TEXAS DEPARTMENT OF TRANSPORTATION

EXECUTIVE SUMMARY

2006 • 2007 • 2008 • 2009 • 2010

Waco Travel Surveys

McLennan County

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ACKNOWLEDGEMENTS

This report provides a summary of the travel surveys conducted during the period between 2006 and 2010 in the Waco MPO study area. Details of these surveys are provided in the following separate technical reports, which are available for viewing through the Waco Metropolitan Planning Organization (WMPO) and the TxDOT Transportation Planning and Programming Division.

- 2007–2008 Waco Metropolitan Planning Organization Household Travel Survey Technical Summary, authored by Debbie Spillane and David Pearson, May 2011.
- 2010 Waco Work Place Travel Survey Technical Summary, authored by Stella Amor F. Nepal and David Pearson, Texas Transportation Institute, June 2011.
- 2006 Waco External Survey Technical Summary, authored by Stephen P. Farnsworth, Texas Transportation Institute, April 2008.
- 2008/2009 Waco Commercial Vehicle Survey Technical Summary, authored by Stella Amor F. Nepal and David F. Pearson, Texas Transportation Institute, December 2010.

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 are a number of individuals who extended technical support and assistance during the preparation of this report. Special thanks are due to Gary Lobaugh, Patti Ellis, and David Pearson of the Texas A&M Transportation Institute. The authors also thank Charlie Hall, TxDOT Travel Survey Program Manager, and the Department for its continuing program to collect and analyze urban travel data to support travel demand modeling.

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

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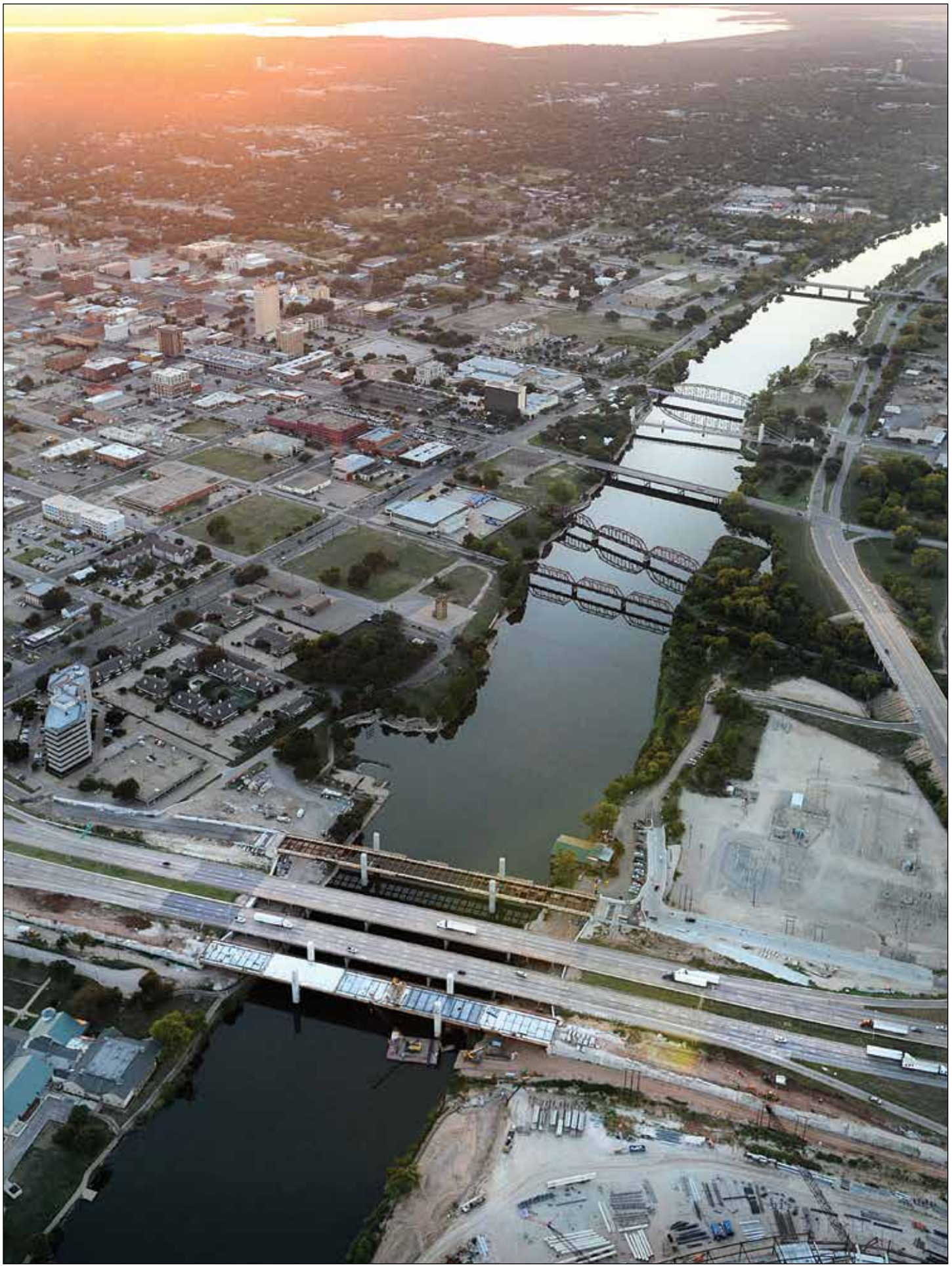
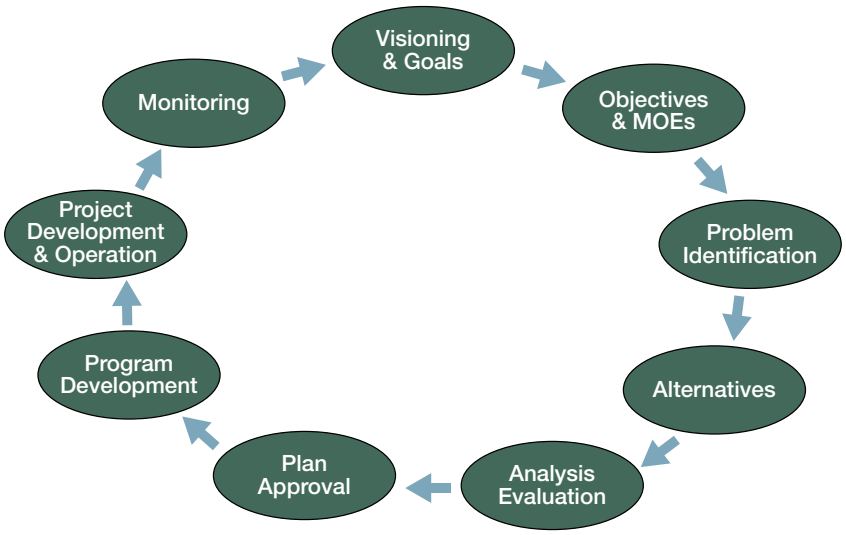


Aerial view of downtown Waco, Texas

INTRODUCTION

The metropolitan transportation planning process is based on the Federal-Aid Highway Acts of 1962 and 1973. These acts established the cooperative, continuing, and comprehensive (3C) transportation planning process and created the metropolitan planning organization (MPO) to assist in conducting the process. Subsequent federal acts strengthened the transportation planning process and the role of MPOs. Figure 1 shows the key elements of the metropolitan transportation planning process.

Figure 1. Key Elements of the Planning Process.



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

The metropolitan transportation planning process is based on the Federal-Aid Highway Acts of 1962 and 1973.

Where do travel surveys fit into 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. MPOs use this analysis 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 year 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.

Travel surveys are required to support travel demand model estimation, calibration, and validation for the model's base year.

Modelers require travel surveys to support travel demand model estimation, calibration, and validation for the model's base year. After the travel demand model is validated, it is used as an evaluation tool to determine how well or how poorly the proposed urban transportation system will perform in the future given the land use forecast of where people will live and work. Travel surveys are the essential first step for travel model estimation, calibration, and validation. 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 2006 and 2010, the Transportation Planning and Programming Division (TPP) of TxDOT funded a comprehensive set of travel surveys in the Waco MPO study area. Four types of travel surveys were conducted to collect information on different aspects of travel and trip-making in the Waco 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* (including special generators) to collect information on the number and types of trips attracted to basic, retail, service, and education establishments.
- 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.

The Waco MPO is the organization responsible for transportation planning for all of McLennan County. This report presents a summary of the travel surveys conducted in McLennan County, in which Waco is the largest city. Figure 2 provides a location map of the travel survey area.

Figure 2. Waco Travel Survey Area.

This section presents selected demographic and transportation statistics to provide a frame of reference for the Waco MPO study area compared to the state of Texas. Improved transportation planning and analysis tools are needed to plan for the future needs of McLennan County. The travel surveys, summarized in the remainder of this report, provide the travel-related data needed to continue to improve these analysis tools.

Improved transportation planning and analysis tools are needed to plan for the future needs of McLennan County.

Population Growth

The Waco area's population is forecasted to increase by about 53,047 or 23.2 percent between 2007 and 2035 (Texas State Data Center, Texas Population Projections Program). The population of the state of Texas as a whole is projected to increase from 23,837,701 in 2007 to 34,962,746 in 2035. Thus, in 2035, McLennan County is projected to make up only 0.80 percent of the Texas population, compared to the 0.96 percent it contained in 2007 (Table 1).

Table 1. Population Estimates.

Geography	Year	
	2007	2035
McLennan County	228,241	281,288
Texas	23,837,701	34,962,746

Source: Census Bureau Pop Estimates 2000-09 Texas Counties and Texas Data Center 2012 Projections (0.5 migration scenario).

Transportation Statistics

Persons commuting to work in the Waco MPO study area primarily drive alone or use carpools (Table 2). In McLennan County, there is limited use of public transportation (even lower than the average for the state of Texas). Part of the reason for this modest use of public transportation is that the percentage of households with a vehicle available in the Waco MPO study area is over 91 percent.

Table 2. Mode of Commuting to Work, 2007.

Mode of Commuting to Work	McLennan County	Texas
Drive Alone	80.43	78.88
Carpool	12.73	12.19
Public Transportation	0.37	1.69
Walk	2.27	1.76
Work at Home	3.20	3.61
Other	1.00	1.87
Total	**100.00**	**100.00**

Source: U.S. Census Bureau, 2007 American Community Survey (ACS).

Persons commuting to work in the Waco MPO study area primarily drive alone or use carpools.

Table 3 shows the population and daily vehicle miles of travel (VMT) estimates and projection for the Waco MPO study area. The daily VMT is projected to increase by around 33.6 percent, and the daily VMT per person is estimated to be 34.2 miles by 2035

Table 3. Population and Vehicle Miles of Travel Data.

Year	Population of McLennan County	Daily Vehicle Miles of Travel (1,000)	Daily Vehicle Miles of Travel per Person
2007	228,241	7,208.2	31.58
2030	272,216	9,135.5	33.56
2035	281,288	9,628.2	34.23

Source of 2007 Daily Vehicle Miles of Travel: Appendix E. of Development of Regional On-Road Mobile Source, 1999 through 2030 Emissions Trends-Executive Summary, Texas Transportation Institute, July 2011.

To estimate future travel, the studies consider the travel 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.

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 distance 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).

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.

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 and 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 household trip making such as the number and age of persons in the household, number of household members employed, household income, and the number of vehicles available to the household. The 2007–2008 Waco household survey included 1,404 households. The results presented in this section are based on expanded survey data, which may differ from estimates determined by other agencies.

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. By closely monitoring trends in these two household characteristics, future travel demand can be estimated with greater accuracy. In general, as household income increases, daily household travel increases. Likewise, when household income increases, daily household travel increases. The average household size in the Waco area from 2006–2007 was 2.7 persons per household.

Figure 3 shows the distribution of households by household size for Waco. As shown, the most common household size is 2 persons (37.7 percent of households). Interestingly, there is nearly the same percentage of 1 person households as 5+ person households (12.0 percent and 13.2 percent, respectively).

Figure 3. Distribution of Households by Household Size.

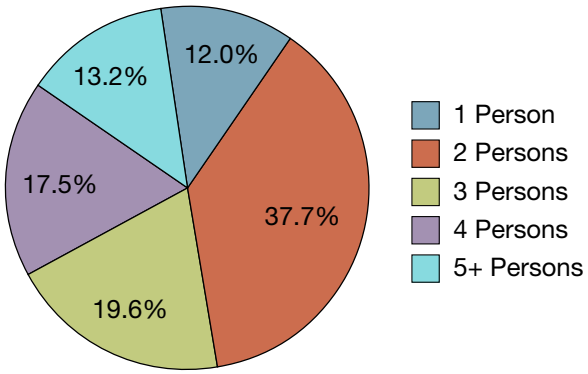
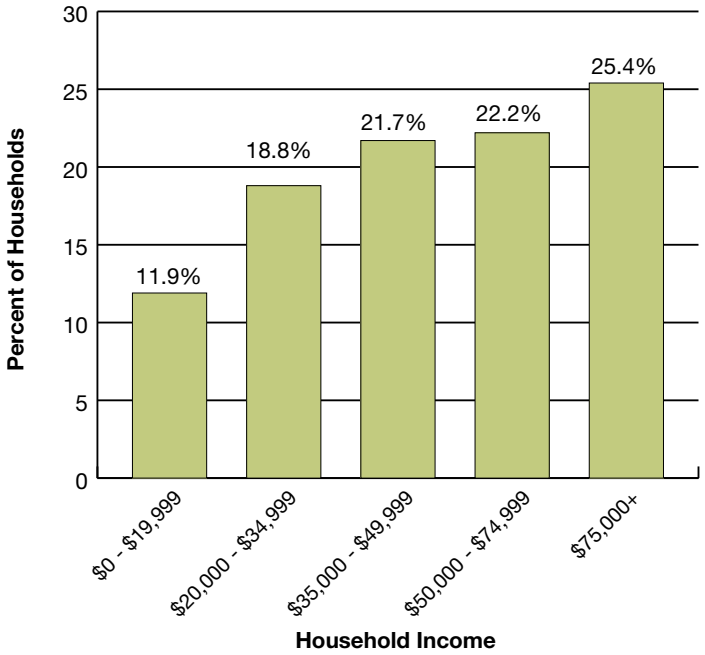


Figure 4 provides the distribution of households by household income. Notice that there are an increasingly higher percentage of households falling into each successive increase in household income category. Over a quarter of households have a household income greater than $75,000, while nearly 12 percent of households have a household income lower than $20,000.

Figure 4. Distribution of Households by Household Income.

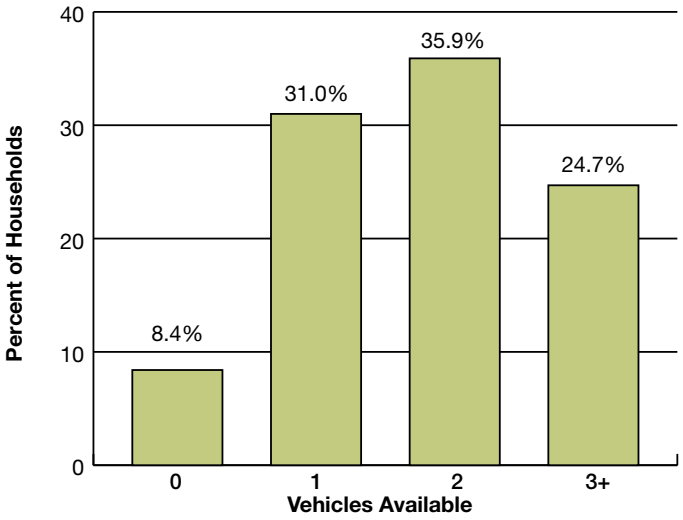


Generally, household travel increases as the number of vehicles available to the household increases.

Vehicles Available

Generally, household travel increases as the number of vehicles available to the household increases. By contrast, the demand for public transportation generally decreases as the household vehicle availability increases. Figure 5 shows the distribution of the number of vehicles available to a household. Note that just over 8 percent (8.4 percent) of households do not have a vehicle available to them. Put another way, over 91 percent of households do have at least one vehicle available to them. The average number of vehicles available per household was 1.9.

Figure 5. Distribution of Households by Vehicles Available.

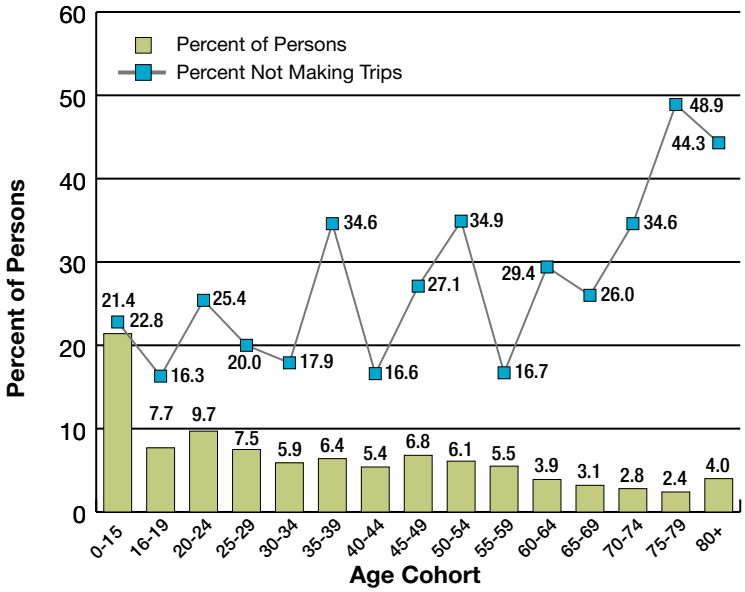


Age Cohort

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 in determining household life cycle. In Figure 6, the population is categorized by age cohort. The percent of persons in each age category not making trips is also shown. The relatively high percentage of older persons not making trips may be partially explained by an inability to safely or conveniently travel. However, the older population is mobile and contributes significantly to the amount of household travel. The percentage of 65+ age cohorts not making internal trips ranged from 26.0 percent of 65-69 year-olds to 48.9 percent of 75–79 year-olds. Also note that the largest age cohort is for ages 0–15, which may stem partially from the fact that the age range for this age cohort is larger than the other age cohort ranges (excepting the open-ended 80+ category).

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

Figure 6. Distribution of Persons by Age Cohort.

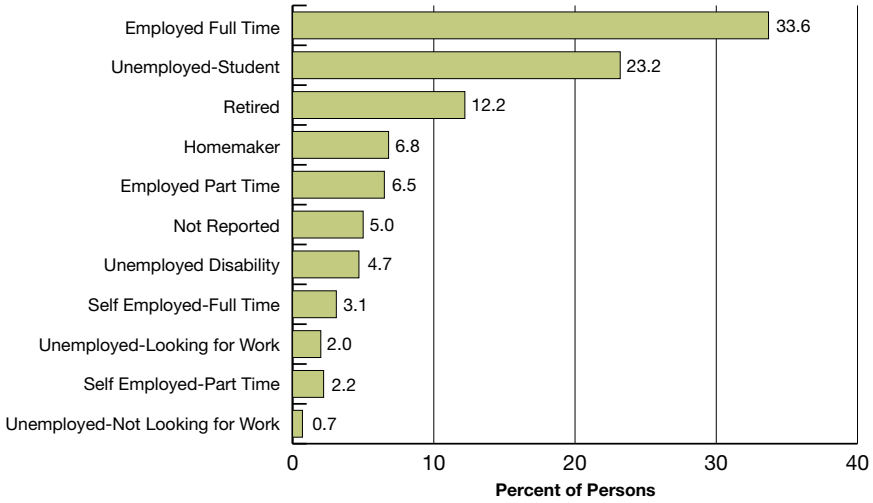


Employment Status

Employment status is used to characterize household life cycle. Life cycle can be a useful 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 7 provides the distribution of persons by employment status. The largest category is "Employed Full Time" with 33.6 percent. There is also a relatively large portion of persons belonging to the "Unemployed-Student" category, which is likely composed of students from the special generators of Baylor University, Texas State Technical College, and McLennan Community College.

Employment status is used to characterize household life cycle.

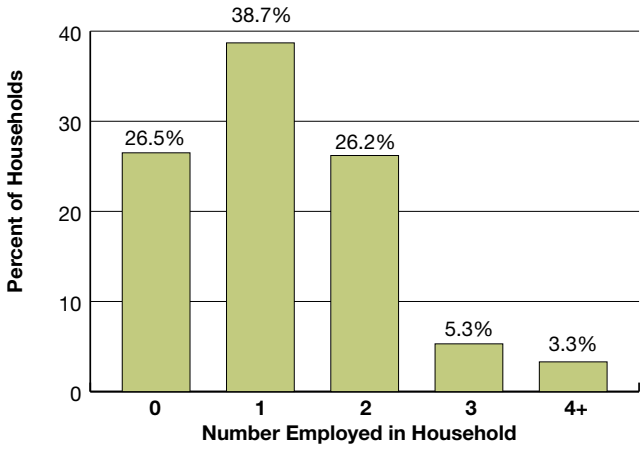
Figure 7. Distribution of Persons by Employment Status.



Source: 2007–2008 Waco MPO Household Travel Survey and TTI Analysis.

Daily household travel also increases as the number of persons employed in the household increases. Figure 8 illustrates the distribution of employed households. Over a quarter of the households do not have any employees. Together, one and two employee households comprise roughly 65 percent of all households. Less than 9 percent of households have more than two employed household members.

Figure 8. Distribution of Employed Household Members.

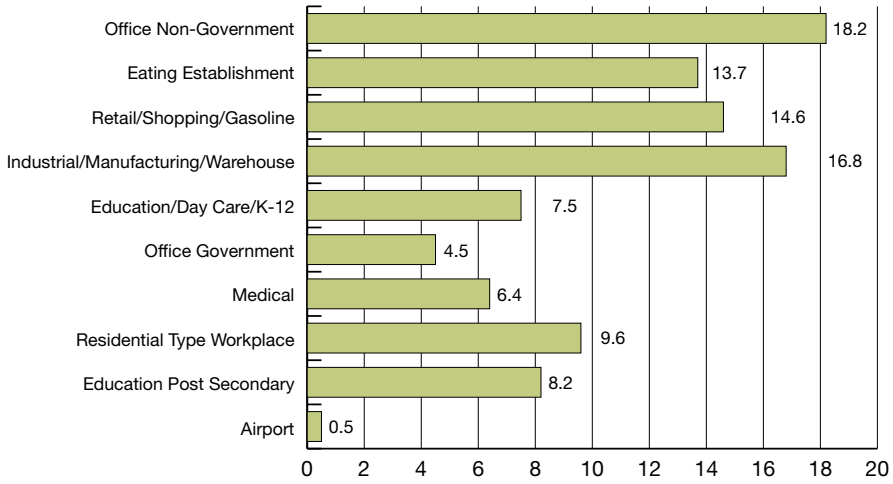


Employment Type

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. While the latter three employment types are fairly self-explanatory, the "basic" category includes a variety of industries such as agriculture, forestry, fishing, and hunting; mining, quarrying, and oil and gas extraction; utilities; construction; manufacturing; wholesale trade; transportation and warehousing. Each of these employment types has a different attracting power or attraction rate. Figure 9 shows the distribution of persons by employment type. The largest employment type is Office Non-Government with 18.2 percent of employees. A close second, with 16.8 percent of employees, is Industrial/Manufacturing/Warehouse. Figure 10 shows the data in Figure 9 summarized into basic, retail, service, and education work place types which are used in travel demand modeling. Retail encompasses the largest percentage of employment types with 32.9 percent.

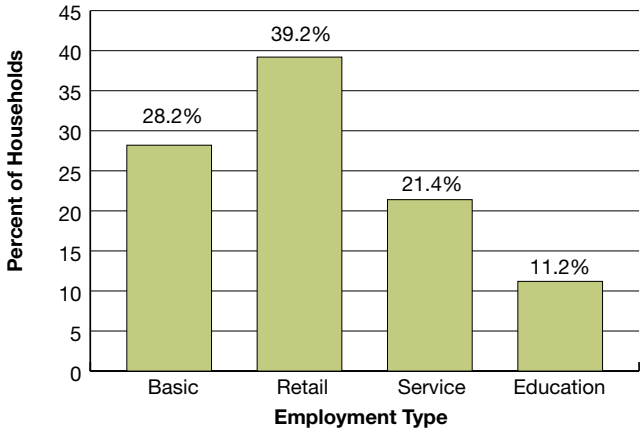
In the travel demand model, the type of employment is summarized into four employment types—basic, retail, service, and education.

Figure 9. Type of Work Place.



Source: 2007–2008 Waco MPO Household Travel Survey and TTI Analysis.

Figure 10. Distribution of Employed Persons by Basic, Retail, Service, and Education Employment.



Source: Texas Workforce Commission, 2004.

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.

Person trips include walk, bicycle, and vehicle trips, while vehicle driver trips are those trips made by an individual driving a vehicle.

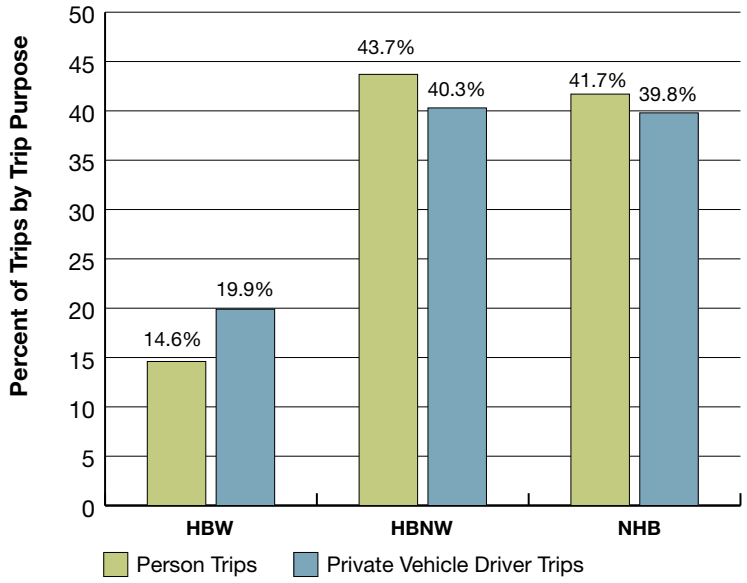
For travel demand model application, the HBNW trip purpose may be further divided among trips to school, trips to shopping centers, and trips to other locations. The trip purposes are also classified in terms of person trips or vehicle driver trips, depending on the mode of travel used. Person trips 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 because 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 11 shows the distribution of trip productions by trip purpose for the Waco study area. HBNW trips account for about 43.7 percent of all household person trips and 40.3 percent of all household vehicle trips.

Figure 11. Distribution of Trip Productions by Trip Purpose.



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 4 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 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 travel study area, is around 8.5 trips per household.

Table 4. Person Trip Rates by Household Size and Household Income

Household Income Range	Household Size				
	1	2	3	4	5+
$0-$17,499	2.1	3.6	6.2	10.3	15.0
$17,500-$32,499	3.3	5.6	11.2	14.9	24.8
$32,500-$49,999	5.4	5.3	11.2	16.8	23.2
$50,000-$74,999	5.6	7.1	6.8	12.7	21.3
$75,000+	5.9	8.8	9.1	12.5	21.4

Travel distances vary by trip purpose with the HBW trip purpose having the longest average trip length.

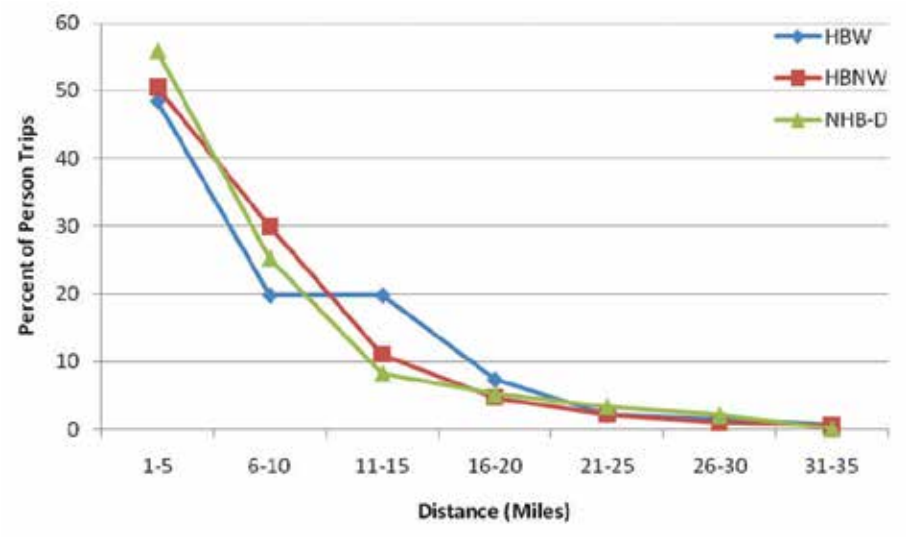
Trip Length

Travel distances vary by trip purpose with the HBW 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. However, these trends may not be true when only considering internal trips. 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.

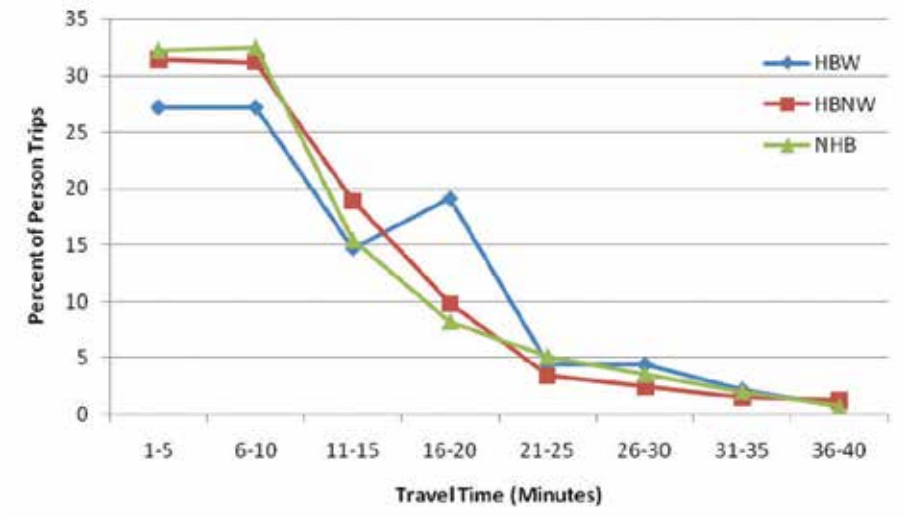
Figure 12 shows the distribution of person trips by travel distance, while Figure 13 provides the distribution of person trips by travel time. The distribution is for internal person trips, which are those trips beginning and ending within the Waco study area. The average person trip length is 7.7 miles for HBW trips, 5.8 miles for HBNW trips, and 4.8 miles for NHB trips.

Figure 12. Distribution of Person Trips by Trip Length in Miles by Trip Purpose.



The time-of-day that people travel is generally dictated by the scheduled start times of their activities.

Figure 13. Distribution of Person Trips by Trip Duration in Minutes by Trip Purpose.



Overall, the average person trip length is 4.10 miles and the average person trip duration is 6.78 minutes.

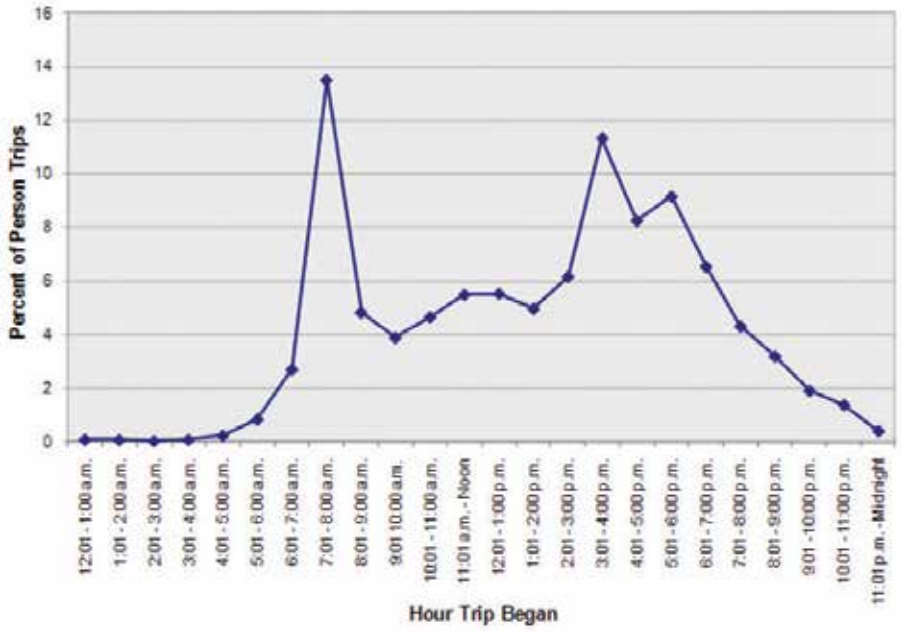
Time-of-Day Travel

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 14 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.

Figure 14. Distribution of Person Trips by Time-of-Day.



The modest noon peak, the school-to-home peak, and the work-to-home peak are all evident.

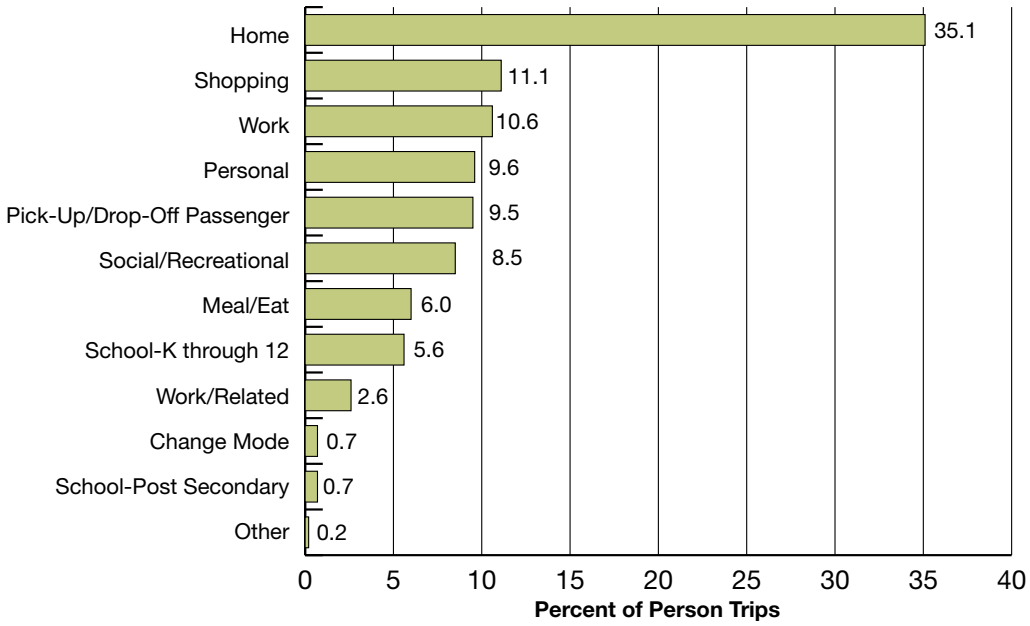
Trip Purpose

As a part of their travel diary, each household member was asked to identify from a list of choices what he or she did at each trip destination. The information about the trip destination was used to categorize the trip according to trip purpose. In travel demand modeling, typically there are three internal trip purposes—HBW, HBNW, and NHB trips—that are used for forecasting future travel. For each of these trip purposes, trip rates and trip length frequency distributions are estimated from the household survey.

Figure 15 shows the distribution of person trips by destination purpose. The most frequent trip destination is the return-to-home trips, which account for 35.1 of person trips on the destination side.

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).

Figure 15. Distribution of Person Trips by Destination Purpose.



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. The 2010 Waco Work Place Travel Survey, such as other work place travel surveys across the U.S., consisted of a combination of survey instruments and data collection efforts, which included:

- A *general survey* of the work place.
- A *travel survey* of employees and visitors at the work place.
- *Counts* of either persons or vehicles traveling to and from the work place.

The primary purpose of a work place survey is to understand the trip attraction characteristics of basic, retail, service, and education establishments.

Data collected from these efforts were used to develop trip attraction rates by purpose, stratified by area type and employment type.

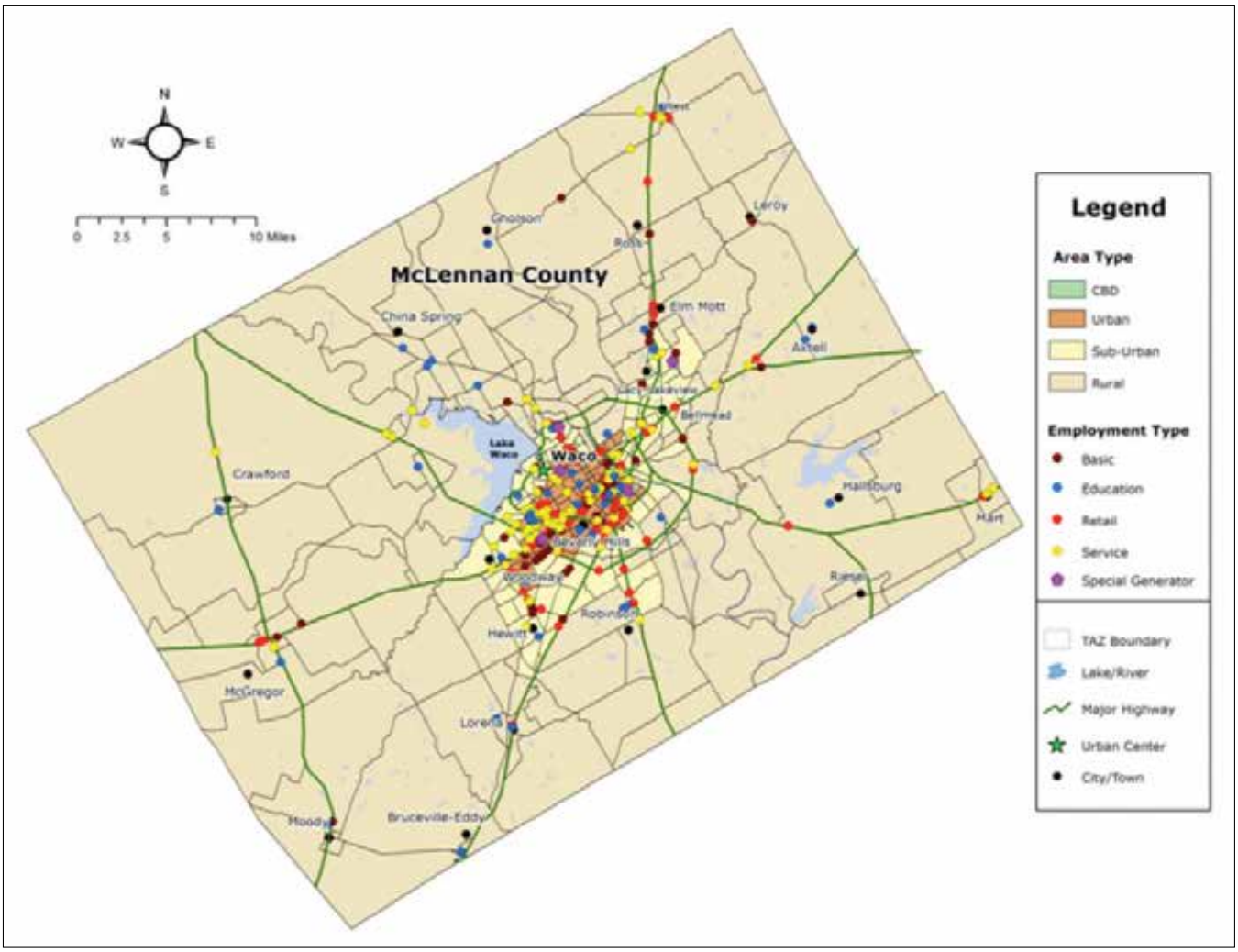
For analysis purposes, TAZs in the work place survey are grouped according to the level of activity within the zone as measured by the density of population and employment within the zone. There are four area types identified in the Waco study area—the central business district (CBD), urban, suburban, and rural.

The 2010 Waco Work Place Travel Survey included 300 randomly selected business establishments, of which 103 had full surveys and 197 had partial surveys. The full surveys consisted of 965 surveyed employees and 1,899 surveyed visitors or non-employees; though the total employment was estimated to be 2,652, with 2,266 employees at work on the survey day. The full surveys also included surveys of vehicles owned and leased by the establishments and used for business purposes, and counts of persons or

vehicles arriving and departing the establishments. The partial survey mainly included a general survey of the establishment, such as the type, location, total employment, and number of employees at work on the day of the survey.

Figure 16 shows the locations of the establishments that participated in the work place survey. The data presented in this section are based on survey data and are not expanded.

Figure 16. McLennan County Work Place Surveyed Establishments.



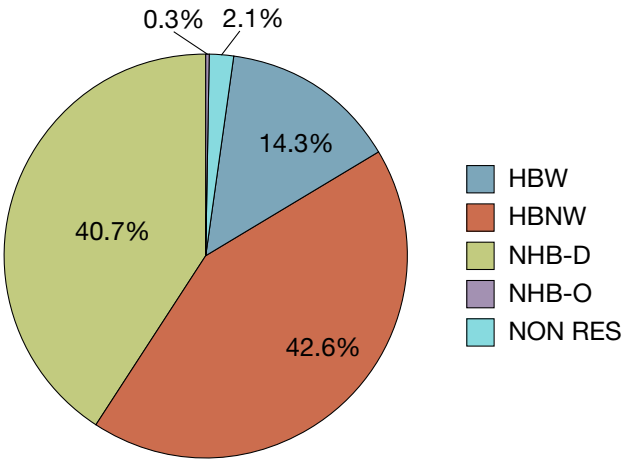
Work Place Travel Characteristics

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), which are 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), which are 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.

The full surveys consisted of 965 surveyed employees and 1,899 surveyed visitors or non-employees.

Figure 17 shows a pie chart showing the distribution of reported trips by trip purpose. Roughly an even proportion of NHB-D and HBNW trips were reported (40.7 percent and 42.6 percent, respectively). A small percent (2.1 percent) of trips were reported as NON-RES, while an even smaller (0.3 percent) of trips were reported as EXT-D. No EXT-O trips were reported.

Figure 17. Distribution of Reported Trips by Trip Purpose.

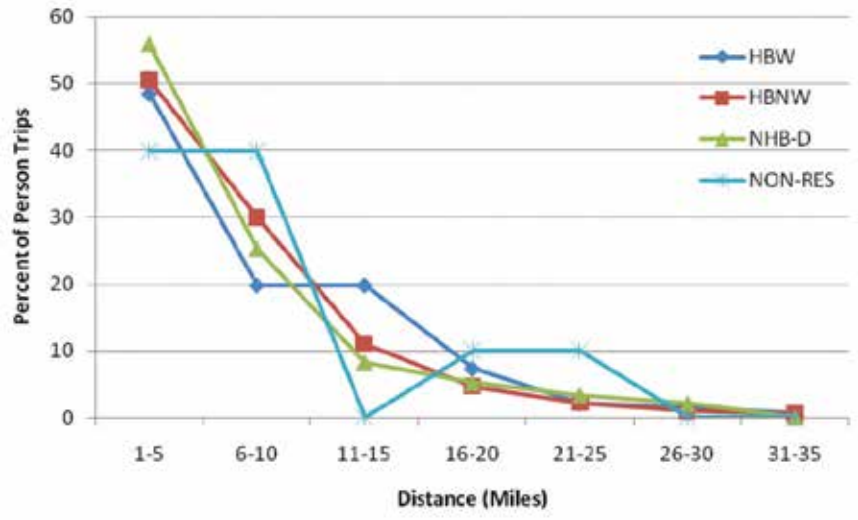


Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Trips with a distance between 1 and 5 miles are the most common trip length.

Figure 18 provides a distribution of person trips by travel distance for the different trip purposes. Notice that long trip lengths are rare compared to the more frequent short distance trips. Trips with a distance between 1 and 5 miles are the most common trip length.

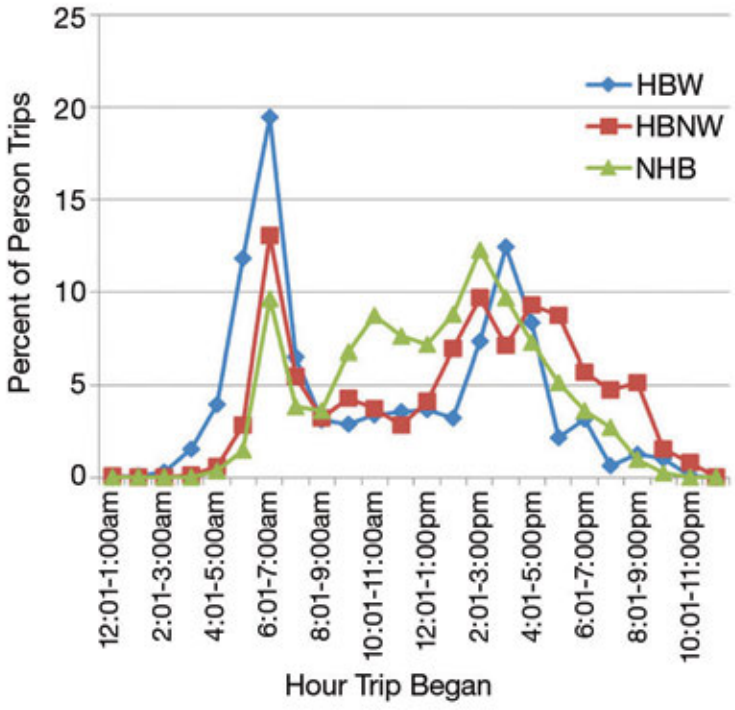
Figure 18. Distribution of Person Trips by Travel Distance.



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Trips by purpose type typically have distinct characteristics by time-or-day that are consistent for nearly all urban areas. Figure 19 shows the distribution of person trips by time-of-day for McLennan County.

Figure 19. Distribution of Person Trips by Time-of-Day.



SPECIAL GENERATORS

Six important work places surveyed—Baylor University, Texas State Technical College (TSTC), McLennan Community College (MCC), Hillcrest Medical Center (HMC), Waco Richland Mall, and Central Texas Marketplace Mall—were treated as special generators. Special generators are those types of development that are considered unique and subject to modeling outside the typical modeling framework. The methodology used to survey special generators is the same as that used for a full work place survey, except to a much larger scale.

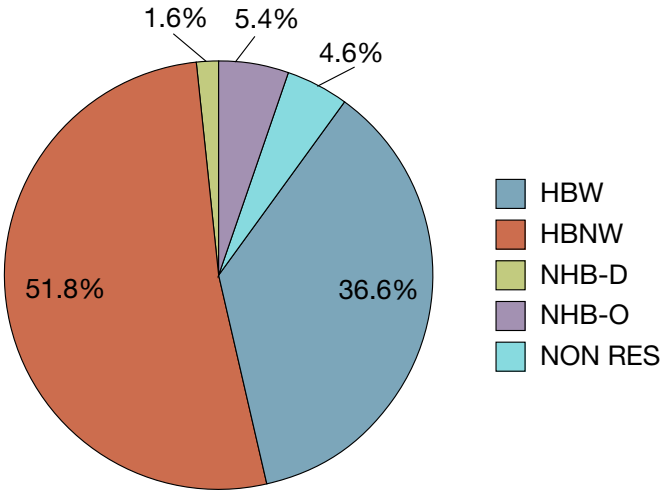
Special generators are those types of development that are considered unique and subject to modeling outside the typical modeling framework.

Baylor University

Vehicle counts for Baylor University were conducted at 19 locations and totaled 23,835, of which roughly 1.6 percent (373 trips) were commercial vehicle trips. Person counts conducted at two locations on campus totaled 3,105 persons. These counts were added to the total person count estimates obtained from the vehicle occupancy counts. A total of 119 employees and 161 non-employees (124 students and 37 visitors) participated in the survey. It was estimated that 2,800 of the 3,000 Baylor employees were at work on the travel survey day.

Figure 20 shows the surveyed trips by trip purpose at Baylor University. Over half of the surveyed trips (51.8 percent) were HBNW, which coincides with all of the students traveling from home to school or school to home. Over a third of the surveyed trips (36.6 percent) were HBW, which may have consisted of professors, staff, and student workers.

Figure 20. Surveyed Trips by Trip Purpose at Baylor University.

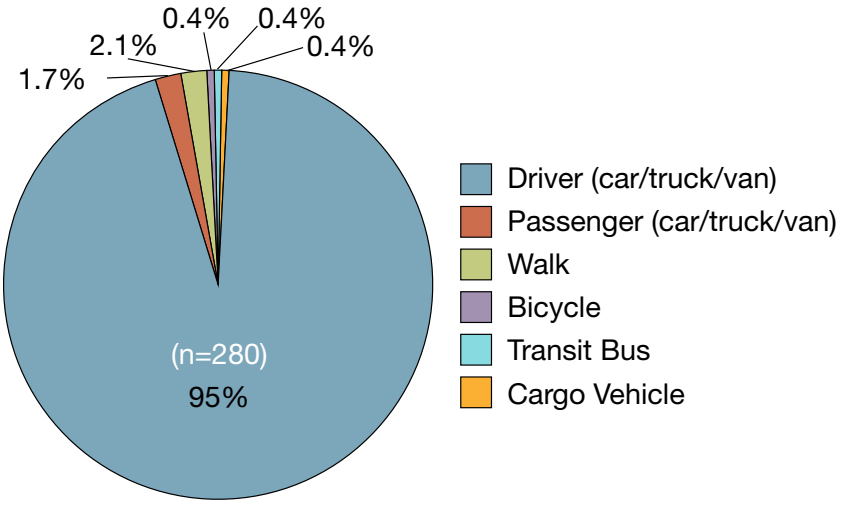


Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

The relatively small sample size was due to the inability to conduct intercept surveys on the Baylor campus for the entire survey time period.

Figure 21 shows the distribution of mode of travel to Baylor University. The relatively small sample size was due to the inability to conduct intercept surveys on the Baylor campus for the entire survey time period. Ninety-five percent of trips were made by vehicle drivers, with passenger, walk, bicycle, transit bus, and cargo vehicle combining to comprise the remaining 5 percent of travel modes for those surveyed.

Figure 21. Mode of Travel to Baylor University.



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

The internal survey trips were geo-coded for both employees and visitors to the TAZs in the Waco 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 5 shows the average trip lengths for the Baylor University trips and Table 6 shows the expanded survey results for Baylor University.

Baylor University, Waco, Texas

The total trips were estimated by multiplying the non-commercial vehicle counts with the average employee and visitor auto-driver vehicle occupancy.

Table 5. Average Trip Lengths for Surveyed Trips to Baylor University.

Trip Purpose	Average Person Miles	Average Vehicle Miles
HBW	9.06	9.06
HBNW	5.89	5.89
NHB-D	6.57	7.67
NON-RES	-	-

Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Table 6. Baylor University Person and Auto-Driver Trips and Attraction Rates.

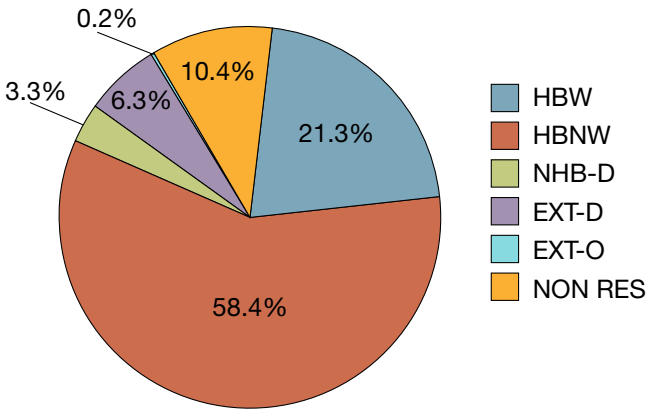
Trip Purpose	Person Trips	Person Trip Rates	Auto-Driver Trips	Auto-Driver Trip Rates
HBW	4,999	1.67	4,951	1.65
HBNW	19,851	6.62	16,087	5.36
NHB	742	0.25	651	0.22
Non-Resident Trips	1,314	0.44	1,123	0.37
Commercial Vehicle Trips	373	0.12	373	0.12
Total	**27,279**	**9.10**	**23,185**	**7.72**

Texas State Technical College (TSTC)

For TSTC, 9,274 vehicles were counted at 14 locations, of which roughly 1.7 percent (158 trips) were commercial vehicle trips. Total daily person trips were around 384. A total of 158 employees and 458 non-employees (432 students and 26 visitors) participated in the survey. It was estimated that 680 of the 700 TSTC employees were at work on the travel survey day.

Figure 22 shows the surveyed trips by trip purpose at TSTC similar to the results obtained for Baylor University, over half of the surveyed trips (58.4 percent) were HBNW. While TSTC had a smaller percentage of HBW trips than Baylor, TSTC had a higher percentage of NON-RES trips (10.4 percent).

Figure 22. Surveyed Trips by Trip Purpose at TSTC.

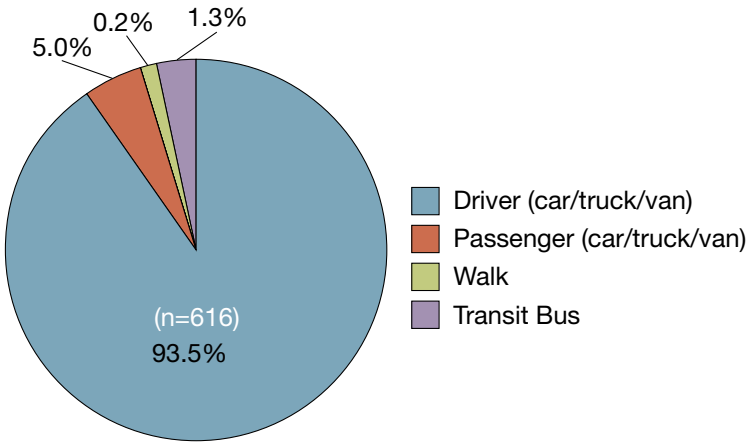


Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

For TSTC, 9,274 vehicles were counted at 14 locations, of which roughly 1.7 percent (158 trips) were commercial vehicle trips.

Figure 23 shows the mode of travel to TSTC. Over 93 percent of trips to TSTC were made as a driver, with roughly 5 percent of trips made as a passenger, and a combined sum of less than 2 percent of trips being made either by walking or transit bus.

Figure 23. Mode of Travel to TSTC.



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

I-35

The average trip length of surveyed trips to TSTC, displayed in terms of person trips and vehicle trips, are shown in Table 7. Notice that NON-RES trips tend to generate the longest trips of all displayed trip purposes. In contrast, EST-D trips have the shortest average trip length.

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

Trip Purpose	Average Person Miles	Average Vehicle Miles
HBW	7.27	7.27
HBNW	7.43	7.51
NHB-D	6.73	6.60
NON-RES	16.50	16.50

Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Table 8 shows the expanded survey results for TSTC.

Table 8. TSTC Person and Auto-Driver Trips and Attraction Rates.

Trip Purpose	Person Trips	Person Trip Rates	Auto-Driver Trips	Auto-Driver Trip Rates
HBW	1,271	1.81	1,248	1.78
HBNW	6,722	9.60	6,021	8.60
NHB	496	0.71	452	0.65
Non-Resident Trips	1,022	1.46	926	1.32
Commercial Vehicle Trips	158	0.23	158	0.23
Total	**9,669**	**13.81**	**8,805**	**12.58**

Baylor University, Waco, Texas

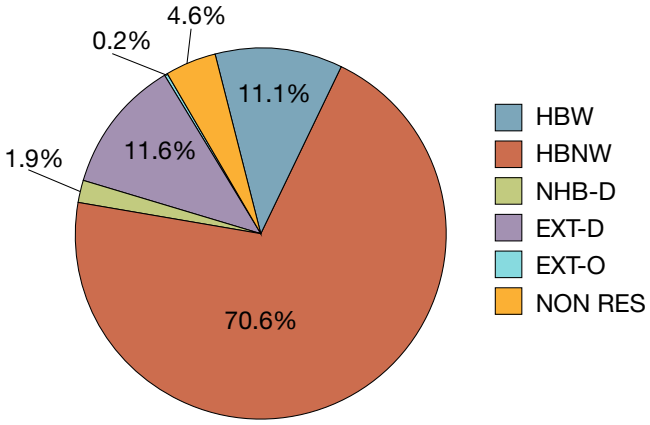
McLennan Community College (MCC)

For MCC, 10,945 vehicles were counted at seven locations, of which roughly 1.1 percent (123 trips) were commercial vehicle trips. A total of 75 employees, 506 students, and 33 non-employees participated in the survey. It was estimated that 700 of the 778 MCC employees were at work on the travel survey day.

For MCC, 10,945 vehicles were counted at seven locations, of which roughly 1.1 percent (123 trips) were commercial vehicle trips.

Figure 24 shows the surveyed trips by trip purpose at MCC. MCC had a relatively high percentage of surveyed trips with a HBNW trip purpose (70.6 percent). Interestingly, MCC had roughly double the percentage of NHB-O trips as Baylor and TSTC. However, the percentage of HBW trips was lower for MCC (11.1 percent, compared to 36.6 percent at Baylor and 21.3 percent at TSTC).

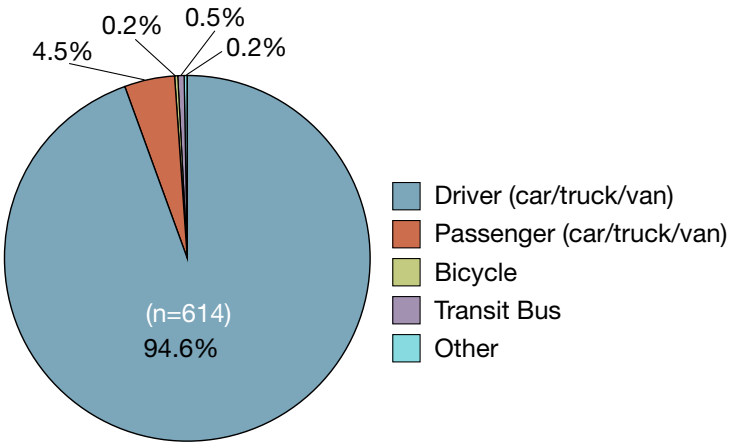
Figure 24. Surveyed Trips by Trip Purpose at MCC.



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Figure 25 shows a distribution of the mode of travel to MCC. Just under 95 percent of trips to MCC were made as a driver. Similar to the distribution seen for TSTC, roughly 5 percent of trips were made as a passenger.

Figure 25. Distribution of Mode of Travel to MCC.



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Table 9 shows the average trip lengths for surveyed trips to MCC. Interestingly, the average HBW trip length, for both person trips and vehicle trips, is shorter to MCC than the results obtained for both Baylor and TSTC. Also of interest, the average trip length to MCC is shorter for the HBW trip purpose than for the EXT-D, which was not the case for either Baylor or TSTC.

Table 9. Average Trip Lengths for Surveyed Trips to MCC.

Trip Purpose	Average Person Miles	Average Vehicle Miles
HBW	5.92	5.92
HBNW	9.29	9.04
NHB-D	6.00	6.22
NON-RES	15.00	15.00

Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Table 10 shows the expanded survey results for MCC.

Table 10. MCC Person and Auto-Driver Trips and Attraction Rates.

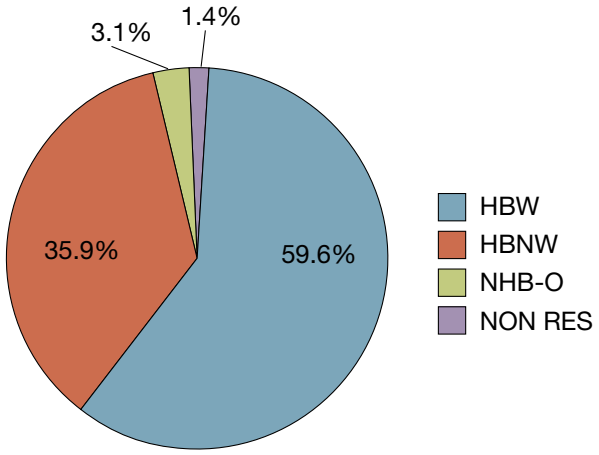
Trip Purpose	Person Trips	Person Trip Rates	Auto-Driver Trips	Auto-Driver Trip Rates
HBW	1,278	1.64	1,275	1.64
HBNW	8,178	10.51	7,582	9.75
NHB	777	1.00	729	0.94
Non-Resident Trips	539	0.69	491	0.63
Commercial Vehicle Trips	123	0.16	123	0.16
Total	**10,895**	**14.00**	**10,200**	**13.12**

Hillcrest Medical Center (HMC)

For HMC, 788 vehicles were counted at four locations, of which roughly 7.1 percent (56 trips) were commercial vehicle trips. A total of 91 employees and 54 non-employees participated in the survey. It was estimated that all 140 HMC employees were at work on the travel survey day.

Figure 26 shows the surveyed trips by trip purpose at the HMC. Nearly 60 percent (59.6 percent) of the surveyed trips were HBW—which is an indication that a large percentage of trips made to this special generator are produced by employees of the medical center. Over a third (35.9 percent) of the surveyed trips was HBNW.

Figure 26. Surveyed Trips by Trip Purpose at HMC.

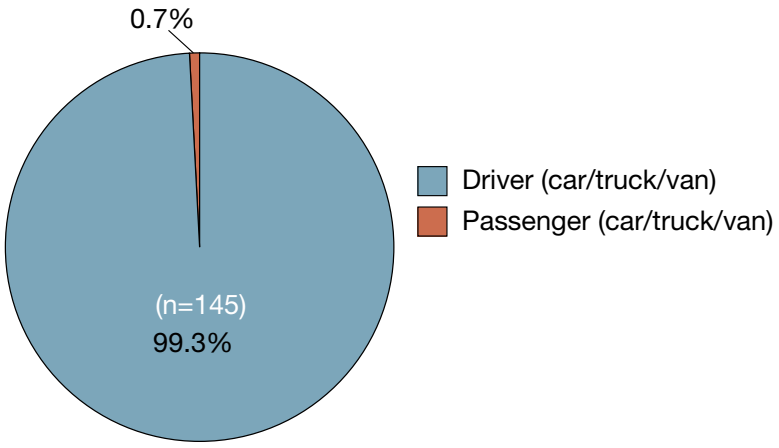


Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

No pedestrian, bicycle, or transit bus trips to HCM were reported.

Figure 27 shows the distribution by mode of travel to HMC. Nearly all trips (over 99 percent) to HCM were made as a driver, with less than 1 percent of trips being made as a passenger. No pedestrian, bicycle, or transit bus trips to HCM were reported.

Figure 27. Mode of Travel to HCM.



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

The McLennan County Courthouse, Waco, Texas (Photo by: Larry D. Moore CC BY-SA 3.0.)

Table 11 shows the average trip lengths for surveyed trips to HMC. Only HBW and HBNW were reported in the survey. The average HBW trip to HMC is roughly a mile longer than the average HBNW trips for both person and vehicle trips.

Table 11. Average Trip Lengths for Surveyed Trips to HCM.

Trip Purpose	Average Person Miles	Average Vehicle Miles
HBW	8.40	8.40
HBNW	7.25	7.50
NHB-D	-	-
NON-RES	-	-

Table 12 shows the expanded survey results for HMC.

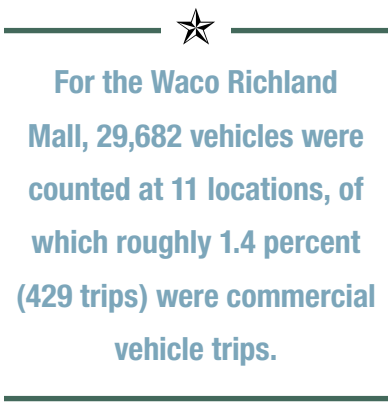
Table 12. HCM Person and Auto-Driver Trips and Attraction Rates.

Trip Purpose	Person Trips	Person Trip Rates	Auto-Driver Trips	Auto-Driver Trip Rates
HBW	286	2.04	282	2.01
HBNW	491	3.51	422	3.01
NHB	12	0.09	11	0.08
Non-Resident Trips	6	0.04	6	0.04
Commercial Vehicle Trips	56	0.40	56	0.40
Total	**851**	**6.08**	**777**	**5.54**

Waco Richland Mall

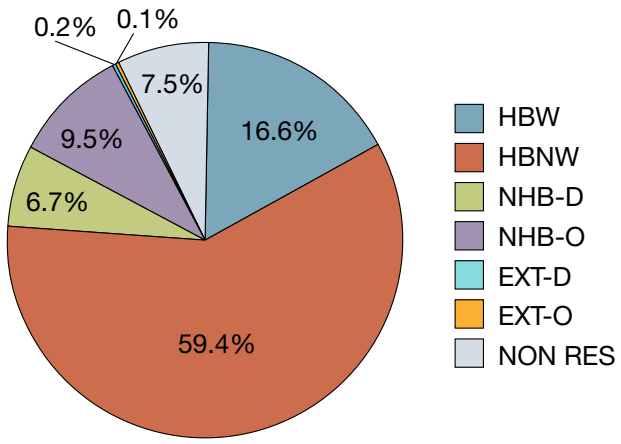
For the Waco Richland Mall, 29,682 vehicles were counted at 11 locations, of which roughly 1.4 percent (429 trips) were commercial vehicle trips. A total of 112 employees and 488 non-employees participated in the survey. It was estimated that 1,050 of the 1,200 Richland Mall employees were at work on the travel survey day.

Figure 28 shows the surveyed trips by trip purpose at the Waco Richland Mall. In comparison to the HCM, the Waco Richland Mall had a larger percentage of surveyed trips with a HBNW trip purpose (59.4 percent compared to 35.9 percent for HCM). Also, the percentage of surveyed HBW trips at the Waco Richland Mall is roughly a quarter of the percentage of surveyed HBW trips at the HCM (16.6 percent compared to 59.7 percent for HCM). This is either an indication that the Waco Richland Mall has more non-employee customers than HCM and/or that HCM has more employees than the Waco Richland Mall. The Waco Richland Mall also has a much larger proportion of NHB-D, NHB-O, and NON-RES trips than HCM.



For the Waco Richland Mall, 29,682 vehicles were counted at 11 locations, of which roughly 1.4 percent (429 trips) were commercial vehicle trips.

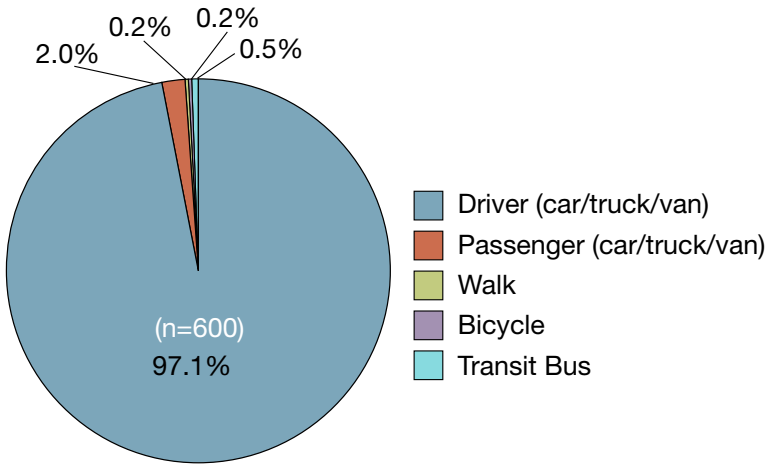
Figure 28. Surveyed Trips by Trip Purpose at Richland Mall.



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Figure 29 shows the distribution by mode of travel to the Richland Mall. A majority of reported trips were made as a driver (over 97 percent), with 2 percent of trips being made as a passenger, and a small percentage of trips being comprised of walking, bicycling, and transit bus ridership. The slightly greater variety in transit mode observed at the Richland Mall compared to the HCM may be a reflection of differences seen in the trip distributions of each special generator.

Figure 29. Mode of Travel to Richland Mall.



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Table 13 shows the average trip lengths for surveyed trips to the Richland Mall. HBW trips have the longest trip purpose averages for both person and vehicle trips. NON-RES trips have the lowest average trip length for both person and vehicle trips, which is in sharp contrast to the longer NON-RES average trip lengths reported for TSTC and MCC. Differences in average trip length may stem from both the location of each of the special generators, as well as the type of locations for these generators.

Differences in average trip length may stem from both the location of each of the special generators, as well as the type of locations for these generators.

Table 13. Average Trip Length for Surveyed Trips to Richland Mall.

Trip Purpose	Average Person Miles	Average Vehicle Miles
HBW	9.83	9.83
HBNW	9.41	8.00
NHB-D	6.40	6.45
NON-RES	4.00	4.33

Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Table 14 shows the expanded survey results for the Richland Mall.

Table 14. Richland Mall Person and Auto-Driver Trips and Attraction Rates.

Trip Purpose	Person Trips	Person Trip Rates	Auto-Driver Trips	Auto-Driver Trip Rates
HBW	2,139	1.78	2,059	1.72
HBNW	25,657	21.38	19,782	16.49
NHB	3,290	2.75	2,567	2.14
Non-Resident Trips	2,797	2.33	2,194	1.83
Commercial Vehicle Trips	429	0.36	429	0.36
Total	**34,312**	**28.60**	**27,031**	**22.54**

I-35 Brazos River Bridge

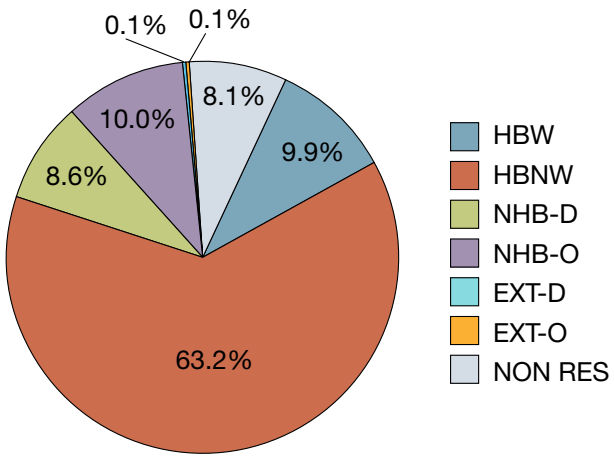
Central Texas Marketplace Mall

For the Central Texas Marketplace Mall, 12,158 vehicles were counted at eight locations, of which roughly 1.0 percent (125 trips) was commercial vehicle trips. A total of 79 employees and 649 visitors participated in the survey. It was estimated that 175 of the 250 Marketplace Mall employees were at work on the travel survey day.

Figure 30 shows the surveyed trips by trip purpose at the Central Texas Marketplace Mall. The trip purpose breakdown at the Marketplace Mall is comparable to that seen for the Waco Richland Mall. The majority of surveyed trips are HBNW (63.2 percent). There is a fairly even distribution of NHB-D, NHB-O, NON-RES, and HBW trips (8.6 percent, 10.0 percent, 8.1 percent, and 9.9 percent, respectively).

The trip purpose breakdown at the Marketplace Mall is comparable to that seen for the Waco Richland Mall.

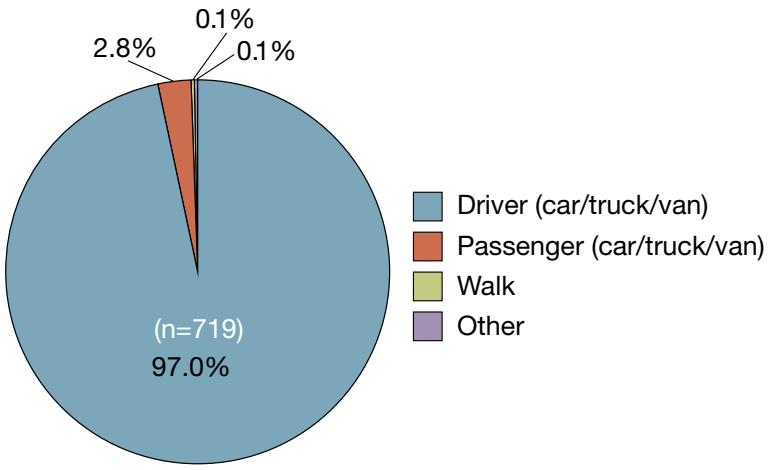
Figure 30. Surveyed Trips by Trip Purpose at Marketplace Mall.



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Figure 31 shows the distribution of mode of travel to the Marketplace Mall. The mode of travel distribution is similar to the distribution seen for the Richland Mall. Nearly 97 percent of surveyed trips were made as a driver, nearly 3 percent were made as a passenger, and a small amount of trips were made by walking or by an unspecified other mode of travel.

Figure 31. Mode of Travel to Marketplace Mall.



Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Table 15 shows the average trip lengths for surveyed trips to the Marketplace Mall. Interestingly, the averages seen for HBW, HBNW, and NHB-D are comparable for both person and vehicle trips. NON-RES trips have the lowest average trip length, while EXT-D trips have the highest average trip length. Keep in mind that this relatively high average trip length reported for EXT-D trip purposes may be the result of a relatively small number of EXT-D being reported within the survey.

Table 15. Average Trip Lengths for Surveyed Trips to Marketplace Mall.

Trip Purpose	Average Person Miles	Average Vehicle Miles
HBW	7.17	7.17
HBNW	6.86	7.10
NHB-D	6.95	7.03
EXT-D	32.00	32.00
NON-RES	4.57	4.83

Source: 2010 Waco Work Place Travel Survey and TTI Analysis.

Table 16 shows the expanded survey results for the Marketplace Mall.

Table 16. Marketplace Mall Person and Auto-Driver Trips and Attraction Rates.

Trip Purpose	Person Trips	Person Trip Rates	Auto-Driver Trips	Auto-Driver Trip Rates
HBW	502	2.01	455	1.82
HBNW	10,373	41.49	8,228	32.91
NHB	1,479	5.91	1,177	4.71
Non-Resident Trips	1,225	4.90	976	3.90
Commercial Vehicle Trips	125	0.50	125	0.50
Total	**13,704**	**54.81**	**10,961**	**43.84**

The total trips for each special generator were estimated by multiplying the non-commercial vehicle counts with the average employee and visitor auto-driver vehicle occupancy. The trip rates for each special generator were estimated by dividing the total trips by the total employment at the site.

Waco interchange – Texas Loop 340 and State Highway 6

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

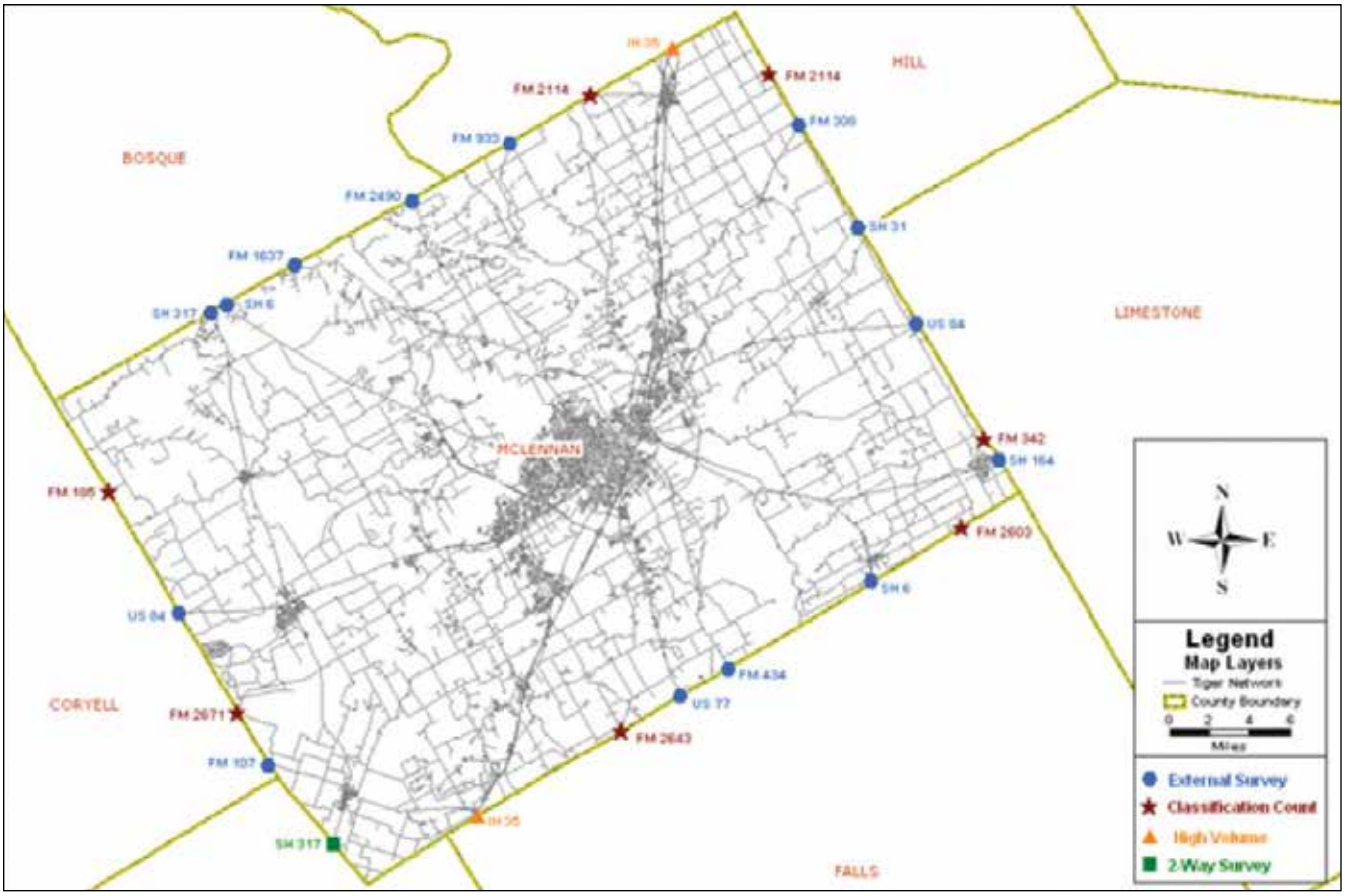
EXTERNAL SURVEY

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 the 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 trips made 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 were 24 locations on the border of the Waco study area identified as external stations. Figure 32 provides a map showing the location of the external station survey locations. The legend provides a description of the type of surveys conducted at each location (i.e., external survey, classification count, high volume, or 2-way survey). These locations are transportation facilities that cross the study area boundary and represent where travelers may enter and exit the study area. Of these 24 locations, 15 were selected for travel surveys using the roadside intercept interview method. One of the 15 survey sites bordered the Killeen/Temple study area, and as a result, this location was surveyed in both directions. In addition to the 15 survey sites, two other locations 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 these high-volume facilities.

Figure 32. Waco External Station Survey Locations.



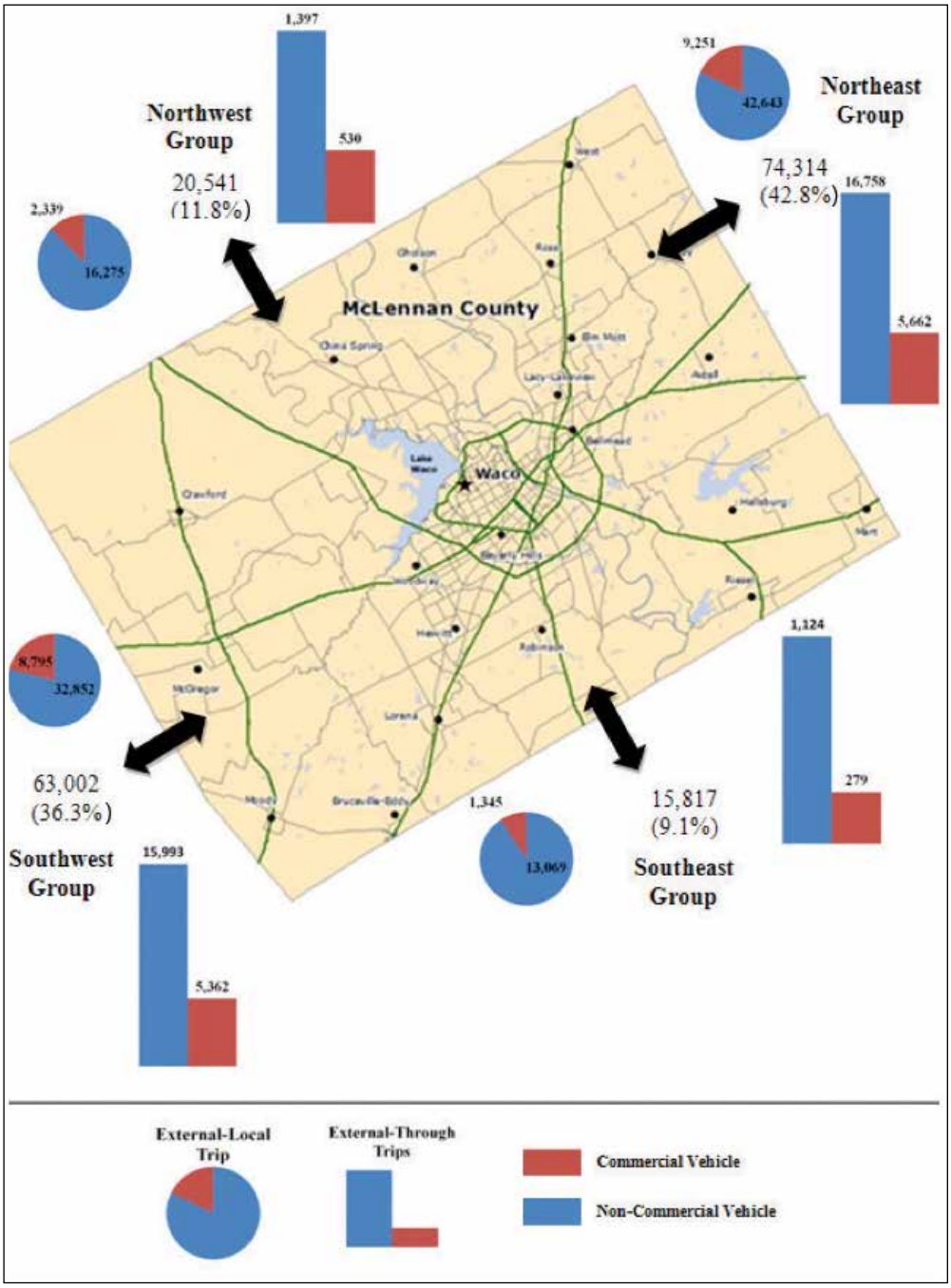
The 2006 Waco external station survey included more than 4,900 randomly selected vehicles traveling within the study area. Approximately 80 percent of the surveyed vehicles were non-commercial vehicles and 20 percent were commercial vehicles.

The estimates presented in this section are based on expanded survey data. Over 173,700 vehicles were estimated to enter or exit the Waco study area on a daily basis. Approximately 73 percent of the total daily trip movements were local trips, while the remaining 27 percent were through trips. Approximately 83 percent of the total external-local trips were made by non-commercial vehicles and the remaining 17 percent were made by commercial vehicles.

Over 173,700 vehicles were estimated to enter or exit the Waco study area on a daily basis.

Figure 33 shows 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 northwest, northeast, southwest, and southeast groups. The largest trip movements occurred in the southwest and northeast sides of the study area.

Figure 33. External-Local and External-Through Trip Movements by Location Group.



The largest external-through travel came from the southwest and northeast groups, comprising nearly 93 percent of the total external–through trips. Likewise, a majority of the external-local trips came from the southwest and northeast groups, which comprised nearly three-quarters of the total external-local trips.

The largest external-through travel came from the southwest and northeast groups, comprising nearly 93 percent of the total external-through trips.

COMMERCIAL VEHICLE SURVEY

The primary purpose of the commercial vehicle survey is to collect data on commercial vehicle trip-making that is needed to estimate total commercial vehicle travel in the Waco MPO study area. In the travel demand model, trips made by commercial vehicles are modeled separately from trips made by non-commercial or private passenger vehicles. The commercial vehicle survey is concerned with internal commercial vehicle trips, which are 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 surveys collect data on commercial cargo/freight vehicles as well as vehicles used for commercial services, such as plumbers, electricians, deliveries, and governmental fleet vehicles. 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.

In the 2008/2009 Waco Commercial Vehicle Survey, a sample of vehicles was randomly selected from motor carrier and vehicle registration databases. The establishments or agencies operating the selected vehicles were contacted and asked to participate in the survey. A total of 312 commercial vehicles participated 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 (if any) 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.

The commercial vehicle survey is concerned with internal commercial vehicle trips, which are trips made within the study area.

The number of commercial vehicles in a designated study area cannot be determined reliably from vehicle registration data due to the presence of commercial vehicles registered in other counties, and in other states. The commercial VMT observed from sampled commercial vehicles in the Waco area was expanded using VMT estimates from the Highway Performance Monitoring System (HPMS), combined with vehicle classification counts by roadway functional classification (freeway, arterial, collector, and local). Table 17 shows the estimated VMT for commercial vehicles operating in the Waco MPO study area by roadway functional classification. The total commercial VMT was 1,304,520 miles, with external commercial VMT estimated at 624,101 miles and internal commercial VMT estimated at 680,419 miles.

Table 17. Estimated VMT for Commercial Vehicles Operating in the Waco MPO Study Area by Roadway Functional Classification.

Functional Classification	Weekday VMT	Percent Commercial Vehicles	Commercial Vehicles Weekday VMT
Freeway	2,747,674	26.63	731,693
Arterial	2,760,567	15.03	414,856
Collector	1,007,029	11.88	119,667
Local	419,082	9.14	38,304
All Classifications	**6,934,352**	**18.81**	**1,304,520**

On a daily basis, approximately 17,954 commercial vehicles were estimated to be operating in the Waco study area, with each vehicle averaging 6.15 internal trips per day and 6.91 total trips per day.

On a daily basis, approximately 17,954 commercial vehicles were estimated to be operating in the Waco study area, with each vehicle averaging 6.15 internal trips per day and 6.91 total trips per day. The average distance traveled was 6.08 miles. Approximately 40.4 percent of the surveyed commercial vehicles in the study area in 2008/2009 were cargo or freight transport, with 59.6 percent being local services transport. Among the surveyed commercial vehicles, the most frequently reported types of cargo included manufactured goods and equipment (25.1 percent of trips); food, health, and beauty products (20.3 percent of trips); and clay/concrete/glass or stone (10.3 percent of trips). Over 10 percent of the surveyed commercial cargo vehicle trips were not carrying any cargo.

SUMMARY OF FINDINGS

The travel surveys conducted in the Waco study area during the period from 2006–2010 provide the household, work place, external station, and commercial vehicle 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. The population of McLennan County is forecasted to increase from 228,241 in 2007 to 281,288 by 2035, an increase of about 23.2 percent. The daily VMT is expected to increase by 33.6 percent during his 28-year period, from 7,208,192 miles in 2007 to 9,628,153 miles by 2035. With this growth, TxDOT and the Waco MPO will need to plan for new and/or improved, facilities to provide added transportation capacity during the next 20 years. Such facilities will be needed to maintain the relatively high level of mobility currently enjoyed by travelers in the Waco MPO study area.

The population of McLennan County is forecasted to increase from 228,241 in 2007 to 281,288 by 2035, an increase of about 23.2 percent.

Household Travel

Less than 1 percent of the household population that traveled used public transportation. On average, the number of vehicles available per household is 1.9 vehicles. The average household size in the study area is 2.7 persons, which is the same estimate obtained for McLennan County in 1990 but lower than the estimate of 4.4 average persons per household in 1960. The average person trip rate for all households, internal to the study area, is around 8.3 trips per household. The average person trip length is 5.8 miles, while the average person trip duration is around 8.8 minutes.

Trip purposes in the household survey were categorized as internal (HBW, HBNW, and NHB) trips. The HBW trips in the Waco MPO study area in 2006–2007 had the longest average travel distance of 7.7 miles and accounted for 17.6 percent of the total household person trips. In terms of trip purpose by destination, the return-to-home trip was the most frequent trip destination, which accounted for 35.1 percent of the total household person trips. HBNW trips accounted for 53.5 percent of the total household person trips, with an average travel distance of 5.8 miles. NHB trips accounted for around 28.9 percent of the total household person trips, with an average travel distance of 4.8 miles. Trips to work, shopping, pick-up/drop-off, and personal business made up over 40 percent of the total person trips by destination purpose.

External-local travel to and from the Waco study area is dominated by traffic coming from and going to the northeast and southwest sides of the study area.

Work Place Travel

Trip purposes to the work place were categorized to include not only internal (HBW, HBNW, and NHB) trips, but also external (EXT-O and NON-RES) trips from and to the study area. Approximately 91.7 percent of the surveyed trips to and from the work place in the Waco study area are internal trips, of which 80.4 percent were home-based and 19.6 percent are NHB. Approximately 37.3 percent of the home-based trips were HBNW and 62.7 percent were HBW. HBW person trips average 7.9 miles, and HBNW trips average 6.7 miles. NHB person trip lengths average 6.7 miles. External trips to the work place account for 8.3 percent of the total trips, of which 87.0 percent were NON-RES trips with average person trip length of about 9.0 miles. The number of EXT-D inter-zonal work place survey trips recorded in the survey totaled only three trips, of which the average person trip was 12.7 miles.

External-Local and External-Through Travel

External-local travel to and from the Waco study area is dominated by traffic coming from and going to the northeast and southwest sides of the study area. The northeast-southwest traffic accounts for 73.9 percent of the total external-local travel. Likewise, the northeast-southwest traffic accounts for 92.9 percent of the total external-through travel, while the remaining 7.1 percent of external-through travel is distributed between the northwest and the southeast side of the study area.

Commercial Vehicle Travel

The total commercial VMT for the Waco MPO study area in 2008/2009 was estimated at 1,304,520 miles, of which 624,101 miles were external commercial VMT and 680,419 miles were internal commercial VMT. On an average weekday basis, approximately 17,954 commercial vehicles were found to be operating in the study area (more than 4.5 times the 3,902 trucks registered in the study area in 2009), with each surveyed vehicle averaging 6.9 trips per day (6.15 internal trips per day). The average travel time was estimated to be 9.1 minutes per trip, with the average travel speed estimated at 37.1 mph.

Approximately 40.4 percent of the surveyed commercial vehicles were cargo or freight transport, while the remaining 59.6 percent were local services transport. Among the surveyed commercial vehicles, the most frequently reported types of cargo included manufactured goods and equipment (25.1 percent of trips); food, health, and beauty products (20.3 percent of trips); and clay/concrete/glass or stone (10.3 percent of trips). Over 10 percent of the surveyed commercial cargo vehicle trips were not carrying any cargo.

COMPARISON TO PREVIOUS SURVEY IN WACO

This section provides a comparison of data available from the 1964 Waco O-D Survey, the 1990 U.S. Census, and the 2006–2007 Waco Household Travel Survey. These comparisons can provide a glimpse of the changes that have occurred between the decades listed. Table 18 provides estimates of the population, households, and persons per household in McLennan County in 1960 and 2006–2007.

In terms of household vehicle availability, on average, more vehicles were available to households each survey and/or census year.

Table 18. Estimated Population, Households, and Persons per Household.

Geographic Area	Year	Population	Number of Households	Persons per Household
McLennan County	1960	150,091	33,864	4.4
McLennan County	2006-2007	228,241	83,995	2.7

In comparing household size in 1990 and 2007–2008, it is evident that the percentage of households with four and five-plus persons per household decreased and the percentage of one-person households decreased by 50 percent. However, despite these individual household size changes, as was mentioned previously, the average persons per household for 1990 and 2007–2008 is the same, with 2.7 persons per household.

In terms of household vehicle availability, on average, more vehicles were available to households each survey and/or census year. This trend points to rising household incomes. The number of households with no vehicles available decreased by 50 percent between 1960 and 1990, but remained the same between 1990 and 2006.

The VMT in McLennan County has increased drastically over the past half century. Table 19 shows the vehicle trip VMT comparisons for McLennan County in 1964, 1985(Forecast), and 2006–2007.

Table 19. Vehicle Trip VMT Comparisons for McLennan County.

Survey Indicator	1964	1985 (Forecast)	2006-2007
Study Area Coverage	McLennan County	McLennan County	McLennan County
Total Internal VMT	288,270	633,667	4,490,426

Changes over time in number of households, household size, household income, and vehicle availability provide the need for periodically updating travel surveys for aid in the travel demand forecasting process.

COMPARISON TO OTHER AREAS

Table 20 shows a comparison of the household survey summary data for McLennan County to Lubbock County, Potter and Randall Counties, and Cameron and Hidalgo Counties.

Table 20. Comparative Household Survey Data for McLennan County, Lubbock County, Potter and Randall Counties, and Cameron and Hidalgo Counties.

Urban Area	Lubbock County	McLennan County	Potter and Randall Counties	Cameron and Hidalgo Counties
Demographics				
Household Population	261,608	228,241	233,533	1,030,139
Licensed Drivers	185,436	151,191	164,001	585,035
Number of Households	97,598	83,995	88,507	294,825
Average Household Size	2.76	2.72	2.64	3.49
Number of Motor Vehicles	186,412	158,805	178,784	555,443
Motor Vehicles per Household	1.91	1.89	2.02	1.88
Number of Daily Trips by Mode				
Total Person Trips	950,628	712,766	830,583	3,583,480
Automobile-Driver Trips	628,352	450,637	523,635	2,023,295
Motor Vehicle Passenger Trips	268,711	223,990	265,544	1,243,681
School Bus Trips	4,957	3,201	7,872	188,781
Walk Trips	14,964	16,627	11,563	93,337
Public Transit Trips	4,957	3,201	7,872	9,889
Bicycle Trips	1,829	4,781	2,002	6,571
Commercial Vehicle Trips*	111,129	111,659	81,403	83,600
Other Modes/Taxi	2,907	NA	1,873	3,709
Number of Daily Trips by Destination/Purpose				
Trips to Home	328,343	254,084	300,993	1,322,199
Trips to Work	111,325	80,919	86,938	353,105
Trips Work Related	43,807	21,604	25,302	109,126
Trips to Shop	94,199	74,105	95,421	333,674
Trips to Pick-Up/Drop Off Passenger	82,822	65,744	77,014	410,936
Trips for Personal Business	73,200	59,229	73,011	228,654
Trips for Social/Recreation	82,872	69,543	68,556	276,680
Trips for School K-12	45,823	35,467	46,973	292,203
Trips for School Post Secondary	17,321	5,739	4,897	46,762
Trips for Meal/Eat	57,574	40,757	46,049	171,603
Trips to Change Mode	6,083	4,038	2,836	24,622
Other Trips	7,261	1,537	2,590	3,596
Daily Trip Rates				
Person Trips per Person	3.8	3.16	3.62	3.48
Person Trips per Household	9.7	8.48	9.38	12.15
Trip Lengths and Durations				
Average Person Trip Length in Miles	5.9	5.8	4.7	6.5
Average Vehicle Trip Length in Miles	6.1	6.3	5.0	7.0
Average Person Trip Duration in Minutes	4.7	8.8	5.9	9.2
Average Vehicle Trip Duration in Minutes	5.0	9.4	6.1	9.8
Vehicle Miles of Travel (VMT)				
VMT per Capita	NA	31.6	11.4	13.8

*Value taken from commercial vehicle reports.

GLOSSARY AND TERMINOLOGY

Within the context of travel surveys there are a number of terms used that may cause confusion. These terms are defined as follows.

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

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

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

Home Based Non Work (HBNW) Trip: A trip which that 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.

Home-Based Work (HBW) Trip: A trip which that 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.

Linked Trips: Trips are linked (i.e., combined) into a single trip that reflects what is perceived to be the true purpose of the trip. Only trips that involve a serve passenger or change mode of travel between home and work (or vice versa) are considered for linking. For example, a person driving a child to a day care center (or school) and then proceeding on to work would have made two unlinked trips, an HBNW trip and an NHB trip. These two trips would be "linked" to create one trip, a HBW trip.

Mode of Travel: 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.

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

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

Person Trip: The movement of an individual from one location to another location. In the 2007-–2008 Waco MPO Household Travel Survey, these trips were recorded for persons five years of age or older in a surveyed household.

Trip Activity: 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.

Trip 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.

Trip 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.

Trip Purpose: 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.

Vehicle Availability: The vehicles available to members of a household for travel.

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

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

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