TEXAS DEPARTMENT OF TRANSPORTATION

EXECUTIVE SUMMARY

2004 • 2005 • 2006

Rio Grande Valley Regional Study Area Travel Surveys

Cameron and Hidalgo Counties

DISCLAIMER

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ACKNOWLEDGEMENTS

This report provides a summary of the travel surveys conducted in Cameron and Hidalgo counties in 2004-2006. Details of these surveys are provided in the following separate technical reports, which are available for viewing through the City of Brownsville Metropolitan Planning Organization, Hidalgo County Metropolitan Planning Organization, Harlingen/San Benito Metropolitan Planning Organization, and the Texas Department of Transportation, Transportation Planning and Programming Division.

- 2005 Rio Grande Valley Travel Time and Delay Survey Technical Summary, authored by Mark Ojah, Timothy L. Forrest, and Stephen P. Farnsworth, Texas Transportation Institute, July 2006.

- 2004 Rio Grande Valley External Survey, Technical Summary, authored by Timothy L. Forrest and David F. Pearson, Texas Transportation Institute, October 2008.

- 2005 Rio Grande Valley Commercial Vehicle Survey Technical Summary, authored by Stephen P. Farnsworth, Jason Beesinger, and David F. Pearson, Texas Transportation Institute, November 2007.

- 2004-2005 Rio Grande Valley Regional Household Travel Survey, Cameron and Hidalgo Counties, Technical Summary, authored by George B. Dresser and David F. Pearson, Texas Transportation Survey, November 2007.

- 2005-2006 Rio Grande Valley Work Place Travel Survey Technical Summary, David F. Pearson, Texas Transportation Survey, November 2007.

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 author is responsible for the opinions, findings, and conclusions.

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The contributions of Charlie Hall, the Texas Department of Transportation project director for this study and the Department's continuing program for the timely collection and analysis of urban travel data are significant and appreciated.

Cover Photo – Harlingen, Texas: Jim Lyle/TTI

2004 • 2005 • 2006

Rio Grande Valley Regional Study Area Travel Surveys

Executive Summary

Sponsored by the Texas Department of Transportation (TxDOT) and the U.S. Department of Transportation Federal Highway Administration (FHWA)

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Valley Baptist Medical Center, Brownsville

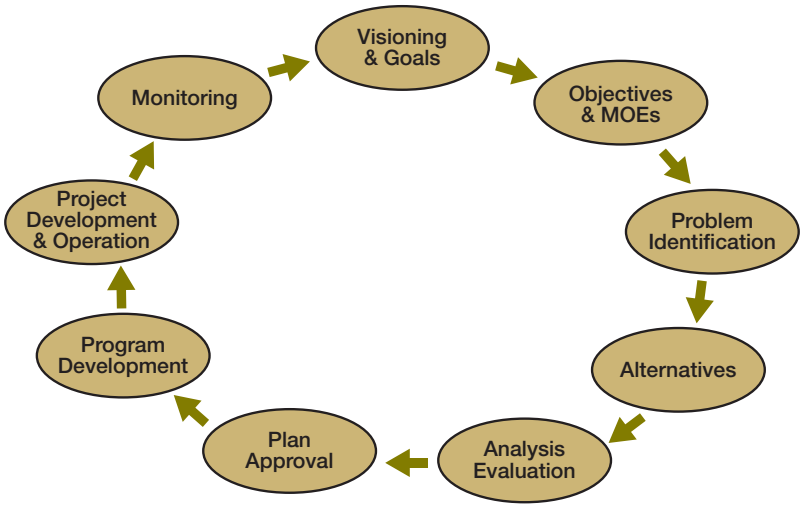
INTRODUCTION

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 the MPO. Figure 1 shows the key elements of the metropolitan transportation planning process.

Where do travel surveys fit in this process? The analysis and evaluation step can, and does, take many forms. One form used by most MPOs is the travel demand model. The travel demand model is used to evaluate how proposed alternative transportation systems, the forecast transportation capacity, and the forecast demand for transportation—the movement of people and goods —will perform. This analysis is used to support the development of their long-range transportation plan and short-range transportation improvement program and adoption by the 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 three years for metropolitan areas that are not in attainment of the NAAQS.

The travel demand model is used to evaluate how proposed alternative transportation systems, the forecast transportation capacity, and the forecast demand for transportation—the movement of people and goods—will perform.

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.

Travel surveys are required to support travel demand model estimation, calibration, and validation for the model's base year. For the Rio Grande Valley Study Area, the travel model base year is 2004-2005, the year the household travel surveys were performed. 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.

Jim Lyle/TTI

Trip generators include fast food establishments

RIO GRANDE VALLEY AREA— CAMERON AND HIDALGO COUNTIES

In this section, selected demographic and transportation statistics are presented to provide a frame of reference for the Rio Grande Valley as compared to the state of Texas. Cameron and Hidalgo Counties are forecast to grow faster than the rate of growth for Texas as a whole. Cameron and Hidalgo Counties are forecast to add over 780,415 persons, or about 79 percent, to its population between 2005 and 2030. Excellent transportation planning and analysis tools will be needed to plan for and to provide the additional transportation facilities that will be needed to accommodate this growth and maintain the excellent 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.

Cameron and Hidalgo Counties are forecast to grow faster than the rate of growth for Texas as a whole.

DEMOGRAPHIC STATISTICS

The Rio Grande Valley area has been growing at a rate that is about one and a half times faster than the growth rate for all of Texas, and this trend is forecast to continue (Table 1).

Table 1. Cameron County, Hidalgo County, and Texas Population Estimates, Population Projections, and Percent Annual Growth Rate: 1960 - 2030

Year	Cameron County Population	Percent Annual Growth Rate	Hidalgo County Population	Percent Annual Growth Rate	Combined Cameron and Hidalgo Counties Population	Percent Annual Growth Rate	Texas Population	Percent Annual Growth Rate
1960	151,098	NA	180,904	NA	332,002	NA	9,579,677	NA
1970	140,368	-0.73	181,535	0.03	321,903	-0.31	11,196,730	1.57
1980	209,727	4.10	283,229	4.55	492,956	4.35	14,229,191	2.43
1990	260,120	2.18	383,545	3.08	643,665	2.70	16,986,510	1.79
2000	335,227	2.57	569,463	4.03	904,690	3.46	20,851,820	2.07
2005	335,227	2.24	657,116	2.90	992,343	1.87	22,556,027	1.58
Population Projections								
2010	415,304	2.09	750,714	2.70	1,166,018	3.28	24,330,643	1.69
2020	499,380	1.86	956,485	2.45	1,455,865	2.24	28,005,792	1.42
2030	587,063	1.63	1,185,695	2.17	1,772,758	1.99	31,830,579	1.28

NA-not available.

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

TRANSPORTATION STATISTICS

The amount of travel in some Texas cities is increasing faster than the amount of capacity (lane-miles) being added to the roadway system, and, as a result, annual delay per peak-period traveler is showing a steady increase as indicated in the city of Brownsville data (Table 2). However, in 2005, compared to those in other urban areas, the travelers in the city of Brownsville enjoyed greater personal vehicle mobility (8 hours vs. 11 hours) (Figure 2).

In 2005, compared to those in other urban areas, the travelers in the city of Brownsville enjoyed greater personal vehicle mobility (8 hours vs. 11 hours).

Table 2. City of Brownsville Mobility Data: 1990-2007

Year	Population (1,000)	Daily VMT (1,000)	Daily VMT per Person	Peak-Period Travelers (1,000)	Annual Delay per Peak Period Traveler (Person Hours)
1990	105	1,415	13.5	46	3
1991	110	1,480	13.5	49	3
1992	115	1,540	13.4	52	3
1993	120	1,600	13.3	56	3
1994	125	1,660	13.3	59	4
1995	130	1,725	13.3	62	4
1996	135	1,735	12.9	65	4
1997	145	1,750	12.1	71	5
1998	145	1,840	12.7	73	5
1999	150	1,870	12.5	76	6
2000	155	1,890	12.2	80	6
2001	160	2,100	13.1	84	7
2002	160	2,400	15.0	85	7
2003	160	2,430	15.2	86	7
2004	165	2,465	15.0	89	8
2005	165	2,365	14.3	90	8
2006	169	2,500	14.8	*	*
2007	173	2,630	15.2	*	*

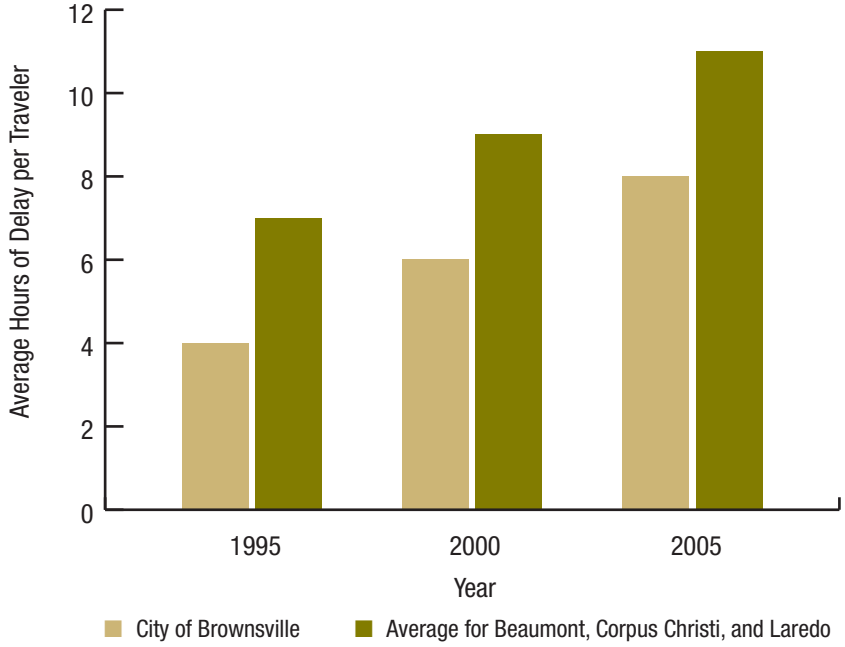
* Unavailable data.

Source: Texas Transportation Institute, Urban Mobility Study, available at http://mobility.tamu.edu/.

Persons commuting to work in the Rio Grande Valley area primarily drive alone or use carpools (Table 3). There is limited use of public transportation. Part of the reason for the modest use of public transportation is that the percentage of households with a vehicle available in the Rio Grande Valley area is high, and the percentage of households with no vehicle available is low (Figure 6).

Persons commuting to work in the Rio Grande Valley area primarily drive alone or use carpools.

Figure 2. Growth in Average Annual Hours of Delay per Peak Traveler



Source: Texas Transportation Institute, Urban Mobility Report, available at http://mobility.tamu.edu.

Table 3. Combined Cameron and Hidalgo Counties Commuting to Work Data in 1990 and 2000 (Percent)

	Commute Mode					
	Drive Alone	Carpool	Public Transportation	Walk	Other	Work at Home
Cameron and Hidalgo Counties, 1990	71.1	21.0	0.5	2.7	1.9	2.8
Texas, 1990	76.5	14.9	2.2	2.7	1.3	2.4
Cameron and Hidalgo Counties, 2000	73.4	19.3	0.5	2.1	2.4	2.3
Texas, 2000	77.6	14.5	1.9	1.9	1.3	2.8

Source: U.S. Census Bureau.

The daily VMT per person in the Rio Grande Valley area is increasing at a small but steady rate over time.

The daily VMT per person in the Rio Grande Valley area is increasing at a small but steady rate over time (Table 4). The product of the projected population and the daily vehicle miles of travel per person will provide a reasonable projection of future VMT. Table 4 shows a projection for the years 2010 to 2030. Daily VMT is projected to increase by about 44 percent from 2005 to 2030.

The information provided in the tables and figures demonstrates the importance of long-range transportation planning for the Rio Grande Valley area. To facilitate this long-range planning, in 2004-2005 TxDOT's Transportation Planning and Programming Division, in cooperation with the City of Brownsville Metropolitan Planning Organization, the Harlingen/San Benito Metropolitan Planning Organization, and the Hidalgo County Metropolitan Planning Organization conducted a comprehensive survey of transportation demand in the Rio Grande Valley Study Area. This report provides a summary of this survey.

Table 4. Cameron and Hidalgo Counties Population, Daily VMT, and Daily VMT per Person

	Cameron and Hidalgo Counties Population	Cameron and Hidalgo Counties Daily VMT	Cameron and Hidalgo Counties Daily VMT Per Person
1990	643,665	10,853,413	16.9
1995	781,048	13,209,404	16.9
2000	904,690	16,842,873	18.6
2001	935,704	17,321,756	19.0
2002	947,683	17,963,113	19.0
2003	990,968	18,630,526	19.7
2004	1,015,969	19,516,821	19.2
2005	1,044,990	19,523,887	18.7
Projections			
2010	1,166,018	22,729,302	19.5
2020	1,455,865	28,759,531	19.8
2030	1,772,758	35,044,703	19.8

*** Unavailable data.**

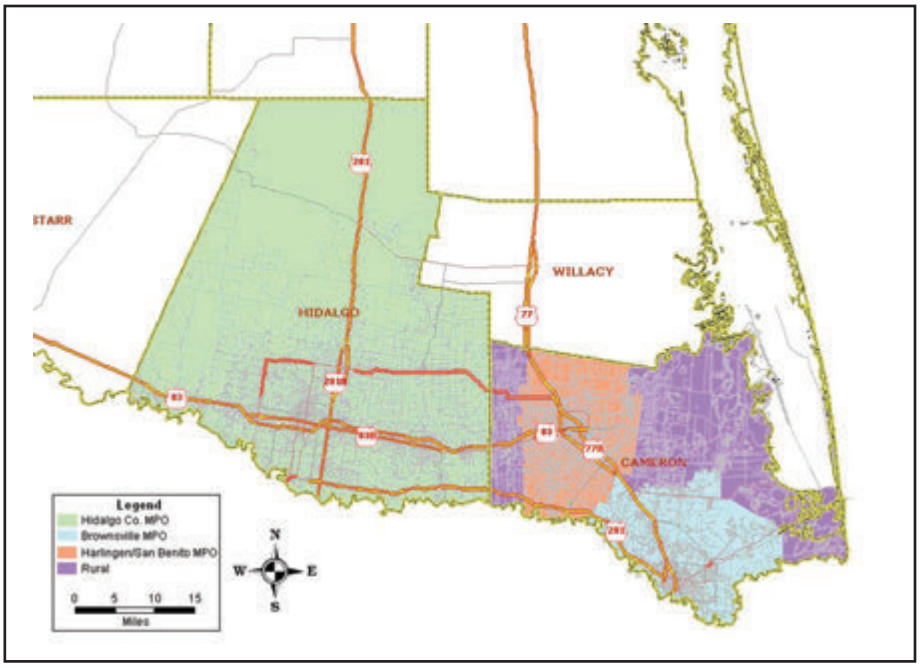
Source: U.S. Census Bureau, Texas State Data Center, Texas Department of Transporation, and TTI.

TRAVEL WITHIN THE REGION

The summary data from the travel surveys in this section and the following sections are for the Rio Grande Valley (Cameron and Hidalgo Counties) Study Area (Figure 3) unless otherwise noted.

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). This section will discuss internal trips.

Figure 3. Rio Grande Valley Study Area



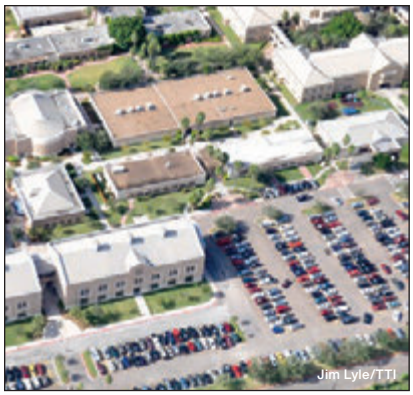
Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Valley Baptist Medical Center, Harlingen

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 SURVEY

The primary purpose of the household survey is to understand the trip-making patterns of households as a function of the household characteristics such as household size, number of workers, household income, vehicle availability, and trip purpose. These data are used in the trip generation step of the travel demand model to estimate trip production rates by trip purpose. A second product of the household survey is estimates of the average trip lengths and the trip length frequency distribution for each trip purpose. The average trip length and trip length frequency distribution estimates and 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 University of Texas (UT)-Brownsville campus

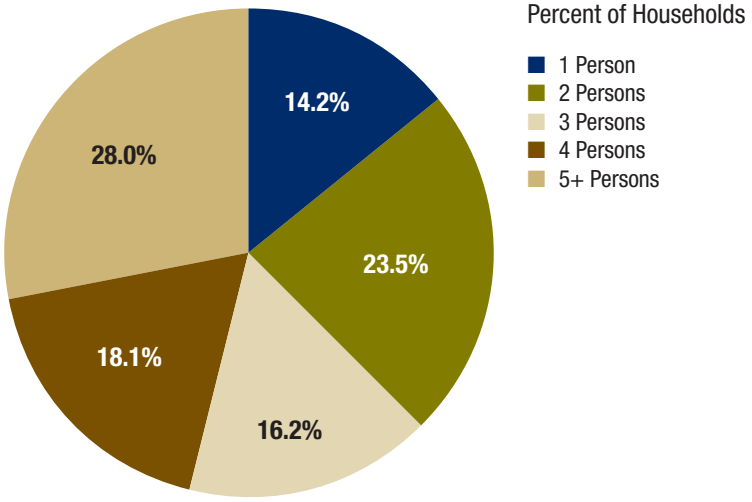
In general, as household size increases, daily household travel increases, and as household income increases, daily household travel increases.

HOUSEHOLD CHARACTERISTICS

Households were selected at random throughout the Rio Grande Valley Study Area, and those households that agreed to participate were asked to record in a diary the travel made by each person 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 household members employed, household income, and the number of vehicles available to the household. The household survey consisted of 2,607 usable surveys.

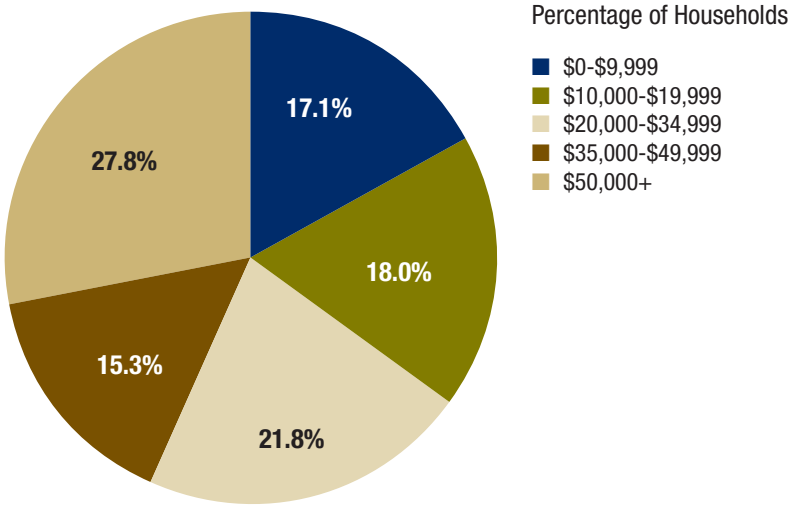
The household characteristics of household size and household income are used in the travel demand model for estimating and forecasting travel demand (Figures 4 and 5). The joint distribution of these two household characteristics from the 2000 decennial Census was projected to 2005 using the estimated population growth from 2000 to 2005, and this distribution was used to expand/weight the household survey data (Table 5). In general, as household size increases, daily household travel increases, and as household income increases, daily household travel increases. By controlling for these two household characteristics, future travel demand can be estimated with greater accuracy.

Figure 4. Rio Grande Valley 2004-2005 Distribution of Households by Household Size



Source: U.S. Census Bureau and 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Figure 5. Rio Grande Valley 2004-2005 Distribution of Households by Household Income



Source: U.S. Census Bureau and 2004-2005 Rio Grande Valley Regional Household Travel Survey.

In general, as the number of vehicles available to the household increases, daily household travel increases.

In addition to household size and income, the household survey asked several other questions that provide interesting perspectives about the characteristics of Cameron and Hidalgo county households. Some of these household characteristics may be used in the future to improve the forecasting ability of the travel demand model.

Table 5. Rio Grande Valley 2004-2005 Percent Distribution of Households by Size and Income

Household Income (In 2005 $)	Household Size				
	1	2	3	4	5+
$0 to $9,999	2.8	4.6	4.7	3.8	4.6
$10,000 to $19,999	2.2	4.2	2.6	4.0	5.1
$20,000 to $34,999	1.9	5.1	3.0	4.2	5.4
$35,000 to $49,999	1.6	4.3	2.8	4.5	4.6
$50,000+	1.7	7.7	4.4	5.7	5.0

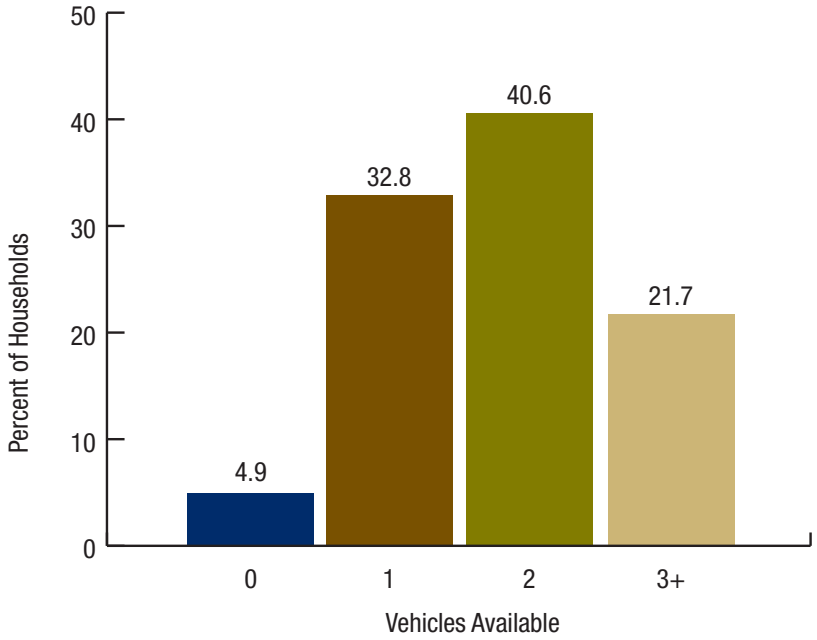
Source: U.S. Census Bureau and 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Vehicles Available

In general, as the number of vehicles available to the household increases, daily household travel increases. This household characteristic also impacts estimating and forecasting the demand for public transportation. Figure 6 shows the 2004-2005 distribution of households by the number of vehicles available to the household. The 2004-2005 distribution shows a decline in the number of households with no vehicle available compared to the distribution from the 2000 Census (Figure 7). The increasing number of vehicles available per household and the decrease in the number of households without a vehicle imply increased daily travel per household and a decline in the demand for public transportation.

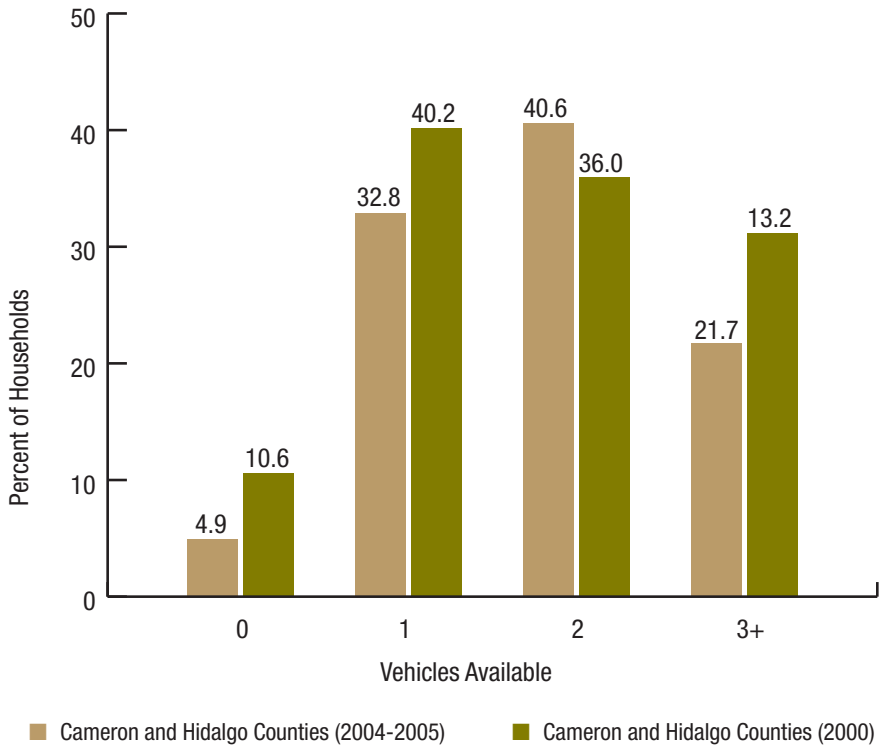
The increasing number of vehicles available per household and the decrease in the number of households without a vehicle imply increased daily travel per household and a decline in the demand for public transportation.

Figure 6. Distribution of Households by Vehicles Available



Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Figure 7. Household Vehicle Availability—Combined Cameron and Hidalgo Counties and Texas, 2000



Source: U.S. Census Bureau 2000 Census and 2004-2005 Rio Grande Valley Regional Household Travel Survey.

In general, as the number of persons employed in the household increases, daily household travel increases.

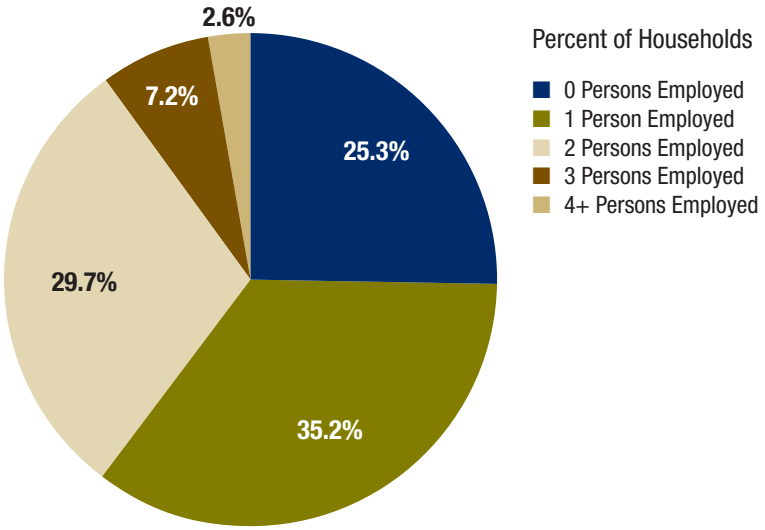
Morningside Park, Brownsville surrounded by residential area

Employment can also be used to characterize the household life cycle.

Distribution of Households by Number of Persons Employed

In general, as the number of persons employed in the household increases, daily household travel increases. Employment can also be used to characterize the household life cycle. Figure 8 shows the distribution of households by number of persons employed.

Figure 8. Distribution of Households by Number of Persons Employed



Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

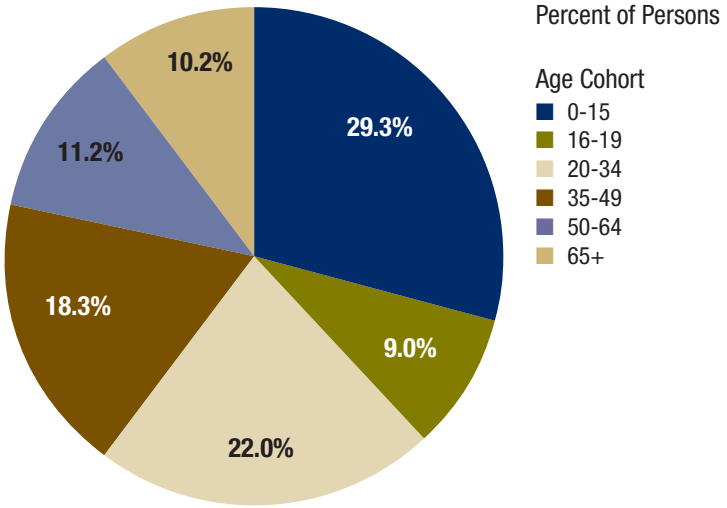
UT-Brownsville campus

Distribution of Persons by Age Cohort

The impact of the age of household members on daily household travel is more complex than the other household characteristics shown and is not currently used directly in the travel demand model. The distribution of persons by age cohort (Figure 9) can be used to characterize household life cycle. Figure 9 shows that almost 30 percent of persons residing in the Cameron and Hidalgo county area are children and teens under 16 years old. Over 21 percent of the persons living in these counties are 50 years of age or older.

The impact of the age of household members on daily household travel is more complex than the other household characteristics shown and is not currently used directly in the travel demand model.

Figure 9. Distribution of Persons by Age Cohort



Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Harlingen grocery store in a strip mall

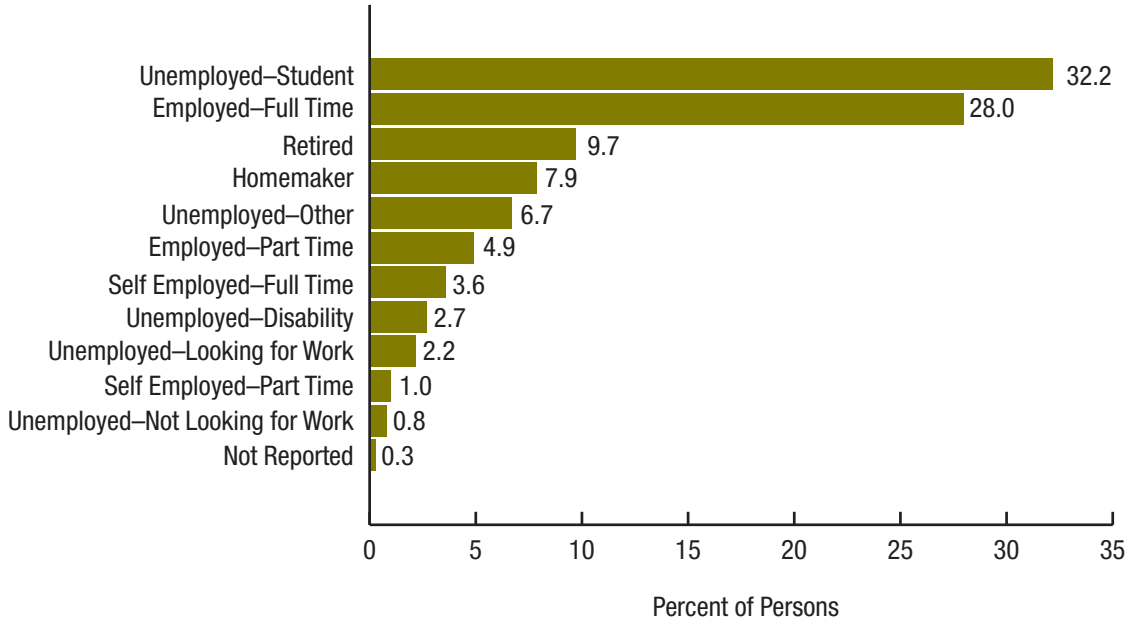
Life cycle can be an excellent household characteristic to help forecast future travel demand.

Distribution of Persons by Employment Status

Employment status is used to characterize household life cycle. Figure 10 indicates the distribution of persons regardless of age by employment status in the Rio Grande Valley.

A household life cycle variable is used in some travel demand models. Life cycle can be defined in different ways. One way to define life cycle is to use a combination of the age of the head of household and the ages of the children in the household, if any. As an example, the travel demand model for the city of Detroit divided households into five categories as a function of the age of the head of the household and whether the household had children of preschool age, children of school age, or no children. Life cycle recognizes that a young couple of working age with no children will have different daily trip-making characteristics than a retired couple with no children at home. Life cycle can be an excellent household characteristic to help forecast future travel demand. The data to characterize households by life cycle are available from the household survey and for future enhancements to the travel demand model.

Figure 10. Distribution of Persons by Employment Status



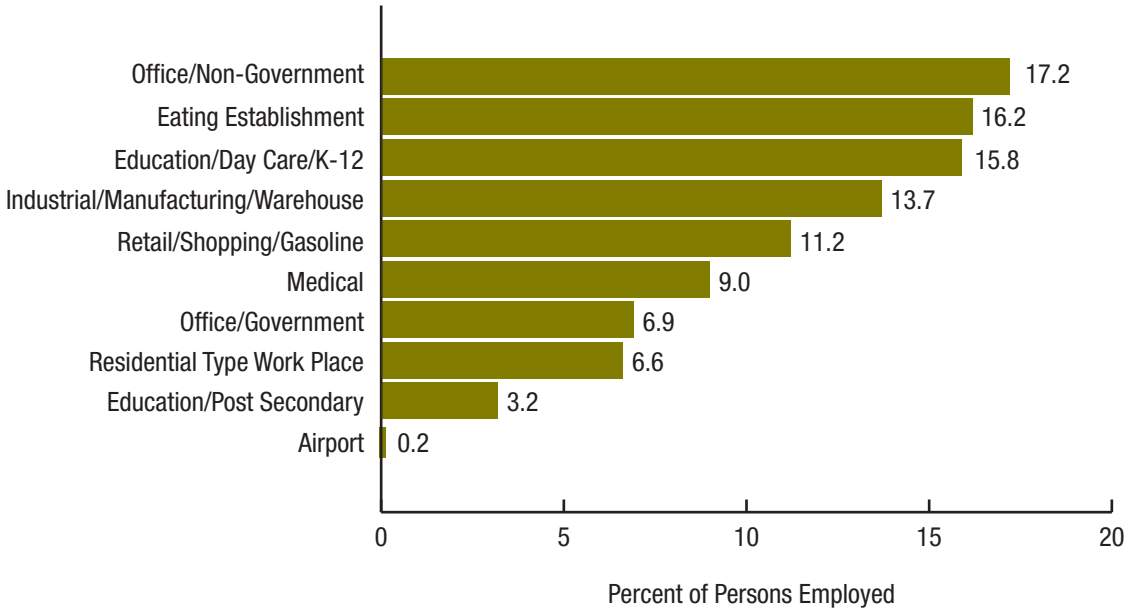
Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Distribution of Employed Persons by Type of Work Place

The household characteristics described above 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. The data on the type of work place for employed persons from the household survey were initially summarized by the types of work places (Figure 11) and then summarized into the basic, retail, service, and education work place types used by the travel demand model (Figure 12).

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

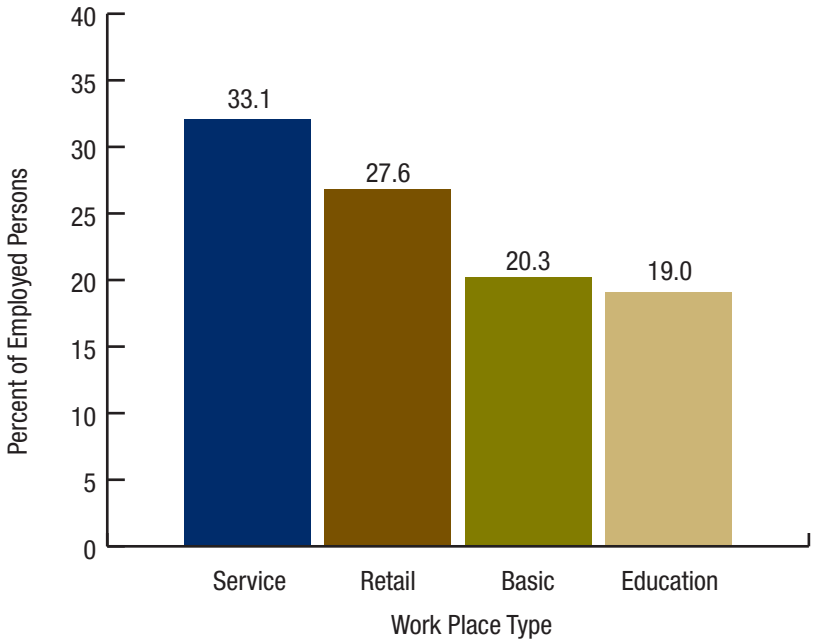
Figure 11. Distribution of Employed Persons by Type of Work Place



Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Life cycle recognizes that a young couple of working age with no children will have different daily trip-making characteristics than a retired couple with no children at home.

Figure 12. Distribution of Employed Persons by Service, Retail, Basic Employment, and Education



Source: TTI analysis from 2004-2005 Cameron and Hidalgo Counties, Texas Household Travel Survey.

Rio Grande Valley Premium Outlets off East Expressway 83, Mercedes

Bill Pate Stadium, Hidalgo

HOUSEHOLD TRAVEL CHARACTERISTICS

The primary purpose of the household survey is to understand the trip-making characteristics of households as a function of the household characteristics such as household size, number of workers, household income, vehicle availability, and trip purpose. Trip purposes are defined as home-based work (HBW) trips, (one end of the trip at home and one end at work), home-based non-work (HBNW) trips (one end of the trip at home and one end not at home and not at work), and non-home based (NHB) trips (neither end of the trip at home). Trips are divided into these purposes to account for the different trip length characteristics of each purpose. HBW trips have the longest average trip length, and HBNW trips have the shortest average trip length. For travel demand model application, the HBNW trip purpose may be further divided among trips to school, trips to shop, etc. The household travel survey accounts for person trips that include walk, bicycle, and motorized vehicle trips. Trips made by an individual driving a motorized vehicle are also summarized with person trips. The figures in this section show trips by trip purpose and by person or vehicle driver trips.

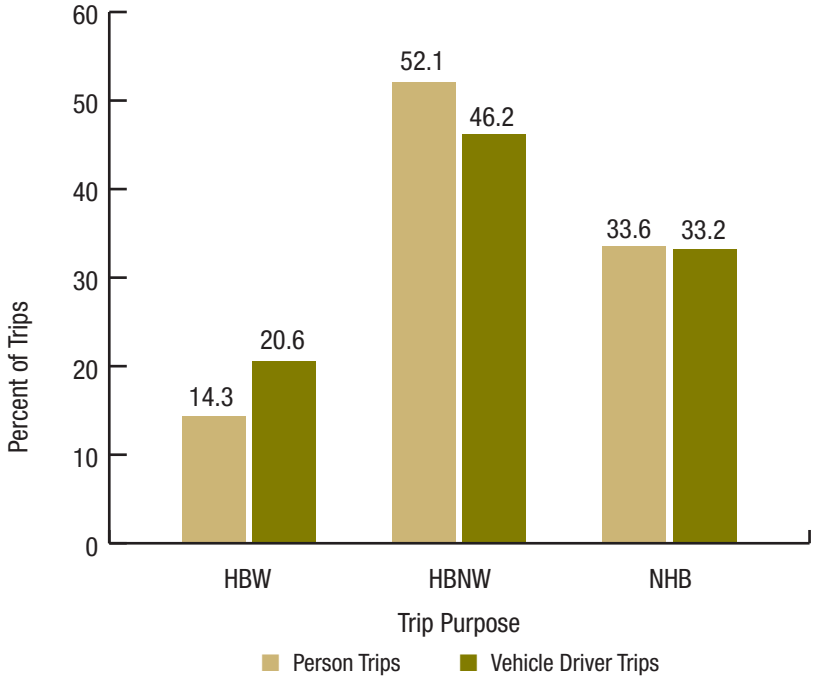
The household travel survey accounts for person trips that include walk, bicycle, and vehicle trips.

Harlingen Soccer Complex

TRIP PRODUCTIONS

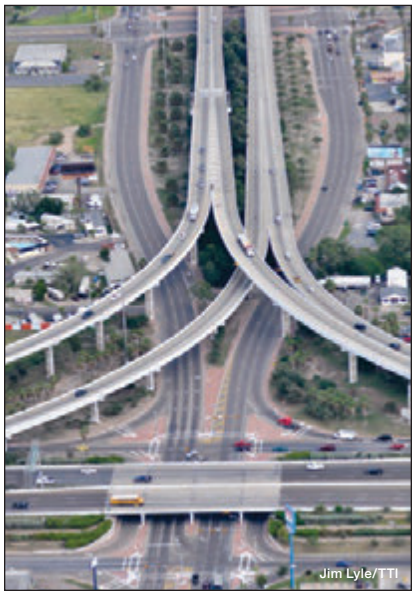
Trip ends are divided between productions, the home end of the trip, and trip attractions, the non-home end of the trip. If neither end of the trip is at home (NHB), the production end of the trip is defined as the origin end of the trip. These distinctions are important as the number of trip productions 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 type of employment. For the Rio Grande Valley Study Area, home-based non-work trips account for about half of all household trip making (Figure 13).

Figure 13. Distribution of Trip Productions by Trip Purpose



Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

S. Tower Road at Miltary Highway (US 281).



US 83, Harlingen

For the Rio Grande Valley Study Area, home-based non-work trips account for about half of all household trip making.

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 10 shows the person trip production rates for all trip purposes. For the application of the travel demand model, trip production rates are applied separately for each of the internal trip purposes.

The following example illustrates how these rates are used to forecast travel demand. The travel demand model assumes that trip production rates do not change over time. Therefore, trip production rates obtained from the 2005 household survey are the trip production rates used to forecast travel for 2025. However, the number of households and the characteristics of these households with respect to household size and household income do change over time. The number of households and their characteristics are forecast for 2025 for the entire study area and for small geographic divisions of the study area. Each small geographic area is called a traffic analysis zone (TAZ). For each TAZ, the number of households in each household size by income range cell is multiplied by the trip production rate for that cell to estimate the total number of daily person trips made by the households in the zone. Table 6 shows the person trip rates for all trip purposes. Table 7 shows an example calculation for households with four persons and a household income range of $20,000-$34,999 per year for a TAZ that had 98 households of this size and income in 2003 and 147 in the forecast year of 2025.

Table 6. Person Trip Production Rates for All Trip Purposes Combined

Household Income Range (In 2005 $)	Person Trips per Household				
	Household Size				
	1	2	3	4	5 +
$0 to $9,999	2.65	3.91	9.10	12.07	18.11
$10,000 to $19,999	3.03	5.51	9.61	13.06	18.26
$20,000 to $34,999	4.37	5.49	10.62	13.72	21.10
$35,000 to $49,999	3.36	5.72	12.80	16.87	21.84
$50,000+	4.24	6.42	12.54	15.75	23.68

Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Table 7. Example Estimation of Trip Productions

Year	Trip Rate (Trips per Household)	Number of Households	Trip Productions
2003	19.35	98	1,896
2025	19.35	147	2,844

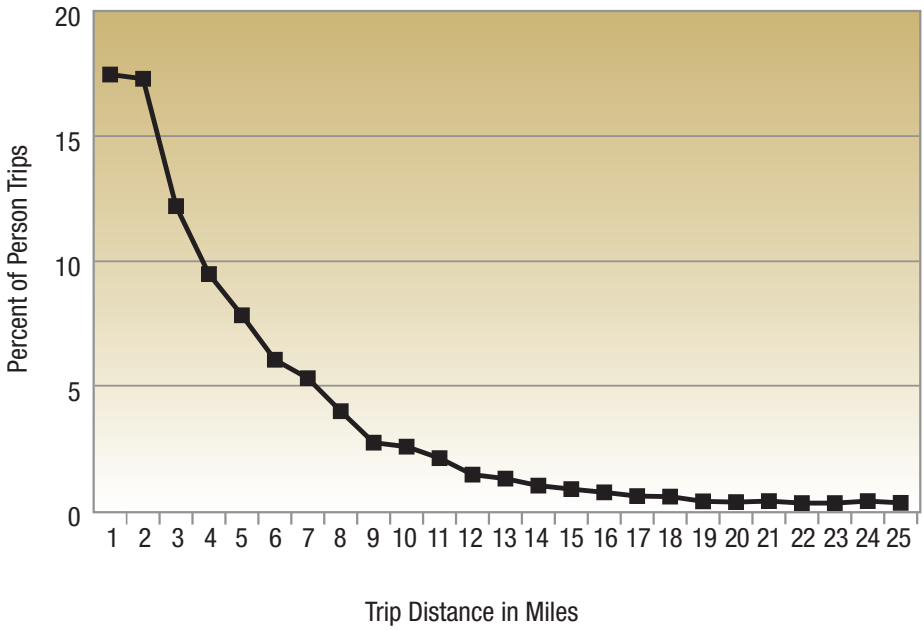
Source: TTI analysis.

Trip Lengths

Trip lengths vary by trip-purpose with the home-to-work trip purpose having the longest average trip length. The average trip lengths and the trip length frequency distributions by trip purpose are estimated from the household survey. The surveyed average trip lengths and the trip length frequency distributions are used to calibrate the trip distribution step of the travel demand model. The trip distribution model is calibrated so that the modeled average trip length and trip length frequency distributions by trip purpose agree with the average trip length and trip length frequency distributions estimated from the travel surveys. Over time, as an urban area grows larger in area, the average trip length for the HBW trip purpose tends to increase 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 will provide new attraction opportunities, new retail, and new schools as the urban area grows. Figure 14 shows the trip length distributions in miles for all internal trip purposes combined, and Figure 15 shows the trip length distributions in minutes for all internal trip purposes combined. Most trips were relatively short in terms of distance and duration. The average person trip was 6.5 miles in length and 9.2 minutes in duration.

Over time, as an urban area grows larger in area, the average trip length for the HBW trip purpose tends to increase and the average trip length for the HBNW trip purpose tends to remain stable.

Figure 14. Distribution of Person Trips by Length in Miles



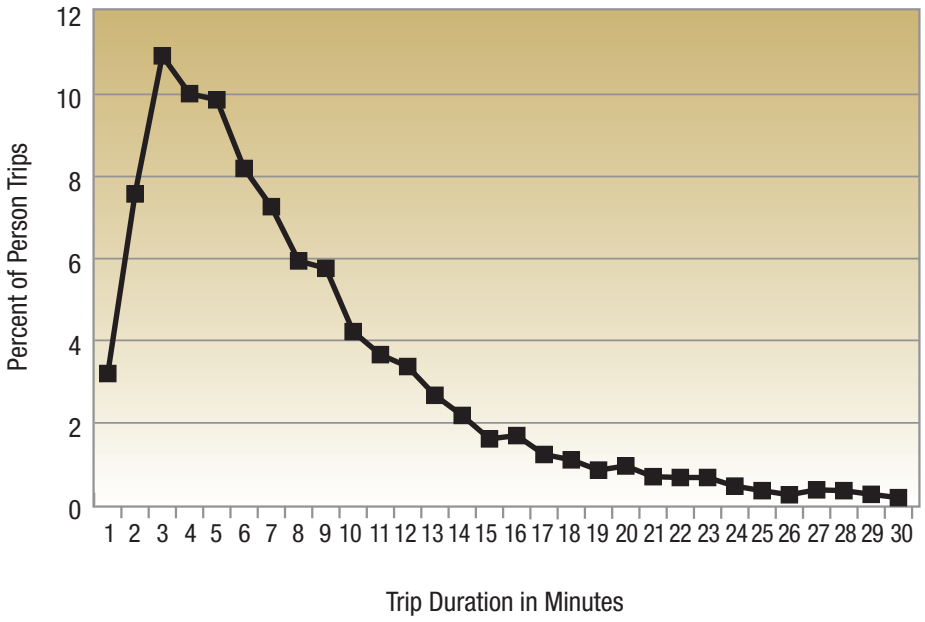
Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey

Most trips were relatively short in terms of distance and duration. The average person trip was 6.5 miles in length and 9.2 minutes in duration.

Trip Purpose

Household members travel for a purpose. This may be to go to work, to go to school, to shop, to eat a meal, to visit a doctor, etc. As discussed previously, for purposes of forecasting future travel, these trips are grouped into three primary purposes—HBW, HBNW, and NHB. For each of these trip purposes, trip rates and trip length frequencies in miles and in minutes are estimated from the household survey. Figure 16 shows the distribution of trip destinations for all trip purposes combined. As would be expected, trips to return home are the most common trip destination. Table 8 shows the average trip length by trip purpose, and Figure 17 shows the trip length frequency distributions estimated from the household survey. The data in Table 8 and Figure 17 are presented for information purposes only.

Figure 15. Distribution of Person Trips by Duration in Minutes



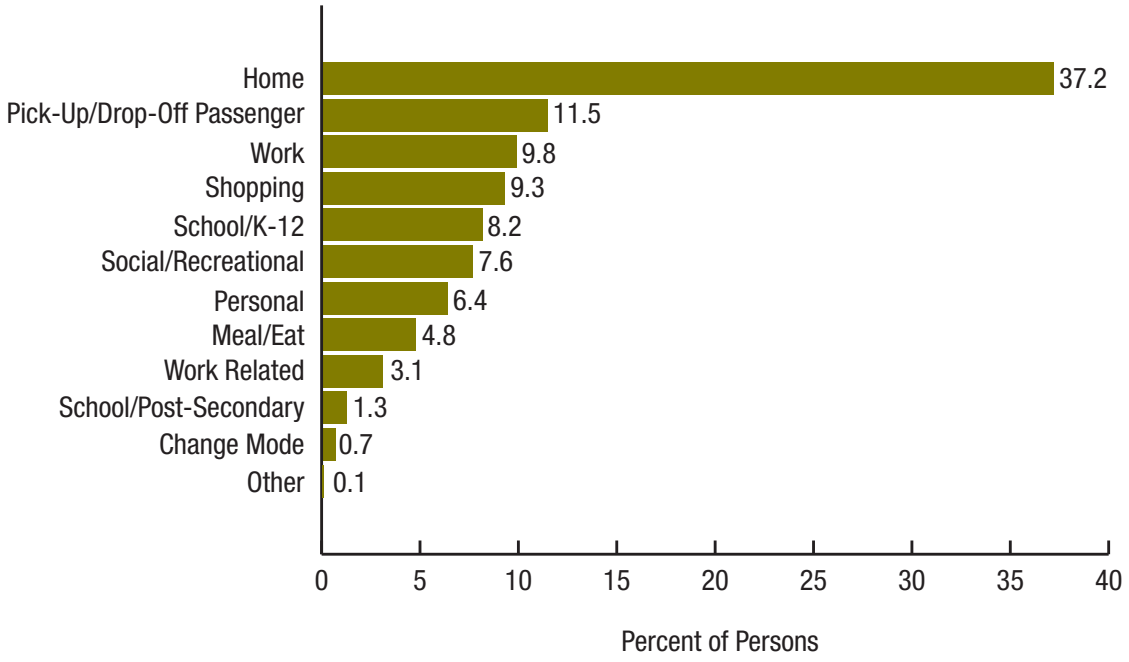
Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Table 8. Combined Average Trip Length by Trip Purpose

Trip Purpose/ Type	Person Trips		Vehicle Trips	
	Observations	Miles	Observations	Miles
HBW	4,858	8.8	4,323	9.0
HBNW	16,398	5.7	7,715	5.8
NHB Destinations	7,005	5.5	4,354	5.9

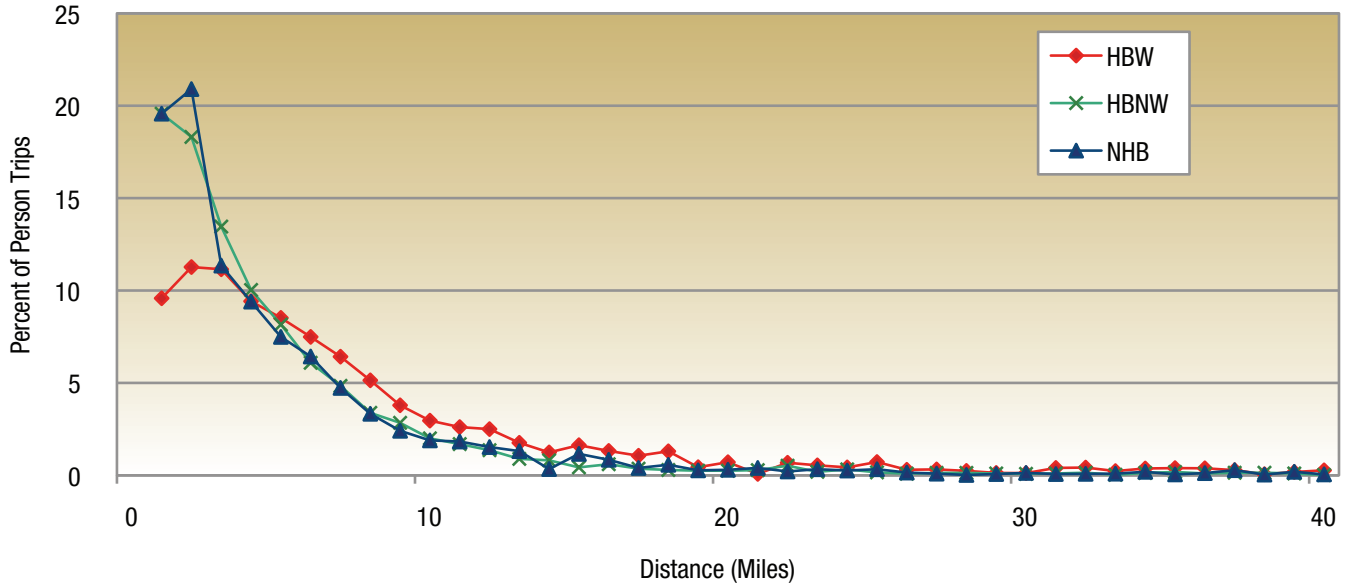
Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Figure 16. Distribution of Person Trips by Destination



Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

Figure 17. Percent Trip Length Frequency Distributions - Household Survey



Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

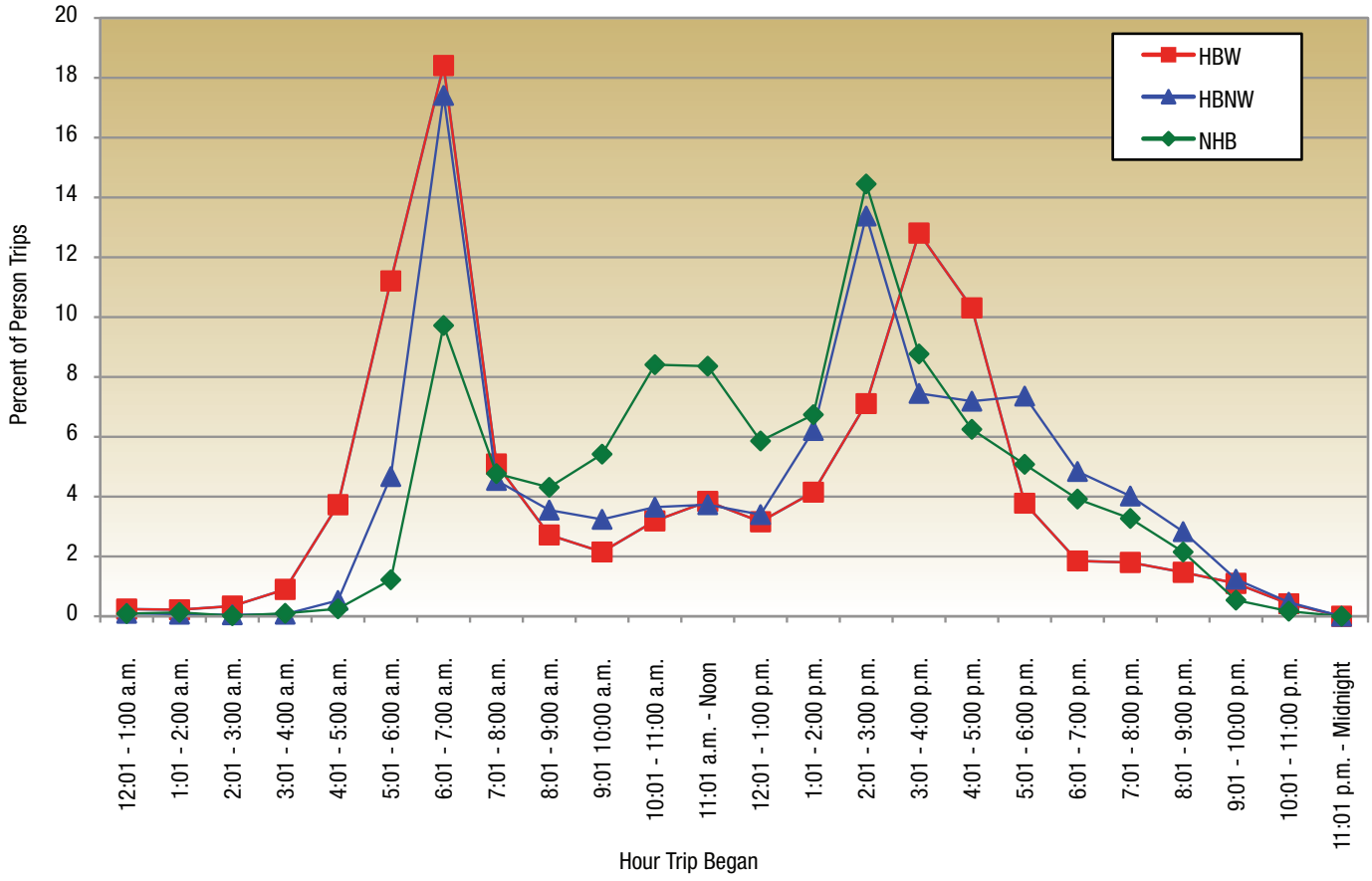
Travel information about destinations that people travel to and travel from comes from the household survey.

Time-of-Day Travel

The household travel survey provides information as to the time of day that people travel. The trip beginning times for home-to-work trips and home-to-school trips depend on the scheduled beginning times for these activities. For other trips, for example home-to-shop trips or home-to-recreation trips, the trip beginning 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 a discretionary trip during a less congested time-of-day.

Figure 18 shows the distribution of daily person trips by the hour the trip began. The highest percentage of daily person trips occurs during the morning peak as both home-to-work trips and home-to-school trips are occurring during this time period. The noon peak, the school-to-home peak, and the work-to-home peak are all evident in Figure 18. 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 to, or just after, the morning and afternoon peaks. This phenomenon is referred to as peak spreading.

Figure 18. Distribution of Person Trip Start Times by Hour the Trip Began



Source: 2004-2005 Rio Grande Valley Regional Household Travel Survey.

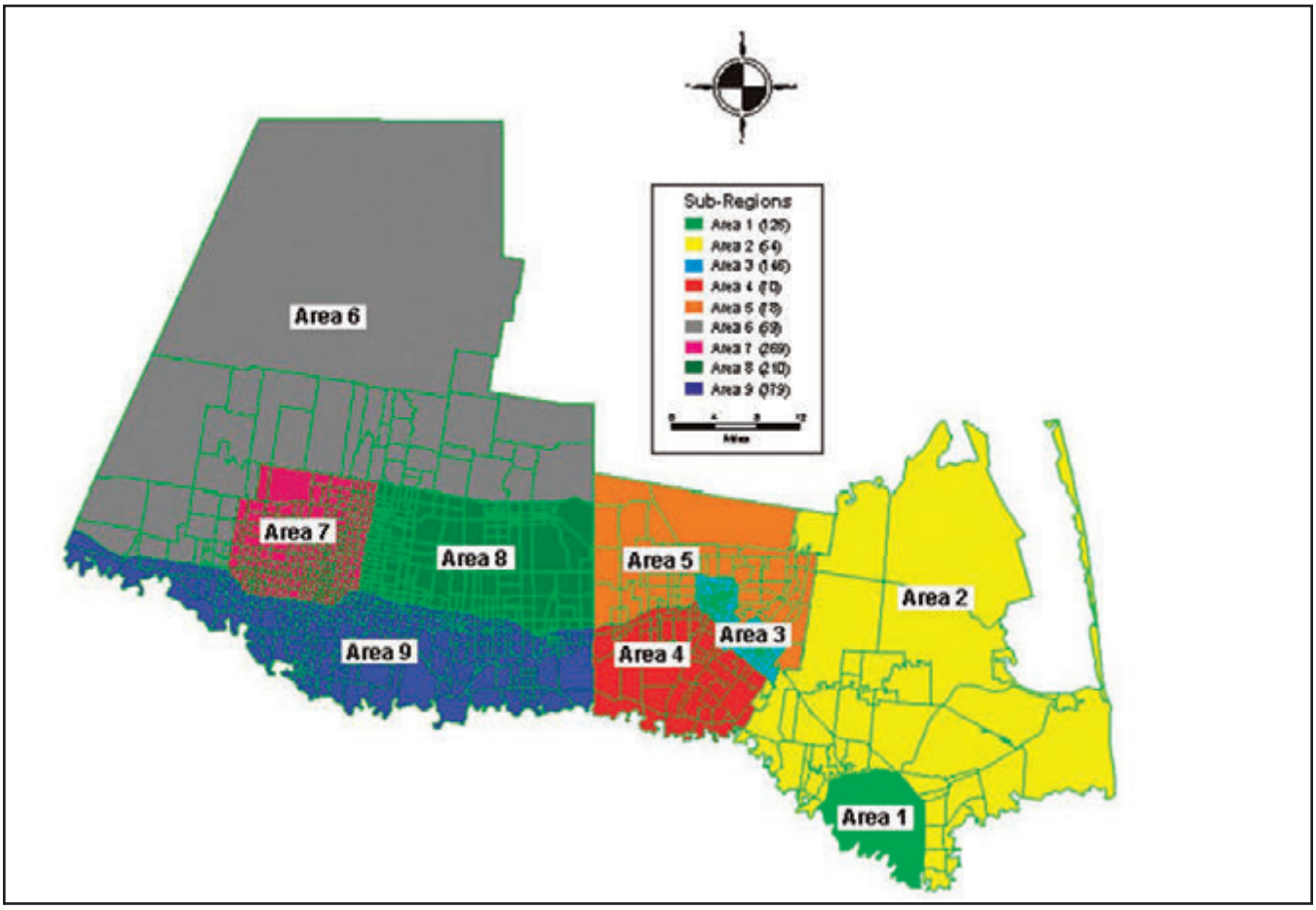
The travel model for the Rio Grande Valley Study Area is a 24-hour model. The time-of-day travel information may be used to estimate time-of-day air quality emissions inventories that are used for air quality photochemical analysis models.

As would be expected, trips to return home are the most common trip destination.

Trip Interchanges

Travel information about destinations that people travel to and travel from comes from the household survey. This information is not used directly in the travel demand model for travel forecasting because there is not sufficient survey data. For the travel demand model, a synthetic gravity model formula is used to estimate trip interchange volumes among the TAZs. From the travel survey, sector (groups of TAZs)-to-sector interchange volumes can be estimated, and these sector-to-sector interchange volumes are interesting to examine. In Figure 19, the Rio Grande Valley Study Area is color coded into nine sectors. Figure 20 shows the sector interchange volumes as indicated by the width of the line—the greater the line width, the greater the sector-to-sector interchange volume. Figure 20 shows the trips that remain in each of the nine sub-areas.

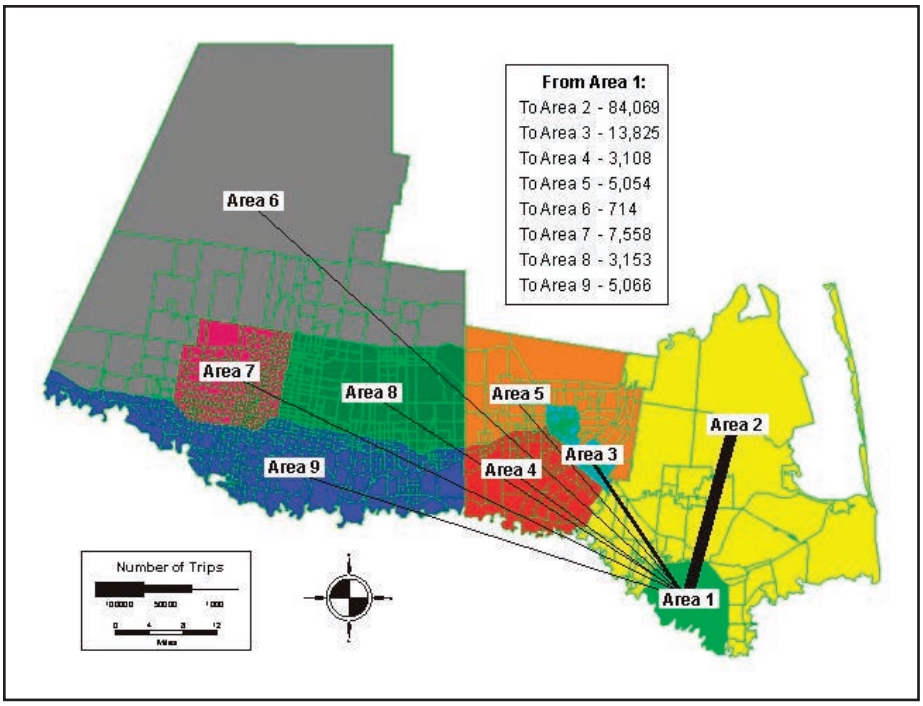
Figure 19. Two-County Rio Grande Valley Study Area and the Nine Sub-Regions within the Study Area



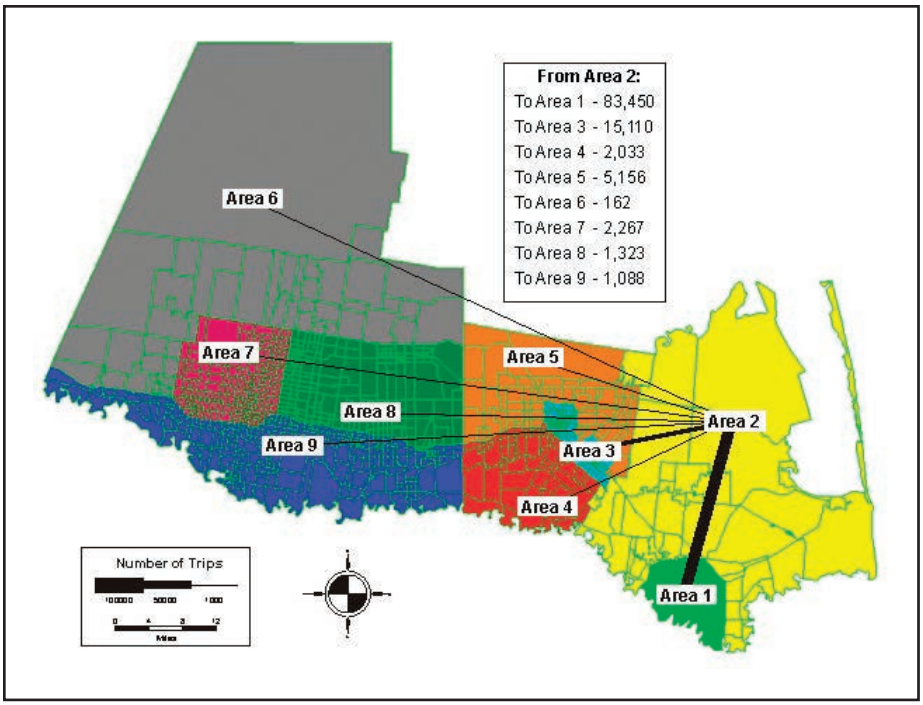
Source: TTI Graphic.

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

Figure 20. Number of Daily Person Trips between Sub-Areas

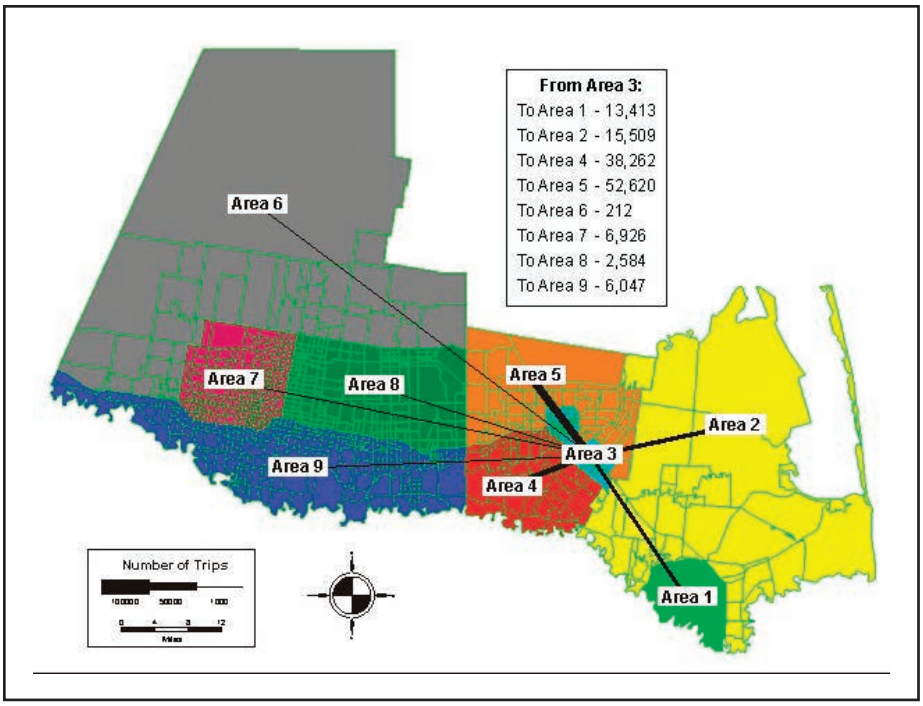


Source: TTI Graphic.

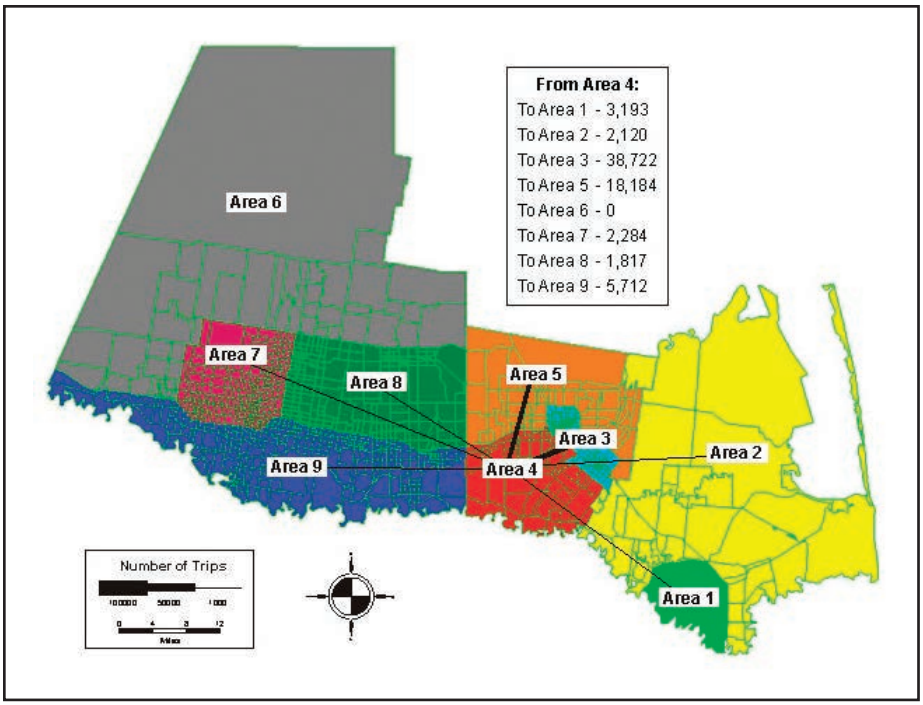


Source: TTI Graphic.

Figure 20. Number of Daily Person Trips between Sub-Areas (Cont.)



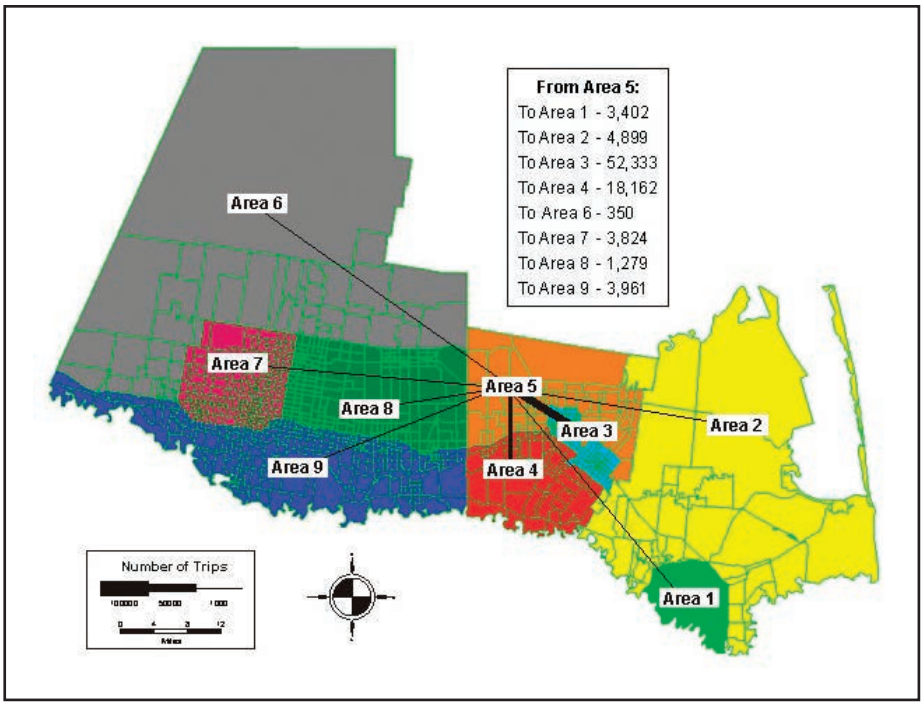
Source: TTI Graphic.



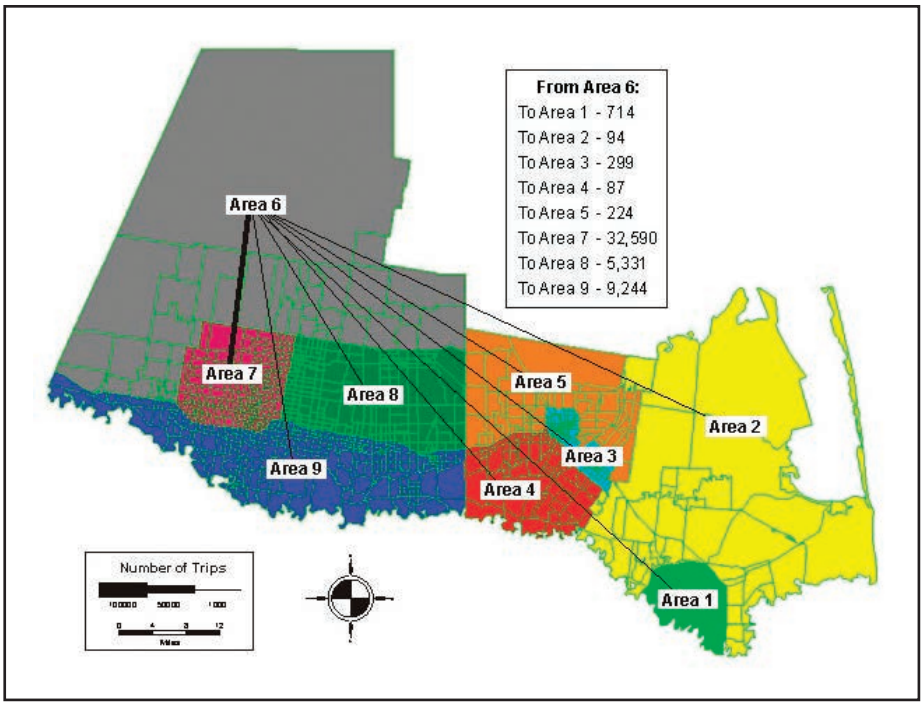
Source: TTI Graphic.

Household members travel for a purpose. This may be to go to work, to go to school, to shop, to eat a meal, to visit a doctor, etc.

Figure 20. Number of Daily Person Trips between Sub-Areas (Cont.)

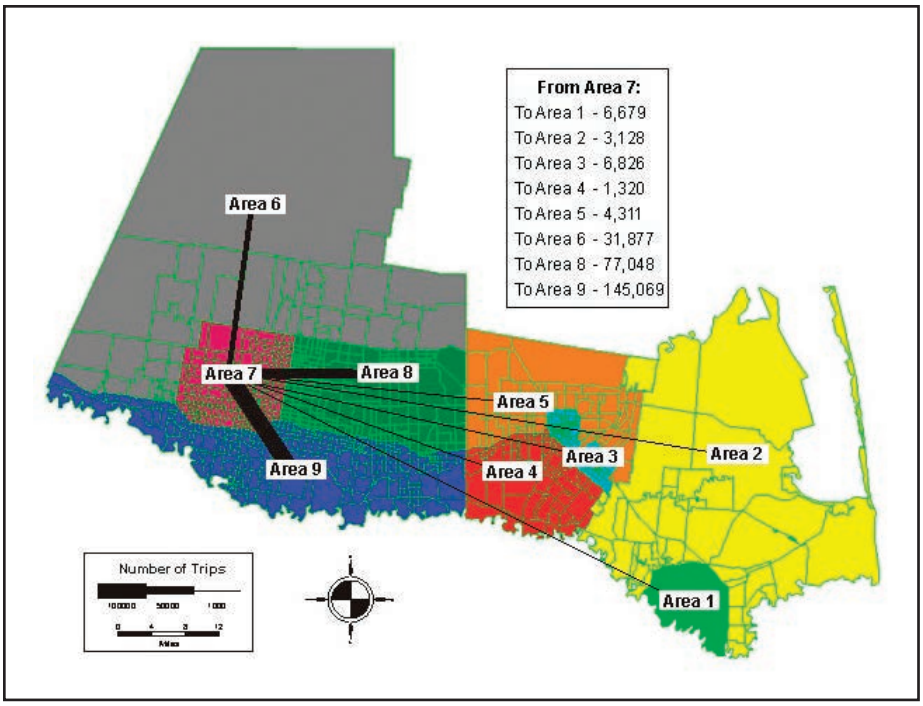


Source: TTI Graphic.

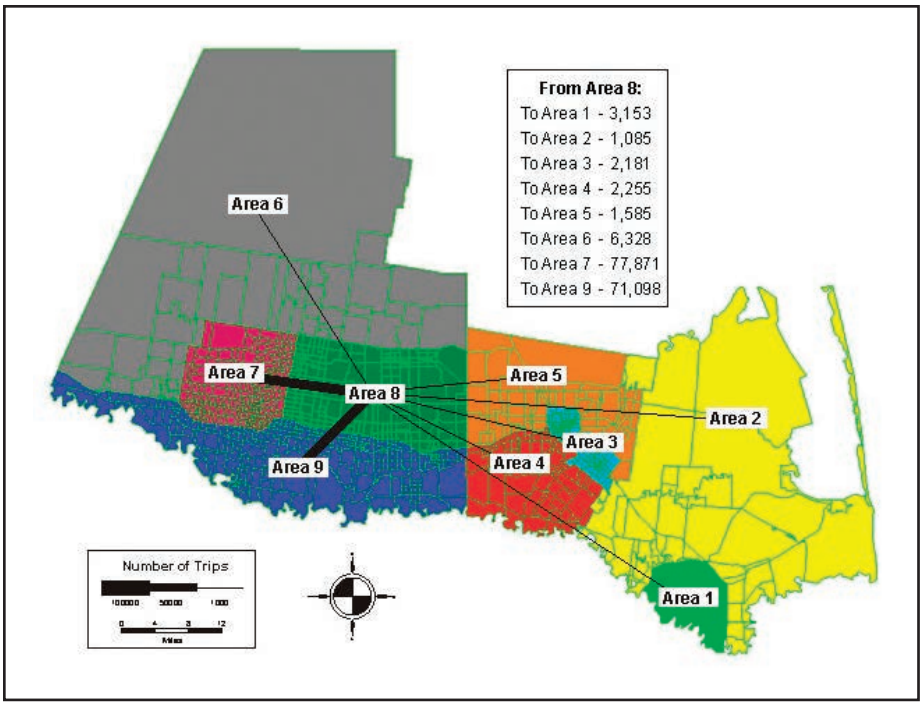


Source: TTI Graphic.

Figure 20. Number of Daily Person Trips between Sub-Areas (Cont.)



Source: TTI Graphic.

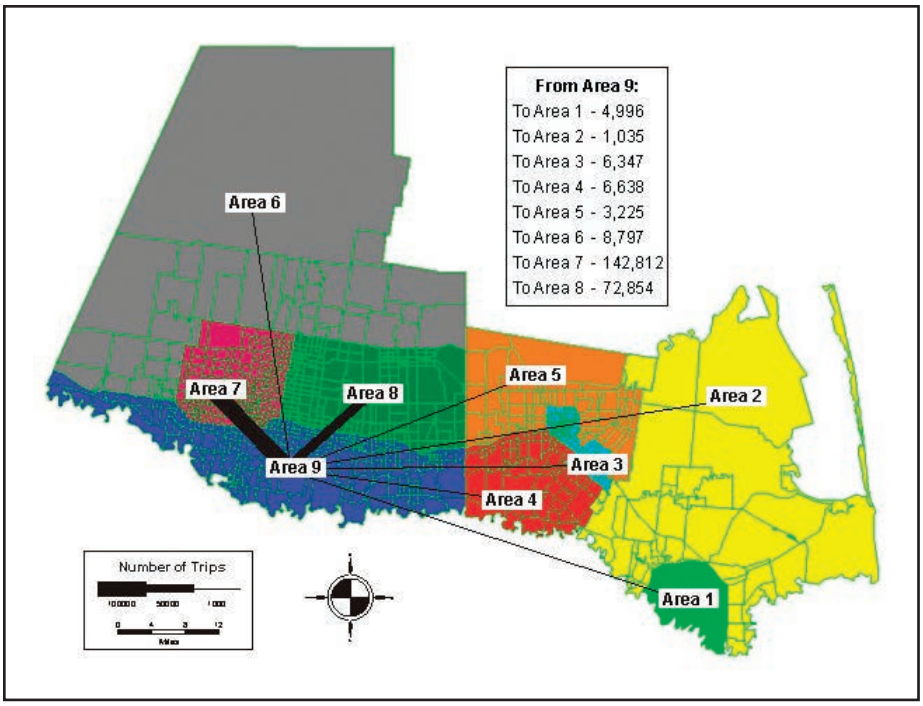


Source: TTI Graphic.

The household survey examines the trip-making characteristics of households as a function of the household characteristics.

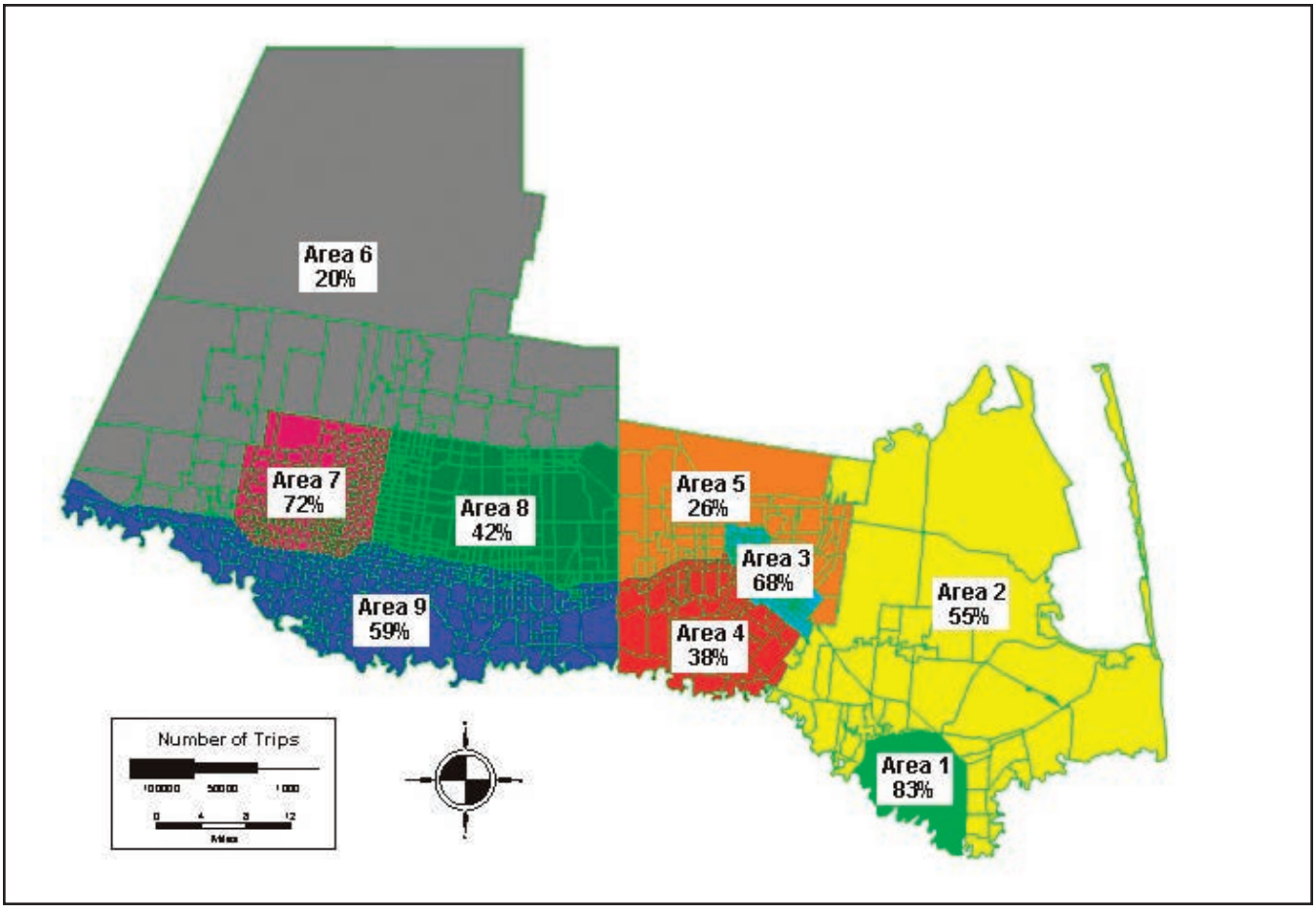
A synthetic gravity model formula is used to estimate trip interchange volumes among the traffic analysis zones.

Figure 20. Number of Daily Person Trips between Sub-Areas (Cont.)



Source: TTI Graphic.

Figure 21. Percent of Daily Person Trips that Remain within Sub-Areas



Source: TTI Graphic.

South Padre Island

The Brownsville-South Padre International Airport and the Valley International Airport were surveyed separately as these work places were expected to attract a significantly higher number of trips per employee than for typical employment work place establishments.

Valley International Airport Terminal

WORK PLACE AND SPECIAL GENERATORS

The primary purpose of the work place and special generator surveys is to understand the trip attraction characteristics of basic, retail, service, and education work places and the trip attraction characteristics of two special generators, the Brownsville-South Padre International Airport and the Valley International Airport. These data are used to estimate work place trip attraction rates by trip purpose. The Brownsville-South Padre International Airport and the Valley International Airport were surveyed separately as these work places were expected to attract a significantly higher number of trips per employee than for typical employment work place establishments. A second product of the work place survey was an average trip length and trip length frequency distribution for each trip purpose.

The work place survey consisted of two parts. The first part was to collect information on a sample of work place establishments by employment type (basic, retail, or service) that were free and non-free standing and by the area type (central business district [CBD], central business district fringe [CBD fringe], suburban, urban, or rural), where the work place was located, and the number of employees at the work place. For the travel demand model, the Rio Grande Valley study area was divided into small geographic areas called zones, and each zone was classified by area type. Work place attraction rates were estimated for each cross classification of employment and area type. Work place locations (employment types) were classified as: basic (mining, construction, or manufacturing), retail, service (finance, insurance, real estate, or government) and education as the trip attraction characteristics (attraction rates) by employment type are similar for work places with the same employment type. Attraction rates for work places within the same area type are more similar than for work places in different area types.

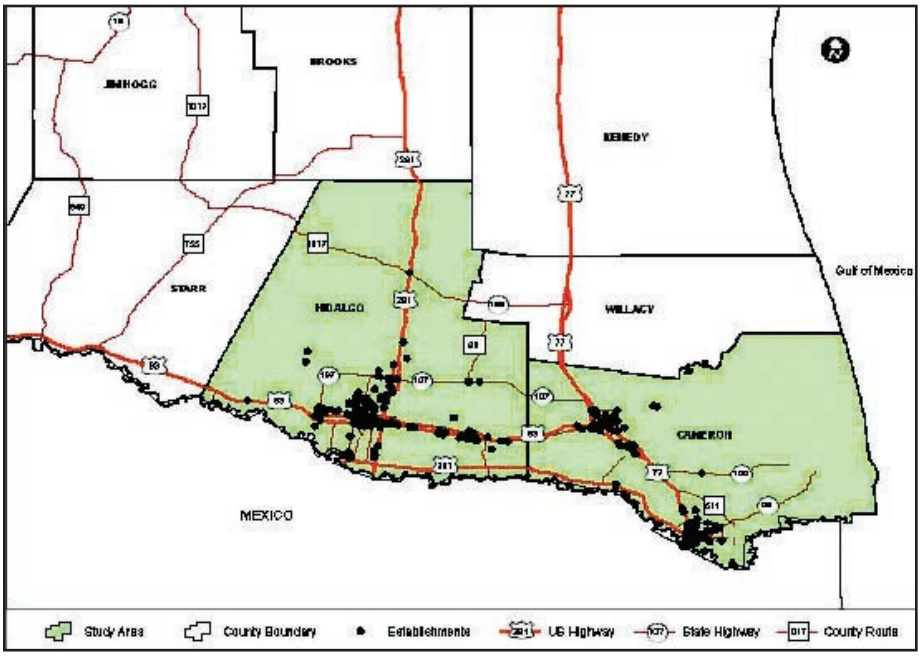
The second part of the work place survey was to select a random sample and collect detailed data for each work place in the sample. Five separate data collections were performed for each work place that agreed to participate in the full survey. The first data collected were a general survey of the establishment to determine if it was free or non-free standing, the number of employees, amount of parking, number of daily deliveries, hours of operation, etc. For the second survey, employees of the establishment were asked to keep a diary of all their trips for a 24-hour period. For the third survey, some of the visitors to the establishment were interviewed to determine their trip-making characteristics. For the fourth survey, a sample of commercial vehicle drivers making deliveries or picking up goods from the establishment was interviewed to determine their trip-making characteristics. The fifth data collection effort was a count of all persons or private vehicles and all commercial vehicles visiting the establishment. These last data were used to establish expansion factors for the establishment being surveyed.

On average, retail work place types attract more trips per employee than do service work place types, and service work place types attract more trips per employee than do basic work place types.

WORK PLACE TRAVEL CHARACTERISTICS

One purpose of the work place survey is to understand the trip-attracting characteristics of work places as a function of the work place employment type, the area type, and the trip purpose. On average, retail work place types attract more trips per employee than do service work place types, and service work place types attract more trips per employee than do basic work place types. Education work places attract trips on a level comparable to retail and service establishments. The area type is a measure of urban density, and the attracting power per employee of a particular work place type varies with the urban density. The work place travel survey accounts for all persons attracted to a work place regardless of mode of travel. Figure 22 shows the location of the work places surveyed. Trip attraction rates were estimated for each combination of trip purpose, employment type, and area type.

Figure 22. Rio Grande Valley Work Place Survey Locations



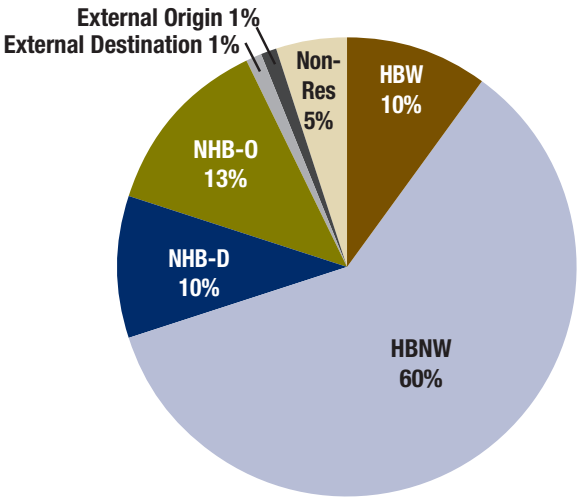
Source: 2005-2006 Rio Grande Valley Work Place Travel Survey Technical Summary.

The trip distribution model is calibrated so that the modeled average trip length and trip length frequency distributions closely match the average trip length and trip length frequency distributions estimated from the travel surveys.

TRIP ATTRACTIONS

The data were summarized by the reported trip purpose. Figure 23 presents the breakdown of percentage of observed trips by HBW, HBNW, non-home based destinations (NHB-D), non-home based origins (NHB-O), external destinations, external origins, and non-resident trips. HBW attractions are those trips with one end at home and the other at work (as indicated by the reported trip purpose). HBNW trips are those trips with one end at home and a reported trip purpose that was not work or work related. NHB-D trips are those trips whose destination was the establishment being surveyed and whose origin was not home. NHB-O trips are those trips that were leaving the establishment being surveyed, with a reported destination that was not home. External destinations are those trips that originated outside the study area, and external origins are those trips whose destination is outside the study area when they leave the establishment. Non-resident trips are those internal trips to the establishment by persons that reported they live outside the study area.

Figure 23. Distribution of Surveyed Trips by Trip Purpose



Source: 2005-2006 Rio Grande Valley Work Place Travel Survey.

Table 9. Average Trip Length by Trip Purpose

Trip Purpose/ Type	Person Trips		Vehicle Trips	
	Observations	Miles	Observations	Miles
HBW	540	5.9	499	5.9
HBNW	3,397	6.3	2,906	6.2
NHB-D	572	5.2	504	5.4
Non-Resident	283	11.7	226	11.9

Source: 2005-2006 Rio Grande Valley Regional Household Travel Survey.

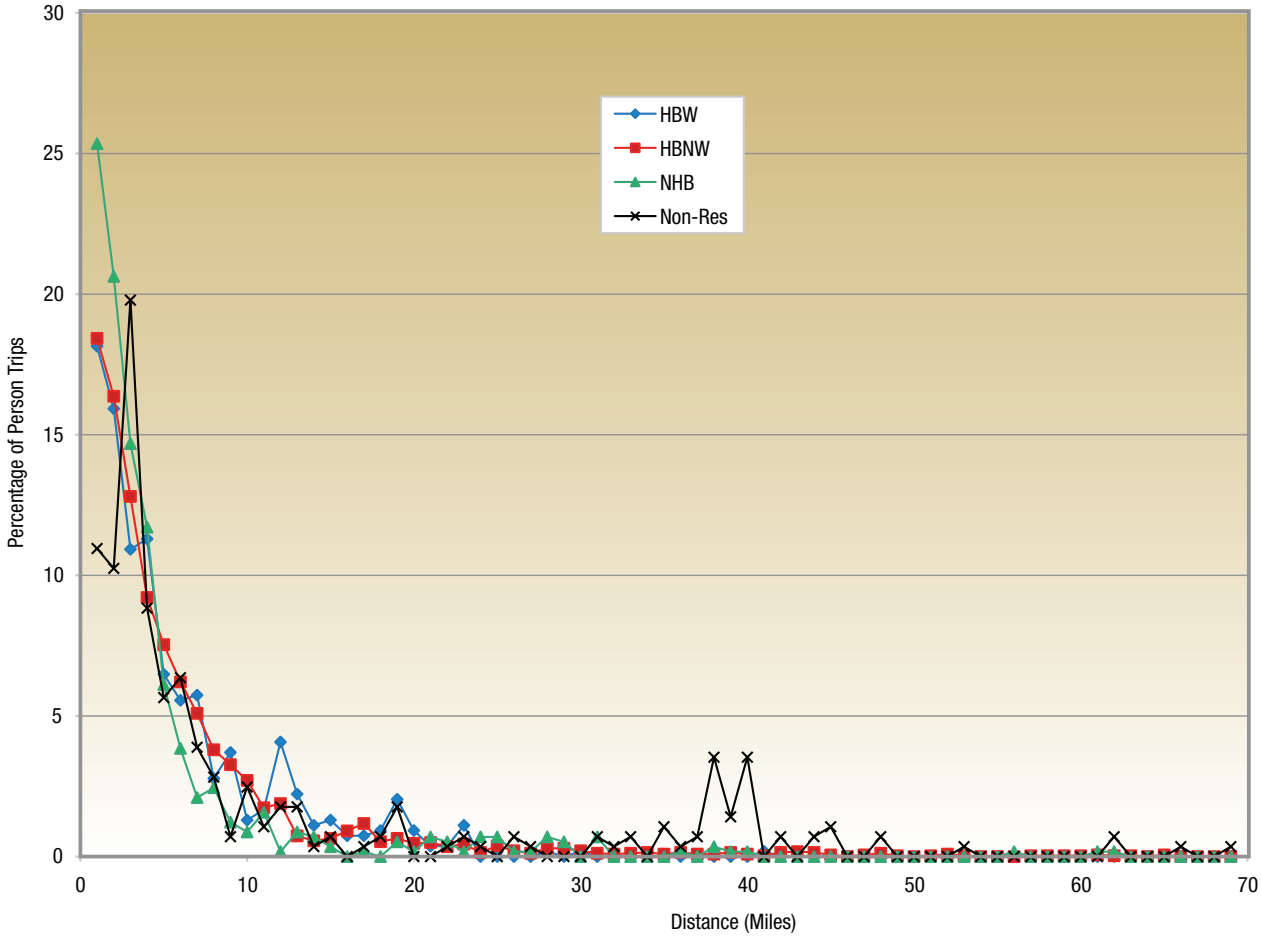
TRIP LENGTHS

Trip lengths vary by trip purpose with the home-to-work trip purpose typically having the longest average trip length. The average trip lengths and the trip length frequency distributions by trip purpose are estimated from both the household survey and the work place survey. The surveyed average trip lengths and the trip length frequency distributions are used to calibrate the trip distribution step of the travel demand model. The trip distribution model is calibrated so that the modeled average trip length and trip length frequency distributions closely match the average trip length and trip length frequency distributions estimated from the travel surveys.

Over time, as an urban area grows larger in area, the average trip length for the HBW trip purpose tends to increase 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 will provide new destination opportunities, new retail, and new schools as the urban area grows. Table 9 shows the average trip length by trip purpose and Figure 24 shows the person trip length frequency distribution estimated from the workplace survey. The average trip lengths and trip length frequency distributions are shown only for HBW, HBNW, NHB destinations, and non-resident travel.

Education work places attract trips on a level comparable to retail and service establishments.

Figure 24. Survey Person Trip Length Frequency Distributions—Work Place Survey



Source: 2005-2006 Rio Grande Valley Work Place Travel Survey.

The trip length frequency distributions indicate that in the Rio Grande Valley Study Area, HBW trip lengths occur at shorter distances, while NBNW and NHB trips have longer trip lengths. These distributions are somewhat inconsistent with other urban areas in that HBW trip lengths are typically higher than those for HBNW and NHB trips.

The trip length frequency distributions indicate that in the Rio Grande Valley study area, HBW trip lengths occur at shorter distances, while HBNW and NHB trips have longer trip lengths. These distributions are inconsistent with other urban areas where HBW trip lengths are typically higher than they are for HBNW and NHB trips. The data in Table 9 and Figure 24 are presented for informational purposes only. The estimates of average trip length and trip length frequency distribution from the household survey are used in the travel demand models. The workplace survey data are considered too small a sample to provide reliable estimates of these data.

For informational purposes, the average trip lengths were also computed for non-resident internal trips. Table 9 also shows these values. These trips generally have about the same average trip lengths as NHB trips; however, this is not the case for the Rio Grande Valley Study Area. The trip length frequency distribution for these trips indicates that a number of non-resident trips were observed in the data with very long trip lengths. Due to the small number of observations, it is not recommended these

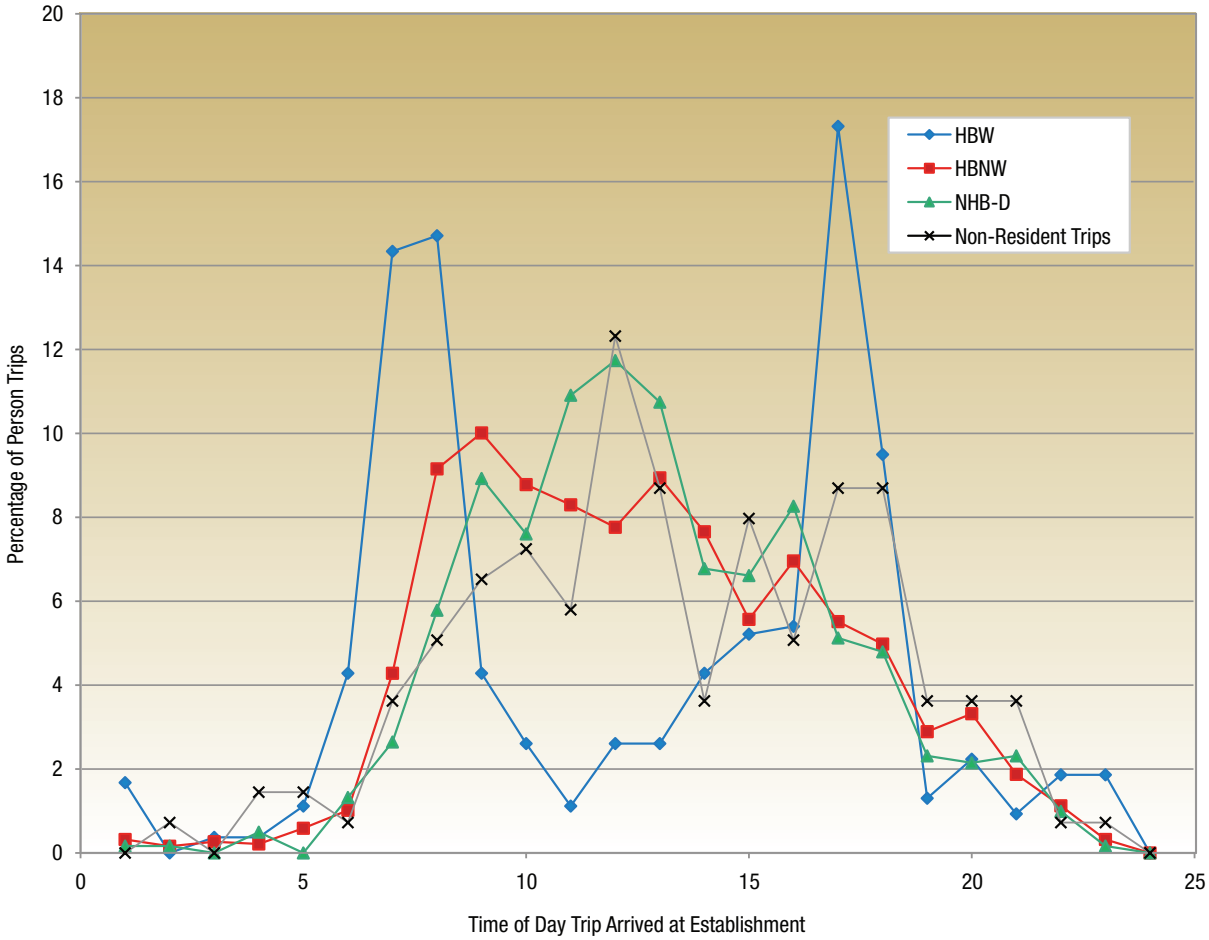
Visitor Directory, Harlingen

TRIP TIME OF ARRIVAL

Trips by trip purpose typically have distinct characteristics by time-of-day that are consistent for nearly all urban areas. Figure 25 presents the distribution of trips by purpose by their time of arrival at the establishments surveyed. The characteristics for travel in the Valley 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. HBNW and NHB trips typically peak during the middle of the day and are spread throughout the day. Figure 25 also shows the distribution of non-resident trips by their time of arrival. Their pattern is similar to that of HBNW and NHB trips. Time is shown in military terms.

Trips by trip purpose typically have distinct characteristics by time-of-day that are consistent for nearly all urban areas.

Figure 29. Distribution of Person Trips by Time of Arrival at Establishments



Source: 2005-2006 Rio Grande Valley Work Place Travel Survey.

SPECIAL GENERATORS

The Brownsville-South Padre International Airport and the Valley International Airport were treated as special generators rather than being included among other work places. Special generators are those types of development that are considered unique and subject to modeling outside the typical modeling framework.

Brownsville-South Padre Island International Airport

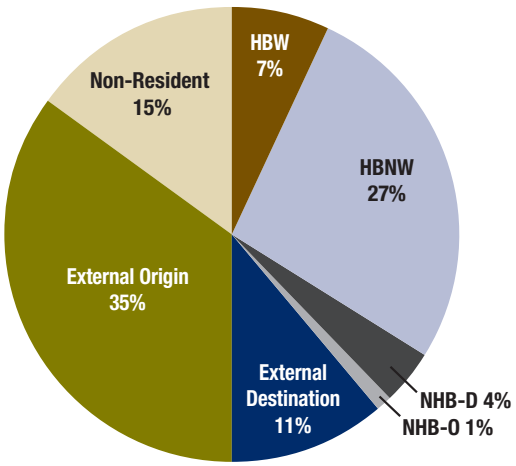
The Brownsville-South Padre Island International Airport was surveyed as a special generator due to its uniqueness as a transportation generator and the impact it has on the community in terms of transportation. Total employment reported at the site (this includes all businesses located on the airport property) was 24, and 19 employees were reported to be at work on the day of the survey. The number of employees that participated in the survey was 6. The number of visitors surveyed at the airport was 121, and the number of commercial vehicles counted was 10. The surveyed employees reported 18 trip ends at the airport, and the visitors reported 242.

Of the 121 visitors surveyed, 8 percent were arriving by plane, and 33 percent were departing by plane. This indicates that most of the trips that were external or non-resident were not by plane.

Figure 26 presents the distribution of surveyed trips by trip purpose. The majority of the surveyed trips (61 percent) at the airport were either external or made by non-residents. Of the 121 visitors surveyed, 8 percent were arriving by plane, and 33 percent were departing by plane. This indicates that most of the trips that were external or non-resident were not by plane.

The internal survey trips were geocoded for both employees and visitors to the TAZs in the Rio Grande Valley 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 10 shows the average trip lengths found for the airport trips.

Figure 26. Distribution of Surveyed Trips at the Brownsville-South Padre Island International Airport



Source: 2005-2006 Rio Grande Valley Work Place Travel Survey.

Brownsville-South Padre Island International Airport

Table 10. Average Trip Lengths for Surveyed Trips to the Brownsville-South Padre Island International Airport

Trip Purpose/Type	Person Trips	Vehicle Trips
	Miles	Miles
HBW	9.2	10.4
HBNW	13.8	13.3
NHB-D	15.9	15.9
Non-Residents	12.4	10.5

Source: 2005-2006 Rio Grande Valley Work Place Travel Survey.

Slightly less than half of the trips (49 percent) are external and made by non-residents, which is 12 percent lower compared with the results for the Brownsville-South Padre International Airport.

Valley International Airport

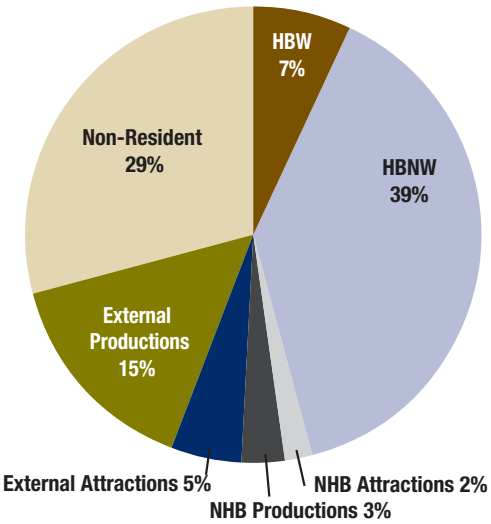
The Valley International Airport is another establishment that is unique and impacts the Rio Grande Valley Study Area in terms of trip generation. Total employment reported at the Valley International Airport was 40, and 36 employees were reported to be at work on the day of the survey. Thirteen employees participated in the survey and 200 visitors were surveyed. The number of commercial vehicles counted at the airport was 12. The surveyed employees reported 22 trips and 400 trips were recorded for the visitors at the site.

Figure 27 presents the distribution of surveyed trips by trip purpose. Slightly less than half of the trips (49 percent) are external and made by non-residents, which is 12 percent lower compared with the results for the Brownsville-South Padre International Airport.

The internal survey trips were geocoded for both employees and visitors to the regional zones in the Rio Grande Valley Study Area. The data were processed and average trip length computed for travel distance by trip purpose. These data are based on a small number of observations and are presented only as a reference to the average trip lengths computed for the full work place surveys. Table 11 shows the average trip lengths found for the Valley International Airport trips.

The household travel survey provides information as to the time of day that people travel. The trip beginning times for home-to-work trips and home-to-school trips depend on the scheduled beginning times for these activities.

Figure 27. Distribution of Surveyed Trips at the Valley International Airport



Source: 2005-2006 Rio Grande Valley Work Place Travel Survey Technical Summary.

Table 11. Average Trip Lengths for Surveyed Trips to the Valley International Airport

Trip Purpose/Type	Person Trips	Vehicle Trips
	Miles	Miles
HBW	10.2	7.6
HBNW	19.6	20.4
NHB-D	14.3	14.3
Non-Residents	25.8	24.8

Source: 2005-2006 Rio Grande Valley Work Place Travel Survey.

SUMMARY OF WORK PLACE AND SPECIAL GENERATOR FINDINGS

A total of 262 employees participated at the 97 establishments that were fully surveyed. The number of visitors surveyed at those sites totaled 2,650. Information was collected on 625 site-related trips for the employees and 5,300 trips for the visitors. Certain demographic data were also collected on both employees and visitors. The average household size for those participating in the survey was 3.7. This was higher than the 2000 census estimate of 3.4 persons per household. The average household income for participants was $43,687, and the median household income was $31,152. The 2000 census reported the average household income for the Rio Grande Valley Study Area was $34,817, and the median household income was $30,035.

Basic employment was found to have the smallest attraction trip rates and retail employment had the highest. The number of HBW person trip attractions per employee (average) ranged from a low of 1.25 to a high of 3.22. The number of HBNW person trip attractions per employee ranged from a low of 0.77 to a high of 61.59. The

number of NHB person trip destinations per employee ranged from a low of 0.23 to a high of 7.54. The number of non-resident person trips per employee ranged from a low of 0.07 to a high of 6.37. These values represent the observed data from the survey and not the final recommended attraction rates.

Travel by non-residents in the Rio Grande Valley Study Area is a significant amount, estimated to be over 250,000 daily person trips. The distribution of trips by purpose as estimated from the work place survey appears to reasonably estimate the amount of HBW travel and over estimate the amount of HBNW travel.

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

TRAVEL INTO, OUT OF, AND THROUGH THE REGION

The primary purpose of the external station survey is to understand the trip-making characteristics of trips entering or leaving 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).

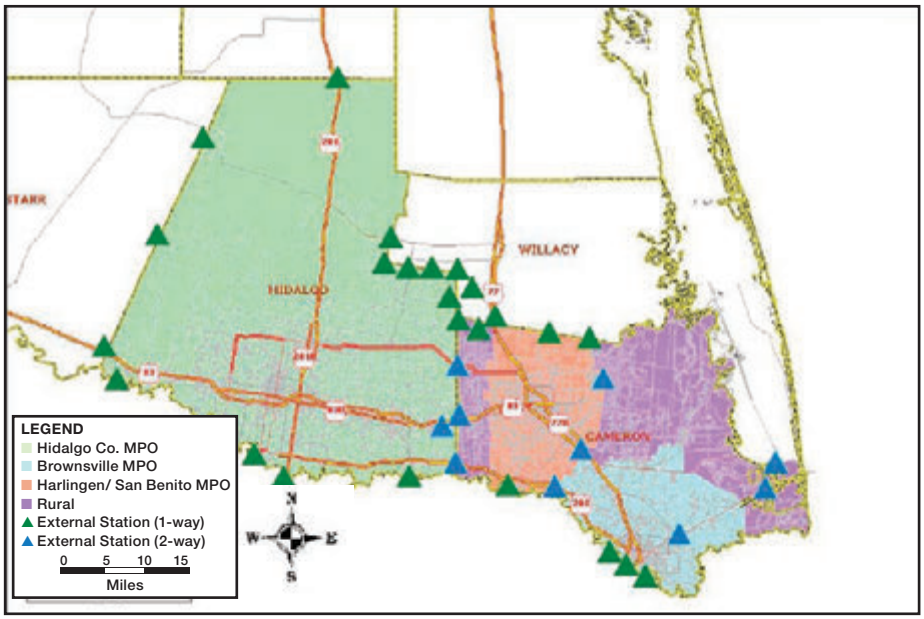
External stations are locations where trips enter and leave the study area. Therefore external stations are locations where a transportation facility crosses the study area boundary. Figure 28 shows the Rio Grande Valley Study Area. Since there are three MPOs in the two-county area, each had its own set of external stations with some being shared on a common study area boundary. To provide data for the potential development of external trip tables for each MPO, it was necessary to survey some locations that would normally be considered internal to the entire Rio Grande Valley Study Area. Figure 29 shows the 34 external station locations, of which 26 locations were surveyed. For the remaining eight sites, six were selected for a vehicle classification count only, and two were considered high volume, requiring a video license plate matching process to be used. Additionally, 10 of the 34 locations were surveyed in both directions (listed as two-way in Figure 32).

At most of the external station locations, vehicles headed in the outbound direction were randomly selected and the drivers interviewed to determine the time, the number of persons in the vehicle, the location of the last place they got into their vehicle, the purpose of the activity, and the time of the activity at that location. Drivers also were asked the purpose of the trip and the next destination, their county of residence, and, if visiting, the number of nights the driver stayed in the two-county area. Finally, the driver was asked to provide a list of locations visited within the two-county area before departing the study area. Separate survey instruments were used for non-commercial and commercial vehicles interviewed at external stations.

On a typical weekday, a large number of vehicles travel into and out of the Rio Grande Valley Study Area. Most of this travel is external-local travel, that is, vehicles coming into or leaving the Rio Grande Valley Study Area on a daily basis.

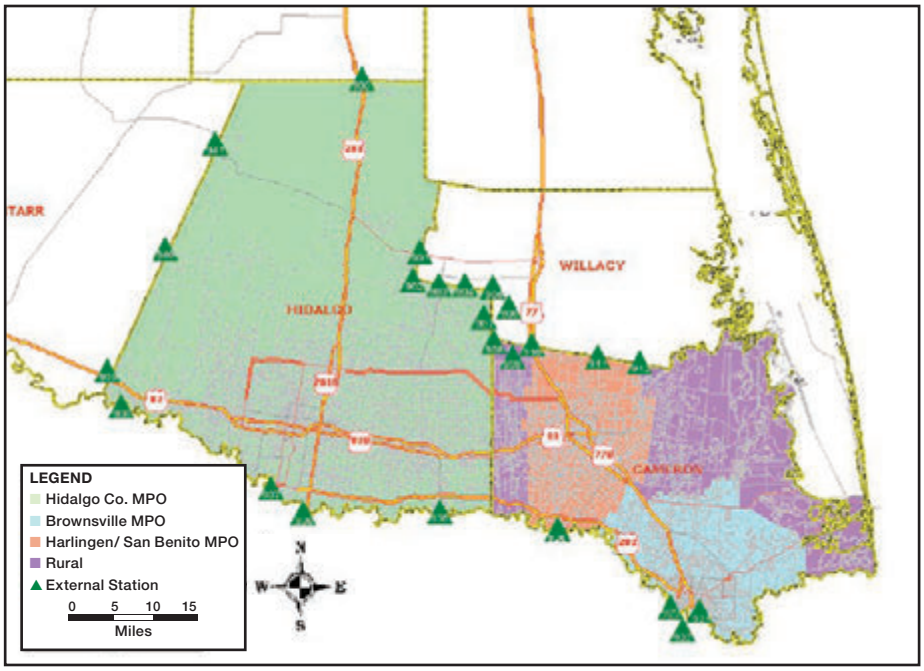
Since there are three MPOs in the two-county area, each had its own set of external stations with some being shared on a common study area boundary.

Figure 28. Rio Grande Valley Study Area



Source: 2004 Rio Grande Valley External Survey.

Figure 29. Rio Grande Valley External Station Locations



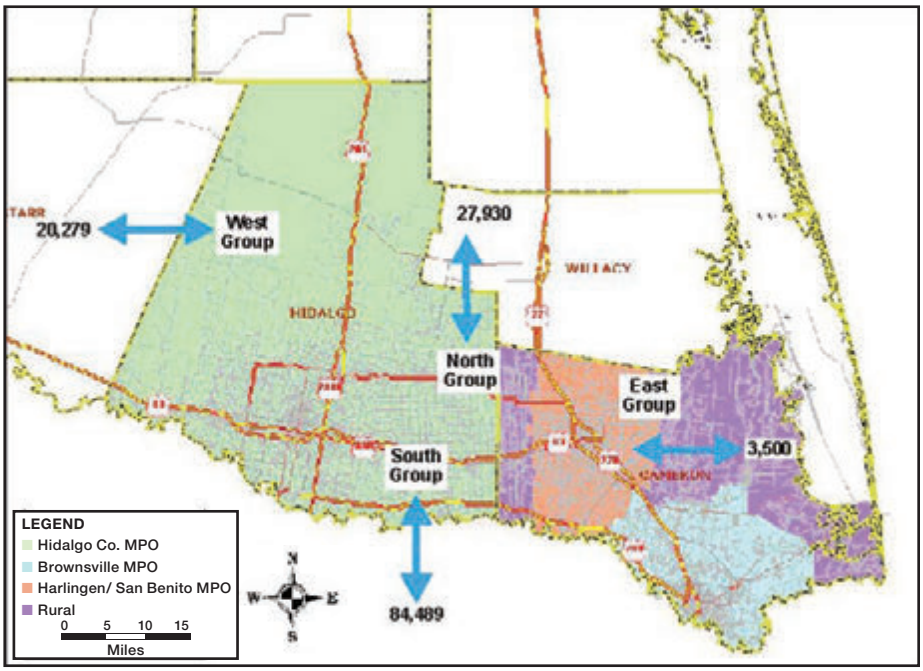
Source: 2004 Rio Grande Valley External Survey.

EXTERNAL-LOCAL TRIPS

Figure 30 shows the two-way, 24-hour external-local vehicle trip volumes entering and leaving the groups of external stations identified as the north, east, south, and west groups, which are aggregations of external stations. The largest number of external-local trips occurred at the south group of external stations, i.e., international crossings.

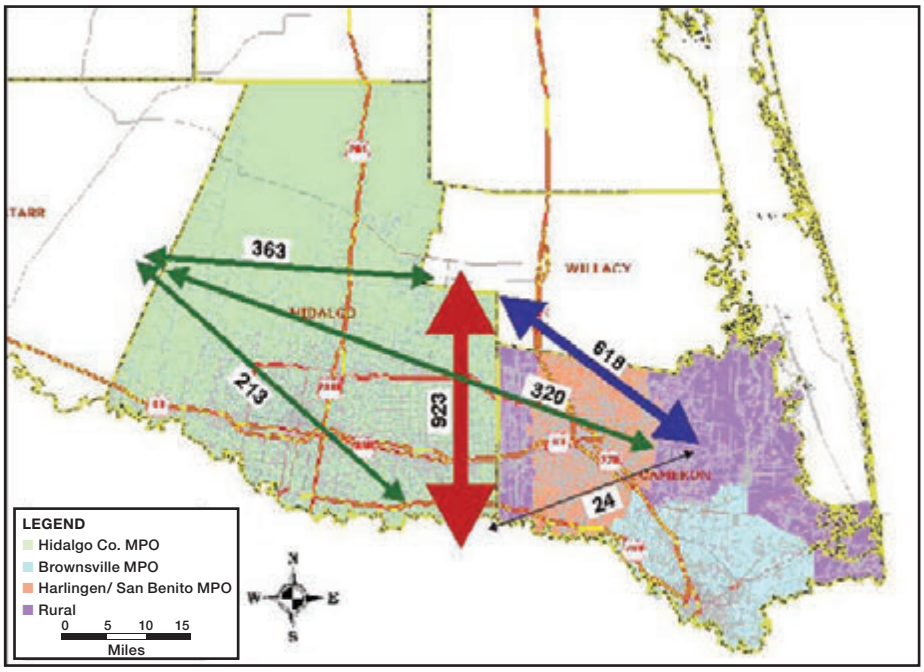
On a typical weekday, a large number of vehicles travel into and out of the Rio Grande Valley Study Area. Most of this travel is external-local travel, that is, vehicles coming into or leaving the Rio Grande Valley Study Area on a daily basis.

Figure 30. Estimates of External-Local Trip Movements by Location Group



Source: 2004 Rio Grande Valley External Survey.

Figure 31. Estimates of External-Through Trip Movements by Location Group



Source: 2004 Rio Grande Valley External Survey Technical Summary.

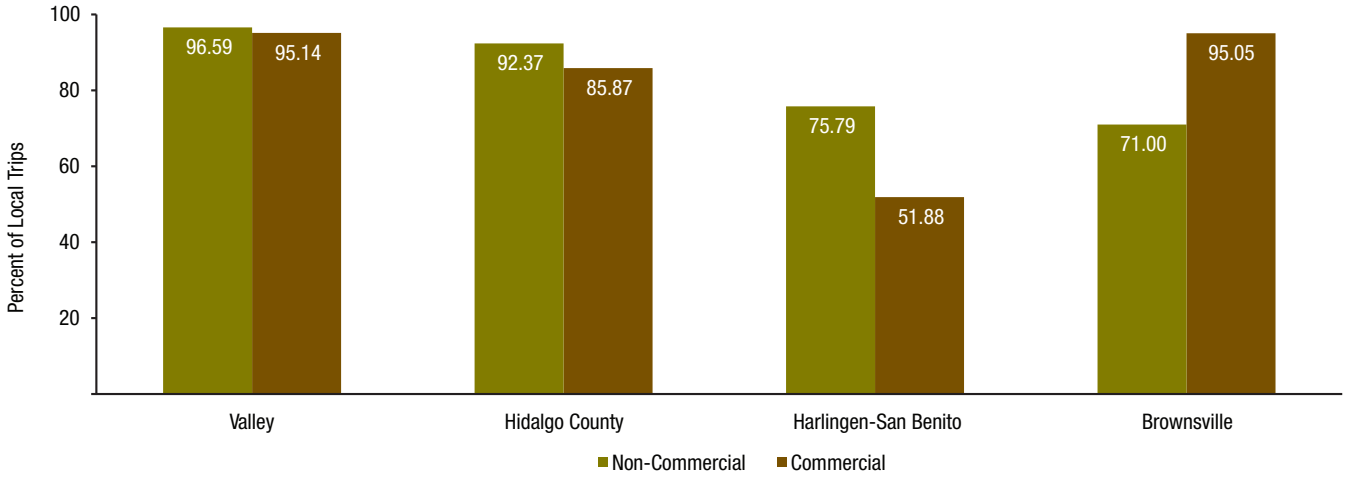
For the Rio Grande Valley Study Area, the most external-through movements were in the north-south, north-west, and south-west pairs.

EXTERNAL-THROUGH TRIPS

Figure 31 shows the two-way, 24-hour external-through vehicle trip volumes entering and leaving the groups of external stations identified as the north, east, south, and west groups, which are aggregations of external stations. For the Rio Grande Valley Study Area, the most external-through movements were in the north-south, north-west, and south-west pairs.

Figure 32 indicates the percent of local trips in the study area. A local trip is one where either the origin or destination of the trip is in the study area and the other trip end is outside the study area. A through trip is one traveling through the study area without stopping. For the study area, over 97 percent of non-commercial vehicle trips and over 95 percent of commercial vehicle trips were local trips.

Figure 32. Percent of Local Trips in Each Study Area



Source: 2004 Rio Grande Valley External Survey.

Example of a Commercial Vehicle Survey Station

For the study area, over 97 percent of non-commercial vehicle trips and over 95 percent of commercial vehicle trips were local trips.

TRAVEL BY COMMERCIAL VEHICLES

The primary purpose of the commercial vehicle survey is to understand the trip-making characteristics of commercial vehicles operating in the Rio Grande Valley 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 boundary. 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 the number of internal commercial vehicle trips.

A sample of vehicles was randomly selected from motor carrier and vehicle registration databases. A commercial vehicle was defined as any vehicle having six or more tires, having a gross vehicle weight of over 8,500 pounds, and used for commercial purposes. The firms operating the selected vehicles were contacted and asked to participate in the survey. The drivers were asked to keep a 24-hour diary of the locations of all trips made by the vehicle. A variety of questions were asked about the vehicle, the cargo, the trip purpose, etc. The questions of primary concern for estimating commercial vehicle trip rates were the location and time of each stop from when the driver of the vehicle began his or her daily activities until the driver of the vehicle completed his or her daily activities. A total of 510 vehicle diaries were obtained from 138 participating firms. The survey area consisted of two counties, Cameron and Hidalgo.

In addition to the commercial vehicle diary surveys, vehicle classification counts were performed at randomly selected locations that included freeways and arterials, collectors, and local streets. The application for this classification data is explained in the next paragraph.

Commercial vehicles account for approximately 6 percent of the VMT in the Rio Grande Valley Study Area.

The number of commercial vehicles in the Rio Grande Valley 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. To calculate an expansion factor for the commercial vehicle survey, the following procedure was used. The annual average daily traffic by roadway functional classification for the Rio Grande Valley Study Area was obtained from TxDOT's Highway Performance Monitoring System data. The annual average daily traffic data were used with vehicle classification count data to estimate the daily VMT for commercial vehicles by roadway functional classification. This estimate was used to expand the daily VMT estimate from the commercial vehicles in the survey.

The commercial vehicle trip purpose in the travel demand model is for commercial vehicles making internal study area trips. External-through and external-local commercial vehicle trips are modeled as a part of the external trips. Therefore, the daily VMT for commercial vehicles making external-through and external-local trips estimated from the external station survey were subtracted from the total commercial VMT to estimate the commercial vehicle VMT for internal trips.

Table 12 shows the total average weekday VMT, the percentage of commercial vehicles, and the commercial vehicle VMT by roadway functional classification for the Rio Grande Valley Study Area. From the external station survey, it was estimated that the daily weekday VMT for commercial vehicles making external-local and external-through trips was 377,256. Subtracting this VMT from 1,320,812 (Table 12) provides an estimate of 943,556 VMT for commercial vehicles making internal trips. Commercial vehicles account for approximately 6 percent of the VMT in the Rio Grande Valley Study Area.

Table 12. Total VMT, Percent Commercial Vehicles, and Commercial Vehicle VMT

Functional Classificaton	Weekday VMT	Percent Commercial Vehicles	Commercial Vehicles Weekday VMT
Freeway	4,460,158	11.92	531,651
Arterial	9,214,886	6.02	554,736
Collector	4,777,336	4.02	192,049
Local	2,057,070	2.06	42,376
Total	20,509,450	—	1,320,812

Source: 2005 Rio Grande Valley Commercial Vehicle Survey.

Veterans International Bridge, Brownsville

TRAVEL TIME AND DELAY

The primary purpose of the travel time and delay survey was to collect travel time data to estimate average speeds during peak and off-peak periods for roadways in the Rio Grande Valley Study Area. The data were collected by the roadway functional classification (Freeway, Expressway, Arterial, Collector, Local, and Frontage) and by the area type (CBD, urban, suburban, and rural) where the roadway is located.

In the travel demand model, the minimum travel time path and the freeflow travel time between any two TAZs are a function of the functional classification, the number of lanes, the area types, and the freeflow speeds of the roadway links that comprise the minimum travel time path. The travel time and delay survey measures speed and delay for a sample of roadway links in the study area and collects information on 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.

For 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 15 different routes during peak and off-peak periods. The routes were designed 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.

The primary purpose of the travel time and delay survey was to collect travel time data to estimate average speeds during peak and off-peak periods for roadways in the Rio Grande Valley Study Area.

A total of 15 routes were developed, and data were collected between 7 a.m. and 6 p.m., Monday through Friday. There were five routes plotted in and around each of the three major cities in the study area:

- McAllen in Hidalgo County (routes 1-5);
- Harlingen in Cameron County (routes 6-10); and
- Brownsville in Cameron County (routes 11-15).

For each of the 15 routes, six runs were made in each direction during the morning peak, the afternoon peak, and the off-peak periods, that is, there were two replicates for each route for each time period and direction combination. Average speeds were calculated for each functional class and area type for the morning peak, the afternoon peak, and the off-peak.

This schedule allowed sufficient time for a driver to travel the routes 12 times at a speed consistent with that of surrounding traffic, without passing or being passed by the majority of other vehicles on the roadway (i.e., the floating car method of data collection). The 12 runs conducted for each route were split equally by direction so that six were in the A-to-B direction and six were in the B-to-A direction. For each group of six runs, three were during the peak periods (7-9 a.m. and 4-6 p.m.), and three were during the off-peak periods (9 a.m.-12 p.m. and 1-4 p.m.). All data were collected between 7 a.m. and 6 p.m.

Additionally, the number of runs was balanced so that equal amounts of peak and off-peak data were collected during both the AM and PM 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 are reduced due to the increased number of traffic control devices, intersections, curb cuts, and turning movements. Tables 13 and 14 summarize the results of the time and delay survey. Table 15 shows the range of speeds limits for each functional class and area type cross classification.

In general, as the density of the land use adjacent to a roadway increases, the speed and capacity of the roadway are reduced due to the increased number of traffic control devices, intersections, curb cuts, and turning movements.

Table 13. Peak Period Average Speeds

	Freeway	Arterial	Collector	Local
CBD	62.3	16.3	20.0	14.3
CBD Fringe	N/A	20.1	18.4	17.2
Urban	46.9	22.7	19.4	16.1
Suburban	52.9	23.5	21.8	18.5
Rural	43.6	25.7	27.7	19.7

Note: Values are MPH.
Source: 2005 Rio Grande Valley Travel Time and Delay Survey.

Table 14. Off-Peak Period Average Speeds

	Freeway	Arterial	Collector	Local
CBD	67.1	16.1	18.9	14.6
CBD Fringe	N/A	22.1	14.4	17.8
Urban	47.6	23.3	20.0	16.3
Suburban	56.6	25.3	22.2	18.6
Rural	45.1	28.3	28.3	20.8

Note: Values are MPH.
Source: 2005 Rio Grande Valley Travel Time and Delay Survey.

Table 15. Posted Speed Limits

	Freeway	Arterial	Collector	Local
CBD	NP	30-45	30	20
CBD Fringe	N/A	20*-35	20*-30	30
Urban	50**-60	20*-45	20*-30	20-30
Suburban	45**-60	25*-55	20*-45	20*-45
Rural	55**-65	30-55	30-55	15*-30

*Note: Values are MPH; * School zone. ** Construction on adjacent lanes. NP-not posted.*Source: 2005 Rio Grande Travel Time and Delay Survey.

The average peak and off-peak speeds in Tables 13 and 14 are similar. This indicates that in 2005, traffic congestion was not appreciably different between the peak and off-peak hours. A comparison of Tables 13 and 14 indicates that off-peak speeds on most functional classifications were slightly higher than peak-period speeds. Also note that most instances in which average peak period speeds exceeded average off-peak period speeds occurred in the CBD and CBD Fringe area types. Traffic in the downtown commercial areas of Brownsville and elsewhere did not appear to pick up appreciably until after 9 a.m., creating congestion in the morning off-peak period as opposed to the peak period. Overall, average speeds among non-Freeway functional classes in a given area type were relatively consistent, differing by less than 10 mph. Speeds in the rural area type were slightly higher than speeds recorded in other areas. The lone exception to this was the Freeway functional classification, which exhibited relatively slow speeds in rural areas. The lowest average speeds were recorded in the CBDs. Again, however, the Freeway functional class contradicted this trend by exhibiting average speeds in the CBD that were higher than those recorded in other area types.

Traffic in the downtown commercial areas of Brownsville and elsewhere did not appear to pick up appreciably until after 9 a.m., creating congestion in the morning off-peak period as opposed to the peak period.

The Arterial and Collector speeds are below the posted speed limits for most area types, including rural. This supports a finding that peak period and off-peak period congestion is similar and that Rio Grande Valley Study Area travelers enjoy a relatively high degree of mobility throughout the average weekday, with the exception of the CBD where the surveyed speed is considerably less than the CBD posted speed limit, a condition typically associated with CBD travel due to the close intersection spacing, curb cuts, turning movements, and pedestrian traffic.

FINDINGS

The travel surveys conducted in 2005 provide the household, commercial vehicle, travel time and delay, work place, and external station travel behavior information needed to estimate, calibrate, and validate a travel demand model that can be used as a transportation analysis tool for planning improvements to the transportation system in the Rio Grande Valley Study Area 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, the Harlingen/San Benito MPO, the Brownsville MPO, and the Hidalgo County MPO will need to plan, design, construct, and operate additional transportation capacity during the next 20 years. This will be needed to maintain the high level of mobility currently enjoyed by travelers in the Rio Grande Valley Study Area.

The household trip rates in the Rio Grande Valley Study Area are, for any combination of household size and household income group, slightly higher than the trip rates for other small Texas urban areas.

GROWTH IN TRAVEL

Daily VMT per person is currently at about 19 VMT per person. The population of the Rio Grande Valley Study Area increased from 643,665 in 1990 to 992,343 in 2005, an increase of 54 percent. The population of the Rio Grande Valley is forecast to increase by 70 percent from 2005 to 2030. Daily VMT can be expected to increase by 80 percent during this same 25-year period.

HOUSEHOLD CHARACTERISTICS AND TRAVEL BEHAVIOR

Persons commuting to work in the Rio Grande Valley Study Area use carpools and public transportation less often than does the average commuter in Texas. In the Rio Grande Valley Study Area, 4.9 percent of the households do not have a vehicle available compared to 7.4 percent of the households in Texas. The average household size in the Rio Grande Valley Study Area is 3.5 persons compared to 2.7 persons for Texas. Urban travel is more closely correlated with the number of households and household size than with the total population. If the average household size in the Rio Grande Valley Study Area decreases further, the total number of trips would be expected to increase.

HOUSEHOLD TRIP PRODUCTIONS

The household trip rates in the Rio Grande Valley Study Area are, for any combination of household size and household income group, slightly higher than the trip rates for other small Texas urban areas. Total trips are a product of the trip rate, for a given household size and income group, and the number of households in that household size and income group summed over all groups. The average household size for Texas is about 21 percent lower than for the two-county Rio Grande Valley area. In time, if the Rio Grande Valley area follows the pattern of other urban areas, as household income increases, and the average household size decreases, the number of trips are expected to increase.

Harlingen

EXTERNAL-LOCAL AND EXTERNAL-THROUGH TRAVEL

More than 145,000 vehicles enter and leave the two-county study area daily, and about 13 percent are commercial vehicles. Less than 4 percent of the approximately 145,000 vehicles are making through trips. Based on the average vehicle occupancy observed in the survey, an estimated 174,000 persons are entering and leaving the study area daily by non-commercial vehicle, and nearly 19,000 persons are entering and leaving by commercial vehicle. The estimated number of non-residents in non-commercial vehicles that enter the study area daily is nearly 57,000. Nearly 28,000 pedestrians move between Mexico and the study area on an average weekday.

For non-commercial vehicles, the total estimated VMT due to external travel in the Rio Grande Valley Study Area was 1,855,000, accumulated over almost 118,000 external-local trips. This resulted in an average trip length of 15.76 miles per trip for non-commercial vehicles. For external-local commercial vehicle trips, the total estimated VMT was 365,000, accumulated over 17,700 trips. This results in an average trip length of 20.56 miles per trip for commercial vehicles. In total, over 2,220,000 miles were accumulated over 135,000 external-local trips, yielding an overall average trip length of 16.39 miles per trip.

There appears to be no clear distinction between peak and off-peak period values, making travel speeds constant with regard to time-of-day.

COMMERCIAL VEHICLE TRAVEL

Since the average number of trips per commercial vehicle in the Valley area is 6.25, the resulting average number of commercial vehicles operating within the study area on an average weekday is 14,271. The commercial vehicle survey data estimated that 943,556 VMT can be attributed to commercial vehicles operating internally on a daily basis.

TRAVEL SPEED AND DELAY

Average off-peak speeds on most functional classification roadways were found to be slightly higher than peak-period speeds, though the difference was always less than 5 mph. An exception was Collectors, which exhibited higher average speeds during the peak period in several areas.

Overall, average speeds among non-Freeway functional classes in a given area type were relatively consistent. There appears to be no clear distinction between peak and off-peak period values, making travel speeds constant with regard to time-of-day. Speeds in the rural-area type were slightly higher than speeds recorded in other areas.

With respect to Freeway data, off-peak average speeds were higher than peak-period average speeds in virtually all area types. This indicates that Freeways in the Rio Grande Valley Study Area are somewhat more susceptible than other functional classes to the effects of peak-period traffic.

HOUSEHOLD SURVEY SUMMARY DATA

Table 16 provides a comparison of the household survey summary data for the Rio Grande Valley Study Area, the Tyler and Smith County area, and the Laredo/Webb County Travel Surveys.

Table 16. Comparative Household Survey Data for Rio Grande Valley, Laredo and Webb Counties, Austin Area, and Amarillo Area

	2005 Rio Grande Valley (Cameron and Hidalgo Counties)	2002 Laredo and Webb County	2004 Bastrop, Caldwell, Hayes, Travis, and Williamson Counties (Austin Area)	2006-2007 Potter and Randall Counties (Amarillo Area)
Household Population	1,030,139	195,670	1,486,117	229,693
Licensed Drivers	585,035	96,025	1,060,436	164,001
Number of Households	294,825	54,569	574,225	88,507
Average Household Size	3.49	3.59	2.59	2.60
Number of Motor Vehicles	555,443	96,969	1,065,898	178,784
Motor Vehicles per Household	1.88	1.80	1.86	2.02
NUMBER OF DAILY TRIPS BY MODE				
Total Person Trips	3,583,480	636,623	5,093,023	830,583
Automobile-Driver Trips	2,023,295	365,503	3,353,404	523,635
Motor Vehicle Passenger Trips	1,243,681	181,534	1,292,793	265,544
School Bus Trips	188,781	24,956	138,951	7,872
Walk Trips	93,337	51,153	189,256	11,563
Public Transit Trips	9.889	8,799	43,475	7,872
Bicycle Trips	6,571	1,012	31,470	2,002
Commercial Vehicle Trips	14,250	1,251	37,962	9,583
Other Modes/Taxi	3,709	1,424	5,712	1,873
DAILY TRIPS BY DESTINATION PURPOSE				
Trips to Home	1,322,199	262,590	1,866,466	300,993
Trips to Work	353,105	89,131	661,624	86,938
Trips Work Related	109,126	--	158,955	25,302
Trips to Shop	333,674	56,809	489,085	95,421
Trips to Pick-Up/ Drop-Off Passenger	410,936	74,290	434,359	77,014
Trips for Personal Business	228,654	37,109	356,953	73,011
Trips for Social/Recreation	276,680	21,140	359,071	68,556
Trips for School K-12	292,203	79,114	302,415	46,973
Trips for School Post-Secondary	46,762	(included in K-12)	56,962	4,897
Trips for Meal/Eat	171,603	--	325,699	46,049
Trips to Change Mode	24,622	--	76,436	2,836
Other Trips	3,596	6,440	4,986	2,590
DAILY TRIPS RATES				
Person Trips per Person	3.48	3.25	3.42	3.62
Person Trips per Household	12.15	11.67	8.87	9.38
TRIP LENGTHS AND DURATIONS				
Average Person Trip Length in Miles	6.5	3.8	7.8	5.9
Average Vehicle Trip Length in Miles	7.0	4.0	8.4	6.1
Average Person Trip Duration in Minutes	9.2	6.8	12.8	4.7
Average Vehicle Trip Duration in Minutes	9.8	7.2	13.8	5.0
VEHICLE MILES OF TRAVEL				
VMT per Capita	13.8	7.5	17.8	13.0

Source: Rio Grande Valley, Laredo/Webb, Austin, and Amarillo Household Travel Surveys.

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.

Person Trip: A person trip is the movement of an individual from one location to another location. In the 2003 Rio Grande Valley Study Area household survey, these trips were recorded for persons five years of age or older in a surveyed household.

Auto Driver Trip: An auto driver trip is the movement of a vehicle from one location to another location. These trips are recorded for the person driving the vehicle. These may also be referred to as "vehicle" trips.

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.

Vehicle Occupancy: This is the number of occupants in a vehicle during a vehicle trip. This number includes the driver of the vehicle.

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.

Home-Based Work (HBW) Trip: This is a trip 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 an HBW trip.

Home-Based Non-Work (HBNW) Trip: This is a trip 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.

Non-Home Based (NHB) Trip: This is a trip that has neither end at home.

Productions: A production is 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.

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

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, an HBW trip.

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