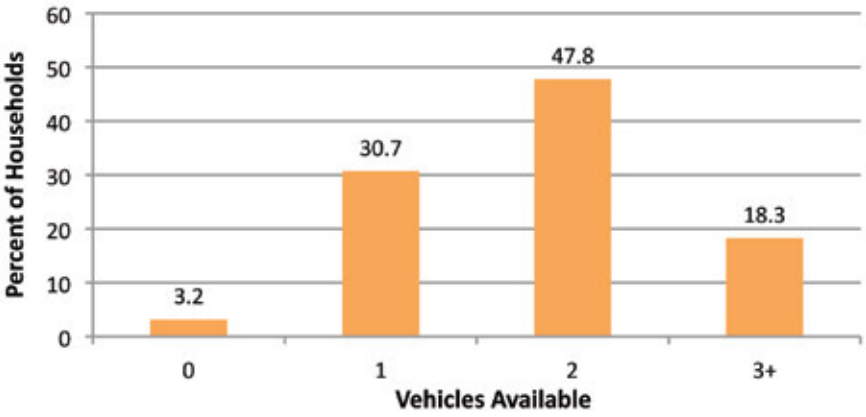
Source: 2006 Austin Household Travel Survey and TTI Analysis.

Vehicles Available

Generally, daily household travel also increases as the number of vehicles available to the household increases. Household demand for public transportation tends to decrease as vehicle availability to the household increases.

Figure 6 shows the distribution of households by the number of vehicles available. Around 3 percent of the households do not have a vehicle available, and nearly one-third have at least one vehicle available.

Figure 6. Distribution of Households by Vehicles Available.



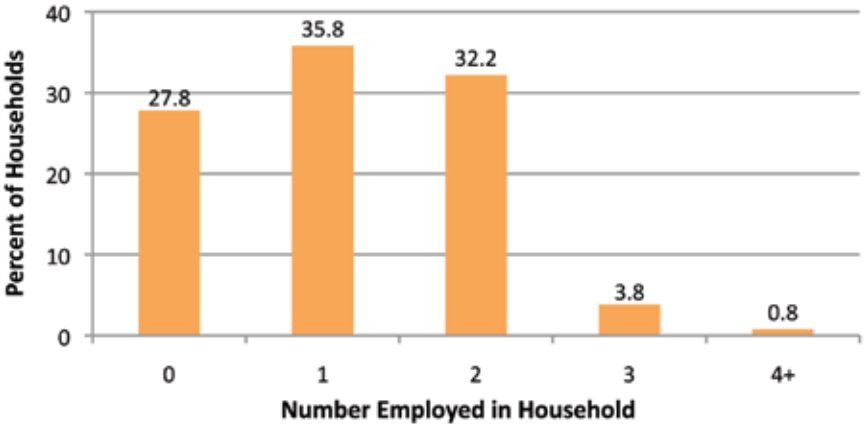
Source: 2006 Austin Household Travel Survey and TTI Analysis.

In general, as household size or vehicle availability increases, daily household travel increases.

MoPac Expressway – Austin, Texas

Daily household travel also increases as the number of persons employed in the household increases. Figure 7 shows the distribution of households by number of persons employed. Interestingly, 28 percent of the households do not have an employed household member.

Figure 7. Distribution of Employed Households.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

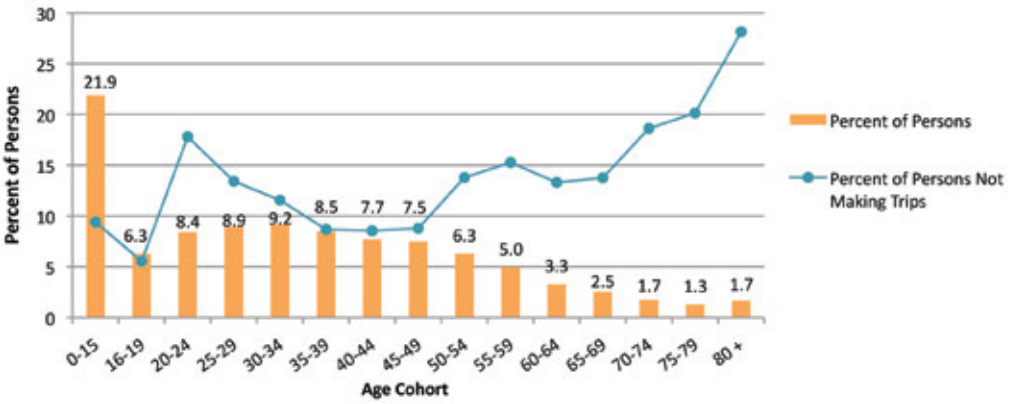
Age Cohort

The impact of age on daily travel of household members is more complex than the other household characteristics shown and is not being used directly in the travel demand model. However, age cohort can be used to characterize household life cycle.

Figure 8 shows the distribution of persons by age cohort and the percentage of persons not making any internal trips on their survey day. As expected, older persons are less likely to travel than younger persons, but the older population is mobile and contribute significantly to the amount of household travel. The rather high percentage (18 percent) of persons not making internal trips in the 20-24 age cohort is probably due to under reporting or not reporting of trips by this age cohort. At least 14 percent to 28 percent of those within the 65+ age cohort have reported not making internal trips.

Older persons are less likely to travel than are younger persons, but the older population is mobile and contribute significantly to the amount of household travel.

Figure 8. Distribution of Persons by Age Cohort.



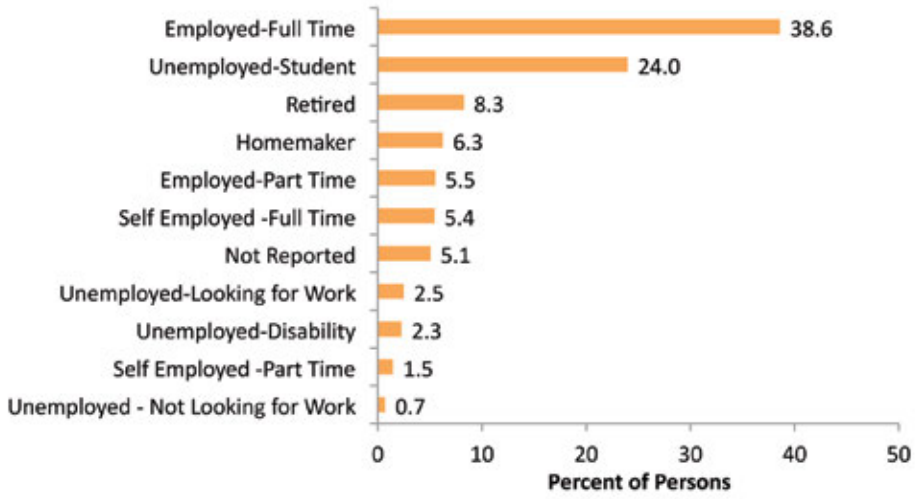
Source: 2006 Austin Household Travel Survey and TTI Analysis.

I-35 – Austin, Texas

Employment Status

Employment status is used to characterize household life cycle. Life cycle can be an excellent household characteristic to help forecast future travel demand. It can be defined by a combination of the ages of the head of household and the ages of the children in the household, if any. A young couple of working age with no children will have different daily trip-making characteristics than will a retired couple with no children at home. Figure 9 shows the distribution of all persons regardless of age by employment status in the Austin five-county area. Nearly 39 percent of the population are employed full time and almost 24 percent of the population are students.

Figure 9. Distribution of Persons by Employment Status.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

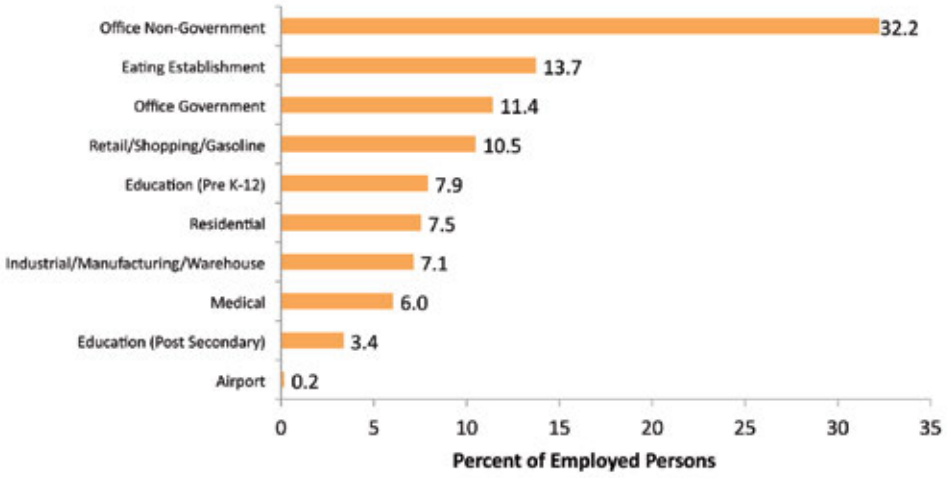
Employment Type

The household characteristics described previously are used to help estimate the demand (trip productions) for travel. Work place characteristics are used to help estimate where people are attracted (trip attractions). In the travel demand model, the type of employment is summarized into four employment types — basic, retail, service, and education. Each of these employment types has a different attracting power or attraction rate.

Work place characteristics are used to help estimate where people are attracted (trip attractions).

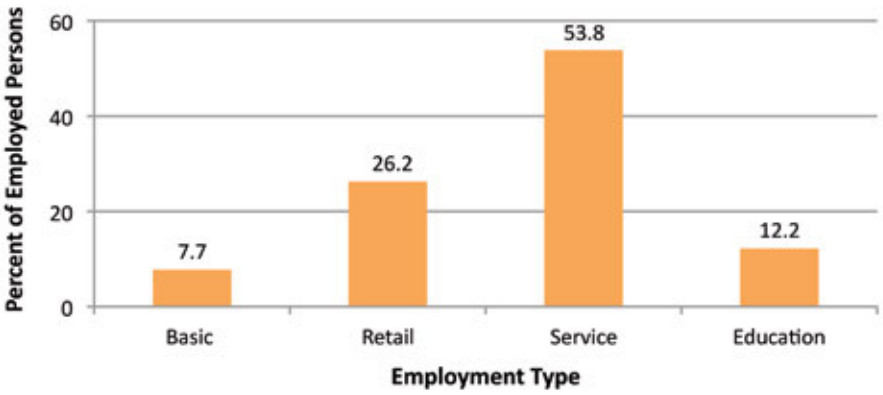
Figure 10 shows the data on the type of work place for employed persons from the household survey. Around 32 percent of employed persons work at non-government offices, 14 percent work at eating establishments, and 11 percent work at government offices. The data are then summarized into basic, retail, service, and education work place types used in travel demand modeling (Figure 11).

Figure 10. Distribution of Persons by Employment Type.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

Figure 11. Distribution of Employed Persons by Basic, Retail, Service, and Education Employment.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

The number of trip attractions is a function of the number of work places, the number of employees, and the types of employment.

I-35 at E. William Cannon Drive – Austin, Texas

HOUSEHOLD TRAVEL CHARACTERISTICS

The travel characteristics of households are determined by the purpose for each trip being made at certain locations. In travel demand modeling, trip purposes are defined as home-based work trips (HBW), home-based non work trips (HBNW), and non home-based trips (NHB).

HBW trips are those trips with one end at home and the other at work. HBNW trips are those trips with one end at home and the other not at work. NHB trips are those trips with neither end at home. Trips are divided into these purposes to account for the different trip length characteristics of each purpose. HBW trips generally have the longest average trip length, while HBNW trips and NHB trips tend to have shorter average trip lengths.

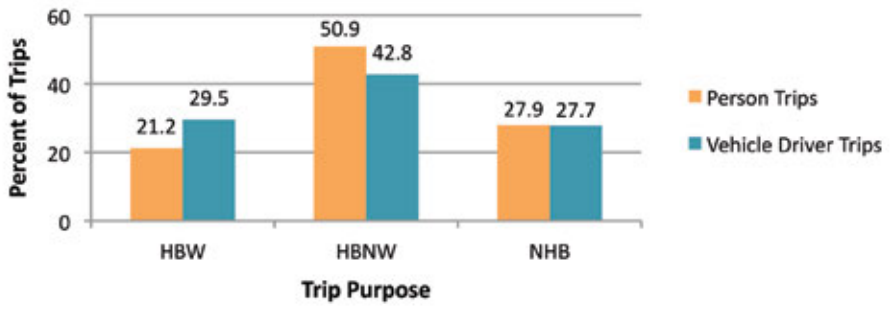
For travel demand model application, the HBNW trip purpose may be further divided among trips to school, trips to shop, and trips to other locations. The trip purposes are also classified in terms of person trips or vehicle driver trips, depending on the mode of travel used. Person trips include walk, bicycle, and vehicle trips, while vehicle driver trips are those trips made by an individual driving a vehicle.

Trip Productions

Trip ends are divided between trip productions, the home end of the trip, and trip attractions, the non-home end of the trip. If neither end of the trip is at home (NHB), the production end of the trip is defined as the origin end of the trip. These distinctions are important as the number of trip productions is a function of the number of households and the household characteristics and the number of trip attractions is a function of the number of work places, the number of employees, and the types of employment.

Figure 12 shows the distribution of trip productions by trip purpose for the Austin five-county study area. HBNW trips account for about 51 percent of all household person trips and 43 percent of all household vehicle trips.

Figure 12. Distribution of Trip Productions by Trip Purpose.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

Trip Production Rates

Among the important products of the household survey are the trip production rates for use in the trip generation step of the travel demand model. Table 5 shows the person trip rates (trips per household) cross classified by household size and household income for all internal trip purposes combined, that is, trips that begin and end inside the five-county household travel survey area. These trip rates are for all trips by all modes including transit, bicycle, and walk trips. For travel forecasting applications, the cross-classified trip rates are disaggregated by trip purpose into HBW trips, HBNW trips, and NHB trips. As part of the travel forecasting process, the person trips are divided among the modes during the mode split step. The average daily person trip rate for all households, internal to the five-county area, is around nine trips per household.

The average daily person trip rate for all households, internal to the five-county area, is around 9 trips per household.

Table 5. Person Trip Rates by Household Size and Household Income.

Household Income Range	Household Size				
	1	2	3	4	5 +
$0 - $19,999	2.2	5.0	12.0	17.0	19.4
$20,000 - $34,999	2.6	4.8	9.4	13.6	19.1
$35,000 - $49,999	3.3	5.1	10.1	13.7	21.0
$50,000 - $74,999	3.0	6.9	11.8	15.1	23.4
$75,000 +	3.7	5.6	11.2	17.3	21.4

Source: 2006 Austin Household Travel Survey and TTI Analysis.

Trip Distance

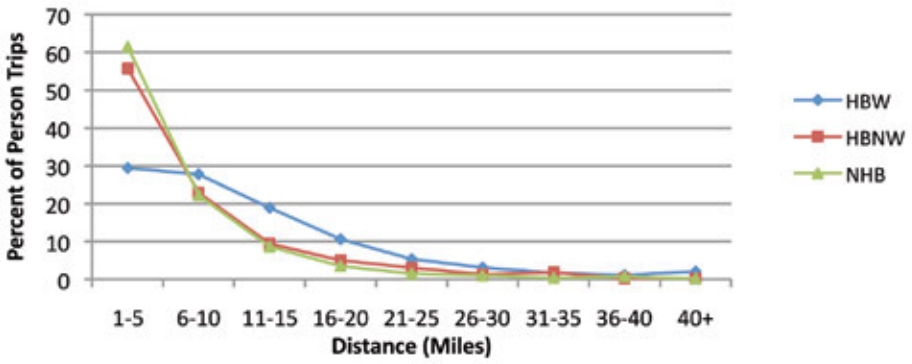
Travel distances vary by trip purpose with the home-to-work trip purpose having the longest average trip length. The average travel distance and trip length frequency distribution by trip purpose are estimated from the household survey. These measures are used to calibrate the trip distribution step of the travel demand model. The trip distribution model is calibrated so that the modeled average travel distance and trip length frequency distributions by trip purpose agree with the values estimated from the travel surveys.

Over time, the average trip length for the HBW trip purpose tends to increase along with urban growth, and the average trip length for the HBNW trip purpose tends to remain stable. For the HBNW trip purposes, which are largely shopping and school trips, the marketplace provides attraction opportunities such as new retail stores and new schools, as the urban area grows.

Figure 13 shows the distribution of person trips by the length of the trip in miles, while Figure 14 shows the distribution of person trips by trip duration in minutes. The distribution is for internal person trips, those trips beginning and ending within the Austin five-county Area. The average person trip length is 7.8 miles, while the average person trip duration is around 13 minutes.

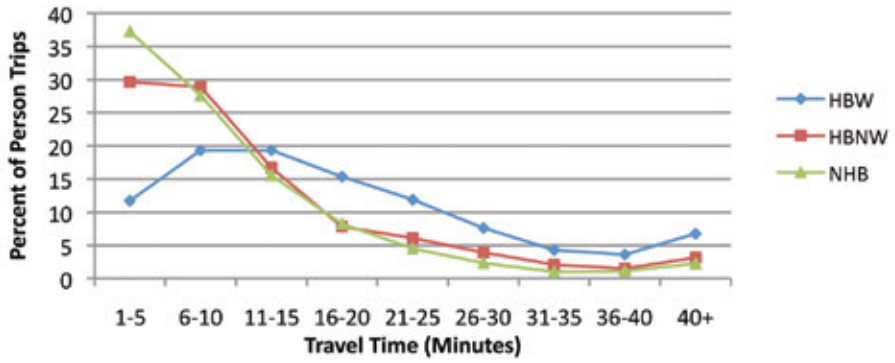
The average travel distance and trip length frequency distribution by trip purpose are estimated from the household survey and used to help calibrate CAMPO's travel demand model for the Austin region.

Figure 13. Distribution of Person Trips by Travel Distance.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

Figure 14. Distribution of Person Trips by Travel Time.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

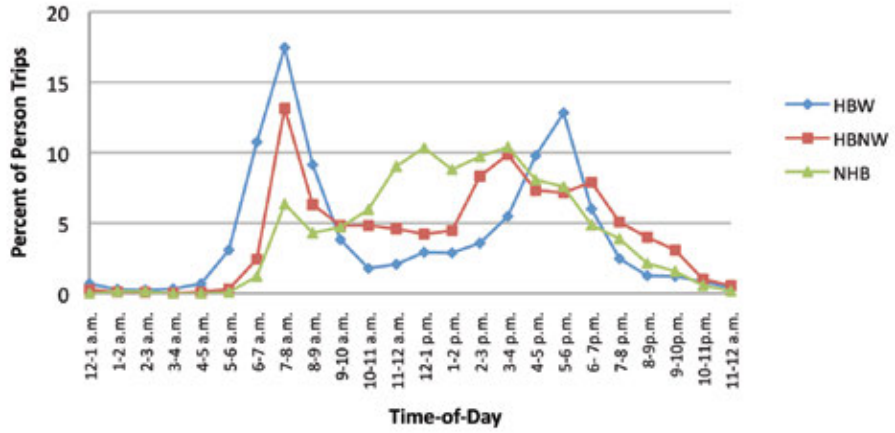
Time-of-Day Travel

The time-of-day that people travel is generally dictated by the scheduled start times of their activities (i.e., home to work/home to school). For other trips, the start times are flexible and the decision as to when to make these trips may partially depend on the amount of traffic congestion that the trip-maker expects to experience. As the amount of peak period traffic increases, a trip-maker may choose to make discretionary trips during a less congested time-of-day.

Figure 15 shows the distribution of daily person trips by time-of-day. The highest percentage of daily person trips occur during the morning peak as both home to work and home to school trips are occurring during this time period. The modest noon peak, the school to home peak, and the work to home peak are all evident. As the amount of travel in an urban area increases, the duration of the morning and afternoon peak periods increases in time as people choose to travel just prior or just after the morning and afternoon peaks. This phenomenon is referred to as peak spreading. Time-of-day travel information may also be used to estimate air quality emissions inventories that are used for air quality photochemical analysis models.

The highest percentage of daily person trips occur during the morning peak as both home to work and home to school trips are occurring during this time period.

Figure 15. Distribution of Person Trips by Time-of-Day.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

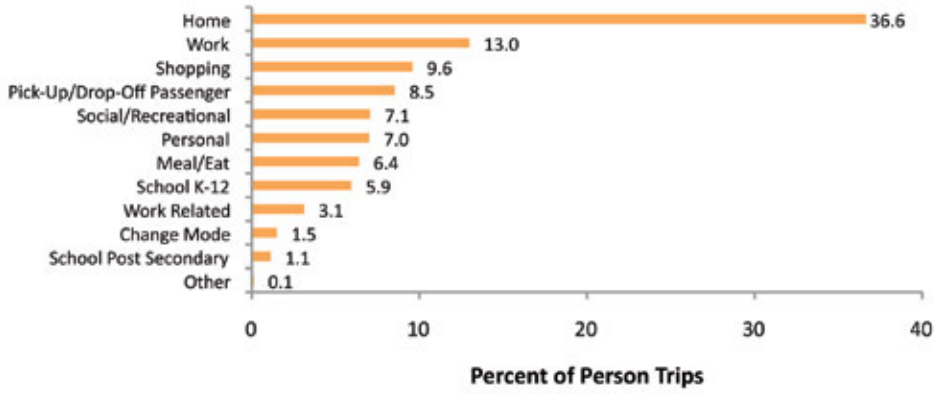
Jim Lyle/TTI

Trip Purpose

As a part of their travel diary, each household member was asked to identify from a list of choices what they did at each trip destination. The information about the trip destination was used to categorize the trip by trip purpose. In travel demand modeling, typically there are three internal trip purposes — HBW, HBNW, and NHB trips.

Figure 16 shows the distribution of person trips by the trip destination purposes used in the survey. As would be expected, the most frequent trip destination is the return to home trip which accounts for over one-third of the total person trips.

Figure 16. Distribution of Person Trips by Destination Purpose.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

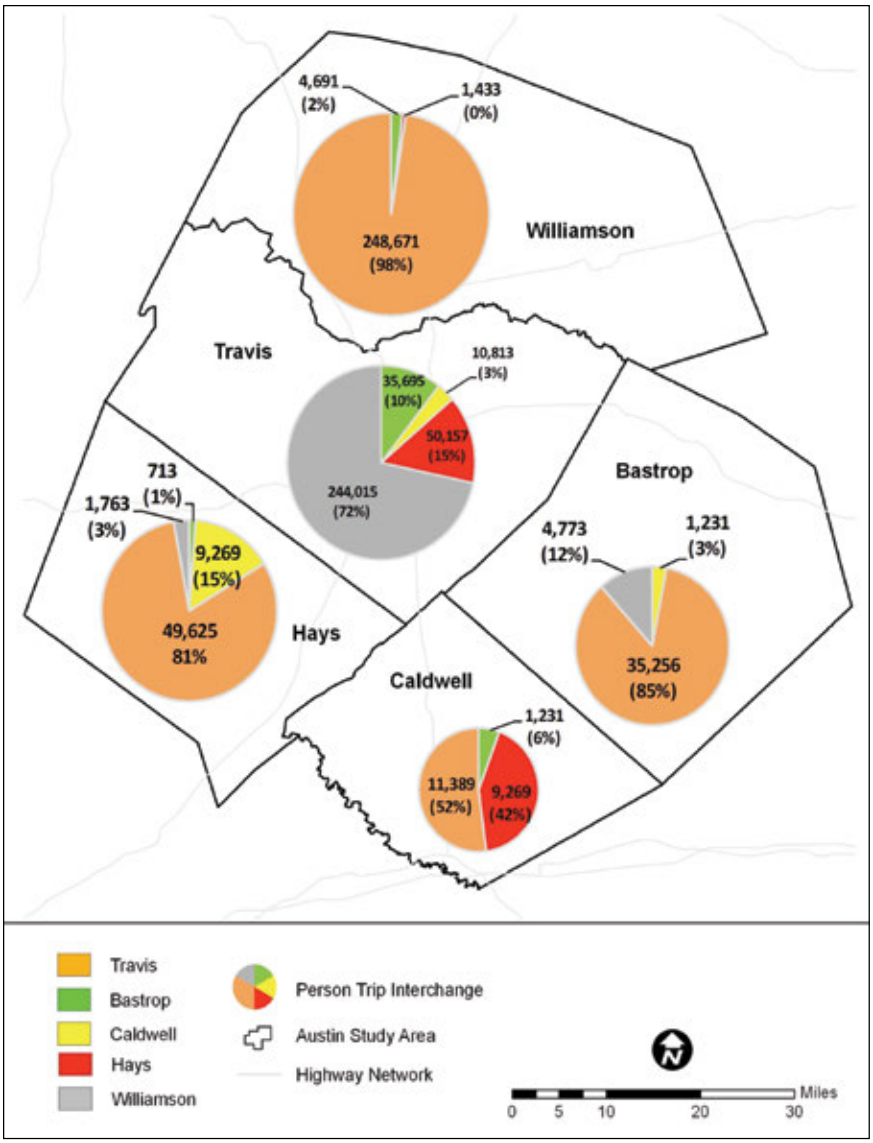
MoPac Expressway, Town Lake Bridge – Austin, Texas

The household survey provides a representative sampling of trip origins and destinations that are used to help estimate trip volumes between traffic analysis zones in the model

The household survey provides a representative sampling of trip origins and destinations within the study area. This information is then used in a gravity model formula to estimate trip volumes between distinct geographical areas used in modeling, termed traffic analysis zones (TAZs).

Using the results from the household survey, the relative amounts of trip-making between counties were developed by aggregating the TAZs to the county level. Figure 17 shows the person trip interchanges within the Austin five-county study area, color-coded by county. The majority of trips originate from Travis County, making up more than 50 percent of the trips in Caldwell, more than 80 percent in Bastrop and Hays, and 98 percent in Williamson County. Within Travis County, around 70 percent of the trips come from Williamson. In terms of the person trips that remain within each county, at least three-quarters of the trips remain within each county (see Figure 18).

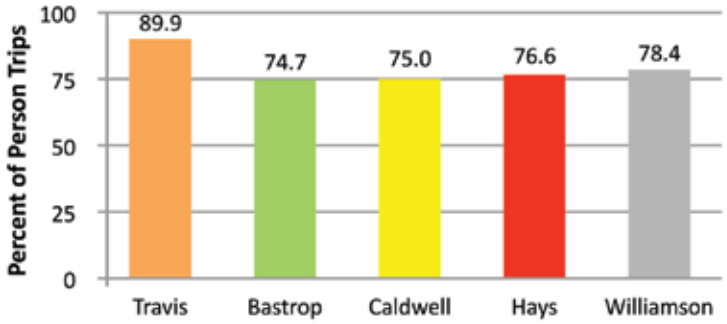
Figure 17. Sub-Areas within Travis County.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

The majority of trip interchanges between each county originate from Travis County, while more than 70 percent of trips in Travis come from Williamson County.

Figure 18. Person Trips that Remain within Each County.



Source: 2006 Austin Household Travel Survey and TTI Analysis.

US 183 and MoPac Expressway Interchange – Austin, Texas

While the household survey collects information on the travel characteristics of persons living in the study area at the household level, the work place survey collects similar information at the destination end of travel.

WORK PLACE SURVEY

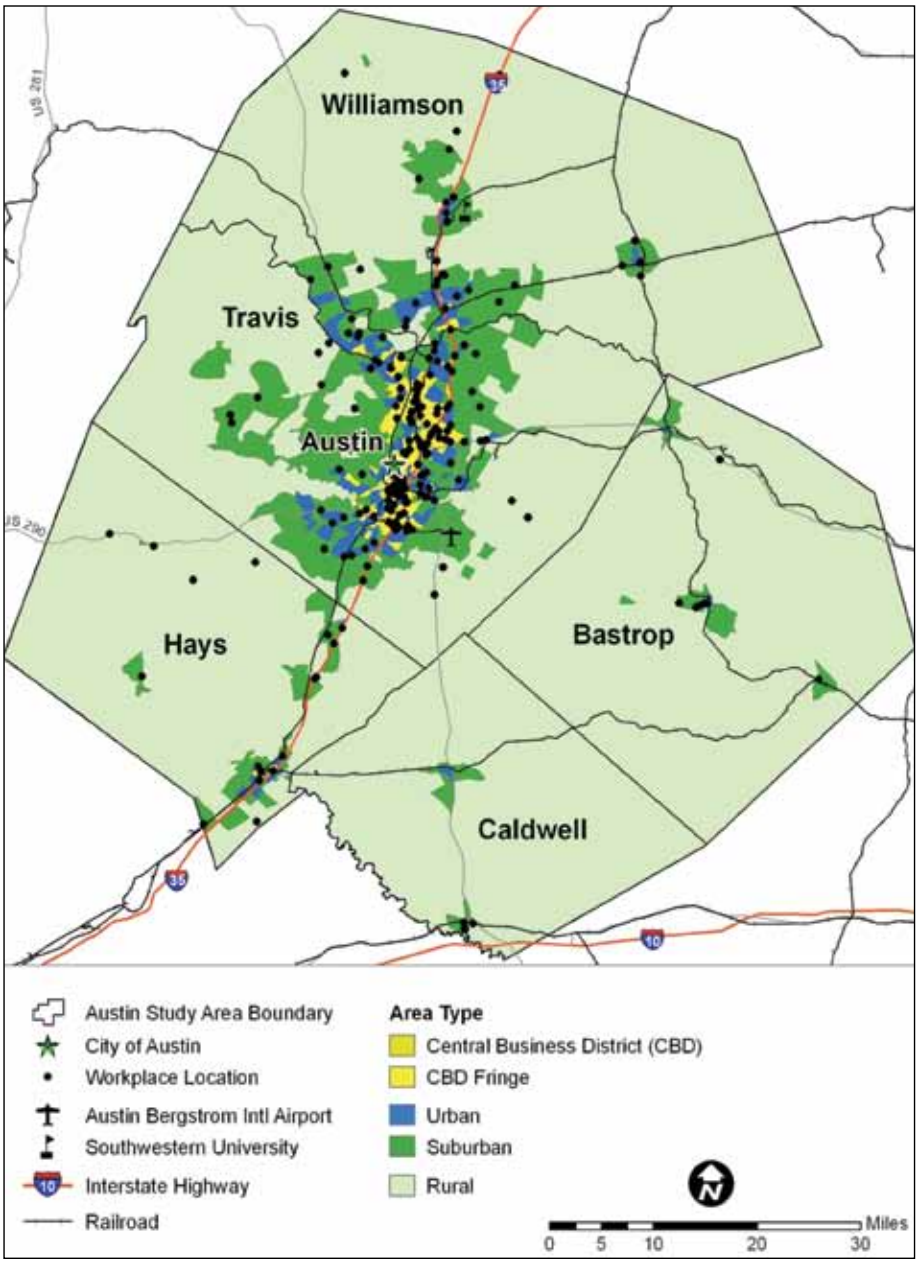
The primary purpose of a work place survey is to understand the trip attraction characteristics of basic, retail, service, and education establishments. While the household survey collects information on the travel characteristics of persons living in the study area at the household level, the work place survey collects similar information at the destination end of travel. This information is used in developing trip attraction models for use in travel demand forecasting.

For analysis purposes, TAZs are grouped according to the level of activity within the zone as measured by the density of population and employment within the zone. There are five area types identified in the Austin five-county study area — the central business district (CBD), the central business district fringe (CBD Fringe), urban, suburban, and rural.

Figure 19 shows the locations of the establishments that participated in the work place survey. A total of 80 establishments had complete full surveys. The majority of these were service and retail establishments. A total of 805 employees and 2,325 visitors (i.e., non-employees) were surveyed. The employment at the sites that were surveyed totaled 14,134 where 83 percent (11,764) were at work on the day of the survey. The sampling rate for the employees at the sites surveyed was approximately 7 percent. There were 130 sites where a partial survey was conducted. The employment at those sites totaled 20,422 where 83 percent (16,980) were at work on the day of the survey.

The data presented in this section are based on survey data and are not expanded.

Figure 19. Austin Five-County Work Place Survey Locations.



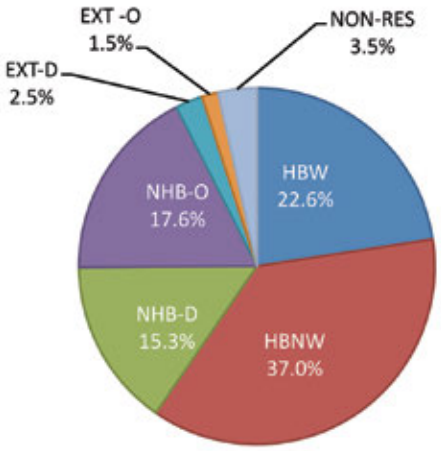
The Austin work place survey provides information on the trip attraction characteristics of basic, retail, service and education establishments in the central business district (CBD), CBD fringe, urban, suburban and rural areas.

WORK PLACE TRAVEL CHARACTERISTICS

Trip purposes to the workplace are categorized to include not only internal home-based and non-home based trips at origin and destination locations (HBW, HBNW, NHB-O and NHB-D), but also external trips from and to the study area. The external trips include external origin trips (EXT-O), trips that originated outside the study area, external destination trips (EXT-D), trips whose destinations are outside the study area when leaving the establishment, and non-resident trips (NON-RES), those internal trips to the establishment made by persons who live outside the study area. Attraction rates are then developed for each trip purpose, area type, and employment type for use in travel demand models.

Figure 20 shows the distribution of person trips by trip purpose. Approximately 92 percent of the trips are internal trips, with 37 percent being HBNW, 22 percent as HBW, and 33 percent as NHB trips. The remaining 8 percent are external trips, with 2.5 percent being EXT-D trips, 1.5 percent as EXT-O trips, and 3.5 percent as NON-RES trips.

Figure 20. Distribution of Reported Trips by Trip Purpose.

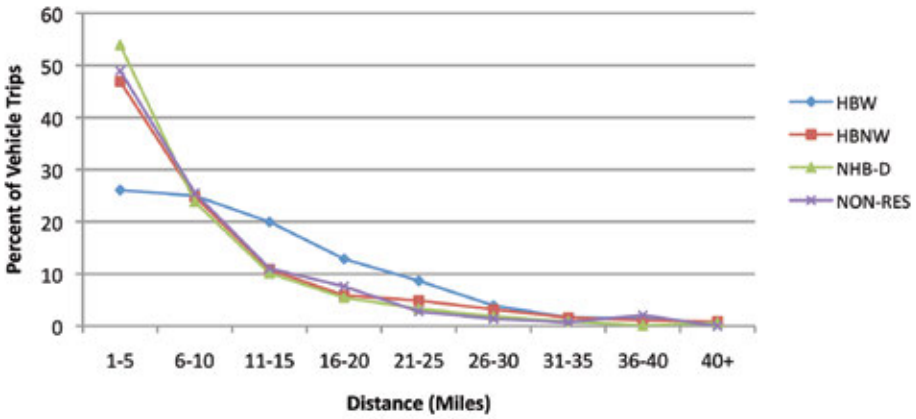


Source: 2006/2007 Austin Work Place Travel Survey and TTI Analysis.

The work place survey found that 92 percent of trips to establishments were from within the five-county study area and 8 percent were from outside of the area.

Figure 21 shows the trip length frequency distributions for person trips by travel distance. The average trip lengths and trip length frequency distributions are shown only for HBW, HBNW, NHB-D and NON-RES travel. The average trip lengths are consistent with observed characteristics in other urban areas in that the trip length for HBW trips are typically higher than those for HBNW and NHB. The trip length for HBNW and NHB are typically about the same value. These may differ depending on the urban area. The trip length frequency distributions are also consistent with other urban areas in that the majority of HBNW and NHB trips occur for shorter distances and travel times while HBW trips have longer trips.

Figure 21. Distribution of Person Trips by Travel Distance.



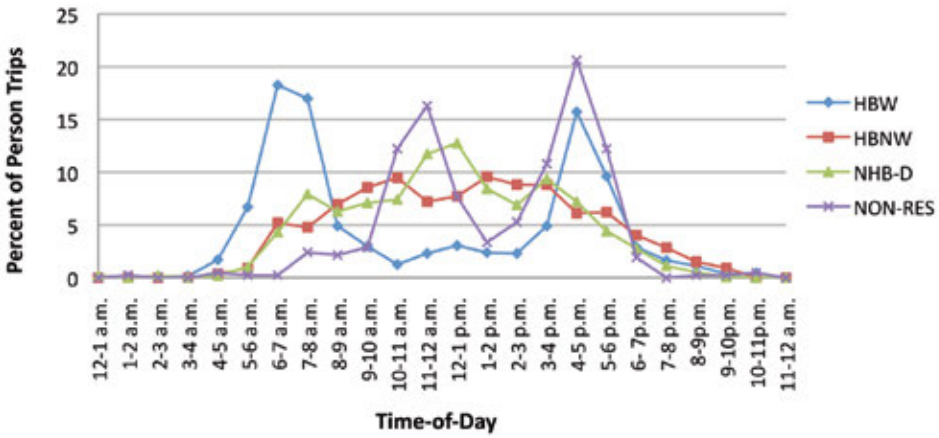
Source: 2006/2007 Austin Work Place Travel Survey and TTI Analysis.

The average person trip length for HBW trips is estimated at 11.9 miles, 9 miles for HBNW trips, 7.3 miles for NHB-D trips, and 7 miles for NON-RES trips.

Trips by purpose type typically have distinct characteristics by time-of-day that are consistent for nearly all urban areas. Figure 22 shows the distribution of trips by purpose by their time of arrival at the establishments surveyed. The results indicate that the characteristics for travel in the Austin five-county area are similar to those for other urban areas. HBW trips exhibit two time periods when those types of trips are most likely to occur, in the morning and afternoon. The morning peak is between 7:00 a.m. and 8:00 a.m., and the afternoon peak is at 5:00 p.m. Typically, HBNW and NHB trips peak during the middle of the day and are spread throughout the day. The distribution of NON-RES trips by their time of arrival shows a pattern similar to that of HBNW and NHB.

Austin-Bergstrom International Airport was surveyed as a special generator due to its uniqueness as a transportation generator and the impact it has on the community in terms of transportation.

Figure 22. Distribution of Person Trips by Time-of-Day.



Source: 2006/2007 Austin Work Place Travel Survey and TTI Analysis.

Austin-Bergstrom International Airport

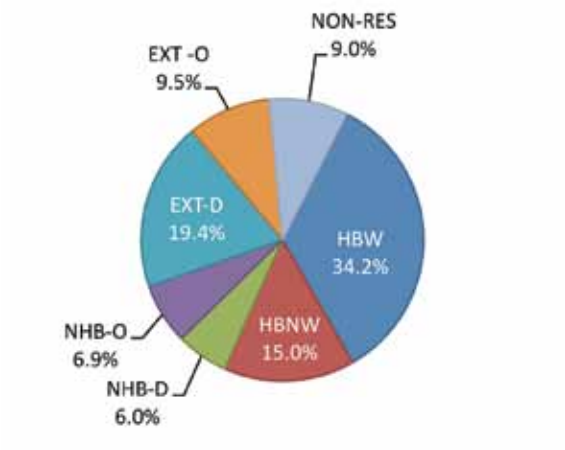
SPECIAL GENERATORS

Two of the work places surveyed were treated as special generators. These were the Austin Bergstrom International Airport and Southwestern University. Special generators are those types of development that are considered unique and subject to modeling outside the typical modeling framework.

Austin Bergstrom International Airport (ABIA) was surveyed as a special generator due to its uniqueness as a transportation generator and the impact it has on the community in terms of transportation. Total daily vehicle trips to the airport were estimated at 34,500, of which roughly 4 percent (1,620 trips) were commercial vehicle trips. Total daily person trips were around 50,500. A total of 157 airport employees and 251 visitors participated in the ABIA survey. Total commercial vehicle counts at the airport included 842 cargo vehicles, 4,558 service vehicles and 1,491 shuttle vans at the airport.

Figure 23 shows the distribution of surveyed trips by trip purpose. Nearly half of the trips are home-based (34 percent work-related and 15 percent non-work). Approximately 29 percent of the trips are external and 9 percent are NON-RES travel. The majority of surveyed airport employees reported their mode of travel as driver of a vehicle. For surveyed visitors, approximately 47 percent reported their mode of travel as driver of a vehicle and 35 percent reported airplane as their mode of departure. Figure 24 shows the reported modes of travel for surveyed airport visitors.

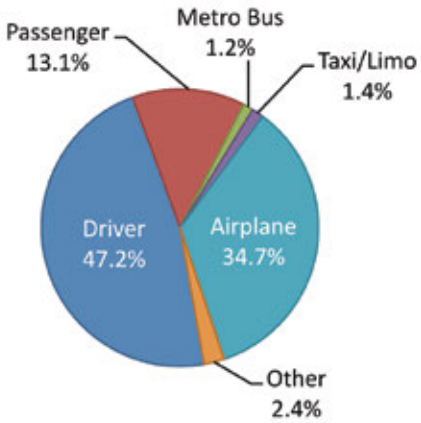
Figure 23. Surveyed Trips by Trip Purpose at ABIA.



Source: 2006/2007 Austin Work Place Travel Survey and TTI Analysis.

The majority of surveyed airport employees reported their mode of travel as driver of a vehicle.

Figure 24. Visitor Trips by Travel Mode at ABIA.



Source: 2006/2007 Austin Work Place Travel Survey and TTI Analysis.

I-35, Austin, Texas

The internal survey trips were geocoded for both employees and visitors to the TAZs in the Austin study area. The data were processed and average trip length computed for travel distance by trip purpose. It is recognized that these data are based on a small number of observations but they do provide a reference of comparison with the average trip lengths found for the full work place survey. Table 6 shows the average trip lengths for the airport trips.

Table 6. Average Trip Lengths for Surveyed Trips to ABIA.

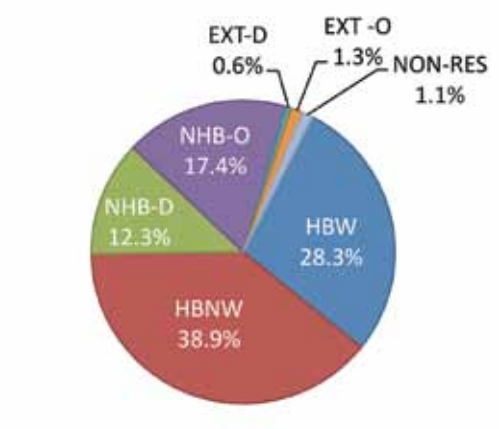
Trip Purpose/Type	Person Trips (Miles)	Vehicle Trips (Miles)
HBW	15.9	16.1
HBNW	24.1	24.4
NHB-D	14.4	14.2
NON-RES	21.0	20.9

Source: 2006/2007 Austin Work Place Travel Survey and TTI Analysis.

Southwestern University (SWU) was also surveyed as a special generator because of its impact on the Austin study area and its special trip generation characteristics. Total daily vehicle trips to the site were around 5,700, of which only seven were commercial vehicle trips. Total daily person trips were around 7,300. A total of 88 employees and 108 visitors participated in the SWU survey.

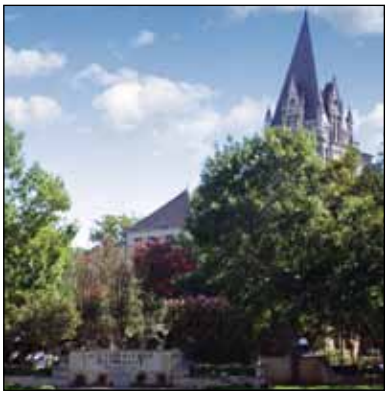
Figure 25 presents the distribution of surveyed trips by trip purpose. Approximately 67 percent are home-based trips (28 percent work-related and 39 percent non-work). Roughly 30 percent of the trips are NHB and only 2 percent are external trips. The majority of the survey participants reported their mode of travel as driver of a vehicle. Figure 26 shows the distribution of trips by mode of travel at the site. Table 7 shows the average trip lengths for surveyed trips to SWU.

Figure 25. Surveyed Trips by Trip Purpose at SWU.



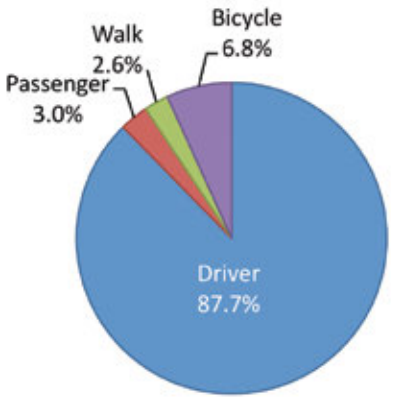
Source: 2006/2007 Austin Work Place Travel Survey and TTI Analysis.

Southwestern University (SWU) was also surveyed as a special generator because of its impact on the Austin study area and its special trip generation characteristics.



Southwestern University, Georgetown, Texas

Figure 26. Surveyed Trips by Travel Mode at SWU.



Source: 2006/2007 Austin Work Place Travel Survey and TTI Analysis.

The primary purpose of the external station survey is to understand the travel patterns of people and vehicles entering and exiting the study area.

Table 7. Average Trip Lengths for Surveyed Trips to SWU.

Trip Purpose/Type	Person Trips (Miles)	Vehicle Trips (Miles)
HBW	7.9	8.0
HBNW	7.5	8.0
NHB-D	6.3	6.3
NON-RES	–	–

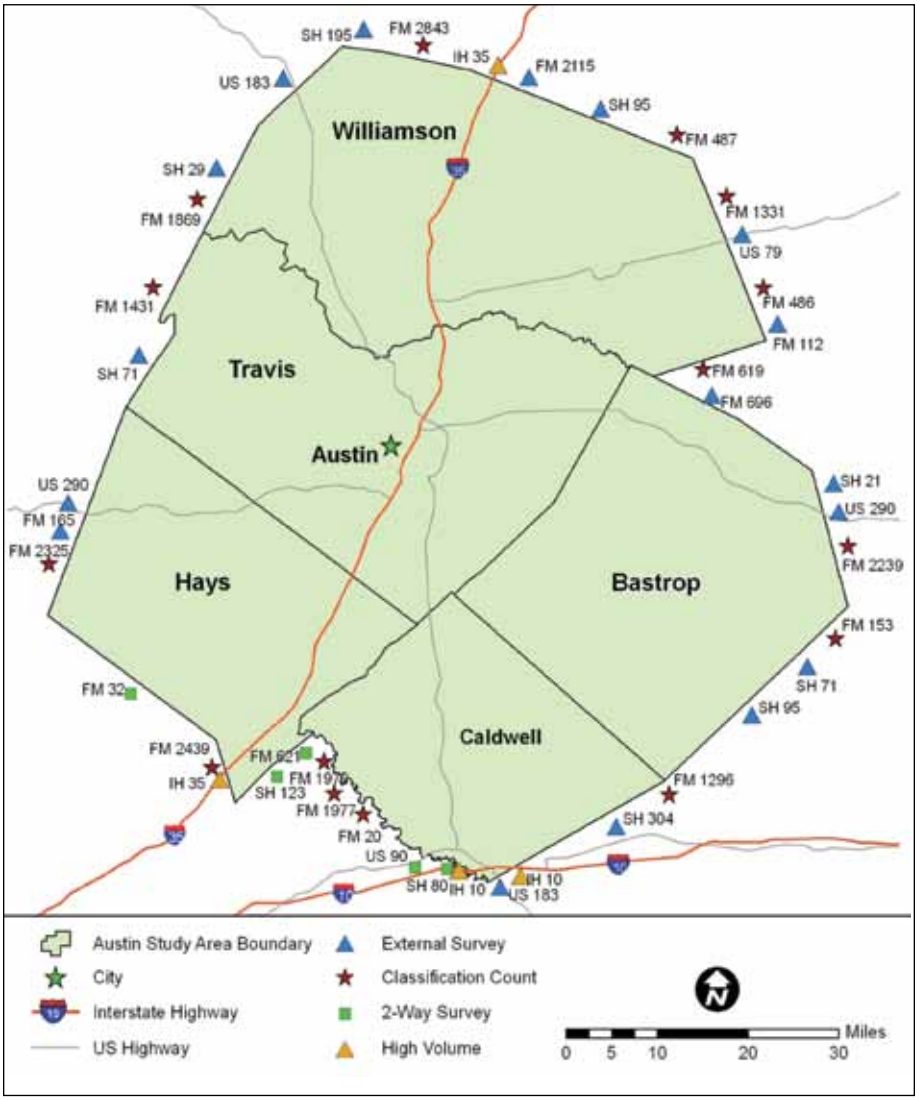
Source: 2006/2007 Austin Work Place Travel Survey and TTI Analysis.

EXTERNAL SURVEY

The primary purpose of the external station survey is to understand the travel patterns of people and vehicles entering and exiting the study area. These trips are subsequently divided between trips passing through the study area (external-through trips) and trips by persons coming into the study area to conduct activities within the study area (external-local trips). Surveys are conducted during daylight hours for one day at each designated location. Additionally, 24-hour vehicle classification counts are performed on the same day as the survey at each survey location. These counts provide a basis for expanding the survey data to represent the average weekday movements into and out of the study area. Data are also collected on the movements of the vehicle during the survey day prior to the point at which the vehicle is surveyed. These data provide a basis for estimating the amount of travel occurring within the study area prior to the time of the survey.

There are 42 locations on the border of the Austin five-county study area identified as external stations (Figure 27). These locations are transportation facilities that cross the study area boundary and represent where travelers may enter and exit the study area. Of these 42 locations, 22 were selected for travel surveys using the roadside intercept interview method. Five of the 22 survey locations bordered the San Antonio study area, and as a result, these locations were surveyed in both directions. Four external stations were identified as high-volume sites. For safety reasons, a license-plate matching methodology was employed to capture the amount of vehicles traveling through the study area on high-volume facilities.

Figure 27. Austin Five-County External Station Survey Locations.



External (roadside) travel surveys were conducted at 22 of 42 locations on the border of the Austin five-county study area identified as external stations.

The 2005 Austin five-county external station survey included more than 8,400 randomly selected vehicles traveling within the study area. Approximately 86 percent of the surveyed vehicles were non-commercial vehicles and 14 percent were commercial vehicles.

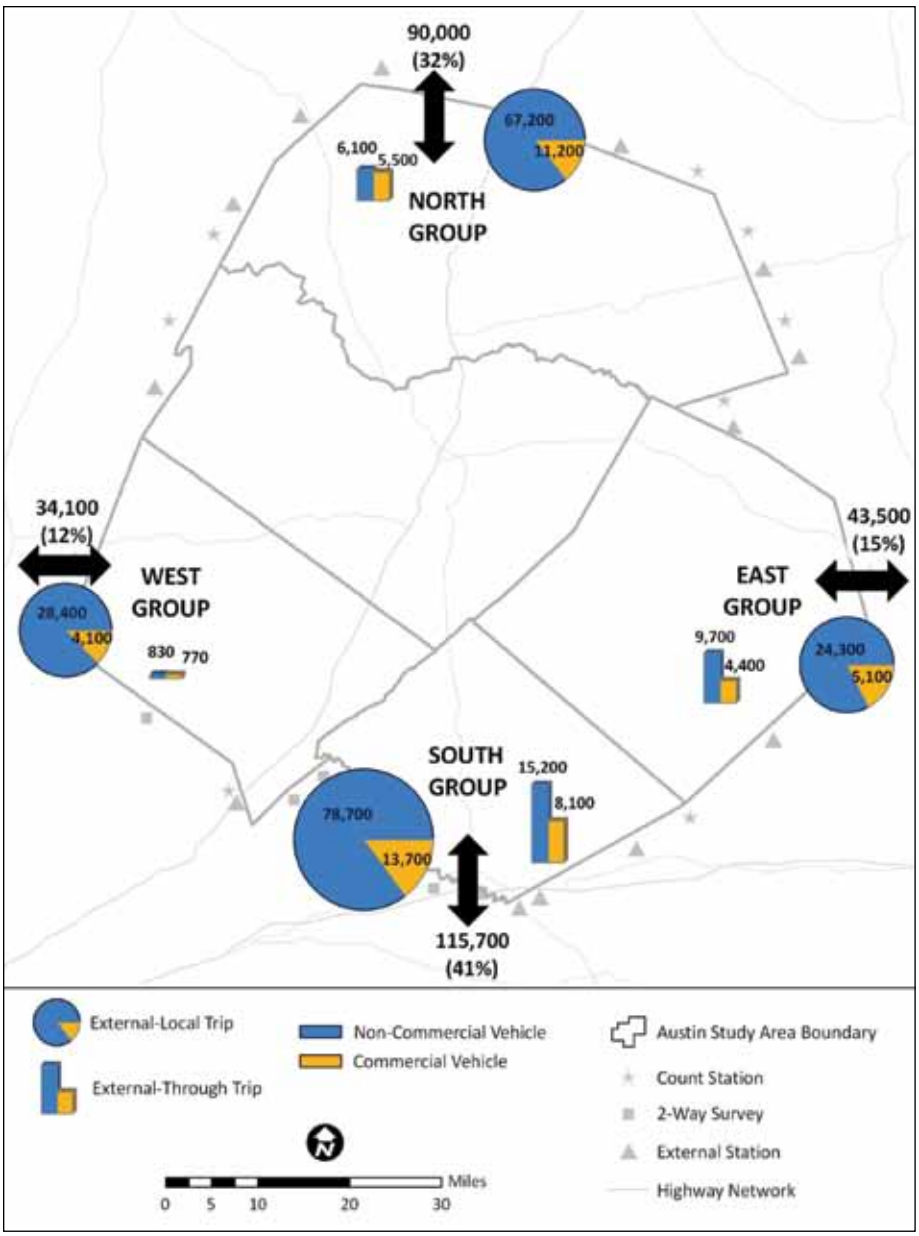
The estimates presented in this section are based on expanded survey data. Over 283,000 vehicles were estimated to enter or exit the Austin five-county study area on a daily basis. Approximately 82 percent of the total daily trip movements were local trips, while the remaining 18 percent were through trips. Approximately 85 percent of the total external-local trips were made by non-commercial vehicles. More than one-third of the total external-through trips were made by commercial vehicles.

Figure 28 shows the estimates of external-local and external-through trip movements of non-commercial and commercial vehicles by direction and location group. The external stations were grouped by location and included north, east, south, and west groups. The largest trip movements occurred in the south and north sides of the study area. Approximately 41 percent of the total daily trips occurred in the south group, and 32 percent in the north group. The largest external-through travel came from the south and east groups, comprising nearly three-quarters of the total external-through trips. Roughly a quarter of the external-through travel originated from the north side of the study area. These estimates may be a little distorted by the traffic generated from the two highway corridors (IH-35 and IH-10) in the study area.

The South group has the largest estimated number of external-local and external-through trip movements, with nearly 115,700 total daily trips.

I-35, Austin, Texas

Figure 28. External-Local and External-Through Trip Movements by Location Group.



Source: 2005 Austin External Travel Survey and TTI Analysis.

COMMERCIAL VEHICLE SURVEY

The primary purpose of the commercial vehicle survey is to understand the trip characteristics of commercial vehicles operating in the Austin five-county study area. In the travel demand model, trips made by commercial vehicles are modeled separately from trips made by privately-owned vehicles. The commercial vehicle survey is concerned with internal commercial vehicle trips, trips made within the study area. Commercial vehicle trips that are coming into or departing the study area boundary are surveyed as a part of the external station survey. The data are used in the trip generation step of the travel demand model to estimate total trips and travel patterns for commercial vehicle trips. A commercial vehicle was defined as any vehicle having six or more tires, a gross vehicle weight of over 8,500 pounds, and used for commercial purposes.

A sample of vehicles was randomly selected from motor carrier and vehicle registration databases. The firms operating the selected vehicles were contacted and asked to participate in the survey. The drivers of the vehicles were asked to keep a 24-hour diary of the locations of all trips made by each vehicle. A variety of questions were asked about the vehicle, such as the type of cargo being transported and the purpose of the trip. The questions of primary concern for estimating commercial vehicle trip patterns were the location and time of each stop from when the driver of the vehicle started his or her daily activities until the driver of the vehicle completed his or her daily activities. A total of 342 commercial vehicles participated in the survey. Figure 29 shows an example of a commercial vehicle survey station.

Figure 29. Example of a Commercial Vehicle Survey Station.

In the travel demand model, trips made by commercial vehicles are modeled separately from trips made by privately-owned vehicles.

Manor Road Exit, I-35 – Austin, Texas

In addition to the commercial vehicle diary surveys, vehicle classification counts were performed at randomly selected locations that included freeways, arterial streets, collector streets, and local streets.

The number of commercial vehicles in the Austin five-county study area cannot be determined reliably from vehicle registration data due to the presence of commercial vehicles registered in other Texas counties, and in other states. The methodology used for expanding the survey data was VMT estimates from the Highway Performance Monitoring System (HPMS), combined with vehicle classification counts by roadway functional classification (freeway, arterial, collector, and local). Essentially, an estimate of the commercial VMT is developed from the HPMS data and is then used to expand the VMT observed from sampled commercial vehicles.

A commercial vehicle was defined as any vehicle having six or more tires, a gross vehicle weight of over 8,500 pounds, and used for commercial purposes.

HPMS data contains annual average daily traffic (AADT) estimates of the total VMT by functional class facilities. Since AADT includes weekend traffic, a correction factor is applied to the data to obtain average weekday VMT by roadway functional classification.

Commercial vehicle counts from the 2005 External Survey and vehicle classification counts conducted in 251 randomly selected locations within the Austin study area were used to determine the percentage of commercial vehicles by roadway functional classification. These percentages were determined separately for external sites and internal sites. The percentage of commercial vehicles for internal sites for each functional classification was combined with the corresponding percentage for external sites based on the percentage of regional VMT estimated to be external travel. External VMT was estimated to be 31 percent of the HPMS estimate of total VMT. Hence, it was assumed that 69 percent of the total VMT was internal. These percentages were applied to obtain the weighted average for internal and external sites for each functional classification.

I-35, Austin, Texas

Table 8 shows the estimated VMT for commercial vehicles operating in the Austin five-county study area by roadway functional classification. The total estimated VMT was 3.8 million. This represented all commercial vehicles. To properly expand the data, it was necessary to remove the VMT estimates obtained in the external survey to avoid double counting. The VMT estimated for commercial vehicles in the external station survey was 1.5 million. This estimate was subtracted from the total commercial vehicle VMT to calculate the internal commercial VMT of 2.3 million.

Table 8. Estimated VMT for Commercial Vehicles by Roadway Functional Classification.

Functional Classification	Weekday Vehicle Miles of Travel
Freeway	1,645,378
Arterial	1,475,825
Collector	601,464
Local	94,958
Total	3,817,625

Source: 2006 Austin Commercial Vehicle Survey.

The internal VMT observed in the commercial vehicle survey was 24,373. This was based on 2,138 observed internal trips (those where the trip length could be estimated), multiplied by the average trip length made by the surveyed vehicles, estimated at 11.4 miles. The total internal commercial vehicle trips were estimated at 202,454, averaging 7.2 trips per vehicle. On a daily basis, approximately 28,276 commercial vehicles were operating in the Austin region, more than the 19,281 registered trucks in the study area in 2006.

Approximately 71 percent of the observed commercial vehicles trips were cargo or freight transport, and the remaining 29 percent were local services transport. The most frequently reported types of cargo included transportation, manufactured goods and equipment, food, health and beauty products, farm products, and clay/concrete/glass or stone, making up nearly 50 percent of the total cargo being transported. More than one-third of the surveyed commercial vehicles were not carrying any cargo.

TRAVEL TIME AND DELAY SURVEY

The primary purpose of the travel time and delay survey is to collect travel time data to estimate average speeds during peak and off-peak periods for roadways in the Austin five-county study area. The data were collected by roadway functional classification (freeway, arterial, collector, and local) and by area type (CBD, CBD fringe, urban, suburban, and rural) where the roadway is located.

The primary purpose of the travel time and delay survey is to collect travel time data to estimate average speeds during peak and off-peak periods.

In the travel demand model, the minimum travel time path and the free flow travel time between any two TAZs is a function of the roadway classification, the number of lanes, the area types, and the free flow speeds of the roadway links that comprise the minimum travel time path.

The free flow speed and capacity for each roadway link in the study area is estimated as a function of the roadway's functional classification, number of lanes, and area type for the peak and off-peak time periods.

The zone-to-zone travel times are used in the trip distribution step of the travel demand model, together with the number of trips produced and attracted by each zone from the trip generation step, to estimate all the trip interchanges for the study area. The zone-to-zone travel times are also used in the trip assignment step of the travel demand model to assign trips to each roadway link in the study area. Consequently, the travel time and delay surveys may assist in the calibration and validation of the trip distribution and trip assignment steps in the travel demand model.

In the travel time and delay survey, a vehicle equipped with a Global Positioning Satellite (GPS) receiver and a laptop computer was driven both directions on six different routes during peak and off-peak periods. The routes were selected so that all roadway functional classifications and all roadway area types were sampled in both the peak and off-peak periods. The routes were subdivided into segments with the functional classification and the area type defined for each segment. Travel times, distance, and average speeds were calculated for each segment. For each of the six

routes, three runs were made in each direction during the peak periods and three runs were made in the off-peak periods. Average speeds were calculated for each functional class and area type for the peak and off-peak periods.

Speeds are cross classified by the area type where the roadway link is located and the roadway link functional classification. The area type reflects the density of the land use adjacent to the roadway link. In general, as the density of the land use adjacent to a roadway increases, the speed and capacity of the roadway is reduced due to the increased number of traffic control devices, intersections, curb cuts, and turning movements.

Tables 9 and 10 summarize the results from the travel time and delay survey. The peak periods were defined as 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. The off-peak periods were defined as 9:00 a.m. to 12 noon and 1:00 p.m. to 4:00 p.m. All data were collected between 7:00 a.m. and 6:00 p.m. Table 11 shows the range of speed limits for each functional class and area type cross classification.

The survey found that the average peak and off-peak speeds for arterials, collectors, and local roadways were similar with only a modest increase in off-peak period speeds compared to peak period speeds. However, there were significant differences between peak and off-peak speeds on the freeways, which indicates peak period traffic congestion in most area types except for rural areas that showed only a minor increase in average speed during off-peak period.

A comparison of Tables 9 and 10 with Table 11 shows that peak and off-peak traffic moves at speeds slower than the posted speed limit for most area type/functional classification cross classifications. This supports a finding that traffic congestion is a concern in the Austin five-county study area. Average freeway speeds particularly at the CBD fringe and urban areas are below the posted speed limits.

The average peak and off-peak speeds for arterials, collectors and local roadways were similar with only a modest increase in off-peak period speeds compared to peak period speeds.

I-35, Austin, Texas

Table 9. Peak Period Average Speeds (mph).

Area Type	Roadway Functional Classification			
	Freeway	Arterial	Collector[1]	Local
CBD	21.1	13.5	11.8	12.2
CBD Fringe	29.8	22.7	19.2	22.0
Urban	28.8	22.7	19.3	20.6
Suburban	48.9	26.4	24.7	22.6
Rural	66.1	39.6	35.4	26.1

[1] Combined with minor arterials.
Source: 2006 Austin Travel Time and Delay Survey.

Table 10. Off-Peak Period Average Speeds (mph).

Area Type	Roadway Functional Classification			
	Freeway	Arterial	Collector[1]	Local
CBD	50.8	17.4	14.6	16.5
CBD Fringe	52.9	23.3	22.5	23.4
Urban	54.3	26.0	23.5	21.4
Suburban	67.8	29.8	24.2	23.3
Rural	68.4	40.6	37.6	32.2

Note: [1]Combined with minor arterials.
Source: 2006 Austin Travel Time and Delay Survey.

Jim Lyle/TTI

Average freeway speeds particularly at the central business district fringe and urban areas are below posted speed limits.

Table 11. Posted Speed Limits (mph).

Area Type	Roadway Functional Classification			
	Freeway	Arterial	Collector[1]	Local
CBD	NP	30-35	20	30
CBD Fringe	55-65	20[2]-60	20[2]-35	20[2]-35
Urban	65-70	20[2]-45	20[2]-40	20[2]-30
Suburban	65-70	20[2]-60	20[2]-55	20[2]-45
Rural	70	40[2]-65	30-55	20[2]-35

[1] Combined with minor arterials. NP – Not Posted
[2] School zone or speed bumps.
Source: 2006 Austin Travel Time and Delay Survey.

Jim Lyle/TTI

I-35, Austin, Texas

MoPac Expressway looking north – Austin, Texas

The daily VMT per person for the Austin five-county study area has been stable at around 26 miles for the last 15 years.

SUMMARY OF FINDINGS

The travel surveys conducted in the Austin five-county study area during the period between 2005 and 2007 provide the household, work place, commercial vehicle, travel time and delay, and external station travel behavior information needed to estimate, calibrate, and validate a travel demand model. This model can be used as a transportation analysis tool for planning improvements to the region's transportation system for the next 20 years. The travel demand model is the preferred tool for supporting analysis and evaluation of proposed transportation alternatives within the transportation planning process. Given the population growth rate and the travel growth rate, which is consistent with the population growth rate, TxDOT and CAMPO will need to plan, design, construct, and operate additional facilities to provide added transportation capacity during the next 20 years. These additional facilities will be needed to maintain the relatively high level of mobility currently enjoyed by travelers in the Austin five-county area.

GROWTH IN TRAVEL

The daily VMT per person for the Austin five-county study area has been stable at around 26 miles for the last 15 years. Population in the study area is forecast to increase from 1.4 million in 2005 to 2.3 million by 2030, an increase of about 62 percent. The daily VMT is expected to increase by as much as 80 percent during this 25-year period, with daily VMT per person forecast at 29.5 miles by 2030.

HOUSEHOLD CHARACTERISTICS AND TRAVEL BEHAVIOR

Persons commuting to work in the Austin five-county study area use carpools and public transportation slightly less often than does the average commuter in Texas. On average, the number of vehicles available per household is two. The average household size in the study area is 2.7 persons, which is nearly the same as the estimate for Texas. The average person trip rate for all households, internal to the five-county study area, is around nine trips per household. The average person trip length is 7.8 miles, while the average person trip duration is around 13 minutes.

TRAVEL PURPOSE

Trip purposes to the work place are categorized to include not only internal (HBW, HBNW, and NHB) trips, but also external (EXT-O, EXT-D, and NON-RES) trips from and to the study area.

Approximately 92 percent of the trips to the work place in the Austin five-county study area are internal trips, of which 69 percent are home-based and 33 percent are NHB. Approximately 37 percent of the home-based trips are HBNW and 22 percent are HBW, with average trip length of about 12 miles. NHB trip length averages 7.3 miles. External trips to the work place account for 8 percent of the total trips, of which 3.5 percent are NON-RES trips with average trip length of about 7 miles.

EXTERNAL-LOCAL AND EXTERNAL-THROUGH TRAVEL

External-local travel to and from the Austin five-county study area is dominated by traffic coming from and going to the south and north sides of the study area. The south-north traffic accounts for 73 percent of the total external-local travel. The south-east traffic accounts for nearly three-quarters of the total external-through travel, while roughly a quarter originated from the north side of the study area. These estimates may be a little distorted by the traffic generated from the two highway corridors (IH-35 and IH-10) in the study area.

COMMERCIAL VEHICLE TRAVEL

More than 28,200 commercial vehicles are estimated to be operating in the Austin five-county study area on a daily basis in 2006. On average, each commercial vehicle makes around 7 trips, with average trip length of about 11.4 miles. The total internal commercial VMT is around 2.3 million miles.

TRAVEL SPEED AND DELAY

The average peak and off-peak speeds for arterials, collectors, and local roadways are similar with only a modest increase in off-peak period speeds compared to peak period speeds. However, there are significant differences between peak and off-peak speeds on the freeways, which indicates peak period traffic congestion in most area types except for rural areas that showed only a minor increase in average speed during off-peak period.

Persons commuting to work in the Austin five-county study area use carpools and public transportation slightly less often than does the average commuter in Texas.

US 183 and MoPac Interchange – Austin, Texas

I-35, Austin, Texas

Although the CAMPO transportation planning area has not changed since 1998, the inclusion of Bastrop and Caldwell counties in the travel demand model will support more accurate travel demand forecasts for the three-county CAMPO planning area.

EXPANSION OF CAMPO MODELING AREA

Travel surveys were conducted in the Austin area during the period between 1997 and 1998. The study area coverage included only three counties – Hays, Travis, and Williamson counties. The 2006 household and commercial vehicle surveys expanded the study area coverage to include two additional counties - Bastrop and Caldwell. Since the 1998 household survey, travel within the five counties has increased. A significant number of household members commute each weekday from Bastrop and Caldwell counties to Hays, Travis, and Williamson counties for work, for shopping, for recreation, and for access to variety of services.

By expanding the geographic area included in the household travel survey, these commute trips are treated within the travel demand model as internal (HBW, HBNW, and NHB) trips rather than external-local trips. The cross classification trip production models used for forecasting internal trips are judged to be significantly more accurate than the growth factor models used for forecasting external-local trips.

Although the CAMPO transportation planning area has not changed since 1998, the inclusion of Bastrop and Caldwell counties in the travel demand model will support more accurate travel demand forecasts for the three-county CAMPO planning area. Additionally, the five-county travel demand model can be used by TxDOT staff for planning transportation system improvements in Bastrop and Caldwell counties.

1997/1998 AND 2006 TRAVEL SURVEYS

This section provides a comparison of data available from the 1997/1998 and 2006 travel surveys in the Austin study area. It is important to note that comparing the data results from the current travel surveys with the previous travel surveys may not provide accurate conclusions, given the difference in area coverage and sample size. However, the comparisons can provide a glimpse of the changes that occurred in the study area.

Table 12 shows a comparison of the data from the 1998 household survey with the 2006 household survey. Table 13 shows a summary of the data results between the two commercial vehicle survey periods.

Table 12. Household Survey Data Comparison (1998 and 2006).

Survey Indicator	Household Survey	
	1998	2006
Study Area Coverage	Three Counties – Hays, Travis, Williamson	Five Counties – Hays, Travis, Williamson, Bastrop, Caldwell
Sample Size	1,997	1,499
Average Household Size	2.7	2.6
Total Trips (Expanded)	3,770,454	5,194,714
Internal Trips	98.3%	98.0%
External Trips	1.7%	2.0%
Total Internal VMT	19,834,000	26,463,000
Average person trip length	8.1 miles	7.8 miles
Average person trip duration	13.2 minutes	12.9 minutes
Average vehicle trip length	8.6 miles	8.4 miles
Average vehicle trip duration	13.9 minutes	13.8 minutes

Source: 1998 and 2006 Austin Household Travel Surveys.

Table 13. Commercial Vehicle Survey Data Comparison (1997 and 2006).

Survey Indicator	Commercial Vehicle Survey	
	1997	2006
Study Area Coverage	Three Counties – Hays, Travis, Williamson	Five Counties – Hays, Travis, Williamson, Bastrop, Caldwell
Sample Size	500	342
Observed Internal Trips	2,935	2,138
Average Trip Length	9.3 miles	11.4 miles
Average Trips per Vehicle	6.9	7.2
Total Commercial VMT	2,089,334	3,817,625
External Commercial VMT	659,977	1,509,652
Total Commercial VMT (Excluding External VMT)	1,300,909	2,307,973
Observed Internal VMT (Sample)	26,937	24,373
Expansion Factor	48.30	94.69
Total Internal Commercial Vehicle Trips	141,746	202,454
Average Daily Traffic	20,454	28,276

Source: 1997 and 2006 Austin Commercial Vehicle Surveys.

It is important to note that comparing the data results from the current travel surveys with the previous travel surveys may not provide accurate conclusions, given the difference in area coverage and sample size.

GLOSSARY AND TERMINOLOGY

Person Trip: A person trip is the movement of an individual from one location to another location. In the 2006 Austin five-county area household survey, these trips were recorded for persons five years of age or older in a surveyed household.

Vehicle Trip: A vehicle trip is the movement of a vehicle from one location to another location. These trips are recorded for the person driving the vehicle.

Trip Purpose: This is the purpose of the trip being made by an individual. It is stated in terms of the purpose at the location the trip began and the purpose at the location the trip ended. For example, a trip that began at home and ended at work would be referred to as a home-based work (HBW) trip.

Trip Activity: This is the activity the individual did at the location the trip began and/or the location the trip ended. These activities were recorded in the survey and post processed to identify the purpose associated with the activity.

Vehicle Availability: This term refers to the vehicles available to members of a household for travel.

Mode of Travel: This is the physical means used to make a trip. The modes recorded in the survey included walk, vehicle driver, vehicle passenger, carpool driver, carpool passenger, vanpool driver, vanpool passenger, commercial vehicle driver, commercial vehicle passenger, public transportation, school bus, taxi/paid limo, bicycle, motorcycle/moped, and other.

Vehicle Miles of Travel: A measurement of the total miles traveled by all vehicles in the area for a specified time period.

Home-Based Work (HBW) Trip: A trip which has one end at home and the other at work. It is non-directional in terms of the activity/purpose, i.e., a trip from home to work or from work to home is still defined as a HBW trip.

Home Based Non Work (HBNW) Trip: A trip which has one end at home and the other at a location other than the work location. It is non-directional in terms of the activity/purpose.

Non Home Based (NHB) Trip: A trip which has neither end at home.

External Origin (EXT-O) Trip: A trip that originated outside the study area.

External Destination (EXT-D) Trip: A trip whose destination is outside the study area when leaving the establishment.

Non-Resident (NON-RES) Trip: An internal trip to the establishment made by a person who lives outside the study area

Trips Productions: The number of trips that are produced by members of a household. These are computed by purpose and mode of travel. Production rates refer to the number of trip productions divided by the number of households.

Trips Attractions: The number of trips that are attracted to a location. These are computed by purpose and mode of travel for different land use categories.

REFERENCES

Dresser, George B. and David Pearson. *2006 Capital Area Metropolitan Planning Organization Household Travel Survey Technical Summary*. Texas Transportation Institute, The Texas A&M University System, College Station, TX, April 2008.

Farnsworth, Stephen P. *2005 Austin External Survey Technical Summary*. Texas Transportation Institute, The Texas A&M University System, College Station, TX, February 2008.

Nepal, Stella Amor, Stephen P. Farnsworth, and David Pearson. *2006 Austin Commercial Vehicle Survey Technical Summary*. Texas Transportation Institute, The Texas A&M University System, College Station, TX, December 2007 (Revised February 2008).

Nepal, Stella Amor F. and David F. Pearson. *2006/2007 Austin Area Work Place Travel Survey Technical Summary*. Texas Transportation Institute, The Texas A&M University System, College Station, TX, March 2009.

SPONSORED BY:

Transportation Planning and Programming Division
Texas Department of Transportation

FOR MORE INFORMATION CONTACT:

Charlie Hall
Travel Survey Program Manager, TxDOT
(512) 456-5120
cdhall@dot.state.tx.us

Edwin Hard
Transportation Planning Program Manager, TTI
(979) 845-8539
e-hard@tamu.edu