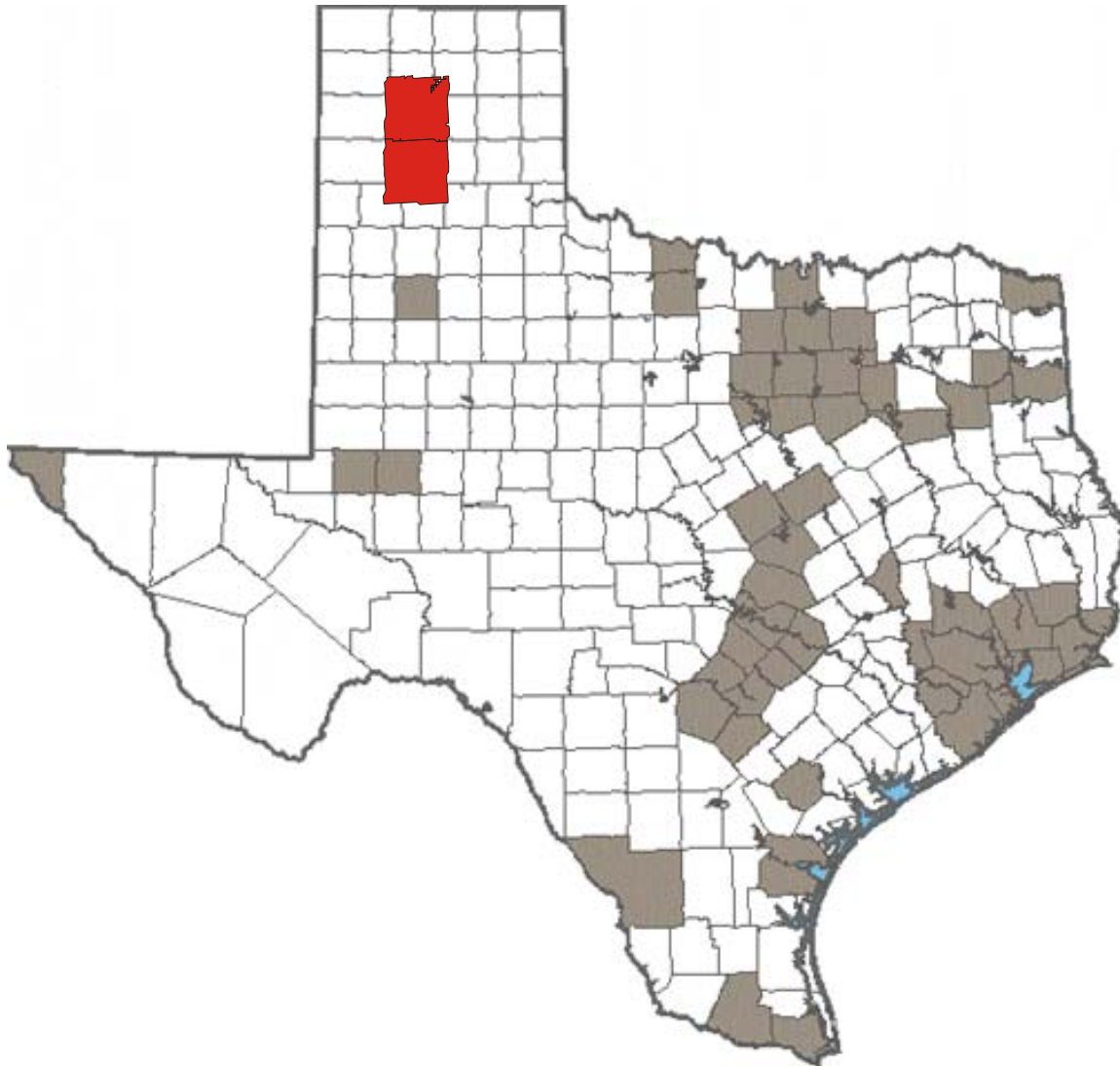


# 2005 Amarillo Commercial Vehicle Survey Technical Summary



Prepared by the  
Texas Transportation Institute  
November 2007



# **2005 Amarillo Commercial Vehicle Survey**

## **TECHNICAL SUMMARY**

**Texas Department of Transportation Travel Survey Program**

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November 2007

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## **DISCLAIMER**

The contents of this report reflect the views of the authors who are responsible for the opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration or the Texas Department of Transportation. This report does not constitute a standard, specification, or regulation. Stella Amor Nepal and Stephen P. Farnsworth were the authors of this report. David F. Pearson, Ph.D., P.E., was the study supervisor. Charlie Hall of the TxDOT Planning and Programming Division was the project director.

## **ACKNOWLEDGEMENTS**

There were several individuals who contributed to, and assisted with, this study and the preparation of this technical summary. Charlie Hall, Project Director of the Texas Department of Transportation, provided guidance and assistance throughout the duration of the study. The contributions of our colleagues at the Texas Transportation Institute are appreciated. Jason Beesinger assisted in data processing and analysis. Ed Hard provided guidance and technical support. Dr. Dennis Perkinson provided supplemental data required in the survey analysis. Finally, Gary Lobaugh helped in the production of this report.



## TABLE OF CONTENTS

List of Figures .....	vii
List of Tables .....	ix
Introduction.....	1
Survey Methodology.....	2
Survey Summaries .....	2
Vehicle Characteristics .....	2
Trip Frequency.....	12
Trip Characteristics.....	17
Surveyed Cargo Characteristics.....	30
Trip Length Characteristics.....	35
Travel Time and Speed Characteristics .....	40
Trip Tour Characteristics .....	50
Survey Expansion .....	57
Data Comparison .....	61
Conclusions.....	62
References.....	63
Appendix.....	65





## LIST OF FIGURES

Figure 1.	Amarillo Study Area.....	1
Figure 2.	Distribution of Registered Trucks by Age.....	4
Figure 3.	Distribution of Surveyed Vehicles by Age and Average Odometer Reading. ....	9
Figure 4.	Distribution of Surveyed Vehicles by Vehicle Classification. ....	10
Figure 5.	Distribution of Surveyed Vehicles by Commercial Type.....	10
Figure 6.	Distribution of Surveyed Vehicles by Fuel Type. ....	11
Figure 7.	Percent of Total and Average Number of Internal Trips By Vehicle Classification. ....	15
Figure 8.	Percent of Total and Average Number of Internal Trips by Commercial Type.....	16
Figure 9.	Distribution of Trip Purposes at Destination. ....	21
Figure 10.	Trip Purposes at Destination by Small and Medium Vehicles. ....	23
Figure 11.	Trip Purpose at Destination by Large Vehicles. ....	25
Figure 12.	Trip Purpose at Destination by Cargo or Freight.....	27
Figure 13.	Trip Purpose at Destination by Local Services.....	29
Figure 14.	Cargo Weight at Pick-up and Drop-off. ....	31
Figure 15.	Trip Length Frequency Distribution by Vehicle Classification. ....	36
Figure 16.	Trip Length Frequency Distribution by Commercial Vehicle Type. ....	37
Figure 17.	Frequency Distribution of Travel Time by Vehicle Classification. ....	42
Figure 18.	Frequency Distribution of Travel Time by Commercial Vehicle Type. ....	42
Figure 19.	Distribution of Trips within Trip Tours by Trip Type.....	53



## LIST OF TABLES

Table 1.	Distribution of Registered Trucks by Age.....	3
Table 2.	Distribution of Registered Diesel Trucks by Model Year and Gross Vehicle Weight.....	5
Table 3.	Distribution of Registered Gasoline Trucks by Model Year and Gross Vehicle Weight.....	6
Table 4.	Distribution of Surveyed Vehicles by Model Year and Gross Vehicle Weight.....	7
Table 5.	Distribution of Surveyed Vehicles by Age and Average Odometer Reading.....	8
Table 6.	Distribution of Surveyed Vehicles by Classification.....	9
Table 7.	Distribution of Surveyed Vehicles by Total Number of Trips.....	12
Table 8.	Frequency of Internal and External Trips.....	13
Table 9.	Distribution of Surveyed Vehicles by Total Number of Internal Trips.....	14
Table 10.	Distribution of Trip Origins and Destinations by Land Use Type.....	17
Table 11.	Distribution of Trips by Vehicle Classification.....	18
Table 12.	Distribution of Trips by Commercial Vehicle Type.....	19
Table 13.	Trip Purposes by Origin and Destination Summary.....	20
Table 14.	Distribution of Trip Purposes at Origin and Destination by Small and Medium Vehicles.....	22
Table 15.	Distribution of Trip Purposes at Origin and Destination by Large Vehicles.....	24
Table 16.	Distribution of Trip Purposes at Origin and Destination by Cargo or Freight.....	26
Table 17.	Distribution of Trip Purposes at Origin and Destination by Local Services.....	28
Table 18.	Distribution of Surveyed Cargo by Origin and Destination.....	30
Table 19.	Distribution of Cargo Weight at Pick Up and Drop Off Locations.....	31
Table 20.	Equivalency between SAM Commodity Groups and Survey Classifications.....	32
Table 21.	Equivalency between Land Use Category and Survey Type of Place Options.....	32
Table 22.	Distribution of Trips at the Destination by Commodity Group and Land Use.....	33
Table 23.	Average Cargo Weight at Drop Off by Commodity Group and Land Use.....	34
Table 24.	Average Cargo Weight at Pick Up by Commodity Group and Land Use.....	34
Table 25.	Trip Length Frequency Distribution by Vehicle Classification.....	35
Table 26.	Trip Length Frequency Distribution by Commercial Vehicle Type.....	36
Table 27.	Trip Length Frequency Distribution (Ungrouped).....	37
Table 28.	Mean Trip Length to Destination by Land Use Type and Vehicle Classification.....	38
Table 29.	Mean Trip Length to Destination by Land Use Type and Commercial Vehicle Type.....	39
Table 30.	Mean Trip Length by Commodity Group.....	40
Table 31.	Frequency Distribution of Travel Time by Vehicle Classification.....	41
Table 32.	Frequency Distribution of Travel Time by Commercial Vehicle Type.....	41
Table 33.	Frequency Distribution of Travel Time (Ungrouped).....	43
Table 34.	Mean Travel Time to Destination by Land Use Type and Vehicle Classification.....	44
Table 35.	Mean Travel Time to Destination by Land Use Type and Commercial Vehicle Type.....	45
Table 36.	Mean Travel Time by Commodity Group.....	46
Table 37.	Mean Travel Speed to Destination by Land Use Type and Vehicle Classification.....	47
Table 38.	Mean Travel Speed to Destination by Land Use Type and Commercial Vehicle Type.....	48
Table 39.	Mean Travel Speed by Commodity Group.....	49

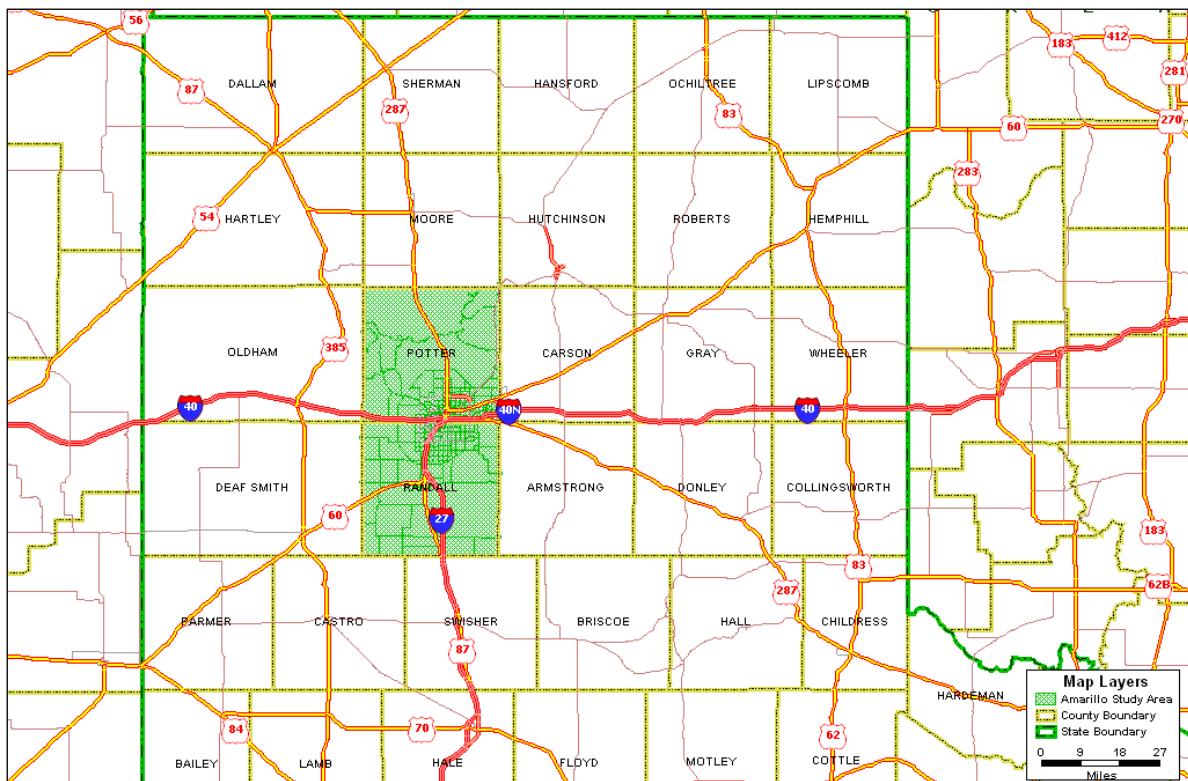
Table 40.	Number of Base and Non-Base Trips by Vehicle Classification. ....	50
Table 41.	Number and Percent of Trip Tours per Vehicle. ....	51
Table 42.	Number and Percent of Trip Tours by Vehicle Classification. ....	51
Table 43.	Number and Percent of Trip Tours by Commercial Vehicle Type. ....	52
Table 44.	Number and Percent of Non-Base Trips within Trip Tours. ....	54
Table 45.	Number and Percent of External Trips within Trip Tours.....	55
Table 46.	Number and Percent of Inter-Zonal Trips within Trip Tours.....	56
Table 47.	Number and Percent of Intra-Zonal trips within Trip Tours. ....	57
Table 48.	2005 HPMS Estimates of Weekday VMT in Amarillo Study Area.....	58
Table 49.	Vehicle Classification Counts by Functional Classification. ....	59
Table 50.	Estimated VMT for Commercial and Non-Commercial Vehicles. ....	60
Table 51.	Commercial Vehicle Survey Data Comparison.....	61

## INTRODUCTION

In 2005, the Texas Department of Transportation (TxDOT) funded a Commercial Vehicle Survey in the Amarillo Metropolitan Planning Organization (MPO) study area. The purpose of this survey was to provide data that would enable TxDOT to forecast total commercial vehicle travel demand within the urban area.

This report presents a Technical Summary of the 2005 Amarillo Commercial Vehicle Survey and documents the data collected and the analysis results for the study area. The survey forms used are presented in the Appendix.

The Amarillo Study Area is located in the Panhandle area of Texas. The study area covers Potter and Randall counties (see Figure 1), with total land area of 1,824 square miles, and population density of approximately 119 persons per square mile. The city of Amarillo is the study area's population center, with an estimated population of 173,627 based on the 2000 Census.



**Figure 1. Amarillo Study Area.**

## **SURVEY METHODOLOGY**

The Commercial Vehicle Survey was conducted during the Spring of 2005 (February – March). A total of 258 commercial vehicles were surveyed. Field observations were conducted to identify companies operating qualifying commercial vehicles in the study area. The information was then used to supplement the Vehicle Registration, Motor Carrier and Employer databases provided by TxDOT. The combined database was sorted according to a list of random numbers assigned to each record to ensure a random sample (ATG, 2006).

## **SURVEY SUMMARIES**

### **Vehicle Characteristics**

As part of the survey, sample data on the year, make and model, odometer reading, classification, commercial vehicle type, and type of fuel use were collected to examine the characteristics and condition of commercial vehicles traveling within the study area.

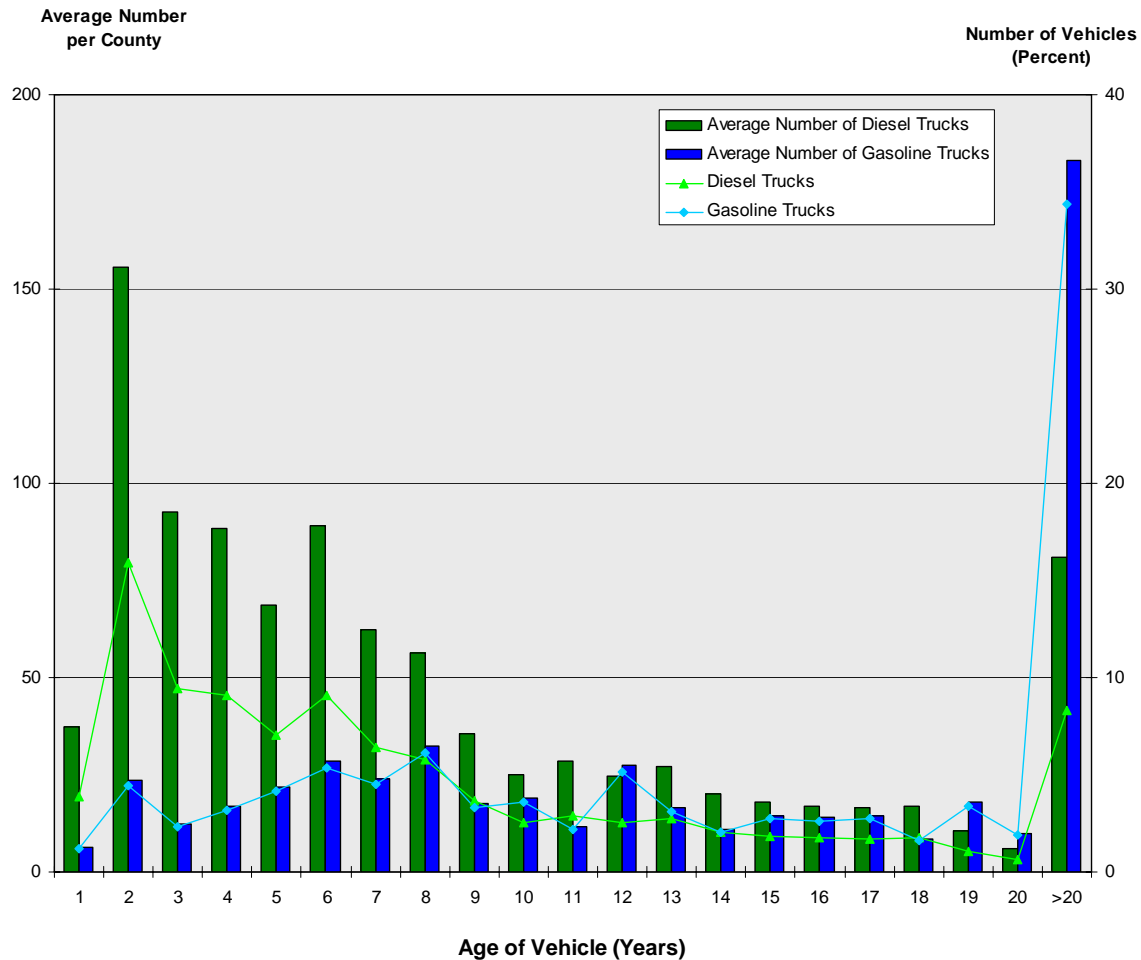
In 2005, there were 1,954 diesel-fueled trucks and 1,064 gasoline-fueled trucks registered in the study area. Approximately 73 percent of the diesel trucks were between 1 and 10 years old, 19 percent were between 11 and 20 years and 8 percent were over 20 years old. For gasoline trucks, 38 percent were between 1 and 10 years old, 28 percent were between 11 and 20 years and 34 percent were above 20 years. Figure 2 shows the distribution of registered trucks in the study area by age (based on the model year).

Table 1 and Figure 2 show the distribution of registered trucks in the study area and average per county by age (based on the model year).

**Table 1. Distribution of Registered Trucks by Age.**

Model Year	Age of Vehicle (Years)	Diesel Trucks	Percent of Total	Gasoline Trucks	Percent of Total	Average Number of Trucks Registered per County	
						Diesel	Gasoline
2006	1	75	3.8	13	1.2	38	7
2005	2	311	15.9	47	4.4	156	24
2004	3	185	9.5	25	2.3	93	13
2003	4	177	9.1	34	3.2	89	17
2002	5	137	7.0	44	4.1	69	22
2001	6	178	9.1	57	5.4	89	29
2000	7	125	6.4	48	4.5	63	24
1999	8	113	5.8	65	6.1	57	33
1998	9	71	3.6	35	3.3	36	18
1997	10	50	2.6	38	3.6	25	19
1996	11	57	2.9	23	2.2	29	12
1995	12	49	2.5	55	5.2	25	28
1994	13	54	2.8	33	3.1	27	17
1993	14	40	2.1	22	2.1	20	11
1992	15	36	1.8	29	2.7	18	15
1991	16	34	1.7	28	2.6	17	14
1990	17	33	1.7	29	2.7	17	15
1989	18	34	1.7	17	1.6	17	9
1988	19	21	1.1	36	3.4	11	18
1987	20	12	0.6	20	1.9	6	10
Older	>20	162	8.3	366	34.4	81	183
<b>Total</b>		<b>1,954</b>	<b>100.0</b>	<b>1,064</b>	<b>100.0</b>	<b>977</b>	<b>532</b>

Source: TxDOT, 2006



**Figure 2. Distribution of Registered Trucks by Age.**

Tables 2 and 3 provide the distribution of registered diesel trucks and gasoline trucks in the study area by gross vehicle weight. Nearly half of the diesel trucks (47 percent) had a gross vehicle weight between 8,500 pounds and 10,000 pounds; 18 percent weighed between 10,000 pounds and 19,500 pounds; and 31 percent weighed more than 19,500 pounds but not more than 60,000 pounds. Only 3 percent of the trucks weighed more than 60,000 pounds. For gasoline trucks, approximately 40 percent had a gross vehicle weight between 8,500 pounds and 10,000 pounds; 39 percent weighed between 10,000 pounds and 19,500 pounds; and 21 percent weighed more than 19,500 pounds but not more than 60,000 pounds.



**Table 2. Distribution of Registered Diesel Trucks by Model Year and Gross Vehicle Weight.**

Model Year	Number of Diesel Trucks by Gross Vehicle Weight (Thousand Lbs.)									Percent of Total
	>8.5	>10	>14	>16	>19.5	>26	>33	>60	Total	
2006	42	6	2	4	6	3	6	6	75	3.8
2005	246	14	10	1	24	3	8	5	311	15.9
2004	152	9	9	1	11	1	2	0	185	9.5
2003	130	16	4	4	15	2	3	3	177	9.1
2002	101	8	2	3	11	3	7	2	137	7.0
2001	79	14	32	4	38	3	8	0	178	9.1
2000	49	20	7	4	24	6	7	8	125	6.4
1999	49	17	10	8	13	6	8	2	113	5.8
1998	21	7	6	5	17	6	5	4	71	3.6
1997	14	3	4	3	8	6	11	1	50	2.6
1996	13	10	3	3	13	5	9	1	57	2.9
1995	5	13	3	3	7	5	7	6	49	2.5
1994	5	16	1	1	7	9	14	1	54	2.9
1993	4	8	1	0	7	3	14	3	40	2.1
1992	5	5	4	2	8	3	9	0	36	1.8
1991	3	5	2	2	10	4	8	0	34	1.7
1990	1	5	1	0	4	5	16	1	33	1.7
1989	3	3	2	1	12	2	9	2	34	1.7
1988	2	3	0	1	5	3	7	0	21	1.1
1987	0	2	1	1	2	1	2	3	12	0.6
1986	0	1	0	2	4	1	6	4	18	0.9
1985	0	2	0	0	2	2	8	4	18	0.9
1984	1	0	0	1	4	7	20	3	36	1.8
1983	0	0	1	0	2	0	1	2	6	0.3
1982	2	2	0	0	3	2	2	1	12	0.6
1981	0	0	0	0	4	0	3	2	9	0.5
Older	0	0	1	2	7	10	41	2	63	3.2
<b>Total</b>	<b>927</b>	<b>189</b>	<b>106</b>	<b>56</b>	<b>268</b>	<b>101</b>	<b>241</b>	<b>66</b>	<b>1,954</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>47.4</b>	<b>9.7</b>	<b>5.4</b>	<b>2.9</b>	<b>13.7</b>	<b>5.2</b>	<b>12.3</b>	<b>3.4</b>	<b>100.0</b>	

Source: TxDOT, 2006.

**Table 3. Distribution of Registered Gasoline Trucks by Model Year and Gross Vehicle Weight.**

Model Year	Number of Gasoline Trucks by Gross Vehicle Weight (Thousand Lbs.)								Total	Percent of Total
	>8.5	>10	>14	>16	>19.5	>26	>33	>60		
2006	11	0	0	0	2	0	0	0	13	1.2
2005	35	7	2	1	1	1	0	0	47	4.4
2004	14	9	2	0	0	0	0	0	25	2.3
2003	20	8	5	1	0	0	0	0	34	3.2
2002	22	16	2	2	1	0	1	0	44	4.1
2001	31	15	4	3	2	1	1	0	57	5.4
2000	24	10	6	1	1	5	1	0	48	4.5
1999	31	21	5	4	2	2	0	0	65	6.1
1998	20	5	1	3	4	2	0	0	35	3.3
1997	12	16	5	1	2	2	0	0	38	3.6
1996	16	2	0	1	3	0	1	0	23	2.2
1995	31	10	1	0	5	3	5	0	55	5.2
1994	14	9	8	2	0	0	0	0	33	3.1
1993	8	9	2	1	1	0	1	0	22	2.1
1992	14	6	1	0	6	1	0	1	29	2.7
1991	12	8	1	1	4	1	0	1	28	2.6
1990	11	4	3	3	5	3	0	0	29	2.7
1989	6	4	3	1	0	2	1	0	17	1.6
1988	19	6	1	3	6	1	0	0	36	3.4
1987	5	4	2	4	4	0	0	1	20	1.9
1986	6	3	3	4	7	2	0	1	26	2.4
1985	8	2	1	2	9	0	1	0	23	2.2
1984	9	2	1	1	5	1	2	0	21	2.0
1983	3	3	1	1	2	2	0	0	12	1.1
1982	3	9	3	4	8	2	0	0	29	2.7
1981	2	2	0	6	7	2	0	0	19	1.8
Older	35	61	25	28	57	9	21	0	236	22.2
<b>Total</b>	<b>422</b>	<b>251</b>	<b>88</b>	<b>78</b>	<b>144</b>	<b>42</b>	<b>35</b>	<b>4</b>	<b>1,064</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>39.6</b>	<b>23.6</b>	<b>8.3</b>	<b>7.3</b>	<b>13.5</b>	<b>4.0</b>	<b>3.3</b>	<b>0.4</b>	<b>100.0</b>	

Source: TxDOT, 2006.

The surveyed vehicle data shows that only 3.5 percent had a gross vehicle weight between 8,500 pounds and 10,000 pounds; 16 percent weighed between 10,000 pounds and 19,500 pounds; and 30 percent weighed more than 19,500 pounds but not more than 60,000 pounds. Approximately 14 percent of the vehicles had a gross vehicle weight over 60,000 pounds. Approximately 36 percent of the vehicles had an unknown gross vehicle weight. Table 4 shows the distribution of surveyed vehicles in the study area by age and gross vehicle weight.

**Table 4. Distribution of Surveyed Vehicles by Model Year and Gross Vehicle Weight.**

Model Year	Age of Vehicle (Years)	Number of Vehicles by Gross Vehicle Weight (Thousand Lbs.)									
		<8.5	>8.5	>10	>14	>16	>19.5	>26	>33	>60	Unknown
2006	1	0	0	0	0	0	0	0	0	0	0
2005	2	0	0	1	0	0	0	0	1	1	0
2004	3	0	1	1	2	0	0	1	5	0	1
2003	4	0	1	1	0	0	0	0	2	2	1
2002	5	0	0	3	0	0	3	1	0	1	1
2001	6	0	0	2	0	1	4	2	1	3	2
2000	7	0	1	3	1	0	4	1	1	3	0
1999	8	0	3	5	1	0	1	2	1	6	0
1998	9	1	0	1	5	0	2	1	5	5	0
1997	10	0	1	2	0	0	1	3	3	1	2
1996	11	0	0	3	0	0	1	3	2	2	1
1995	12	1	0	3	1	0	1	0	3	3	2
1994	13	0	0	1	0	1	1	2	0	0	0
1993	14	0	0	1	0	0	2	0	0	3	0
1992	15	1	0	1	0	0	1	1	0	0	0
1991	16	0	0	0	0	0	0	0	1	1	1
1990	17	0	0	0	1	1	0	2	1	2	0
1989	18	0	0	1	0	0	0	0	0	1	0
1988	19	0	0	0	0	0	0	0	1	0	0
1987	20	0	0	0	0	0	1	0	0	0	0
Older	>20	0	2	0	0	0	2	1	5	1	0
Unknown		0	0	0	0	0	0	0	0	0	81
<b>Total</b>		<b>3</b>	<b>9</b>	<b>29</b>	<b>11</b>	<b>3</b>	<b>24</b>	<b>20</b>	<b>32</b>	<b>35</b>	<b>92</b>
<b>Percent of Total</b>		<b>1.2</b>	<b>3.5</b>	<b>11.2</b>	<b>4.2</b>	<b>1.2</b>	<b>9.3</b>	<b>7.8</b>	<b>12.4</b>	<b>13.6</b>	<b>35.6</b>

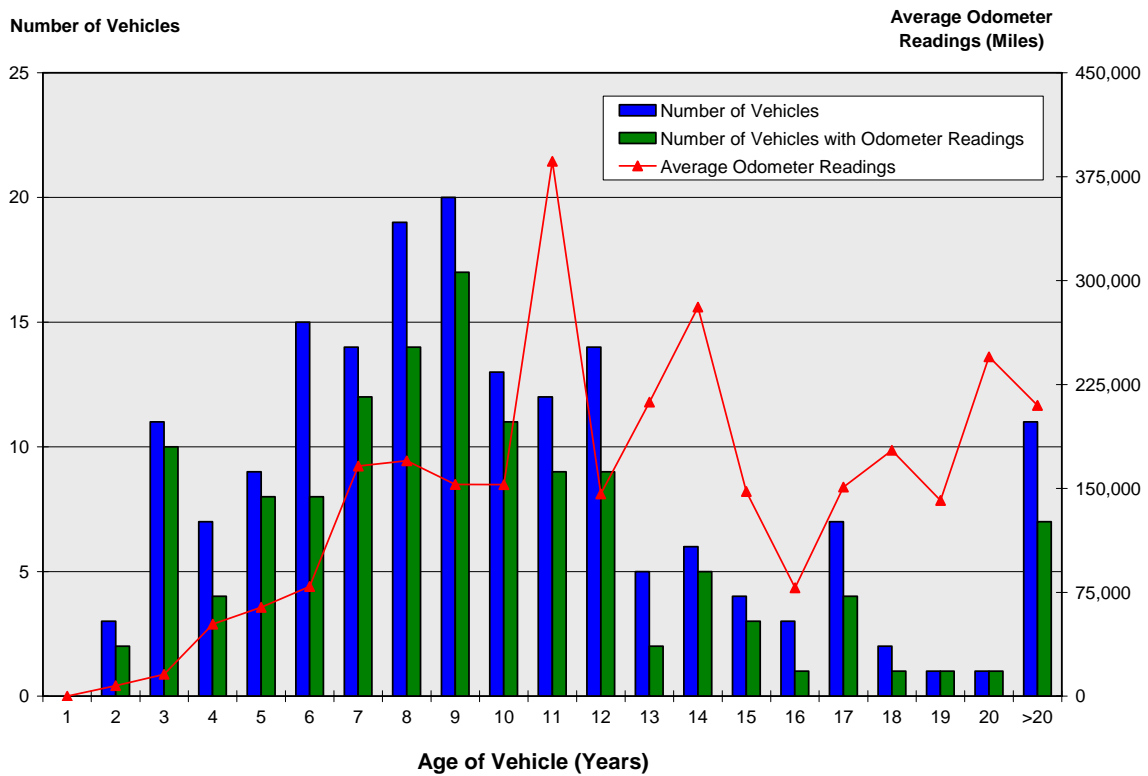
In terms of age (calculated based on the model year of the vehicle), approximately 63 percent of the surveyed vehicles were between 2 and 10 years old, 31 percent were between 11 and 20 years old, and 6 percent were more than 20 years old. The average age of the vehicles was 10 years. About 51 percent of the vehicles (132 trucks) reported odometer readings at the beginning of the trip survey, indicating an average odometer value of 155,002 miles. Table 5 and Figure 3 show the distribution by age and odometer readings.

**Table 5. Distribution of Surveyed Vehicles by Age and Average Odometer Reading.**

Vehicle Age (Years)	Number of Vehicles	Percent of Total <sup>1</sup>	Cumulative Percent of Total	Number of Vehicles that Reported Odometer Readings	Percent of Total	Average of Reported Odometer Readings
2	3	1.7	1.7	2	1.5	7,512
3	11	6.2	7.9	10	7.6	15,885
4	7	4.0	11.9	4	3.0	51,994
5	9	5.1	17.0	8	6.1	64,230
6	15	8.5	25.5	8	6.1	79,168
7	14	7.9	33.4	12	9.1	166,179
8	19	10.7	44.1	14	10.6	169,937
9	20	11.3	55.4	17	12.9	152,891
10	13	7.3	62.7	11	8.3	152,630
11	12	6.8	69.5	9	6.8	386,150
12	14	7.9	77.4	9	6.8	145,972
13	5	2.8	80.2	2	1.5	212,340
14	6	3.4	83.6	5	3.8	280,910
15	4	2.2	85.8	3	2.2	147,719
16	3	1.7	87.5	1	0.8	78,288
17	7	4.0	91.5	4	3.0	150,940
18	2	1.1	92.6	1	0.8	177,530
19	1	0.6	93.2	1	0.8	141,379
20	1	0.6	93.8	1	0.8	245,033
>20	11	6.2	100.0 <sup>1</sup>	7	5.3	209,913
Unknown	81	(31.4) <sup>2</sup>		3	2.2	167,669
<b>Total</b>	<b>258</b>			<b>132</b>	<b>100.0</b>	<b>155,002</b>

<sup>1</sup> Percentage computed out of 177 trucks.

<sup>2</sup> Percentage computed out of total 258 trucks.



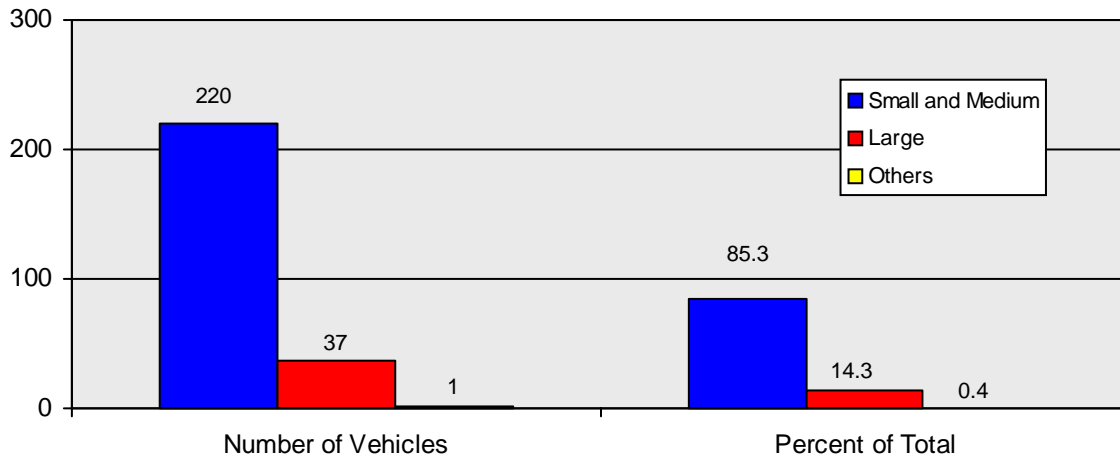
**Figure 3. Distribution of Surveyed Vehicles by Age and Average Odometer Reading.**

Table 6 shows the distribution of surveyed vehicles according to the Texas 6 classification of vehicles system. Approximately 58 percent of the vehicles were single unit, 2-axle vehicles, 27 percent were single unit, 3-axle vehicles, 1 percent were single unit, 4-axle vehicles, and 14 percent were semi tractor-trailers.

**Table 6. Distribution of Surveyed Vehicles by Classification.**

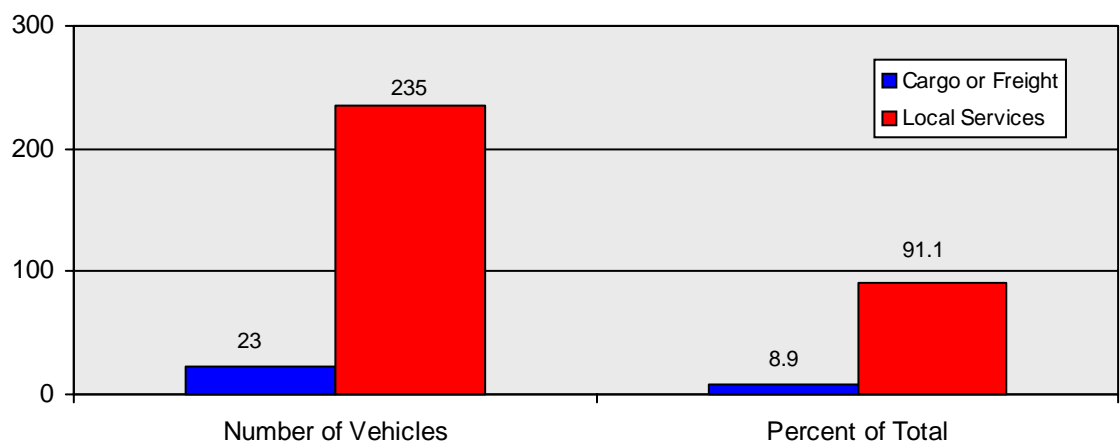
Vehicle Classification	Number of Vehicles	Percent of Total	Cumulative Percent of Total
Single Unit, 2-axle (6 wheels)	149	57.8	57.8
Single Unit, 3-axle (10 wheels)	69	26.7	84.5
Single Unit, 4-axle (14 wheels)	2	0.8	85.3
Semi (all Tractor-Trailer Combinations)	37	14.3	99.6
Other	1	0.4	100.0
<b>Total</b>	<b>258</b>	<b>100.0</b>	

Due to similarities among certain classes of vehicles, the classification groups provided in the previous table were aggregated into three new groups. All of the single unit, multi-axle vehicles were classified as “Small and Medium,” semi/tractor-trailer combinations were classified as “Large,” and any vehicles listed as other were classified as “Other.” Figure 4 shows that nearly 85 percent of the surveyed vehicles were small and medium and 14 percent were large.



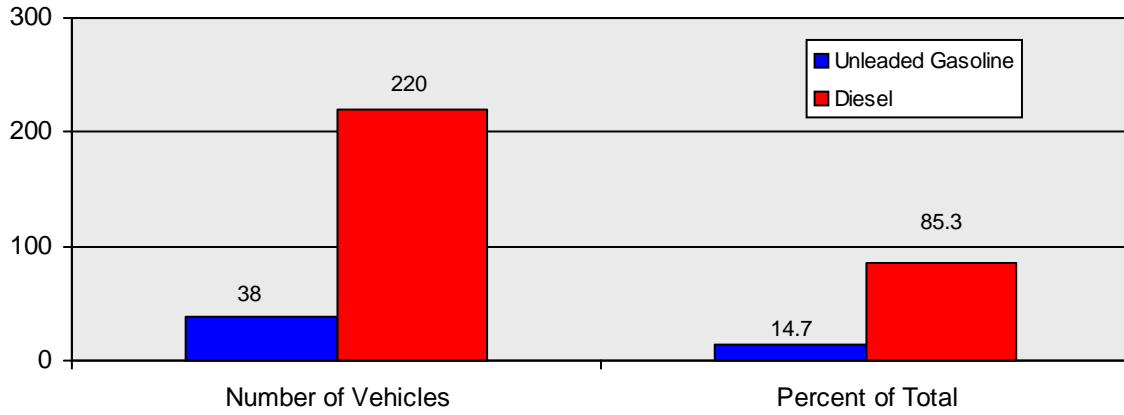
**Figure 4. Distribution of Surveyed Vehicles by Vehicle Classification.**

In terms of commercial type, only 9 percent of the surveyed vehicles were used for cargo or freight transport, and the majority (91 percent) were used for local services (see Figure 5).



**Figure 5. Distribution of Surveyed Vehicles by Commercial Type.**

In terms of type of fuel used by the surveyed vehicles, the majority (85 percent) used diesel, and 15 percent used unleaded gasoline (see Figure 6).



**Figure 6. Distribution of Surveyed Vehicles by Fuel Type.**

## Trip Frequency

Table 7 shows the total number of trips made by the surveyed vehicles. Approximately 13 percent of the vehicles made at least 2 trips. Approximately 42 percent made 5-to-10 trips per day, and nearly a quarter of the vehicles made more than 10 trips per day. Overall, 1,890 trips were generated. These included internal trips as well as external trips.

**Table 7. Distribution of Surveyed Vehicles by Total Number of Trips.**

Number of Trips	Number of Vehicles	Percent of Total	Cumulative Percent of Total	Total Number of Trips	Percent of Total
2	33	12.8	12.8	66	3.5
3	25	9.7	22.5	75	4.0
4	30	11.6	34.1	120	6.4
5	19	7.4	41.5	95	5.0
6	29	11.2	52.7	174	9.2
7	12	4.7	57.4	84	4.4
8	19	7.4	64.8	152	8.0
9	13	5	69.8	117	6.2
10	16	6.2	76.0	160	8.5
11	15	5.8	81.8	165	8.7
12	6	2.3	84.1	72	3.8
13	3	1.2	85.3	39	2.1
14	8	3.1	88.4	112	5.9
15	27	10.4	98.8	405	21.4
16	1	0.4	99.2	16	0.9
19	2	0.8	100.0	38	2.0
<b>Total</b>	<b>258</b>	<b>100</b>		<b>1,890</b>	<b>100.0</b>



Internal trips were those trips made within the study area. These were further distinguished by travel within or between zones; referred to as inter-zonal trips, those trips made from one zone to another, or intra-zonal, trips made within the same zone. External trips were those trips made outside of the study area.

Table 8 shows the distribution of internal and external trips made by the surveyed vehicles. Approximately 93 percent (1,767 trips) of the total trips generated by the vehicles were internal, and the remaining 7 percent (123 trips) were external travel. Of the total internal trips, approximately 91 percent were inter-zonal (or 85 percent of the total trips) and 9 percent were intra-zonal (or 8 percent of the total trips).

**Table 8. Frequency of Internal and External Trips.**

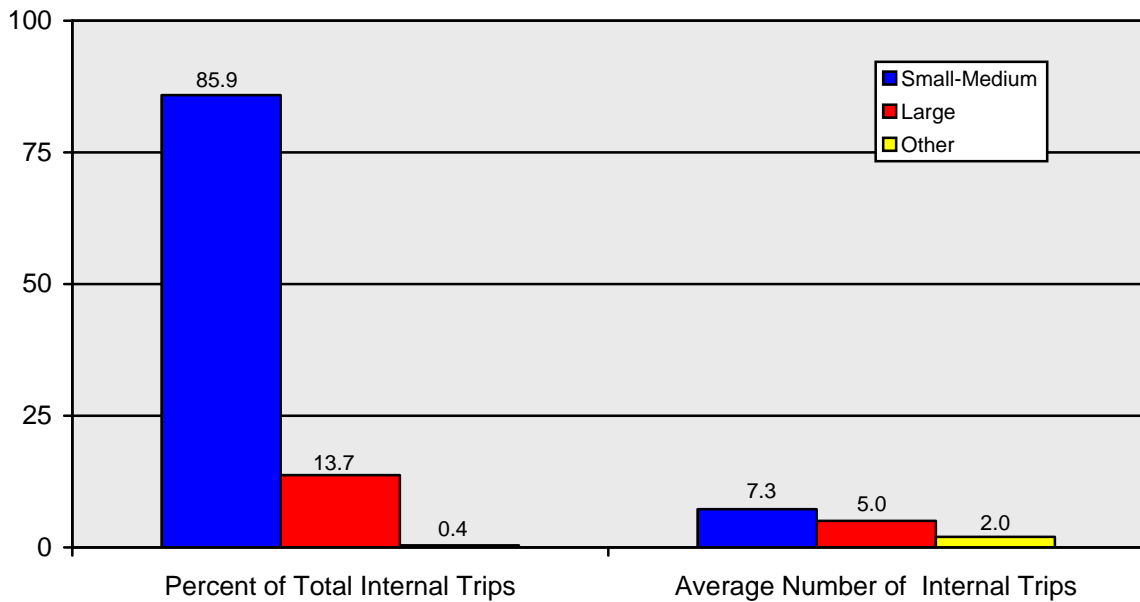
<b>Trip Type</b>	<b>Number of Trips</b>	<b>Percent of Total</b>
Inter-Zonal	1,613	85.3
Intra-Zonal	154	8.2
<b>Total Internal</b>	<b>1,767</b>	<b>93.5</b>
External	123	6.5
<b>Total Trips</b>	<b>1,890</b>	<b>100.0</b>

Table 9 shows the distribution of total number of internal trips. Approximately 4 percent of the surveyed vehicles made 1 internal trip; compared to the 2 trips made at the minimum by approximately 13 percent of the vehicles (see Table 7). This difference is attributable to the inclusion of external trips in Table 7. The distribution of trips changed when external trip counts were excluded, and only internal trips were counted.

**Table 9. Distribution of Surveyed Vehicles by Total Number of Internal Trips.**

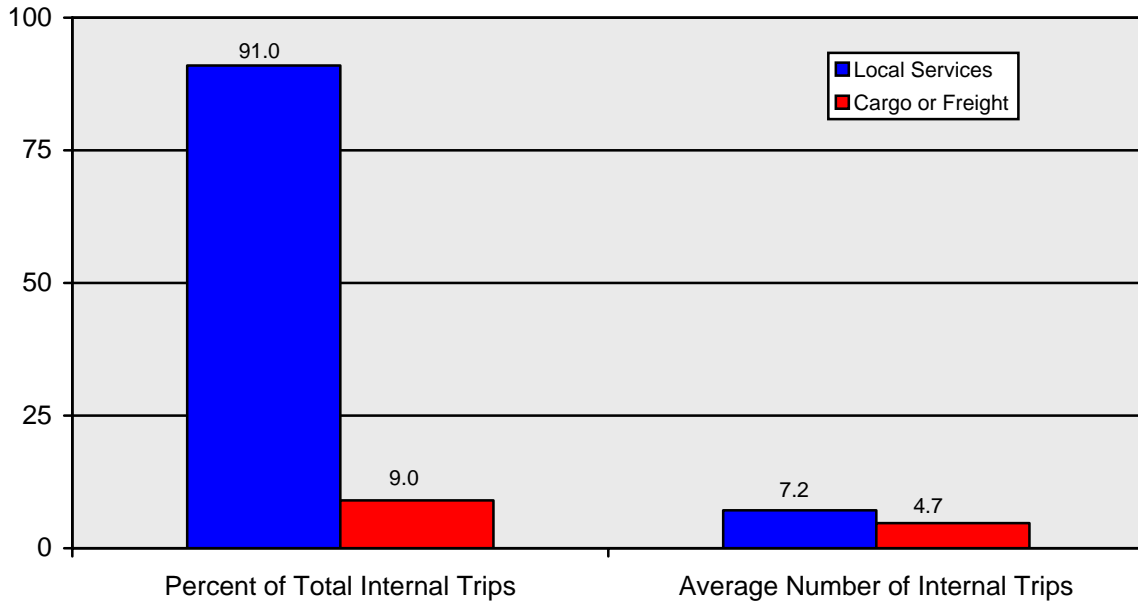
<b>Number of Trips</b>	<b>Total Number of Vehicles</b>	<b>Percent of Total</b>	<b>Cumulative Percent of Total</b>	<b>Total Internal Trips</b>	<b>Percent of Total</b>
1	9	3.5	3.5	9	0.5
2	43	16.8	20.4	86	4.9
3	22	8.6	29.0	66	3.7
4	25	9.8	38.8	100	5.7
5	16	6.3	45.1	80	4.5
6	29	11.4	56.5	174	9.8
7	11	4.3	60.8	77	4.4
8	17	6.7	67.5	136	7.7
9	10	3.9	71.4	90	5.1
10	15	5.9	77.3	150	8.5
11	13	5.1	82.4	143	8.1
12	4	1.6	83.9	48	2.7
13	4	1.6	85.5	52	2.9
14	8	3.1	88.6	112	6.3
15	26	10.2	98.8	390	22.1
16	1	0.4	99.2	16	0.9
19	2	0.8	100.0	38	2.2
<b>Total</b>	<b>255</b>	<b>100.0</b>		<b>1,767</b>	<b>100.0</b>

Figure 7 shows the distribution of internal trips by vehicle classification. Approximately 86 percent of the trips were made by small and medium vehicles, averaging 7 trips per vehicle. For large vehicles, which accounted to approximately 14 percent of the trips, the average number of trips per day was 5.



**Figure 7. Percent of Total and Average Number of Internal Trips By Vehicle Classification.**

Figure 8 shows the distribution of internal trips by commercial type. Only 9 percent of the trips were made for cargo or freight transport, averaging nearly 5 trips per day. The majority (91 percent) of internal trips were made for local services, averaging 7 trips per day.



**Figure 8. Percent of Total and Average Number of Internal Trips by Commercial Type.**

In the succeeding sections, the analyses of trips in terms of land use activity, purpose, and cargo, were focused primarily on internal trips. Trip-related characteristics for vehicles making external trips were only included in the analysis of trip tours presented in a latter section of this report.

## Trip Characteristics

The frequency of trips at origin and destination, as disaggregated by land use type, indicated four most common sites: retail/shopping (21 percent), industrial/manufacturing site (13 percent), construction site (13 percent), and residential (14 percent). These comprised a combined total of approximately 61 percent of the total trips made by the vehicles. Table 10 shows the distribution of trip origins and destinations by land use type. Since the distribution of trips at the origin and destination was similar, the succeeding tables present trips made at the destination only.

**Table 10. Distribution of Trip Origins and Destinations by Land Use Type.**

Land Use Type	Origin	Percent of Total	Destination	Percent of Total
Office Building	21	1.2	18	1.0
Retail/Shopping	367	20.8	379	21.4
Industrial/Manufacturing	224	12.7	228	12.9
Medical/Hospital	27	1.5	27	1.5
Education (12th Grade or Less)	6	0.3	5	0.3
Education (College, Trade)	2	0.1	1	0.1
Government Building	60	3.4	57	3.2
Residential	251	14.2	246	13.9
Airport	1	0.1	1	0.1
Warehouse	113	6.4	114	6.5
Distribution Center	79	4.5	75	4.2
Construction Site	232	13.1	236	13.4
Other	166	9.4	166	9.4
Refused/Unknown	218	12.3	214	12.1
<b>Total</b>	<b>1,767</b>	<b>100.0</b>	<b>1,767</b>	<b>100.0</b>

Table 11 shows the distribution of trips by land use and vehicle classification. Small and medium vehicles made the majority (90 percent) of trip origins and destinations. The remaining 10 percent were by large vehicles.

**Table 11. Distribution of Trips by Vehicle Classification.**

Land Use Type	Small and Medium	Percent of Total	Large	Percent of Total	Other	Percent of Total	Total	Percent of Total
Office Building (Non-Government)	18	1.1	0	0.0	0	0.0	18	1.0
Retail/Shopping	312	19.6	67	38.1	0	0.0	379	21.4
Industrial/Manufacturing	223	14.0	5	2.8	0	0.0	228	12.9
Medical/Hospital	24	1.5	3	1.7	0	0.0	27	1.5
Education (12th Grade or Less)	2	0.1	3	1.7	0	0.0	5	0.3
Education (College, Trade)	1	0.1	0	0.0	0	0.0	1	0.1
Government Office/Building	46	2.9	10	5.6	1	50.0	57	3.2
Residential	235	14.8	11	6.3	0	0.0	246	13.9
Airport	1	0.1	0	0.0	0	0.0	1	0.1
Warehouse	110	6.9	4	2.3	0	0.0	114	6.5
Distribution Center	66	4.2	9	5.1	0	0.0	75	4.2
Construction Site	213	13.4	22	12.5	1	50.0	236	13.4
Other	146	9.2	20	11.4	0	0.0	166	9.4
Refused/Unknown	192	12.1	22	12.5	0	0.0	214	12.1
<b>Total</b>	<b>1,589</b>	<b>100.0</b>	<b>176</b>	<b>100.0</b>	<b>2</b>	<b>100.0</b>	<b>1,767</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>89.9</b>		<b>10.0</b>		<b>0.1</b>		<b>100.0</b>	

By commercial type, only 6 percent of the trips were made for cargo or freight transport and the majority (94 percent) were for local services (see Table 12).

**Table 12. Distribution of Trips by Commercial Vehicle Type.**

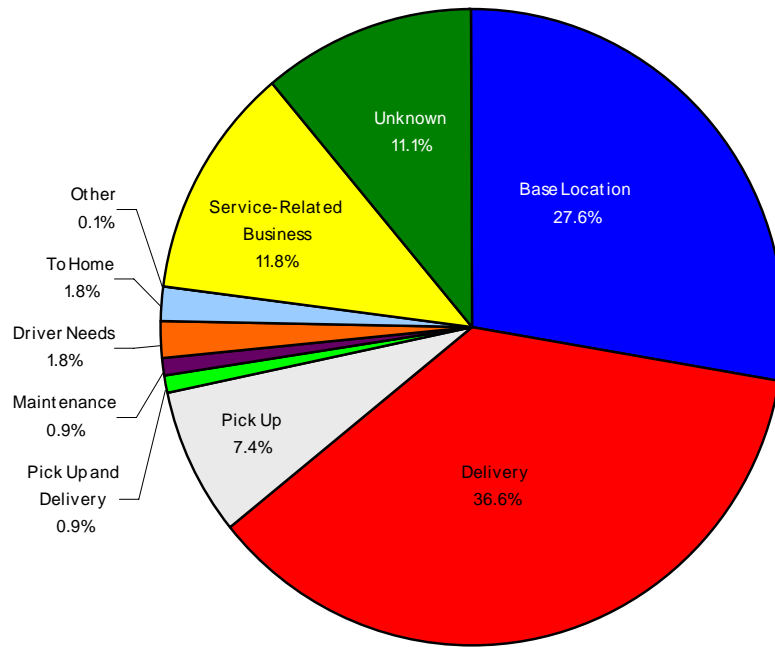
<b>Land Use Type</b>	<b>Cargo or Freight</b>	<b>Percent of Total</b>	<b>Local Services</b>	<b>Percent of Total</b>	<b>Total</b>	<b>Percent of Total</b>
Office Building (Non-Government)	0	0.0	18	1.1	18	1.0
Retail/Shopping	34	31.2	345	20.8	379	21.4
Industrial/Manufacturing	12	11.0	216	13.0	228	12.9
Medical/Hospital	2	1.8	25	1.5	27	1.5
Education (12th Grade or Less)	0	0.0	5	0.3	5	0.3
Education (College, Trade)	0	0.0	1	0.1	1	0.1
Government Office/Building	0	0.0	57	3.4	57	3.2
Residential	13	11.9	233	14.1	246	13.9
Airport	0	0.0	1	0.1	1	0.1
Warehouse	1	0.9	113	6.8	114	6.5
Distribution Center	6	5.5	69	4.1	75	4.2
Construction Site	20	18.4	216	13.0	236	13.4
Other	7	6.4	159	9.6	166	9.4
Refused/Unknown	14	12.9	200	12.1	214	12.1
<b>Total</b>	<b>109</b>	<b>100.0</b>	<b>1,658</b>	<b>100.0</b>	<b>1,767</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>6.2</b>		<b>93.8</b>		<b>100.0</b>	

Table 13 shows a summary of trip purposes at the origin and destination. The results indicated that delivery was the main trip purpose, comprising 31 percent of the trips at the origin and 37 percent of the trips at the destination. Other purposes at the destination consisted mainly of return to base location (28 percent), service-related business (12 percent), and pick up (7 percent). Approximately 11 percent of the trips had unknown purposes (see Figure 9).

**Table 13. Trip Purposes by Origin and Destination Summary.**

Trip Purpose at Origin	Trip Purpose at Destination										Total	Percent of Total
	Base/Return to Base Location	Delivery	Pick Up	Pick Up and Delivery	Maint. (Fuel, Oil, Etc.)	Driver Needs	To Home	Other	Service-Related Business	Unknown		
Base Location/Return to Base Location	74	241	65	3	6	8	5	1	78	181	662	37.5
Delivery	148	354	29	6	3	6	0	0	0	5	551	31.2
Pick Up	30	42	30	1	1	0	1	0	1	4	110	6.2
Pick Up and Delivery	0	7	1	6	0	0	0	0	0	1	15	0.8
Maintenance (Fuel, Oil, Etc.)	8	0	1	0	3	0	0	0	2	0	14	0.8
Driver Needs (Lunch, Etc.)	2	1	4	0	1	0	4	0	15	1	28	1.6
To Home	1	0	0	0	0	4	22	0	2	0	29	1.6
Other	0	0	0	0	0	0	0	0	1	0	1	0.1
Service-Related Business	54	0	0	0	1	13	0	1	111	4	184	10.4
Unknown	171	1	0	0	0	0	0	0	0	1	173	9.8
<b>Total</b>	<b>488</b>	<b>646</b>	<b>130</b>	<b>16</b>	<b>15</b>	<b>31</b>	<b>32</b>	<b>2</b>	<b>210</b>	<b>197</b>	<b>1,767</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>27.6</b>	<b>36.6</b>	<b>7.4</b>	<b>0.9</b>	<b>0.9</b>	<b>1.8</b>	<b>1.8</b>	<b>0.1</b>	<b>11.8</b>	<b>11.1</b>	<b>100.0</b>	



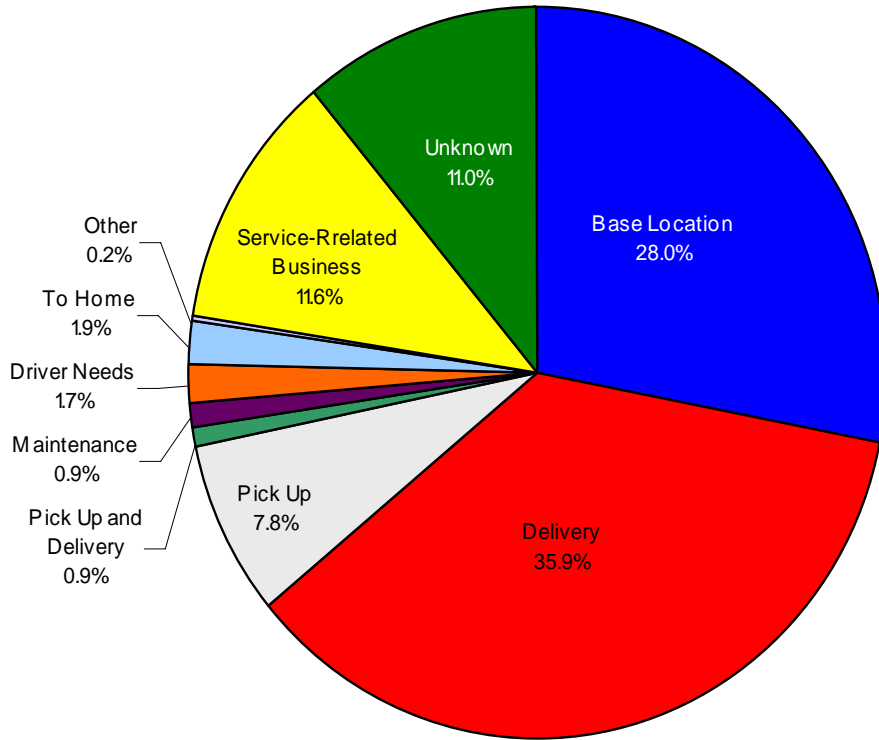


**Figure 9. Distribution of Trip Purposes at Destination.**

By vehicle classification, small and medium vehicles made approximately 36 percent of the trips for delivery, 12 percent for service-related business, and 28 percent for return to base location (see Table 14 and Figure 10). For large vehicles, delivery (43 percent), service-related business (14 percent) and return to base location (24 percent) were the main trip purposes (see Table 15 and Figure 11).

**Table 14. Distribution of Trip Purposes at Origin and Destination by Small and Medium Vehicles.**

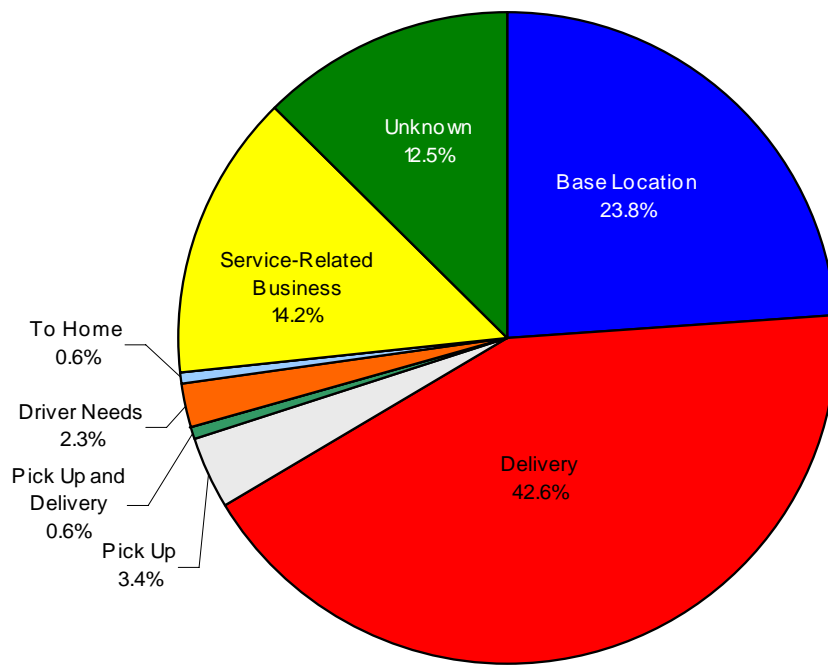
Trip Purpose at Origin	Trip Purpose at Destination (Small and Medium Vehicles)											
	Base/Return to Base Location	Delivery	Pick Up	Pick Up and Delivery	Maint. (Fuel, Oil, Etc.)	Driver Needs	To Home	Other	Service-Related Business	Unknown	Total	Percent of Total
Base Location/Return to Base Location	68	214	62	2	6	7	4	1	71	162	597	37.6
Delivery	138	309	26	6	3	6	0	0	0	4	492	31.0
Pick Up	30	39	30	1	1	0	1	0	1	2	105	6.6
Pick Up and Delivery	0	6	1	6	0	0	0	0	0	1	14	0.8
Maintenance (Fuel, Oil, Etc.)	8	0	1	0	3	0	0	0	2	0	14	0.8
Driver Needs (Lunch, Etc.)	2	1	4	0	1	0	4	0	11	1	24	1.5
To Home	1	0	0	0	0	4	22	0	1	0	28	1.8
Other	0	0	0	0	0	0	0	0	1	0	1	0.1
Service-Related Business	46	0	0	0	1	10	0	1	98	4	160	10.1
Unknown	152	1	0	0	0	0	0	0	0	1	154	9.7
<b>Total</b>	<b>445</b>	<b>570</b>	<b>124</b>	<b>15</b>	<b>15</b>	<b>27</b>	<b>31</b>	<b>2</b>	<b>185</b>	<b>175</b>	<b>1,589</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>28.0</b>	<b>35.9</b>	<b>7.8</b>	<b>0.9</b>	<b>0.9</b>	<b>1.7</b>	<b>2.0</b>	<b>0.2</b>	<b>11.6</b>	<b>11.0</b>	<b>100.0</b>	



**Figure 10. Trip Purposes at Destination by Small and Medium Vehicles.**

**Table 15. Distribution of Trip Purposes at Origin and Destination by Large Vehicles.**

Trip Purpose at Origin	Trip Purpose at Destination (Large Vehicles)											
	Base/Return to Base Location	Delivery	Pick Up	Pick Up and Delivery	Maint. (Fuel, Oil, Etc.)	Driver Needs	To Home	Other	Service-Related Business	Unknown	Total	Percent of Total
Base Location/Return to Base Location	6	26	3	1	0	1	1	0	7	19	64	36.3
Delivery	9	45	3	0	0	0	0	0	0	1	58	33.0
Pick Up	0	3	0	0	0	0	0	0	0	2	5	2.8
Pick Up and Delivery	0	1	0	0	0	0	0	0	0	0	1	0.6
Maintenance (Fuel, Oil, Etc.)	0	0	0	0	0	0	0	0	0	0	0	0.0
Driver Needs (Lunch, Etc.)	0	0	0	0	0	0	0	0	4	0	4	2.3
To Home	0	0	0	0	0	0	0	0	1	0	1	0.6
Other	0	0	0	0	0	0	0	0	0	0	0	0.0
Service-Related Business	8	0	0	0	0	3	0	0	13	0	24	13.6
Unknown	19	0	0	0	0	0	0	0	0	0	19	10.8
<b>Total</b>	<b>42</b>	<b>75</b>	<b>6</b>	<b>1</b>	<b>0</b>	<b>4</b>	<b>1</b>	<b>0</b>	<b>25</b>	<b>22</b>	<b>176</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>23.8</b>	<b>42.6</b>	<b>3.4</b>	<b>0.6</b>	<b>0.0</b>	<b>2.3</b>	<b>0.6</b>	<b>0.0</b>	<b>14.2</b>	<b>12.5</b>	<b>100.0</b>	

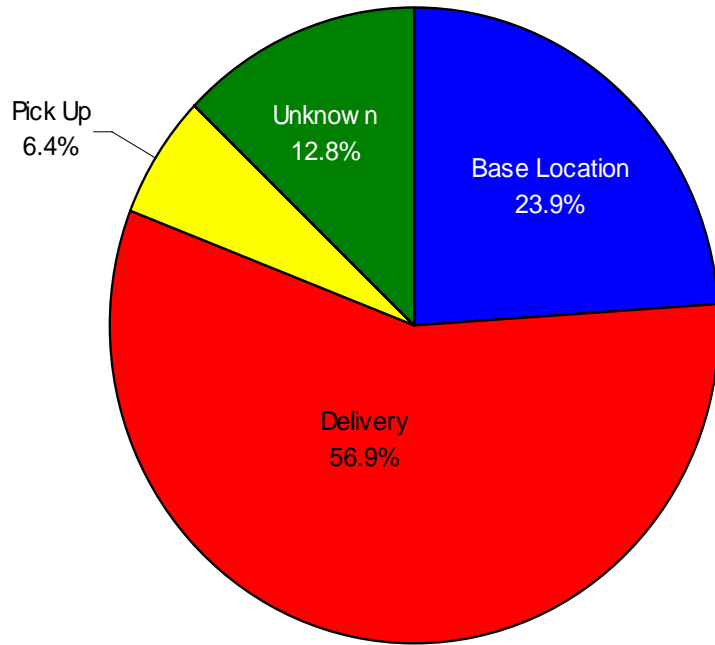


**Figure 11. Trip Purpose at Destination by Large Vehicles.**

By commercial type, the main trip purposes for cargo or freight transport consisted of delivery (57 percent), return to base location (24 percent), unknown trip purposes (13 percent), and pick up (6 percent). For local services, delivery (35 percent), return to base location (28 percent), service-related business purposes (13 percent) and pick up (7 percent) were the main trip purposes, comprising approximately 83 percent of the total trips (see Tables 16 and 17, and Figures 12 and 13).

**Table 16. Distribution of Trip Purposes at Origin and Destination by Cargo or Freight.**

Trip Purpose at Origin	Trip Purpose at Destination (Cargo or Freight)											
	Base/Return to Base Location	Delivery	Pick Up	Pick Up and Delivery	Maint. (Fuel, Oil, Etc.)	Driver Needs	To Home	Other	Service-Related Business	Unknown	Total	Percent of Total
Base Location/Return to Base Location	3	25	3	0	0	0	0	0	0	13	44	40.4
Delivery	12	33	4	0	0	0	0	0	0	0	49	45.0
Pick Up	0	4	0	0	0	0	0	0	0	1	5	4.6
Pick Up and Delivery	0	0	0	0	0	0	0	0	0	0	0	0.0
Maintenance (Fuel, Oil, Etc.)	0	0	0	0	0	0	0	0	0	0	0	0.0
Driver Needs (Lunch, Etc.)	0	0	0	0	0	0	0	0	0	0	0	0.0
To Home	0	0	0	0	0	0	0	0	0	0	0	0.0
Other	0	0	0	0	0	0	0	0	0	0	0	0.0
Service-Related Business	0	0	0	0	0	0	0	0	0	0	0	0.0
Unknown	11	0	0	0	0	0	0	0	0	0	11	10.0
<b>Total</b>	<b>26</b>	<b>62</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>14</b>	<b>109</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>23.9</b>	<b>56.9</b>	<b>6.4</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>12.8</b>	<b>100.0</b>	

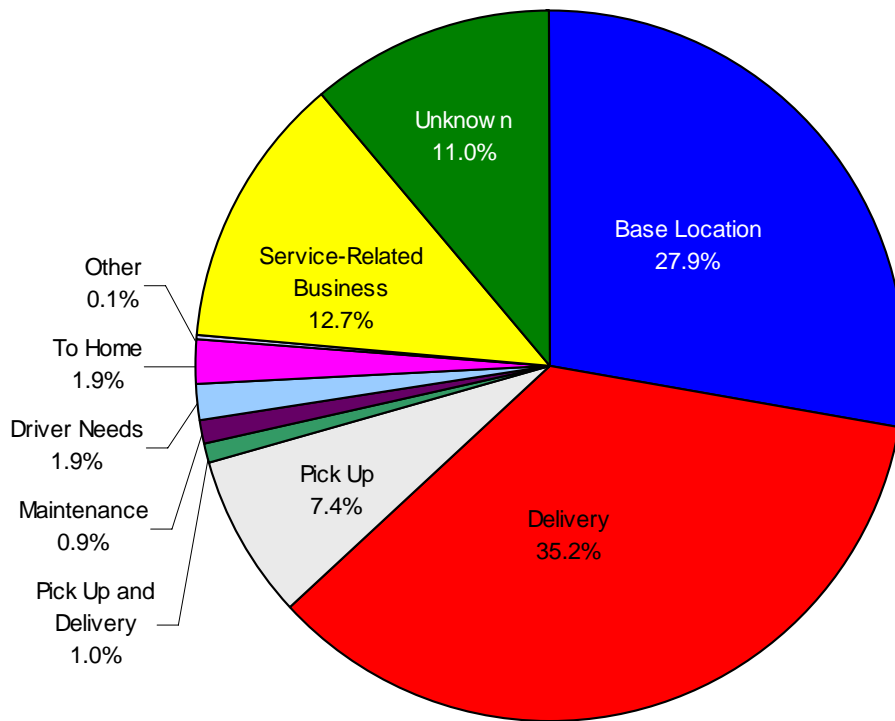


**Figure 12. Trip Purpose at Destination by Cargo or Freight.**

**Table 17. Distribution of Trip Purposes at Origin and Destination by Local Services.**

Trip Purpose at Origin	Trip Purpose at Destination (Local Services)											Percent of Total
	Base/Return to Base Location	Delivery	Pick Up	Pick Up and Delivery	Maint. (Fuel, Oil, Etc.)	Driver Needs	To Home	Other	Service-Related Business	Unknown	Total	
Base Location/Return to Base Location	71	216	62	3	6	8	5	1	78	168	618	37.3
Delivery	136	321	25	6	3	6	0	0	0	5	502	30.3
Pick Up	30	38	30	1	1	0	1	0	1	3	105	6.3
Pick Up and Delivery	0	7	1	6	0	0	0	0	0	1	15	0.9
Maintenance (Fuel, Oil, Etc.)	8	0	1	0	3	0	0	0	2	0	14	0.8
Driver Needs (Lunch, Etc.)	2	1	4	0	1	0	4	0	15	1	28	1.7
To Home	1	0	0	0	0	4	22	0	2	0	29	1.7
Other	0	0	0	0	0	0	0	0	1	0	1	0.1
Service-Related Business	54	0	0	0	1	13	0	1	111	4	184	11.1
Unknown	160	1	0	0	0	0	0	0	0	1	162	9.8
<b>Total</b>	<b>462</b>	<b>584</b>	<b>123</b>	<b>16</b>	<b>15</b>	<b>31</b>	<b>32</b>	<b>2</b>	<b>210</b>	<b>183</b>	<b>1,658</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>27.9</b>	<b>35.2</b>	<b>7.4</b>	<b>1.0</b>	<b>0.9</b>	<b>1.9</b>	<b>1.9</b>	<b>0.1</b>	<b>12.7</b>	<b>11.0</b>	<b>100.0</b>	





**Figure 13. Trip Purpose at Destination by Local Services.**

## Surveyed Cargo Characteristics

Survey respondents were asked to provide the type of cargo being delivered or picked up at each stop. Approximately 30 percent of the trips at origin and destination were reported to have empty cargo, and 16 percent were unclassified cargo. The surveyed cargo mainly consisted of manufactured goods or equipment (20 percent), food, health, and beauty products (14 percent), and clay, concrete, glass, or stone (7 percent). Table 18 shows a breakdown of the surveyed cargo at the origin and destination locations.

**Table 18. Distribution of Surveyed Cargo by Origin and Destination.**

Cargo Type	Number of Trips at Origin	Percent of Total	Number of Trips at Destination	Percent of Total
Forest Products	1	0.1	1	0.1
Metals and Minerals	25	1.4	24	1.4
Food, Health, and Beauty Products	241	13.6	249	14.1
Textiles	8	0.5	8	0.5
Wood Products	54	3.1	51	2.8
Chemical Products	17	1.0	17	1.0
Refined Petroleum or Coal Products	20	1.1	19	1.1
Clay, Concrete, Glass, or Stone	126	7.1	123	7.0
Manufactured Goods/Equipment	358	20.2	353	20.0
Wastes	53	3.0	58	3.2
Miscellaneous	22	1.2	22	1.2
Transportation	11	0.6	11	0.6
Unclassified/Other Cargo	277	15.7	279	15.8
Driver Refused to Answer	17	1.0	18	1.0
Unknown to Driver	1	0.1	1	0.1
Empty	536	30.3	533	30.1
<b>Total</b>	<b>1,767</b>	<b>100.0</b>	<b>1,767</b>	<b>100.0</b>

Data on cargo weights at pick up and at drop off locations were also collected but the results indicated no data responses on the majority of trips (93 percent at pick up and 81 percent at drop off). This no response issue was recognized during data review, but was not resolved despite attempts made by field personnel to obtain the missing information (ATG, 2006).

On trips where cargo weights were reported, the data revealed that the majority (60 percent at pick up and 83 percent at drop off locations) had cargo weights less than 10,000 pounds. Figure 14 and Table 19 show the distribution of cargo weights.

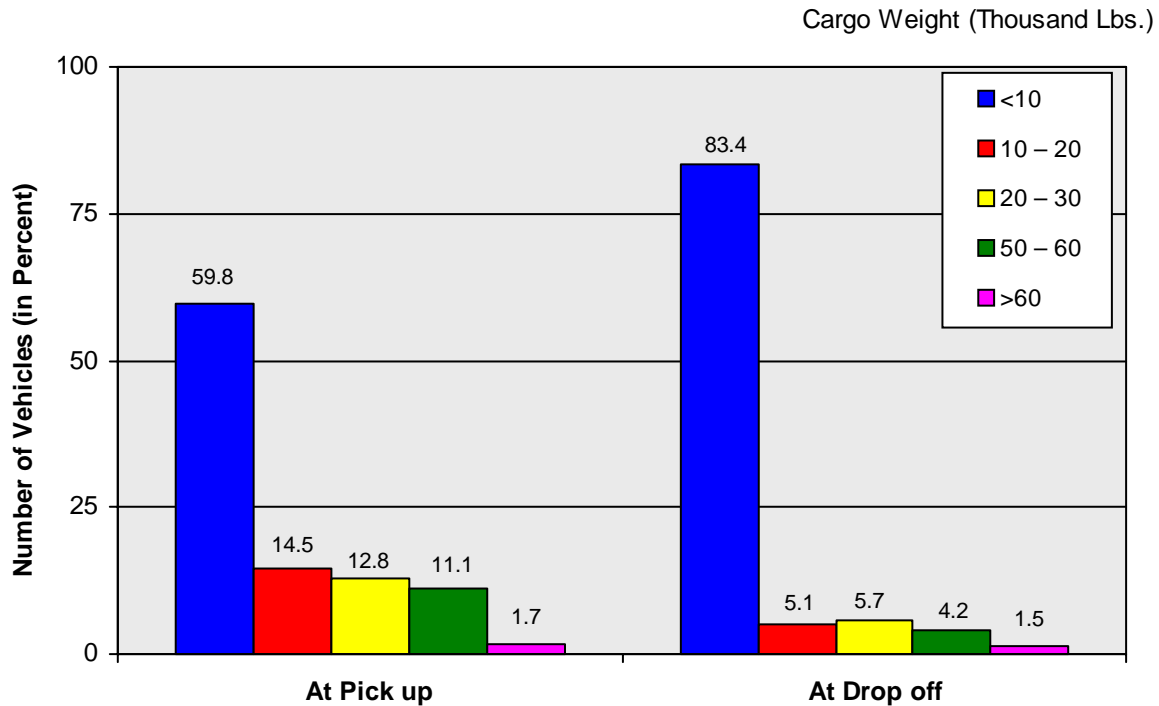


Figure 14. Cargo Weight at Pick-up and Drop-off.

Table 19. Distribution of Cargo Weight at Pick Up and Drop Off Locations.

Cargo Weight (Lbs.)	Number of Trips at Pick Up	Percent of Total	Number of Trips at Drop Off	Percent of Total
<10,000	70	59.8	276	83.4
10,000 – 20,000	17	14.6	17	5.1
20,000 – 30,000	15	12.8	19	5.8
30,000 – 40,000	0	0.0	0	0.0
40,000 – 50,000	0	0.0	0	0.0
50,000 – 60,000	13	11.1	14	4.2
>60,000	2	1.7	5	1.5
<b>Total</b>	<b>117</b>	<b>100.0</b>	<b>331</b>	<b>100.0</b>

In the analysis of surveyed cargo, the cargo classification was grouped according to the Texas Statewide Analysis Model (SAM) commodity groups (see Table 20), and the land use types were grouped into eight land use categories (see Table 21) to determine the distribution of trips and average cargo weights by commodity group and land use.

**Table 20. Equivalency between SAM Commodity Groups and Survey Classifications.**

<b>Commodity Group</b>	<b>Survey Cargo Classification</b>
Agriculture	Farm Products, Forest Products, Marine Products
Raw Materials	Metals and Minerals, Chemical Products, Refined Petroleum, or Coal Products
Food	Food, Health and Beauty Products, Tobacco Products
Textiles	Textiles, Rubber, Plastic, and Styrofoam Products
Wood	Wood Products, Printed Matter
Building Materials	Clay, Concrete, Glass, or Stone Products
Machinery	Manufactured Goods/Equipment
Miscellaneous	Wastes, Miscellaneous Shipments
Secondary	Unclassified Cargo
Hazardous Materials	Hazardous Materials
<i>Transportation</i>	<i>Transportation</i>
<i>Empty</i>	<i>Empty</i>
<i>Unknown</i>	<i>Unknown to Driver/ Driver Refused to Answer</i>

**Table 21. Equivalency between Land Use Category and Survey Type of Place Options.**

<b>Land Use Category</b>	<b>Type of Place Options</b>
Office	Office Building
Retail	Retail/Shopping
Industrial	Industrial/Manufacturing
Medical	Medical/Hospital
Education	Educational (12th Grade or Less and College, Trade, Etc.)
Government	Government Office/Building
Residential	Residential
<i>Other</i>	<i>Airport, Inter-modal Facility, Warehouse, Distribution Center, Construction Site, Other</i>

The cargo types (in italics) that did not have equivalents in the commodity grouping were still included in the data processing and analysis. The land use types that did not have equivalents in the category were grouped together as “Other.”

As Table 22 shows, nearly half (46 percent) of the surveyed cargo were attracted to other land use types. Approximately 22 percent were attracted to retail, 14 percent to residential, and 13 percent to industrial land use. By commodity group, machinery (20 percent), secondary (16 percent), and food (14 percent), comprised a combined total of approximately 50 percent of the total trips.

**Table 22. Distribution of Trips at the Destination by Commodity Group and Land Use.**

Commodity Group	Land Use								Total	Percent of Total
	Office	Retail	Ind'l	Med	Edu	Gov't	Res	Other		
Agriculture	0	1	0	0	0	0	0	0	1	0.1
Raw Materials	0	15	10	1	1	3	5	25	60	3.4
Food	2	153	9	6	1	0	1	77	249	14.1
Textile	1	3	2	0	1	0	0	1	8	0.5
Wood	0	12	3	7	1	1	5	22	51	2.8
Building Materials	0	8	18	0	0	3	3	91	123	7.0
Machinery	2	54	33	3	0	3	157	101	353	20.0
Miscellaneous	0	6	18	0	0	3	4	49	80	4.5
Secondary	10	45	38	9	1	14	53	109	279	15.8
Transportation	0	4	7	0	0	0	0	0	11	0.6
Empty	1	73	90	1	1	28	15	324	533	30.1
Unknown	2	5	0	0	0	2	3	7	19	1.1
<b>Total</b>	<b>18</b>	<b>379</b>	<b>228</b>	<b>27</b>	<b>6</b>	<b>57</b>	<b>246</b>	<b>806</b>	<b>1,767</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>1.1</b>	<b>21.5</b>	<b>12.9</b>	<b>1.5</b>	<b>0.3</b>	<b>3.2</b>	<b>13.9</b>	<b>45.6</b>	<b>100.0</b>	

The average weight for all cargo types was estimated at 1,263 pounds at drop off, with building materials showing the highest average cargo weight to residential and other land use types (see Table 23). The average cargo weight at pick up was estimated at 879 pounds, with miscellaneous cargo showing the highest average cargo weight to residential land use type (see Table 24).

**Table 23. Average Cargo Weight at Drop Off by Commodity Group and Land Use.**

Commodity Group	Average Cargo Weight at Drop Off by Land Use (Thousand Lbs.)							
	Office	Retail	Ind'l	Med	Educ	Gov't	Res	Other
Agriculture	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Raw Materials	0.0	0.1	0.1	0.0	9.0	4.4	0.0	0.5
Food	0.1	0.3	0.4	0.3	0.8	0.0	0.0	0.4
Textiles	1.1	0.4	0.6	0.0	1.1	0.0	0.0	0.0
Wood	0.0	0.0	0.0	2.9	0.5	0.0	1.6	0.8
Building Materials	0.0	0.2	0.0	0.0	0.0	2.3	20.0	10.2
Machinery	0.7	0.9	0.1	0.0	0.0	0.0	0.1	4.8
Miscellaneous	0.0	0.0	1.5	0.0	0.0	6.6	0.0	1.1
Secondary	0.3	0.9	0.8	0.2	0.0	0.0	0.9	2.0
Transportation	0.0	9.5	0.5	0.0	0.0	0.0	0.0	0.0
Empty	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6

**Table 24. Average Cargo Weight at Pick Up by Commodity Group and Land Use.**

Commodity Group	Average Cargo Weight at Pick Up by Land Use (Thousand Lbs.)							
	Office	Retail	Ind'l	Med	Educ	Gov't	Res	Other
Agriculture	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Raw Materials	0.0	0.0	0.0	0.0	0.0	0.2	0.0	1.2
Food	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Textile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wood	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.1
Building Materials	0.0	0.0	1.1	0.0	0.0	0.0	0.0	2.9
Machinery	0.0	0.4	0.0	0.0	0.0	1.9	0.1	0.1
Miscellaneous	0.0	0.8	0.1	0.0	0.0	0.0	9.8	3.5
Secondary	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0
Transportation	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0
Empty	0.0	0.1	9.1	0.0	0.0	0.0	0.0	0.1
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	5.6	3.6

## Trip Length Characteristics

Odometer readings at the beginning and end of the trip would have been useful in estimating the trip lengths of external and intra-zonal trips. However, in the survey, only odometer readings at the beginning of the trip were provided. Therefore, trip length, travel time and speed of the internal trips generated by the vehicles were measured based on network travel time, and distance matrices. Only inter-zonal trips (with known trip lengths) were included in the analysis. In this survey, 1,613 inter-zonal trips were made by the vehicles, of which 32 trips had unknown trip lengths and were therefore excluded from the analysis.

Approximately 56 percent of the trips made by the surveyed vehicles had travel distances less than five miles, 26 percent traveled between 6 and 10 miles, 13 percent traveled between 11 and 20 miles, and the remaining 5 percent traveled more than 20 miles. Small and medium vehicles generated approximately 89 percent of the trips and large vehicles accounted for 11 percent of the trips. By commercial type, only 7 percent of the trips were for cargo or freight transport, and the majority (93 percent) were for local services. Tables 25 and 26 provide the trip length frequency distribution by vehicle and commercial types.

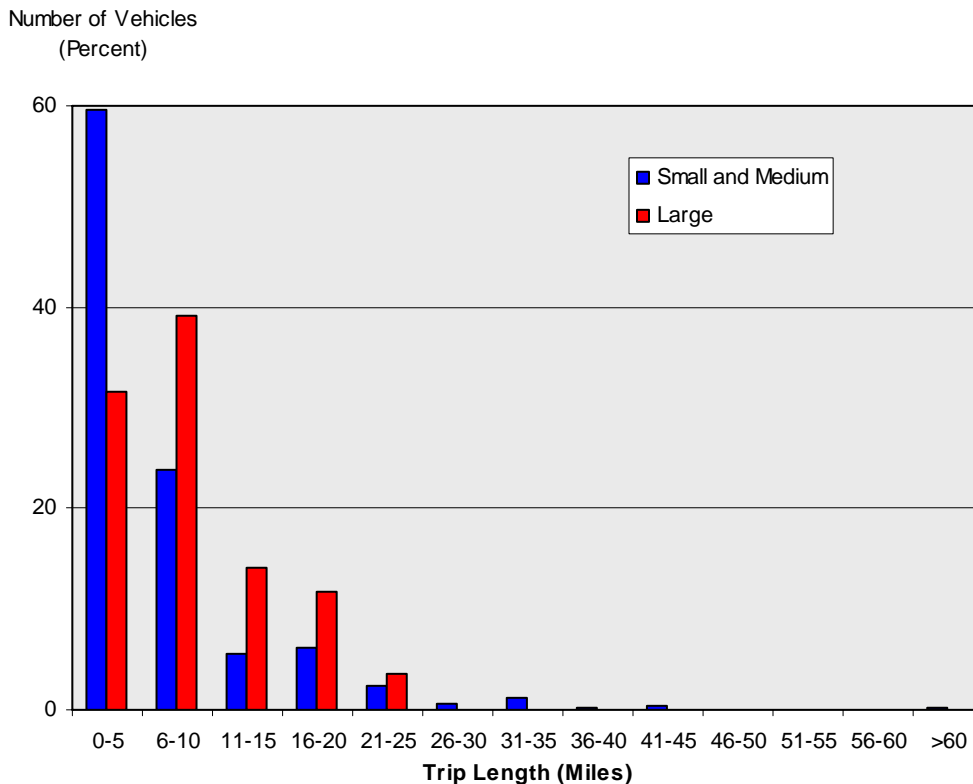
**Table 25. Trip Length Frequency Distribution by Vehicle Classification.**

Trip Length (Miles)	Small and Medium	Percent of Total	Large	Percent of Total	Other	Percent of Total	Total	Percent of Total
0-5	838	59.5	54	31.6	0	0.0	892	56.4
6-10	336	23.9	67	39.2	0	0.0	403	25.5
11-15	79	5.6	24	14.0	0	0.0	103	6.5
16-20	87	6.2	20	11.7	0	0.0	107	6.8
21-25	33	2.3	6	3.5	2	100.0	41	2.6
26-30	8	0.6	0	0.0	0	0.0	8	0.5
31-35	16	1.1	0	0.0	0	0.0	16	1.0
36-40	3	0.2	0	0.0	0	0.0	3	0.2
41-45	5	0.4	0	0.0	0	0.0	5	0.3
>60	3	0.2	0	0.0	0	0.0	3	0.2
<b>Total</b>	<b>1,408</b>	<b>100.0</b>	<b>171</b>	<b>100.0</b>	<b>2</b>	<b>100.0</b>	<b>1,581</b>	<b>100.0</b>

**Table 26. Trip Length Frequency Distribution by Commercial Vehicle Type.**

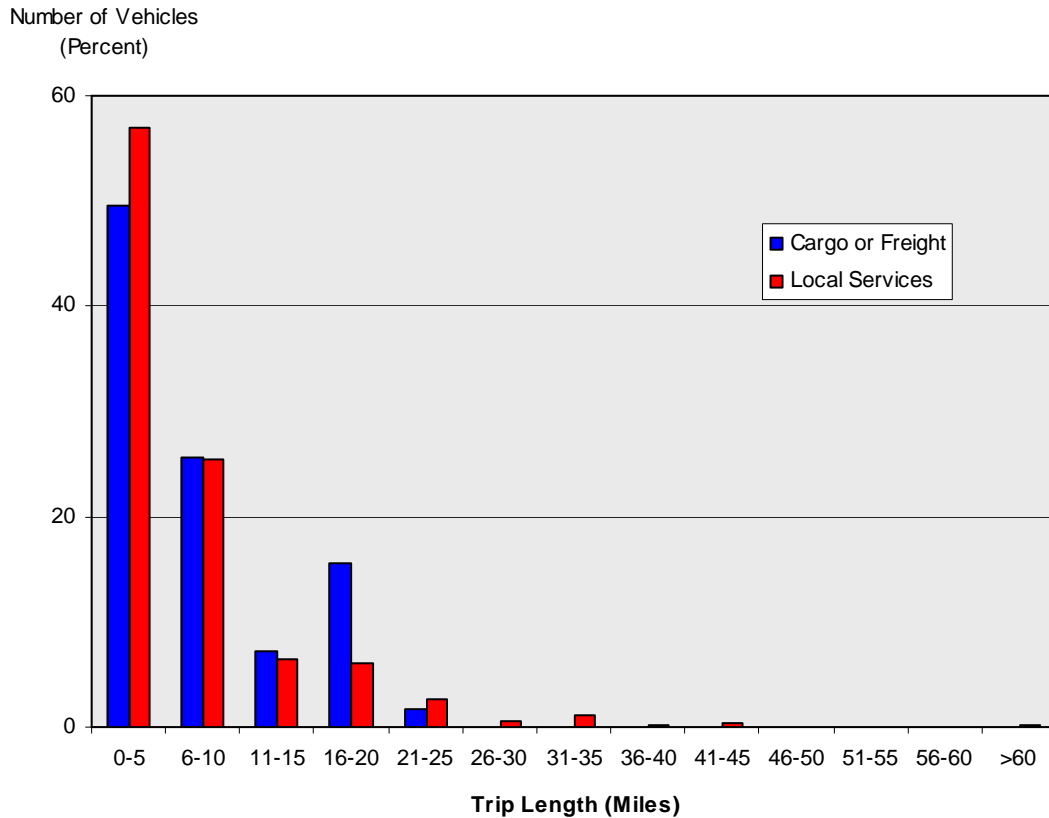
Trip Length (Miles)	Cargo or Freight	Percent of Total	Local Services	Percent of Total	Total	Percent of Total
0-5	54	49.6	838	56.9	892	56.4
6-10	28	25.7	375	25.5	403	25.5
11-15	8	7.3	95	6.5	103	6.5
16-20	17	15.6	90	6.1	107	6.8
21-25	2	1.8	39	2.7	41	2.6
26-30	0	0.0	8	0.5	8	0.5
31-35	0	0.0	16	1.1	16	1.0
36-40	0	0.0	3	0.2	3	0.2
41-45	0	0.0	5	0.3	5	0.3
>60	0	0.0	3	0.2	3	0.2
<b>Total</b>	<b>109</b>	<b>100.0</b>	<b>1,472</b>	<b>100.0</b>	<b>1,581</b>	<b>100.0</b>

Figures 15 and 16 show the distribution of the trip lengths by vehicle classification and commercial types. Table 27 shows the ungrouped trip length frequency distribution.



**Figure 15. Trip Length Frequency Distribution by Vehicle Classification.**





**Figure 16. Trip Length Frequency Distribution by Commercial Vehicle Type.**

**Table 27. Trip Length Frequency Distribution (Ungrouped).**

Trip Length (Miles)	Number of Trips	Percent of Total	Trip Length (Miles)	Number of Trips	Percent of Total	Trip Length (Miles)	Number of Trips	Percent of Total
1	285	18.0	13	17	1.1	25	9	0.6
2	195	12.3	14	15	0.9	28	6	0.4
3	200	12.7	15	23	1.5	29	2	0.1
4	120	7.6	16	36	2.3	31	9	0.6
5	92	5.8	17	14	0.9	32	1	0.1
6	95	6.0	18	10	0.6	33	1	0.1
7	75	4.7	19	12	0.8	34	5	0.3
8	65	4.1	20	35	2.2	38	2	0.1
9	36	2.3	21	11	0.7	39	1	0.1
10	132	8.3	22	5	0.3	43	5	0.3
11	35	2.2	23	13	0.8	61	3	0.2
12	13	0.8	24	3	0.2	<b>Total</b>	<b>1,581</b>	<b>100.0</b>

Overall, average distances traveled by all surveyed vehicles were 7.3 miles, 7 miles for small and medium vehicles, and 10 miles for large vehicles (Table 28).

**Table 28. Mean Trip Length to Destination by Land Use Type and Vehicle Classification.**

Land Use Type	Overall Mean Trip Length (Miles)	Mean Trip Length (Miles)		
		Small and Medium	Large	Other
Office Building (Non-Government)	9.0	9.0		
Retail/Shopping	7.2	7.1	7.8	
Industrial/Manufacturing	5.9	5.8	10.9	
Medical/Hospital	5.2	5.2	4.5	
Education (12th grade or less)	15.8	15.0	16.4	
Education (college, trade )	0.4	0.4		
Government Office/Building	7.7	6.6	10.5	25.6
Residential	6.6	6.3	13.3	
Airport	3.1	3.1		
Warehouse	6.8	6.6	12.1	
Distribution Center	5.8	5.8	5.4	
Construction Site	10.4	10.2	11.1	25.6
Other	7.6	6.9	12.0	
Refused/Unknown	6.8	6.2	11.9	
<b>Average</b>	<b>7.3</b>	<b>7.0</b>	<b>9.9</b>	<b>25.6</b>

By commercial vehicle type, the average travel distance was 7.7 miles for cargo or freight transport and 7.3 miles for local services (Table 29).

**Table 29. Mean Trip Length to Destination by Land Use Type and Commercial Vehicle Type.**

Land Use Type	Overall Mean Trip Length (Miles)	Mean Trip Length (Miles)	
		Cargo or Freight	Local Services
Office Building (Non-Government)	9.0		9.0
Retail/Shopping	7.2	6.4	7.3
Industrial/Manufacturing	5.9	8.4	5.8
Medical/Hospital	5.2	8.8	4.9
Education (12th grade or less)	15.8		15.8
Education (college, trade )	0.4		0.4
Government Office/Building	7.7		7.7
Residential	6.6	7.9	6.6
Airport	3.1		3.1
Warehouse	6.8	16.5	6.7
Distribution Center	5.8	5.0	5.9
Construction Site	10.4	10.3	10.4
Other	7.6	5.0	7.7
Refused/Unknown	6.8	8.2	6.7
<b>Average</b>	<b>7.3</b>	<b>7.7</b>	<b>7.3</b>

Table 30 shows the distribution of average travel distance by commodity group. The results indicate that building materials and textile types of cargo exceeded the overall mean trip length, with travel distances averaging between 8 miles-to-11 miles. Empty cargo had an average trip length of 7.7 miles.

**Table 30. Mean Trip Length by Commodity Group.**

<b>Commodity Group</b>	<b>Mean Trip Length (Miles)</b>
Agriculture	3.2
Raw Materials	5.1
Food	6.0
Textiles	8.8
Wood	7.2
Building Materials	11.4
Machinery	7.1
Miscellaneous	6.4
Secondary	6.9
Transportation	3.8
Empty	7.7
Unknown/Refused	9.1
<b>All Combined</b>	<b>7.3</b>

### **Travel Time and Speed Characteristics**

Survey respondents were also asked to provide arrival and departure times for each logged trip on the day of the survey. The travel logs could be compared to travel times provided in network travel time and distance matrices. However, in this analysis, reported travel time data were not utilized due to some inconsistencies observed during data processing. Hence, all travel time results were based on network and travel time matrices for inter-zonal trips. Results of this analysis are shown by vehicle classification (Table 31) and by commercial type (Table 32).

The majority of trips took less than half an hour, of which 48 percent occurred in less than five minutes, 25 percent were between 6 and 10 minutes, 20 percent were between 11 and 20 minutes and 5 percent were between 21 and 30 minutes. Small and medium vehicles made the majority of these trips (87 percent), and approximately 93 percent were for local services.

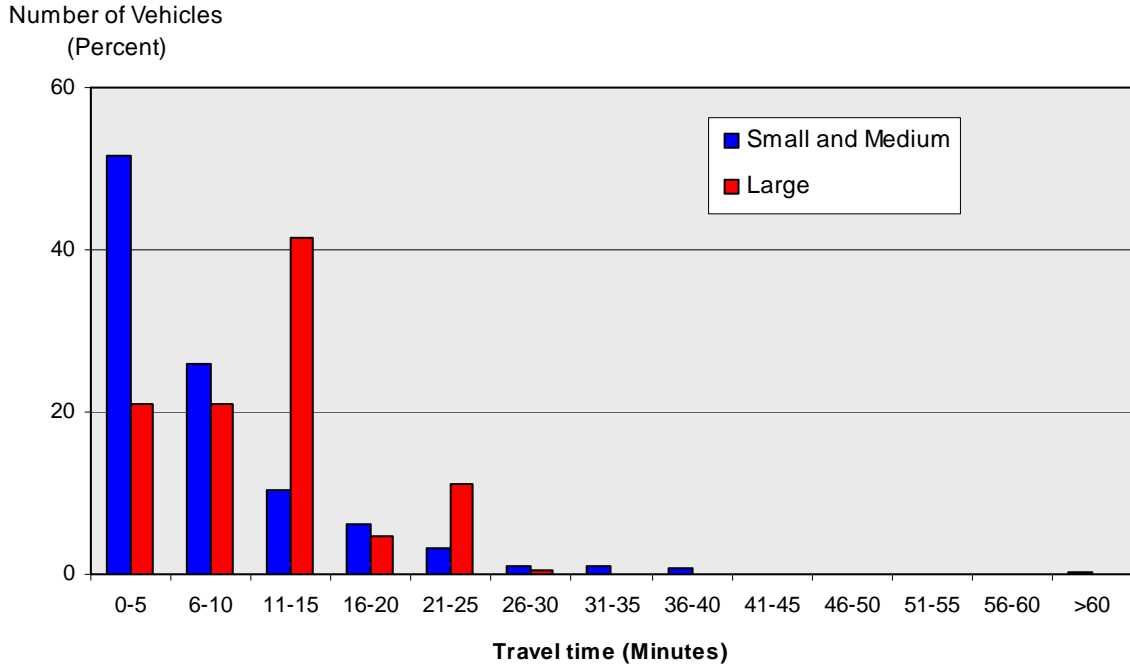
**Table 31. Frequency Distribution of Travel Time by Vehicle Classification.**

Travel Time (Minutes)	Small and Medium	Percent of Total	Large	Percent of Total	Other	Percent of Total	Total Number of Trips	Percent of Total
0-5	726	51.6	36	21.1	0	0.0	762	48.2
6-10	366	26.0	36	21.1	0	0.0	402	25.4
11-15	145	10.3	71	41.5	0	0.0	216	13.7
16-20	86	6.1	8	4.6	0	0.0	94	5.9
21-25	45	3.2	19	11.1	2	100.0	66	4.2
26-30	13	0.9	1	0.6	0	0.0	14	0.9
31-35	15	1.1	0	0.0	0	0.0	15	0.9
36-40	9	0.6	0	0.0	0	0.0	9	0.6
41-45	0	0.0	0	0.0	0	0.0	0	0.0
46-50	0	0.0	0	0.0	0	0.0	0	0.0
51-55	0	0.0	0	0.0	0	0.0	0	0.0
56-60	0	0.0	0	0.0	0	0.0	0	0.0
>60	3	0.2	0	0.0	0	0.0	3	0.2
<b>Total</b>	<b>1,408</b>	<b>100.0</b>	<b>171</b>	<b>100.0</b>	<b>2</b>	<b>100.0</b>	<b>1,581</b>	<b>100.0</b>

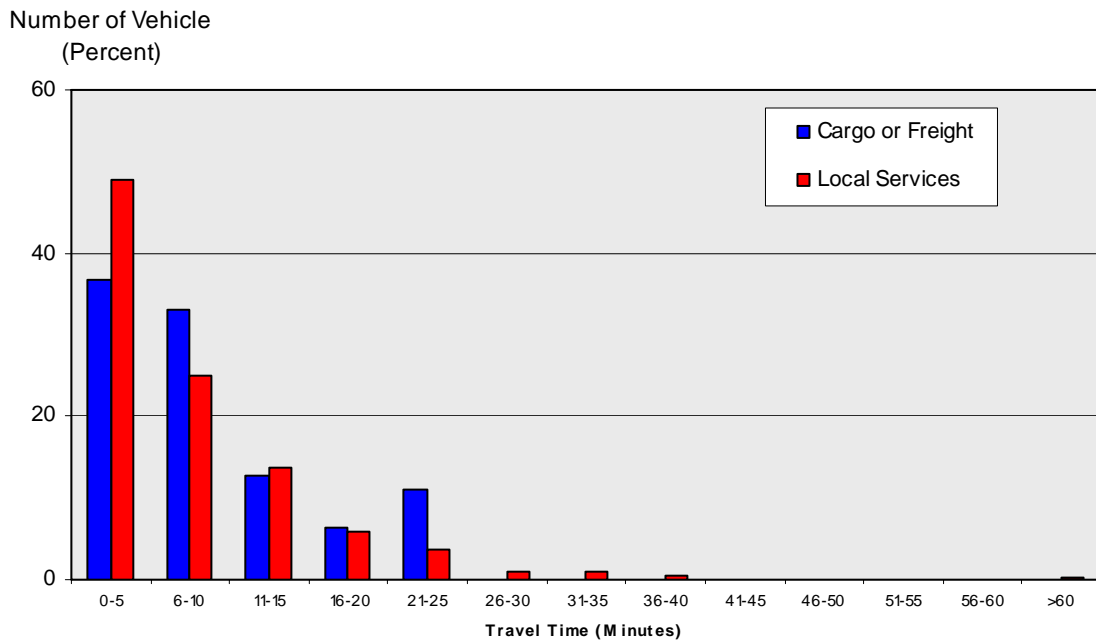
**Table 32. Frequency Distribution of Travel Time by Commercial Vehicle Type.**

Travel Time (Minutes)	Cargo or Freight	Percent of Total	Local Services	Percent of Total	Total	Percent of Total
0-5	40	36.7	722	49.0	762	48.2
6-10	36	33.0	366	24.9	402	25.4
11-15	14	12.9	202	13.7	216	13.7
16-20	7	6.4	87	5.9	94	5.9
21-25	12	11.0	54	3.7	66	4.2
26-30	0	0.0	14	1.0	14	0.9
31-35	0	0.0	15	1.0	15	0.9
36-40	0	0.0	9	0.6	9	0.6
41-45	0	0.0	0	0.0	0	0.0
46-50	0	0.0	0	0.0	0	0.0
51-55	0	0.0	0	0.0	0	0.0
56-60	0	0.0	0	0.0	0	0.0
>60	0	0.0	3	0.2	3	0.2
<b>Total</b>	<b>109</b>	<b>100.0</b>	<b>1,472</b>	<b>100.0</b>	<b>1,581</b>	<b>100.0</b>

Figures 17 and 18 display the distribution of travel time by vehicle classification and by commercial vehicle type. Table 33 shows the ungrouped distribution of travel time.



**Figure 17. Frequency Distribution of Travel Time by Vehicle Classification.**



**Figure 18. Frequency Distribution of Travel Time by Commercial Vehicle Type.**

**Table 33. Frequency Distribution of Travel Time (Ungrouped).**

Travel Time (Minutes)	Number of Trips	Percent of Total	Travel Time (Minutes)	Number of Trips	Percent of Total
1	122	7.7	21	27	1.7
2	146	9.2	22	7	0.4
3	176	11.1	23	14	0.9
4	184	11.6	24	12	0.8
5	134	8.5	25	6	0.4
6	115	7.3	26	3	0.2
7	87	5.5	27	3	0.2
8	87	5.5	28	3	0.2
9	63	4.0	29	5	0.3
10	50	3.2	31	7	0.4
11	29	1.8	32	1	0.1
12	134	8.5	33	5	0.3
13	13	0.8	34	1	0.1
14	34	2.2	35	1	0.1
15	6	0.3	36	1	0.1
16	30	1.9	38	1	0.1
17	16	1.0	39	2	0.1
18	11	0.7	40	5	0.3
19	15	0.9	60	3	0.2
20	22	1.4	<b>Total</b>	<b>1,581</b>	<b>100.0</b>

Overall, the average travel time to the destination was estimated at 8.5 minutes; 8.1 minutes for small and medium vehicles, 11.3 minutes for large vehicles, and 25.4 minutes for other vehicles (see Table 34).

**Table 34. Mean Travel Time to Destination by Land Use Type and Vehicle Classification.**

Land Use Type	Overall Mean Travel Time (Minutes)	Mean Travel Time (Minutes)		
		Small and Medium	Large	Other
Office Building (Non-Government)	10.6	10.6		
Retail/Shopping	8.4	8.2	9.1	
Industrial/Manufacturing	7.1	7.0	12.4	
Medical/Hospital	6.3	6.3	6.1	
Education (12th Grade or Less)	16.9	16.3	17.3	
Education (College, Trade)	1.0	1.0		
Government Office/Building	8.9	7.7	12.3	25.4
Residential	7.9	7.5	15.0	
Airport	4.0	4.0		
Warehouse	8.1	7.8	14.1	
Distribution Center	7.0	7.0	6.8	
Construction Site	11.3	11.1	12.6	25.4
Other	8.8	8.0	13.6	
Refused/Unknown	8.0	7.3	13.6	
<b>Average</b>	<b>8.5</b>	<b>8.1</b>	<b>11.3</b>	<b>25.4</b>



By commercial type, the average travel time was 9.2 minutes for cargo or freight transport and 8.4 minutes for local services (see Table 35).

**Table 35. Mean Travel Time to Destination by Land Use Type and Commercial Vehicle Type.**

Land Use Type	Overall Mean Travel Time (Minutes)	Mean Travel Time (Minutes)	
		Cargo or Freight	Local Services
Office Building (Non-Government)	10.6		10.6
Retail/Shopping	8.4	8.1	8.4
Industrial/Manufacturing	7.1	9.6	7.0
Medical/Hospital	6.3	9.5	6.0
Education (12 <sup>th</sup> Grade or Less)	16.9		16.9
Education (College, Trade)	1.0		1.0
Government Office/Building	8.9		8.9
Residential	7.9	9.3	7.8
Airport	4.0		4.0
Warehouse	8.1	21.0	8.0
Distribution Center	7.0	6.1	7.1
Construction Site	11.3	11.5	11.3
Other	8.8	6.2	8.9
Refused/Unknown	8.0	10.3	7.8
<b>Average</b>	<b>8.5</b>	<b>9.2</b>	<b>8.4</b>

Table 36 shows the average travel time by commodity group. The results indicate that the average travel time varied from 4.5 minutes for agriculture type of cargo to 12.4 minutes for building materials.

**Table 36. Mean Travel Time by Commodity Group.**

<b>Commodity Group</b>	<b>Mean Travel Time (Minutes)</b>
Agriculture	4.5
Raw Materials	6.3
Food	7.2
Textiles	9.9
Wood	8.3
Building Materials	12.4
Machinery	8.2
Miscellaneous	7.4
Secondary	8.3
Transportation	4.9
Empty	8.9
Unknown/Refused	10.8
<b>All Combined</b>	<b>8.5</b>

Table 37 shows that the travel speed of vehicles averaged at 46.5 miles per hour (mph); 46 mph for small and medium vehicles, and approximately 50 mph for large vehicles.

**Table 37. Mean Travel Speed to Destination by Land Use Type and Vehicle Classification.**

Land Use Type	Overall Mean Travel Speed (mph)	Mean Travel Speed (mph)		
		Small and Medium	Large	Other
Office Building (Non-Government)	48.6	48.6		
Retail/Shopping	46.1	45.6	48.5	
Industrial/Manufacturing	44.6	44.4	50.9	
Medical/Hospital	45.9	46.4	42.0	
Education (12th Grade or Less)	52.6	46.8	56.5	
Education (College, Trade)	22.4	22.4		
Government Office/Building	48.7	47.7	51.4	60.4
Residential	46.5	46.1	53.3	
Airport	45.7	45.7		
Warehouse	46.4	46.2	51.3	
Distribution Center	44.8	44.3	48.0	
Construction Site	49.3	49.2	50.0	60.4
Other	46.1	45.6	49.7	
Refused/Unknown	46.5	45.9	51.5	
<b>Average</b>	<b>46.5</b>	<b>46.1</b>	<b>49.8</b>	<b>60.4</b>

By commercial type, travel speeds were 47 mph for cargo or freight transport and 46 mph for local service or delivery (Table 38).

**Table 38. Mean Travel Speed to Destination by Land Use Type and Commercial Vehicle Type.**

Land Use Type	Overall Mean Travel Speed (mph)	Mean Travel Speed (mph)	
		Cargo or Freight	Local Services
Office Building (Non-Government)	48.6		48.6
Retail/Shopping	46.1	45.9	46.2
Industrial/Manufacturing	44.6	48.3	44.3
Medical/Hospital	45.9	55.7	45.0
Education (12th Grade or Less)	52.6		52.6
Education (College, Trade)	22.4		22.4
Government Office/Building	48.7		48.7
Residential	46.5	48.5	46.3
Airport	45.7		45.7
Warehouse	46.4	47.0	46.4
Distribution Center	44.8	49.3	44.3
Construction Site	49.3	49.0	49.3
Other	46.1	45.2	46.2
Refused/Unknown	46.5	45.0	46.6
<b>Average</b>	<b>46.5</b>	<b>47.3</b>	<b>46.4</b>

Table 39 shows the average travel speed by commodity group. The results indicate that the average travel speed varied from 42 mph for agriculture type of cargo to approximately 49 mph for building materials and textiles.

**Table 39. Mean Travel Speed by Commodity Group.**

<b>Commodity Group</b>	<b>Mean Travel Speed (mph)</b>
Agriculture	42.3
Raw Materials	45.4
Food	44.9
Textiles	49.2
Wood	45.8
Building Materials	48.6
Machinery	46.7
Miscellaneous	46.2
Secondary	45.4
Transportation	43.5
Empty	47.4
Unknown/Refused	50.5
<b>All Combined</b>	<b>46.5</b>

## Trip Tour Characteristics

Trip tours may be defined as a combination (or chaining) of trips in which a vehicle leaves and returns to a common point, typically its base location. To accurately analyze the trip tours, external trips needed to be included in the analysis. This was performed since it was possible for trip tours to begin within the study area, travel outside of the study area, and return back during the one-day survey period.

For each trip recorded, information was provided on whether or not the trip origin location was the vehicle's base location. This served as the basis for determining if the trip was a base trip or a non-base trip. For a trip to be a base trip, either the origin or destination of the trip had to be at the base location. If the trip did not start and end at the base location, then the trip was considered a non-base trip.

Table 40 shows the distribution of base and non-base trips by vehicles. Approximately 61 percent of the total trips made by the surveyed vehicles were non-base and 39 percent were base trips. Small and medium vehicles made nearly 89 percent of the non-base trips.

**Table 40. Number of Base and Non-Base Trips by Vehicle Classification.**

Trip Type	Small and Medium		Large		Other		Total	
	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total
Base	633	38.4	109	45.4	2	100.0	744	39.4
Non-Base	1,015	61.6	131	54.6	0	0.0	1,146	60.6
<b>Total</b>	<b>1,648</b>	<b>100.0</b>	<b>240</b>	<b>100.0</b>	<b>2</b>	<b>100.0</b>	<b>1,890</b>	<b>100.0</b>

In the analysis of trips made by the surveyed vehicles, the number of trip tours was counted to determine how many of the trips that started at the base location indeed ended at the base. The results indicated that of the total 258 vehicles, 231 made 359 trip tours. There were 27 open tours — trips that did not start and end at the base location.

The number of trip tours ranged from 1-to-9, of which approximately 63 percent of the surveyed vehicles only made one tour. These comprised 45 percent of the total number of trip tours. Table 41 shows a breakdown of the number of trip tours per vehicle.

**Table 41. Number and Percent of Trip Tours per Vehicle.**

Number of Trip Tours	Number of Vehicles	Percent of Total Number of Vehicles	Total Number of Trip Tours	Percent of Total Number of Trip Tours
0	27	10.5	0	0.0
1	162	62.8	162	45.1
2	36	14.0	72	20.1
3	19	7.4	57	15.9
4	8	3.1	32	8.9
5	4	1.6	20	5.6
7	1	0.4	7	1.9
9	1	0.4	9	2.5
<b>Total</b>	<b>258</b>	<b>100.0</b>	<b>359</b>	<b>100.0</b>

Approximately 63 percent of small and medium vehicles made 1 tour, and 24 percent made 2-to-4 tours. For large vehicles, nearly 60 percent made 1 tour and 30 percent made 2-to-4 tours (see Table 42).

**Table 42. Number and Percent of Trip Tours by Vehicle Classification.**

Number of Trip Tours	Small and Medium		Large		Other	
	Number of Vehicles	Percent of Total	Number of Vehicles	Percent of Total	Number of Vehicles	Percent of Total
0	24	10.9	3	8.1	0	0.0
1	139	63.2	22	59.5	1	100.0
2	28	12.7	8	21.6	0	0.0
3	17	7.7	2	5.4	0	0.0
4	7	3.2	1	2.7	0	0.0
5	3	1.4	1	2.7	0	0.0
7	1	0.5	0	0.0	0	0.0
9	1	0.5	0	0.0	0	0.0
<b>Total</b>	<b>220</b>	<b>100.0</b>	<b>37</b>	<b>100.0</b>	<b>1</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>85.3</b>		<b>14.3</b>		<b>0.4</b>	

By commercial type, approximately 87 percent of the trips for cargo or freight transport, and 60 percent of the trips for local services had 1 trip tour (see Table 43).

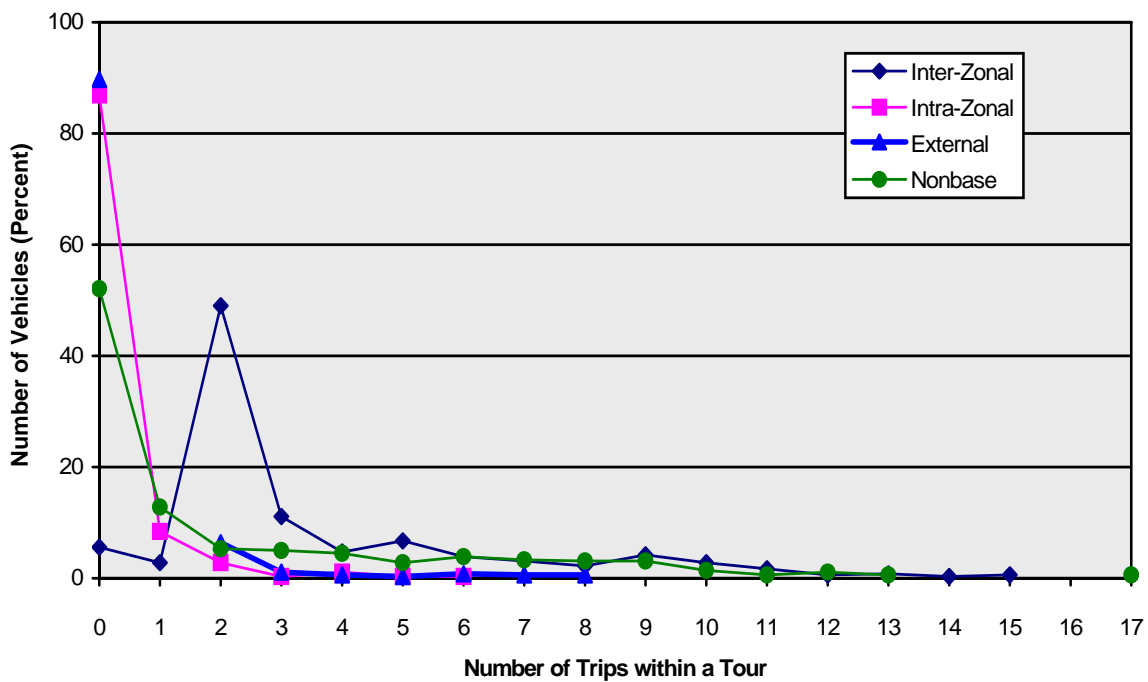
**Table 43. Number and Percent of Trip Tours by Commercial Vehicle Type.**

Number of Trip Tours	Cargo or Freight		Local Services	
	Number of Vehicles	Percent of Total	Number of Vehicles	Percent of Total
0	0	0.0	27	11.5
1	20	87.0	142	60.4
2	0	0.0	36	15.3
3	2	8.7	17	7.2
4	0	0.0	8	3.4
5	1	4.3	3	1.3
7	0	0.0	1	0.4
9	0	0.0	1	0.4
<b>Total</b>	<b>23</b>	<b>100.0</b>	<b>235</b>	<b>100.0</b>
<b>Percent of Total</b>	<b>8.9</b>		<b>91.1</b>	



In the analysis of trip tours, the number and type of trips that were made within the tour had to be measured to examine the total amount and type of travel that occurred during the course of the tour. Therefore, the review of trip tour data was divided into three components: the number of non-base trips within trip tours, the number of external trips within trip tours, and the number of inter-zonal and intra-zonal trips within trip tours.

Figure 19 shows the distribution of these trips by trip type, and Tables 44 through 47 show the detailed breakdown of these trips.



**Figure 19. Distribution of Trips within Trip Tours by Trip Type.**

The results indicate that 48 percent of the trips that occurred within the trip tours were non-base, and the number of trips made by the surveyed vehicles varied from 1-to-17 trips (see Table 44).

**Table 44. Number and Percent of Non-Base Trips within Trip Tours.**

<b>Number of Non-Base Trips</b>	<b>Number of Vehicle Trips</b>	<b>Percent of Total</b>	<b>Cumulative Number of Vehicle Trips</b>	<b>Cumulative Percent of Total</b>
0	187	52.1	187	52.1
1	46	12.8	233	64.9
2	19	5.3	252	70.2
3	18	5.0	270	75.2
4	16	4.5	286	79.7
5	10	2.8	296	82.5
6	14	3.9	310	86.4
7	12	3.3	322	89.7
8	11	3.1	333	92.8
9	11	3.1	344	95.8
10	5	1.4	349	97.2
11	2	0.6	351	97.8
12	4	1.1	355	98.9
13	2	0.6	357	99.4
17	2	0.6	359	100.0

The data also shows that approximately 10 percent of the trip tours were external. Approximately 6 percent of the trips that occurred within the tour had 2 external trips (see Table 45).

**Table 45. Number and Percent of External Trips within Trip Tours.**

<b>Number of External Trips</b>	<b>Number of Vehicle Trips</b>	<b>Percent of Total</b>	<b>Cumulative Number of Vehicle Trips</b>	<b>Cumulative Percent of Total</b>
0	322	89.7	322	89.7
2	23	6.4	345	96.1
3	4	1.1	349	97.2
4	2	0.6	351	97.8
5	1	0.3	352	98.1
6	3	0.8	355	98.9
7	2	0.6	357	99.4
8	2	0.6	359	100.0

The results also indicate that 94 percent of the trip tours were inter-zonal. Approximately 49 percent of the trips that occurred within the trip tour had 2 inter-zonal trips (see Table 46).

**Table 46. Number and Percent of Inter-Zonal Trips within Trip Tours.**

Number of Inter-Zonal Trips	Number of Vehicle Trips	Percent of Total	Cumulative Number of Vehicle Trips	Cumulative Percent of Total
0	20	5.6	20	5.6
1	10	2.8	30	8.4
2	176	49.0	206	57.4
3	40	11.1	246	68.5
4	17	4.7	263	73.3
5	24	6.7	287	79.9
6	14	3.9	301	83.8
7	11	3.1	312	86.9
8	8	2.2	320	89.1
9	15	4.2	335	93.3
10	10	2.8	345	96.1
11	6	1.7	351	97.8
12	2	0.6	353	98.3
13	3	0.8	356	99.2
14	1	0.3	357	99.4
15	2	0.6	359	100.0

Approximately 13 percent of the trip tours were intra-zonal, and 8 percent of the trips that occurred within the trip tour had 1 intra-zonal trip. Only 3 percent of the trips that occurred within the trip tour had 2 intra-zonal trips (see Table 47).

**Table 47. Number and Percent of Intra-Zonal trips within Trip Tours.**

Number of Intra-Zonal Trips	Number of Vehicle Trips	Percent of Total	Cumulative Number of Vehicle Trips	Cumulative Percent of Total
0	312	86.9	312	86.9
1	30	8.4	342	95.3
2	10	2.8	352	98.1
3	1	0.3	353	98.3
4	4	1.1	357	99.4
5	1	0.3	358	99.7
6	1	0.3	359	100.0

### Survey Expansion

Expansion of the commercial vehicle survey data was performed in an indirect manner. Typically, an estimate of the population being sampled is known and the survey data are expanded to represent that population. However, the total number of commercial vehicles operating in the Amarillo study area is not known. Vehicle registration is not considered a viable basis to estimate the number of commercial vehicles in the study area because other vehicles operating within the area may be registered in neighboring counties. In the analysis, the survey data was compared with the vehicle registration data.

The methodology used for expanding the survey data was vehicle miles of travel (VMT) estimates from the Highway Performance Monitoring System (HPMS), combined with vehicle classification counts by functional classification. Essentially, an estimate of the commercial VMT is developed from the HPMS data and is then used to expand the VMT observed from sampled commercial vehicles. HPMS data contains annual average daily traffic (AADT) estimates of the total VMT by functional class facilities. Since AADT includes weekend traffic, a correction factor is applied to the data to obtain average weekday VMT by functional classification (Freeway, Arterial, Collector, and Local).

Table 48 provides the adjusted 2005 HPMS VMT estimates for the Amarillo study area.

**Table 48. 2005 HPMS Estimates of Weekday VMT in Amarillo Study Area.**

<b>Functional Classification</b>	<b>Total Weekday VMT</b>
Freeway	2,122,505
Arterial	2,395,024
Collector	1,263,146
Local	396,790
<b>Total</b>	<b>6,177,466</b>

Commercial vehicle counts from the 2005 External Survey and vehicle classification counts conducted at 112 randomly selected locations within the Amarillo study area were used to determine the percentage of commercial and non-commercial vehicles by functional classification. The percentage of commercial vehicles for internal sites for each functional classification was combined with the corresponding percentage for external sites based on the percentage of regional VMT estimated to be external travel.

External VMT was estimated to be 29 percent of the HPMS estimate of total VMT. Hence, it was assumed that 71 percent of the total VMT was internal. These percentages were applied to obtain the weighted average for each functional classification. Table 49 provides the internal, external, and weighted percentage of commercial and non-commercial vehicles by functional classification as determined from the vehicle classification counts and external surveys performed in 2005.

**Table 49. Vehicle Classification Counts by Functional Classification.**

Functional Classification	Percent of Commercial Vehicles			Percent of Non-Commercial Vehicles		
	Internal Sites (71%)	External Sites (29%)	Weighted Average	Internal Sites (79%)	External Sites (21%)	Weighted Average
Freeway	19.5	38.7	25.1	80.5	61.3	77.0
Arterial	10.3	23.8	14.2	89.7	76.2	87.2
Collector	8.7	13.0	10.0	91.3	87.0	90.5
Local	4.5	16.8	8.1	93.8	83.2	95.5

The weighted percentage of commercial and non-commercial vehicles by functional classification (as shown in Table 49) was then applied to the HPMS estimated weekday VMT to calculate the total VMT for commercial and non-commercial vehicles operating in the study area. The resulting estimate was 1,031,230. Table 50 provides the estimated VMT for commercial and non-commercial vehicles operating in the study area.

**Table 50. Estimated VMT for Commercial and Non-Commercial Vehicles.**

Functional Classification	Commercial VMT	Non-Commercial VMT
Freeway	532,316	1,635,110
Arterial	341,102	2,089,462
Collector	125,808	1,143,327
Local	32,004	378,974
<b>Total</b>	<b>1,031,230</b>	<b>5,246,873</b>

This estimate represented all commercial vehicles. To properly expand the data, it was necessary to remove the VMT estimates obtained in the external survey to avoid double counting. The VMT estimated for commercial vehicles in the 2005 external station survey was 436,989. This estimate was subtracted from the total commercial vehicle VMT to calculate the internal commercial VMT. The resulting estimate was 594,241.

The internal VMT observed in the 2005 commercial vehicle survey was 11,541. This was based on 1,581 observed internal trips (those where the trip length could be estimated), multiplied by the average trip length made by the surveyed vehicles, estimated at 7.3 miles.

To estimate the total internal commercial vehicle trips, the survey expansion factor was then calculated by dividing the total VMT (594,241) by the sample internal VMT (11,541). The resulting expansion factor was 51.49, which was then multiplied by the survey internal trips (1,581) producing 81,403 total internal commercial vehicle trips. With the number of internal trips per vehicle averaging at 6.9 trips, the number of commercial vehicles operating in the Amarillo study area on a daily basis totaled 11,746. This estimate is nearly 4 times the 3,018 registered trucks in the study area in 2005.



## Data Comparison

To assess the changes that occurred in terms of commercial vehicle flow in the study area, a comparison was made with the results from the commercial vehicle survey conducted in 1991. The previous study did not have the information to indicate the number of commercial trucks from which the sample was drawn. Hence, the data comparison between the 1991 and 2005 surveys was limited to the reported trip data. The 1991 study reported a sample size of 444 trucks (Pearson, 1996). The observed internal trips were estimated at 2,331. The average trips per vehicle were estimated at 5.25. The average trip length was estimated at 5.6 miles (Pearson, 1996).

Table 51 provides a summary of the trip data between the two commercial survey periods. No conclusion could be drawn from the data comparison except that the average trip length has increased slightly.

**Table 51. Commercial Vehicle Survey Data Comparison.**

Survey Indicator	1991 Commercial Vehicle Survey	2005 Commercial Vehicle Survey
Study Area Coverage	Amarillo Study Area	Two counties – Potter and Randall
Sample Size	444	258
Observed Internal Trips	2,331	1,581
Average Trip Length (miles)	5.60	7.30
Average Trips per Vehicle	5.25	6.93

## **CONCLUSIONS**

This commercial vehicle survey has provided information on the characteristics and distribution of commercial vehicles operating in the Amarillo study area. Through the analysis of 258 vehicles that participated in the survey, key indicators such as vehicle age, fuel use, truck classification, commercial type, cargo type, trip purposes, land use, trip length, travel time, travel speed, and types of trips being made, were evaluated and quantified. Estimates on the total number of internal trips, average number of trips per vehicle, and average travel distance, combined with HPMS data on VMT by functional classification, facilitated the estimation of the volume of commercial vehicle traffic operating in the study area on a daily basis.

## REFERENCES

1. Alliance Transportation Group (ATG), Inc. *Amarillo/Lubbock Commercial Vehicle Survey Final Report*. March 2006.
2. Pearson, David. *Urban Travel in Texas: An Evaluation of Travel Surveys*. Texas Department of Transportation (TxDOT) Research Report 1099-3F. Texas Transportation Institute, The Texas A&M University System, College Station, TX, January 1996.
3. Texas Department of Transportation (TxDOT). *Diesel and Gas Truck Counts by County using Gross Weight*. January 2006.
4. Texas Department of Transportation (TxDOT). *Rural, Small Urban, and Urbanized Mileage by County and Functional System*. December 2005.



## **APPENDIX**



**COMMERCIAL VEHICLE SURVEY  
 PART 1: VEHICLE INFORMATION**

(If you have participated in prior surveys, please fill out this form anyway.)

Vehicle ID#: \_\_\_\_\_

Vehicle License # : \_\_\_\_\_

Survey Location (zone): \_\_\_\_\_

SIC Code: \_\_\_\_\_

Travel Day: \_\_\_\_\_  
 Month / Day

Company or Name of Owner (name on registration):

\_\_\_\_\_

Address of location where vehicle was based at beginning of travel day:

\_\_\_\_\_

(Street Address or Nearest Intersection)

City \_\_\_\_\_ State \_\_\_\_\_ ZIP \_\_\_\_\_

Type of Place vehicle was based at on beginning of travel day. (SEE BELOW) \_\_\_\_\_

Vehicle Info: Make: \_\_\_\_\_; Model: \_\_\_\_\_; Year: \_\_\_\_\_

- Vehicle Type
- 1)  Major Cargo / Freight Transport (e.g. regional or long haul, bulk loads/shipments, etc.)
  - 2)  Local Service or Delivery (e.g. plumbing/landscaping contractors, local government fleet or maintenance vehicles, local FedEx/UPS deliveries, etc. )

- Vehicle Fuel:
- 1)  Leaded Gas    2)  Unleaded Gas    3)  Diesel    4)  Propane
  - 5)  Other \_\_\_\_\_(Specify)

- Vehicle Classification:
- 1)  Single Unit 2-axle (6 wheels)
  - 2)  Single Unit 3-axle (10 wheels)
  - 3)  Single Unit 4-axle (14 wheels)
  - 4)  Semi (all Tractor-Trailer combinations)
  - 5)  Other \_\_\_\_\_

Gross Vehicle Weight: \_\_\_\_\_ pounds

Beginning Odometer Reading: \_\_\_\_\_ Number of Trips Total: \_\_\_\_\_

Type of Place Codes		
(1) Office Building	(6) Educational (College, Trade, etc.)	(11) Warehouse
(2) Retail / Shopping	(7) Government Office/Building	(12) Distribution Center
(3) Industrial/Manufacturing	(8) Residential	(13) Construction Site
(4) Medical / Hospital	(9) Airport	(14) Other (specify )
(5) Educational (12 <sup>th</sup> grade or less)	(10) Intermodal Facility	(99) Refused/Unknown

## COMMERCIAL VEHICLE TRAVEL SURVEY

VEHICLE LICENSE #: \_\_\_\_\_

### PART 2: Travel Log

**THE PLACE MY TRAVEL BEGAN TODAY WAS:**

At Work / Base Location?     - YES     - NO    What Type of Place is This? (See Options Below) \_\_\_\_\_

\_\_\_\_\_  
 (Street address or nearest intersection for place travel began)

\_\_\_\_\_  
 \_\_\_\_\_ pm  
 (City, state, zip co)

TRAVEL DATE \_\_\_\_\_  
 Month / Day  
 am

DEPARTURE TIME: \_\_\_\_\_

When you left the above location was your vehicle:     Fully Loaded     Partially Loaded     Empty

If loaded, what is the weight of the cargo being transported? \_\_\_\_\_ (pounds/lbs.)

	RECORD the following information about each place <i>NAME of Place:                      Address including city, state, and zip OR Nearest street intersection or Landmark</i>	What time did you arrive and depart this location? <small>(record exact times)</small>	Activity – What are you doing at this location? <small>(see options below)</small>	Is this the work / base location for this vehicle?  <input type="checkbox"/> - YES  <input type="checkbox"/> - NO	What type of place is this? <small>(see options below)</small>	Type of Cargo  What is it?	Cargo Weight  (in pounds/lbs)  _____ Picked-Up _____ Dropped-Off
<b>PLACE 1</b>		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES  <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
<b>PLACE 2</b>		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES  <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
<b>PLACE 3</b>		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES  <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off

ACTIVITY OPTIONS		TYPE OF PLACE OPTIONS		
(1) Base Location / Return to Base Location	(6) Driver Needs (lunch, etc.)	(1) Office Building	(6) Educational (college, trade)	(11) Warehouse
(2) Delivery	(7) Other	(2) Retail / Shopping	(7) Government Office/Building	(12) Distribution Center
(3) Pick-up	(8) To Home	(3) Industrial/Manufacturing	(8) Residential	(13) Construction Site
(4) Pick-up and Delivery	(9) Service Related (to job or work site)	(4) Medical / Hospital	(9) Airport	(14) Other (specify)
(5) Maintenance (fuel, oil, etc.)	(99) Refused / Unknown	(5) Education (12 <sup>th</sup> grade or less)	(10) Intermodal Facility	(99) Refused / Unknown



# COMMERCIAL VEHICLE TRAVEL SURVEY (con't)

VEHICLE LICENSE #: \_\_\_\_\_

RECORD the following information about each place		What time did you arrive and depart this location? (record exact times)	Activity – What are you doing at this location? (see options below)	Is this the work / base location for this vehicle?	What type of place is this? (see options below)	Type of Cargo What is it?	Cargo Weight (in pounds/lbs)
NAME of Place:	Address including city, state, and zip OR Nearest street intersection or Landmark						
PLACE 4 PLACE 5 PLACE 6 PLACE 7 PLACE 8 PLACE 9		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off

ACTIVITY OPTIONS		TYPE OF PLACE OPTIONS		
(1) Base Location / Return to Base Location	(6) Driver Needs (lunch, etc.)	(1) Office Building	(6) Educational (college, trade)	(11) Warehouse
(2) Delivery	(7) Other	(2) Retail / Shopping	(7) Government Office/Building	(12) Distribution Center
(3) Pick-up	(8) To Home	(3) Industrial/Manufacturing	(8) Residential	(13) Construction Site
(4) Pick-up and Delivery	(9) Service Related (to job or work site)	(4) Medical / Hospital	(9) Airport	(14) Other (specify)
(5) Maintenance (fuel, oil, etc.)	(99) Refused / Unknown	(5) Education (12 <sup>th</sup> grade or less)	(10) Intermodal Facility	(99) Refused / Unknown

# COMMERCIAL VEHICLE TRAVEL SURVEY (con't)

VEHICLE LICENSE #: \_\_\_\_\_

RECORD the following information about each place		What time did you arrive and depart this location? <small>(record exact times)</small>	Activity – What are you doing at this location? <small>(see options below)</small>	Is this the work / base location for this vehicle?  <input type="checkbox"/> - YES <input type="checkbox"/> - NO	What type of place is this? <small>(see options below)</small>	Type of Cargo What is it?	Cargo Weight <small>(in pounds/lbs)</small>
NAME of Place:	Address including city, state, and zip OR Nearest street intersection or Landmark						
PLACE 10 PLACE 11 PLACE 12 PLACE 13 PLACE 14 PLACE 15		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
		Arrive: _____ am/pm Depart: _____ am/pm		<input type="checkbox"/> - YES <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off

ACTIVITY OPTIONS		TYPE OF PLACE OPTIONS		
(1) Base Location / Return to Base Location	(6) Driver Needs (lunch, etc.)	(1) Office Building	(6) Educational (college, trade)	(11) Warehouse
(2) Delivery	(7) Other	(2) Retail / Shopping	(7) Government Office/Building	(12) Distribution Center
(3) Pick-up	(8) To Home	(3) Industrial/Manufacturing	(8) Residential	(13) Construction Site
(4) Pick-up and Delivery	(9) Service Related (to job or work site)	(4) Medical / Hospital	(9) Airport	(14) Other (specify)
(5) Maintenance (fuel, oil, etc.)	(99) Refused / Unknown	(5) Education (12 <sup>th</sup> grade or less)	(10) Intermodal Facility	(99) Refused / Unknown

# COMMERCIAL VEHICLE TRAVEL SURVEY (con't)

VEHICLE LICENSE #: \_\_\_\_\_

PLACE #	RECORD the following information about each place		What time did you arrive and depart this location?  (record exact times)	Activity – What are you doing at this location?  (see options below)	Is this the work / base location for this vehicle?	What type of place is this?  (see options below)	Type of Cargo  What is it?	Cargo Weight  (in pounds/lbs)
	NAME of Place:	Address including city, state, and zip OR Nearest street intersection or Landmark						
			Arrive: _____ am/pm  Depart: _____ am/pm		<input type="checkbox"/> - YES  <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
			Arrive: _____ am/pm  Depart: _____ am/pm		<input type="checkbox"/> - YES  <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
			Arrive: _____ am/pm  Depart: _____ am/pm		<input type="checkbox"/> - YES  <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
			Arrive: _____ am/pm  Depart: _____ am/pm		<input type="checkbox"/> - YES  <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
			Arrive: _____ am/pm  Depart: _____ am/pm		<input type="checkbox"/> - YES  <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off
			Arrive: _____ am/pm  Depart: _____ am/pm		<input type="checkbox"/> - YES  <input type="checkbox"/> - NO			_____ Picked-Up _____ Dropped-Off

ACTIVITY OPTIONS		TYPE OF PLACE OPTIONS		
(1) Base Location / Return to Base Location	(6) Driver Needs (lunch, etc.)	(1) Office Building	(6) Educational (college, trade)	(11) Warehouse
(2) Delivery	(7) Other	(2) Retail / Shopping	(7) Government Office/Building	(12) Distribution Center
(3) Pick-up	(8) To Home	(3) Industrial/Manufacturing	(8) Residential	(13) Construction Site
(4) Pick-up and Delivery	(9) Service Related (to job or work site)	(4) Medical / Hospital	(9) Airport	(14) Other (specify)
(5) Maintenance (fuel, oil, etc.)	(99) Refused / Unknown	(5) Education (12 <sup>th</sup> grade or less)	(10) Intermodal Facility	(99) Refused / Unknown