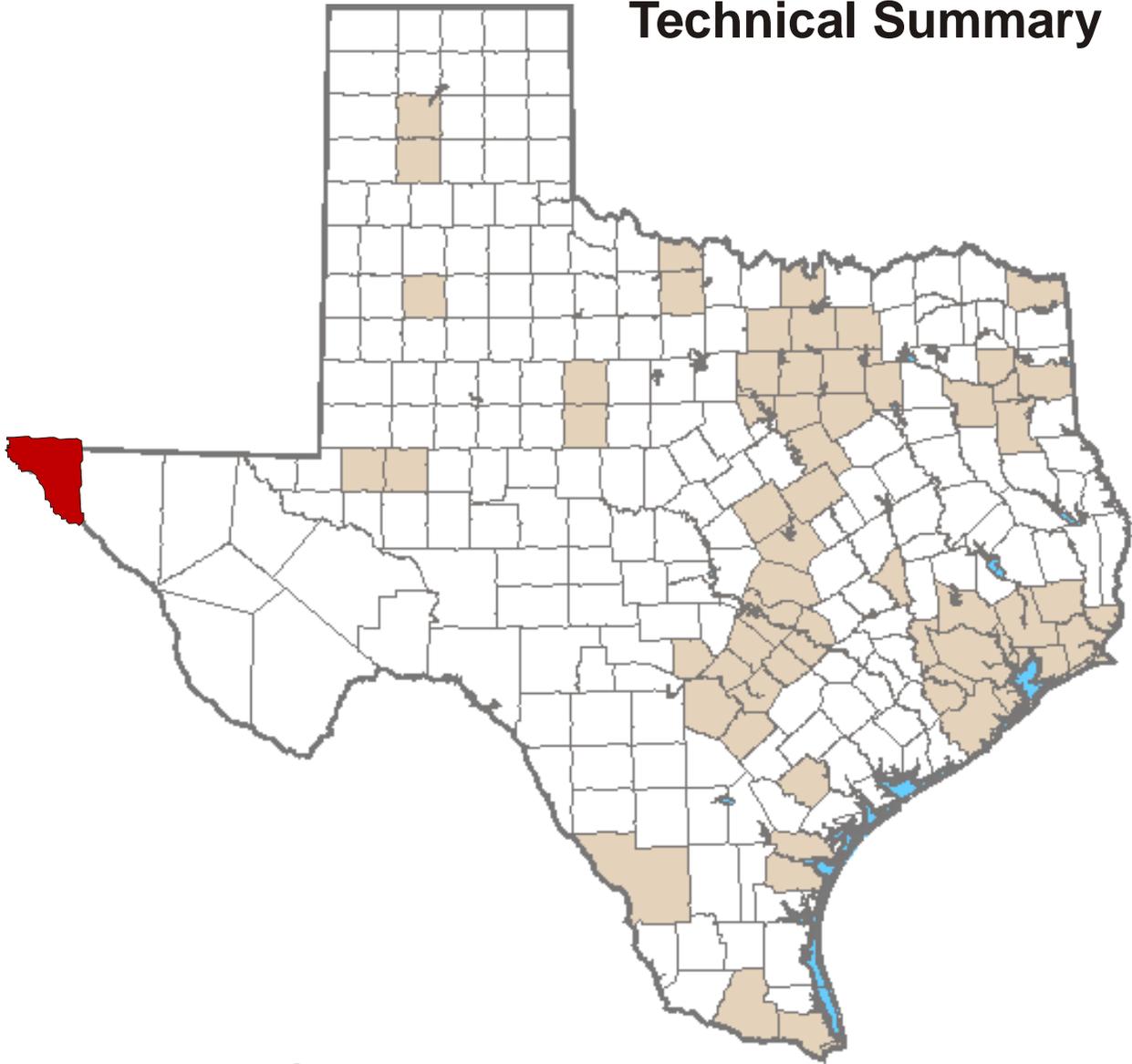


2010-2011 El Paso Urban Transportation Study Commercial Vehicle Survey Technical Summary



Prepared by the
Texas A&M Transportation Institute
November 2012

**2010-2011 El Paso Urban
Transportation Study (EUTS)
Commercial Vehicle Survey**

TECHNICAL SUMMARY

Texas Department of Transportation Travel Survey Program

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November 2012

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ACKNOWLEDGEMENTS

There were a number of individuals who extended technical support and assistance during the preparation of this report. Special thanks are due to Stella Nepal, Mark Ojah, Dr. Dennis Perkinson, and Gary Lobaugh of the Texas A&M Transportation Institute.

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

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INTRODUCTION

In 2010, the Texas Department of Transportation (TxDOT) funded a commercial vehicle survey in the El Paso Urban Transportation Study (EUTS) area. The purpose of this survey was to provide data that would enable TxDOT to forecast total commercial vehicle travel demand within El Paso County area.

The study area is located in far West Texas and, as shown in Figure 1, comprises the entirety of El Paso County. The city of El Paso had an approximate population of 649,100 in 2010, while the county had an approximate 2010 population of 800,600.

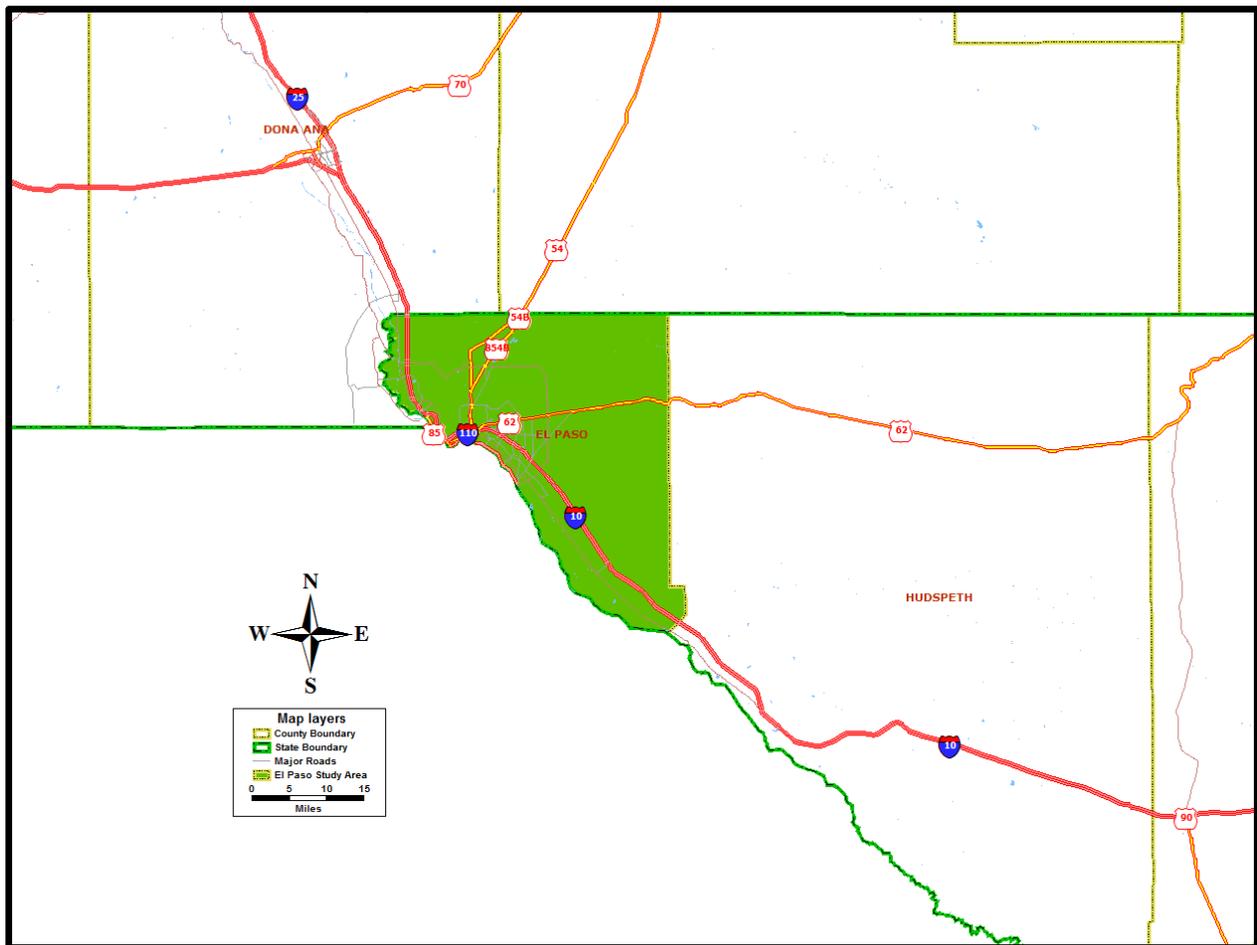


Figure 1. El Paso Study Area.

This report presents a technical summary of the commercial vehicle travel survey conducted in 2010 in the El Paso region and documents the data collected and the analysis of results for the study area. The forms used in the survey are included in the Appendix of this report.

SURVEY METHODOLOGY

The commercial vehicle surveys for the EUTS study area were conducted during the period between November 2010 and March 2011. ETC Institute was contracted by TxDOT to conduct the commercial vehicle surveys for the study area, with technical assistance from the Texas Transportation Institute (TTI). In September 2010, a pilot study of 25 commercial vehicles was carried out¹.

The survey sample was randomly selected from a listing of all business individuals, companies, and public agencies that own, operate, or lease commercial vehicles within the study areas. This list was generated from the Texas Workforce Commission (TWC) employer database that was provided by TxDOT in random order. Selected businesses were contacted and requested to participate in the survey. Those who agreed to participate were provided survey packets and instructions on how the survey forms should be filled out. The drivers of the commercial vehicles were asked to keep a 24-hour diary of the locations of all trips made by each vehicle.

As Table 1 shows, more than 800 companies/individuals were contacted during the recruitment process. Contacts were tracked based on the following three categories:

- Agreed to Participate – The company or individual operated qualifying vehicles making trips within the study area, agreed to participate, and complete and return the survey materials.
- Refused to Participate – The company or individual operated qualifying vehicles making trips within the study area but refused to participate in the survey.
- Not Participating – The company or individual did not operate a qualifying vehicle making trips within the study area; or the company or individual did operate a qualifying vehicle that did not make trips within the study area.

¹ El Paso Transportation Study 2010-11 Commercial Vehicle Survey – Final Summary Report. ETC Institute. October 2011.

Table 1. Survey Participation Rates.

Category	Contact Calls	
	Number	Percent of Total
Agreed to Participate	322	38.6
Refused to Participate	397	47.6
Not participating	115	13.8
Total	834	100.0

Source: El Paso Transportation Study 2010-11 Commercial Vehicle Survey – Final Summary Report. ETC Institute

A total of 278 companies participated in the EUTS commercial vehicle survey, from which a total of 641 commercial vehicle surveys were obtained. Data editing and review processes were performed by TTI to ensure that the survey data collected were complete and followed the guidelines set forth in TxDOT’s bid specification for the project. A data check program was also utilized to examine the accuracy of geocoding of locations and logic of survey responses. The majority of data errors were expected to be corrected prior to final data submittals by the contractor (ETC Institute). However, it was not unusual to find errors during actual data processing and analysis. In this study, survey responses with irreconcilable data were not included in the survey analysis. Also, inconsistent trip records were dropped from the survey analysis. As a result of this process, the data from 24 survey records were dropped from the analyses.

The results presented in this technical summary are therefore based on data from 617 surveyed commercial vehicles.

SURVEY RESULTS

Vehicle Characteristics

This section presents the characteristics of registered trucks and surveyed commercial vehicles to provide an overview of the type and condition of commercial vehicles operating within the EUTS study area. Information on registered trucks include the number of diesel-fueled, gasoline-fueled, propane-fueled, and other-fueled trucks by gross vehicle weight and by model year. Information on surveyed commercial vehicles include the vehicle's make, model and year, odometer reading, gross vehicle weight, vehicle classification, and fuel use.

Registered Commercial Vehicles

Based on TxDOT's vehicle registration data, there were approximately 6,300 trucks registered in the EUTS study area in 2012. Table 2 shows the distribution of registered diesel trucks and gasoline trucks by gross vehicle weight. Approximately 68 percent of all trucks registered in the EUTS study area are diesel-fueled vehicles. Over half of all registered trucks had a gross vehicle weight of less than 10,000 pounds.

Table 2. Gross Vehicle Weight of Registered Trucks in the EUTS Study Area.

Gross Vehicle Weight	Diesel Trucks		Gasoline Trucks		Total	
	Number of Vehicles	% of Diesel Trucks	Number of Vehicles	% of Gasoline Trucks	Number of Vehicles	% of Total Trucks
< 10000	2,357	54.7	1,104	54.6	3,461	54.7
> 10000	461	10.7	442	21.9	903	14.3
> 14000	183	4.2	128	6.3	311	4.9
> 16000	171	4.0	66	3.3	237	3.7
> 19500	475	11.0	187	9.3	662	10.5
> 26000	212	4.9	40	2.0	252	4.0
> 33000	385	8.9	49	2.4	434	6.9
> 60000	63	1.5	5	0.2	68	1.1
Total	4,307	100.0	2,021	100.0	6,328	100.0

Source: TxDOT 2012

Figure 2 shows the distribution of registered diesel trucks and gasoline trucks by model year. Registered diesel trucks were slightly newer relative to the gasoline trucks. The majority of the diesel trucks (64 percent) were less than ten years old, which was more than the 42 percent of gasoline trucks within that age range. Less than eight percent of the nearly 4,300 registered diesel trucks were older than 20 years, while slightly more than 16 percent of registered gasoline trucks were older than 20 years.

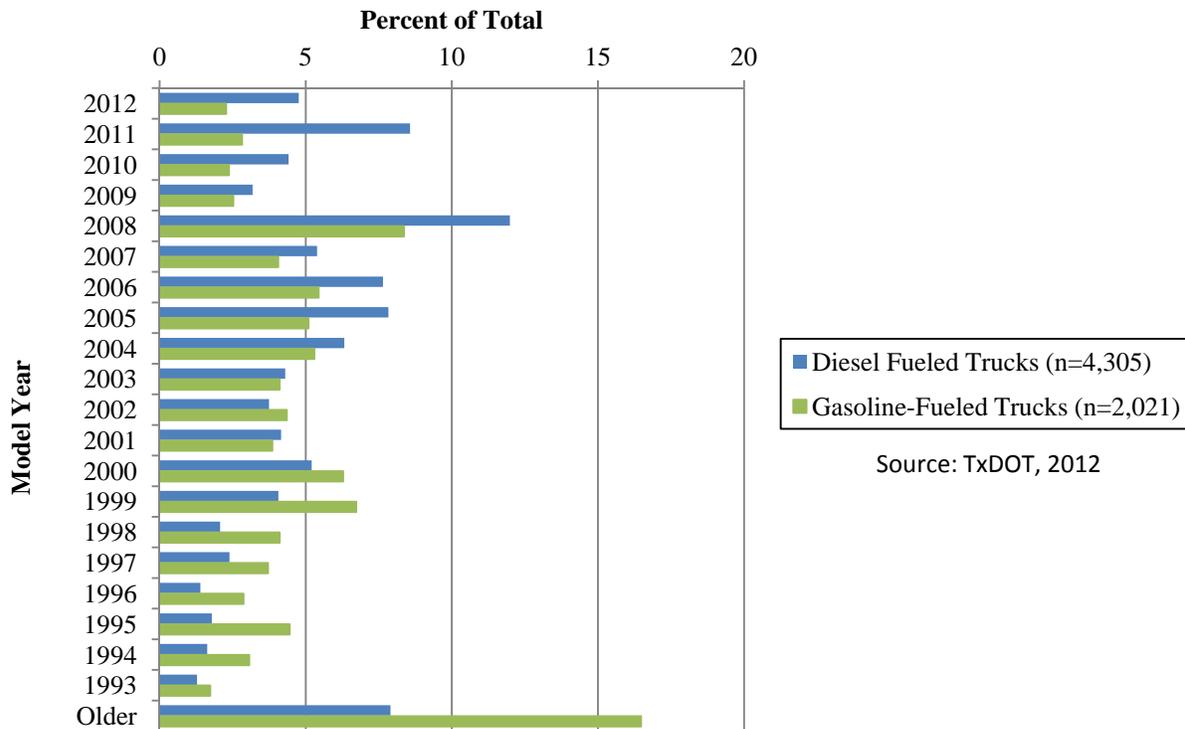


Figure 2. Model Year of Registered Trucks in the EUTS Study Area.

Surveyed Commercial Vehicles

Commercial vehicles that participated in the EUTS commercial vehicle survey were distinguished based on the ten classification types listed in Table 3. These were further categorized by commercial type as either major cargo/freight transport or local service vehicles, simply referred to in this report as cargo vehicles and service vehicles.

Cargo vehicles were defined as vehicles mainly used to transport cargo or freight which were typically bulk goods, materials, and cargo in large quantities for wholesale distribution. Service vehicles were defined as vehicles mainly used to perform services such as those used by building

contractors, plumbers, electricians, cable and telephone services/repairs, and delivery vans/vehicles used by local retailers. These also included company fleet vehicles or fleets and maintenance vehicles of public agencies such as TxDOT, city, county or school district.

Table 3 shows the distribution of surveyed vehicles by vehicle classification type and commercial type. Out of the total 617 vehicles surveyed, 296 were cargo vehicles and 321 were service vehicles. Among cargo vehicles, approximately 26 percent were semi-tractor/trailer combinations, 26 percent were pick-up trucks, 21 percent were single unit 2-axle trucks. Among service vehicles, approximately 51 percent were pick-up trucks, 29 percent were vans, and 12 percent were passenger vehicles.

Table 3. Vehicle Classification Type of Surveyed Commercial Vehicles.

Vehicle Classification	Cargo Vehicles		Service Vehicles		Total Vehicles	
	Number of Vehicles	Percent of Cargo	Number of Vehicles	Percent of Service	Number of Vehicles	Percent of Total
Passenger Car	5	1.7	39	12.1	44	7.1
Pickup Truck	76	25.7	162	50.5	238	38.6
Van (passenger or mini)	43	14.5	92	28.7	135	21.9
Sport Utility Vehicle	2	0.7	23	7.2	25	4.1
Single Unit 2-axle (6 wheels)	61	20.6	2	0.6	63	10.2
Single Unit 3-axle (10 wheels)	20	6.8	0	0.0	20	3.2
Single Unit 4-axle (14 wheels)	6	2.0	0	0.0	6	1.0
Semi (Tractor-Trailer)	77	26.0	0	0.0	77	12.5
Other	6	2.0	3	0.9	9	1.5
Total	296	100.0	321	100.0	617	100.0

Figure 3 shows the distribution of surveyed vehicles by fuel type. Approximately 52 percent of the surveyed vehicles used diesel and 48 percent used unleaded gasoline. Among cargo vehicles, 61 percent used diesel and 39 percent used gasoline. Among service vehicles, 91 percent used gasoline and nine percent used diesel.

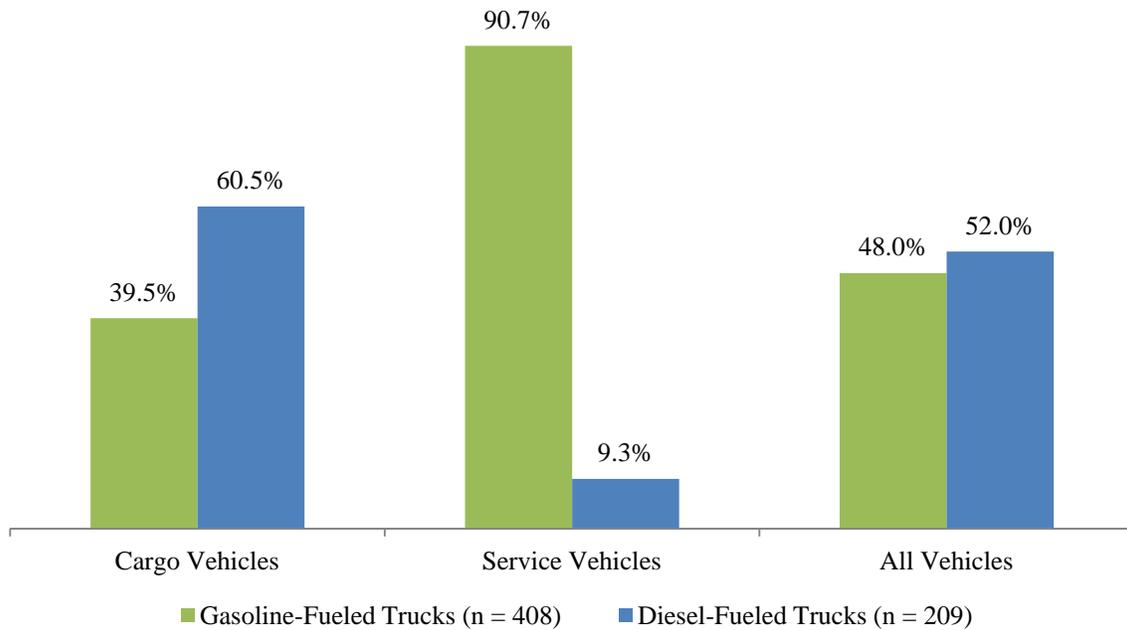


Figure 3. Type of Fuel Used by Surveyed Commercial Vehicles.

Table 4 shows the distribution of surveyed vehicles by gross vehicle weight. The survey included commercial vehicles with gross vehicle weight of less than 10,000 pounds. Approximately 97 percent of the service vehicles belonged to this category, while approximately 42 percent of the cargo vehicles weighed more than 19,500 pounds.

Table 4. Gross Vehicle Weight.

Gross Vehicle Weight (lbs.) Min / Max	Cargo		Service		Total	
	Number of Vehicles	% of Cargo Vehicles	Number of Vehicles	% of Service Vehicles	Number of Vehicles	% of Total Vehicles
0 / 10,000	135	45.6	311	96.9	446	72.3
10,001 / 14,000	15	5.1	4	1.2	19	3.1
14,001 / 16,000	16	5.4	2	0.6	18	2.9
16,001 / 19,500	6	2.0	0	0.0	6	1.0
19,501 / 26,000	24	8.1	1	0.3	25	4.1
26,001 / 33,000	8	2.7	3	0.9	11	1.8
33,001 / 60,000	34	11.5	0	0.0	34	5.5
> 60,001	58	19.6	0	0.0	58	9.4
Unknown	0	0.0	0	0.0	0	0.0
Total	296	100.0	321	100.0	617	100.0

Figure 4 shows the distribution of surveyed vehicles by model year. Approximately 56 percent of service vehicles and 74 percent of cargo vehicles were less than 10 years old. The average age for cargo vehicles was 8.7 years, while the average age for service vehicles was 6.9 years.

Model Year

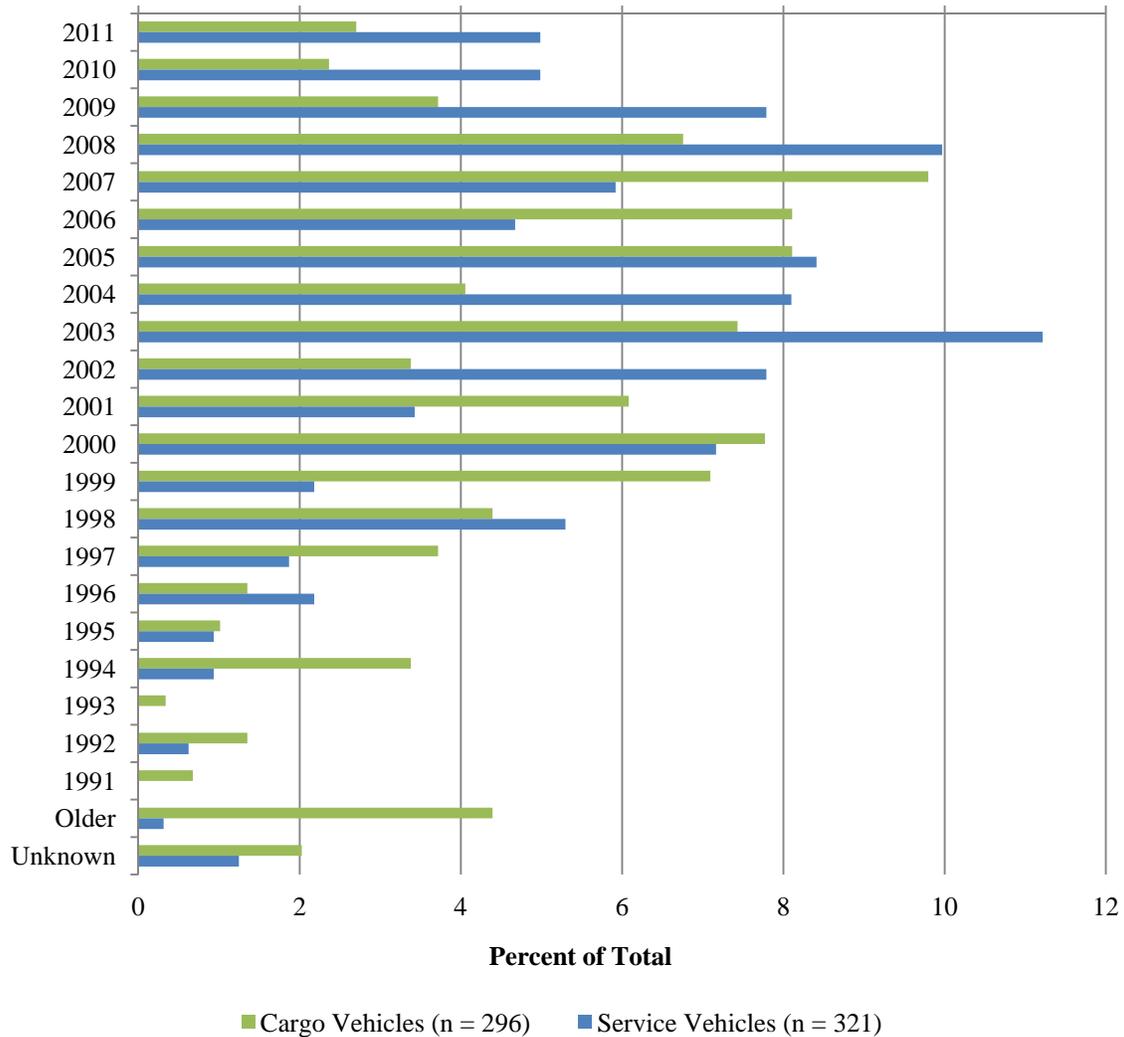


Figure 4. Vehicle Model Year.

Table 5 shows the average vehicle mileage by model year based on reported odometer readings from 617 surveyed vehicles at the beginning of their survey travel day. Cargo vehicles reported higher average odometer readings of about 207,100 miles compared to just under 99,000 miles for service vehicles.

Table 5. Average of Reported Odometer Readings by Model Year.

Model Year	Cargo Vehicles		Service Vehicles		Total Vehicles	
	Number of Vehicles	Avg. Odometer Reading	Number of Vehicles	Avg. Odometer Reading	Number of Vehicles	Avg. Odometer Reading
2011	8	24,976	16	14,527	24	18,010
2010	7	21,072	16	17,562	23	18,631
2009	11	33,199	25	33,357	36	33,309
2008	20	115,601	32	51,352	52	76,063
2007	29	293,747	19	82,771	48	210,236
2006	24	145,929	15	73,964	39	118,250
2005	24	104,101	27	104,553	51	104,340
2004	12	200,551	26	118,697	38	144,546
2003	22	235,654	36	100,376	58	151,688
2002	10	138,272	25	149,782	35	146,494
2001	18	175,741	11	153,585	29	167,337
2000	23	195,205	23	148,311	46	171,758
1999	21	265,451	7	140,098	28	234,113
1998	13	410,730	17	149,206	30	262,533
1997	11	326,504	6	151,590	17	264,770
1996	4	198,578	7	144,767	11	164,334
1995	3	404,799	3	120,875	6	262,837
1994	10	337,456	3	243,194	13	315,704
1993	1	N/A	0	0	1	N/A
1992	4	419,720	2	238,940	6	359,460
1991	2	208,395	0	0	2	208,395
Older	13	299,897	1	132,908	14	287,969
Unknown	6	205,646	4	147,982	10	182,580
Total	296	207,053	321	98,989	617	150,832

Trip Frequency

The surveyed vehicles generated a total of 2,738 trips, of which 2,513 were internal trips and 225 were external trips. Internal trips were defined as those trips made within the El Paso County area. These trips were further distinguished by determining whether travel occurred within or between zones. Trips made from one zone to another are referred to as inter-zonal trips, and those trips made within the same zone are referred to as intra-zonal trips. External trips were those trips made where one or both of the trip ends were outside of the study area.

Figure 5 shows the distribution of inter-zonal, intra-zonal and external trips, while the breakdown of these trips is provided in Table 6. Cargo vehicles generated 1,332 trips, of which approximately 85 percent were inter-zonal trips, three percent were intra-zonal trips, and 12 percent were external trips. Service vehicles generated 1,406 trips, of which around 92 percent were inter-zonal trips, three percent were intra-zonal trips, and five percent were external trips.

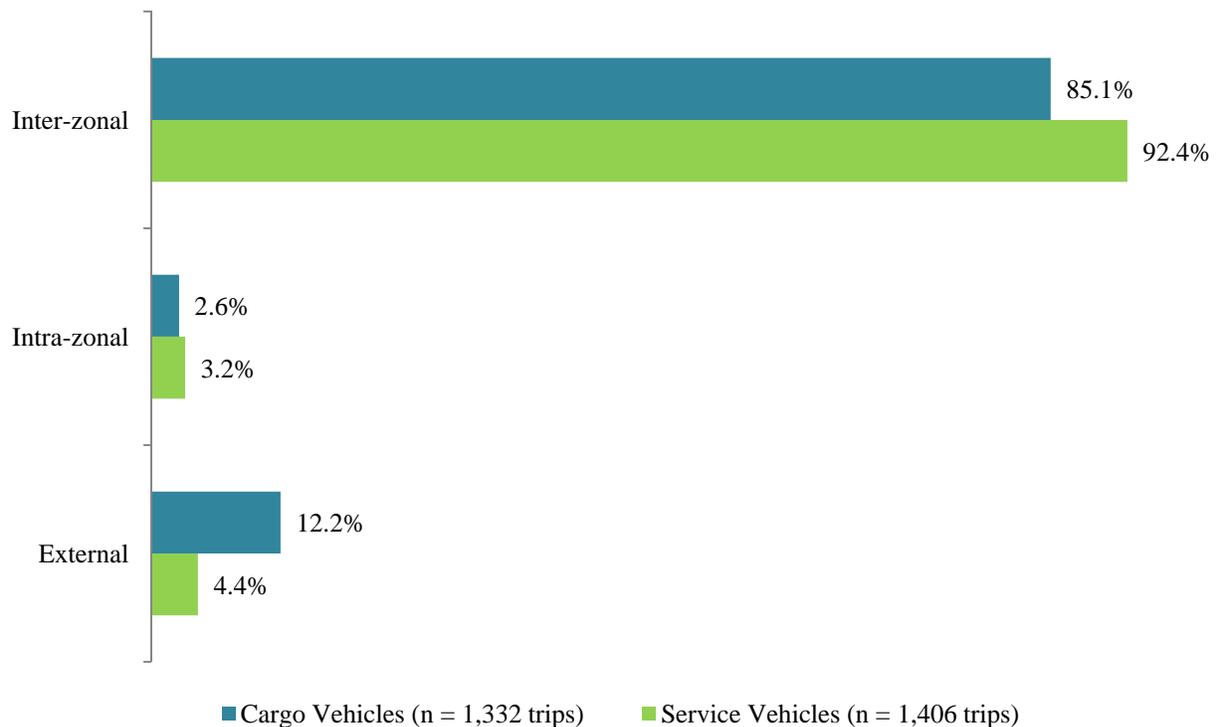


Figure 5. Inter-Zonal, Intra-Zonal, and External Trips.

Table 6. Total Internal and External Trips.

Vehicle Type Trip Type	Cargo Vehicles		Service Vehicles		Total Vehicles	
	Number	% of Total	Number	% of Total	Number	% of Total
Inter-zonal	1,134	85.2	1,299	92.4	2,433	88.9
Intra-zonal	35	2.6	45	3.2	80	2.9
Total Internal	1,169	87.8	1,344	95.6	2,513	91.8
External	163	12.2	62	4.4	225	8.2
Total	1,332	100.0	1,406	100.0	2,738	100.0

Figure 6 shows the distribution of total trips (internal and external trips) which varied from two trips to 20 or more trips per cargo and service vehicle. The most number of trips made by any one surveyed vehicle was 18. However, these additional trips were not recorded in their travel diary due to lack of space. The average number of total trips per day was 4.5 trips for cargo vehicles and 4.4 trips for service vehicles.

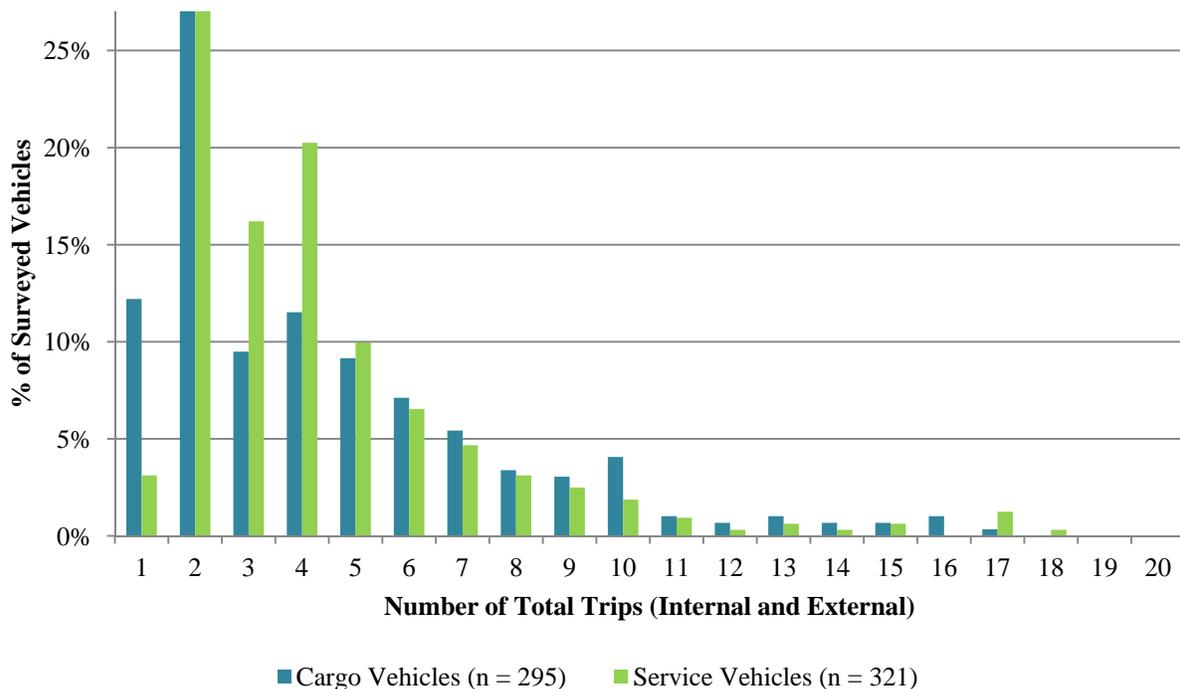


Figure 6. Total Trips per Vehicle.

Figure 7 shows the distribution of internal trips only. Approximately five percent of cargo vehicles and three percent of service vehicles made one internal trip per day. In contrast, the total

trips made by the surveyed vehicles indicated a minimum of two trips per day. The variation is attributed to the exclusion of external trips. The average number of internal trips per day was 4.0 trips for cargo vehicles and 4.2 trips for service vehicles.

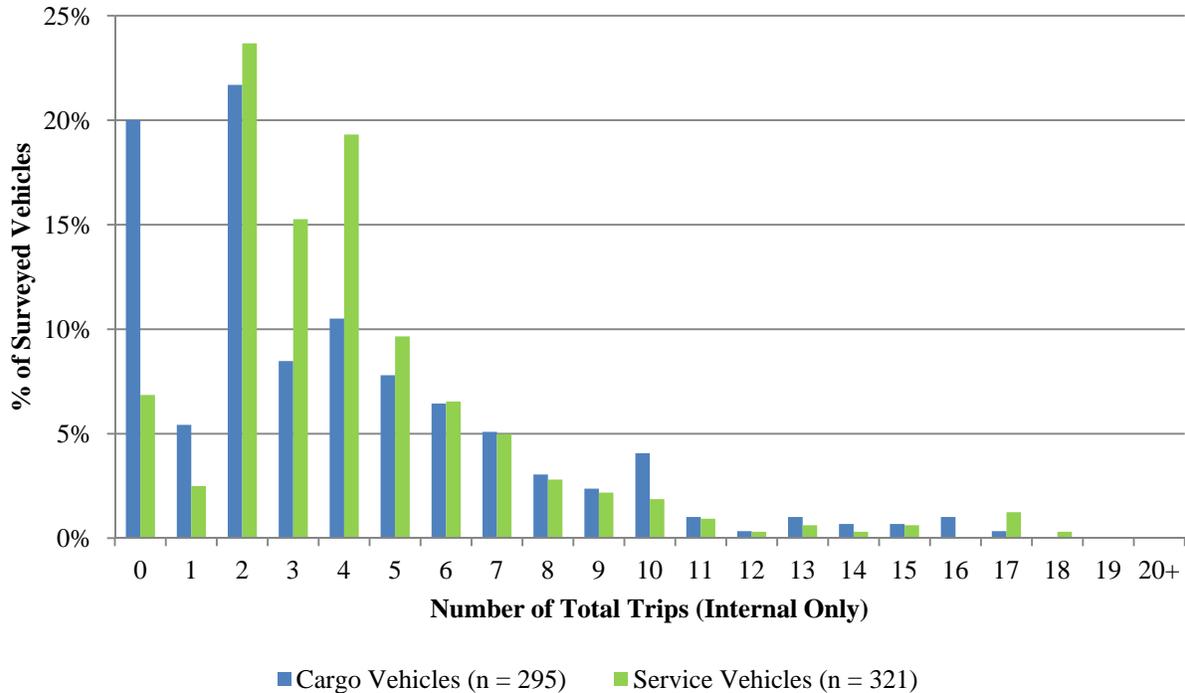


Figure 7. Total Internal Trips per Vehicle.

Trip Characteristics

Information on travel purpose and the type of land use activity where these trips occurred are important in estimating commercial vehicle trip patterns. The analysis of trips presented in this section is based solely on internal trips and does not include external trips.

Table 7 shows the distribution of internal trips by land use type at trip destinations. Approximately 26 percent of the trips made by cargo vehicles were to retail locations, followed by 15 percent to residential locations, and 14 percent to warehouses. For service vehicles, nearly 19 percent of the trips took place at residential sites, followed by 18 percent at office locations, and nearly 16 percent at retail locations.

Table 7. Distribution of Internal Trips by Land Use Type at Trip Destinations.

Frequency	Cargo		Service	
	Number	Percent of Cargo	Number	Percent of Service
Office Building (Non-government)	93	8.0	242	18.0
Retail/Shopping	309	26.4	218	16.2
Industrial/Manufacturing	69	5.9	28	2.1
Medical/Hospital	87	7.4	69	5.1
Education (< 12th grade)	6	0.5	180	13.4
Education (College, Trade)	13	1.1	23	1.7
Government Office/Building	41	3.5	78	5.8
Residential	171	14.6	259	19.3
Airport	1	0.1	9	0.7
Intermodal Facility	0	0.0	1	0.1
Warehouse	161	13.8	37	2.8
Distribution Center	63	5.4	30	2.2
Construction Site	87	7.4	86	6.4
Other	67	5.7	84	6.3
Refused/Unknown	1	0.1	0	0.0
Total Trips	1,169	100.0	1,344	100.0

Table 8 shows the distribution of internal trips by trip purposes at trip destinations. Half (50 percent) of the cargo vehicle internal trips were delivery, 24 percent were base related, and 17 percent were pick-up. For trips made by service vehicles, approximately 31 percent were base related, 28 percent were sales, and 17 percent were service.

Table 8. Trip Purposes at Destination Locations.

Trip Purpose	Cargo		Service	
	Number	Percent of Cargo	Number	Percent of Service
Return to Base Location	285	24.4	423	31.5
Maintenance (Fuel, oil, etc.)	12	1.0	18	1.3
Driver Needs (Lunch, etc.)	10	0.9	79	5.9
Delivery	579	49.5	2	0.1
Pick-up	199	17.0	1	0.1
Pick-up and Delivery	63	5.4	0	0.0
Government	0	0.0	57	4.2
Service-Related	11	0.9	229	17.0
Sales	8	0.7	381	28.3
Other	1	0.1	154	11.5
Refused / Unknown	1	0.1	0	0.0
Total Trips	1,169	100.0	1,344	100.0

Cargo Characteristics

Information on the type of cargo being delivered or picked up at each stop, the weight of cargo, and the type of land use where the cargo trip occurred was collected in the JOHRTS commercial vehicle survey to examine the movement of commodities within and outside of the study area. The analyses presented in this section is for both internal and external trips made by surveyed cargo vehicles only, and do not include the trips made by service vehicles.

The analysis of cargo trip data examined the types of cargo being transported at trip destinations, the trip purpose and land use activity at each stop, and the estimated net weight of the cargo being picked up and/or delivered for each trip. Several inconsistencies were observed during the processing and analysis of cargo trip data. There were some trips with full or partial cargo loads that did not report cargo weights but actually reported the type of cargo being transported. There were some trips that indicated delivery trip purpose but did not report any cargo weights at drop-off. Also, there were some trips that reported cargo weights at pick-up but the weights that were reported were not consistent at drop-off. Such inconsistencies generated errors in the estimation of net weight of cargo for that particular trip. Therefore, it was necessary to manually process the

cargo trip data and to make assumptions regarding cargo weights. The types of cargo in the survey were based on 22 classification types listed in Table 9.

Table 9. Cargo Classification Types.

Cargo Classifications	Cargo Descriptions
1. Farm Products	Livestock, fertilizer, dirt, landscaping, etc.
2. Forest Products	Trees, sod, etc.
3. Marine Products	Fresh fish, seafood, etc.
4. Metals and Minerals	Crude petroleum, natural gas, propane, metals, gypsum, ores, etc.
5. Food, Health, and Beauty Products	Assorted food products, cosmetics, etc.
6. Tobacco Products	Cigarettes, cigars, and chewing tobacco
7. Textiles	Clothing, linens, etc.
8. Wood Products	Lumber, paper, cardboard, wood pulp, etc.
9. Printed Matter	Newspapers, magazines, books, etc.
10. Chemical Products	Soaps, paints, household or industrial chemicals, etc.
11. Refined Petroleum or Coal Products	Gasoline, etc.
12. Rubber, Plastic, and Styrofoam Products	Finished products of rubber, plastic, or Styrofoam
13. Clay, Concrete, Glass, or Stone	Finished products of clay, concrete, glass, or stone
14. Manufactured Goods/Equip.	Miscellaneous products (machinery, appliances, furniture, etc.)
15. Wastes	Waste products including scrap and recyclable materials
16. Miscellaneous Shipments	U.S. mail, U.P.S., Federal Express, and other mixed cargo
17. Hazardous Materials	Hazardous chemicals and substances
18. Transportation	Automobiles and other transport vehicles
19. Unclassified Cargo	Cargo not falling within one of the above categories
20. Driver Refused to Answer	Driver refused to answer
21. Unknown to Driver	Unknown to driver
22. Empty	Empty (including empty shipping containers)

The distribution of trips by cargo type is provided in Table 10. Approximately 24 percent of the total cargo vehicle trips were transporting manufactured goods, followed by 11 percent transporting wood products, and nearly nine percent carrying food, health, and beauty products. Approximately 12 percent of the cargo trips were reported as empty, including empty shipping containers.

Table 10. Distribution of Trips by Cargo Type at Destinations.

Cargo Type	Number of Trips	% of Total
Farm Products	25	1.9
Forest Products	4	0.3
Marine Products	0	0.0
Metals and Minerals	62	4.7
Food, Health, and Beauty Products	124	9.3
Tobacco Products	1	0.1
Textiles	60	4.5
Wood Products	142	10.7
Printed Matter	29	2.2
Chemical Products	3	0.2
Refined Petroleum or Coal Products	0	0.0
Rubber, Plastic, and Styrofoam Products	86	6.5
Clay, Concrete, Glass, or Stone	91	6.8
Manufactured Goods/Equipment.	324	24.3
Wastes	30	2.3
Miscellaneous Shipments	51	3.8
Hazardous Materials	15	1.1
Transportation	20	1.5
Unclassified/Other Cargo	60	4.5
Driver Refused to Answer	11	0.8
Unknown to Driver	40	3.0
Total Trips with Cargo	1,178	88.4
Empty	154	11.6
Total Cargo Vehicle Trips	1,332	100.0

The commodity grouping scheme used by TxDOT in the Texas Statewide Analysis Model (SAM) was used to simplify the cargo types into 10 commodity groups. The types of place option in the survey were categorized into seven land use categories.

Table 11 shows the equivalency between SAM commodity groups and cargo classifications from the survey, while Table 12 shows the land use categories and their corresponding equivalents in

the type of place options from the survey. Those items (in italics) did not have equivalents but were added or grouped together so as not to exclude any trips in the analysis.

Table 11. Equivalency between SAM Commodity Groups and Survey Classifications.

SAM Commodity Group	Survey Cargo Classification
1. Agriculture	Farm Products, Forest Products, Marine Products
2. Raw Materials	Metals and Minerals, Chemical Products, Refined Petroleum or Coal Products
3. Food	Food, Health and Beauty Products, Tobacco Products
4. Textiles	Textiles, Rubber, Plastic, and Styrofoam Products
5. Wood	Wood Products, Printed Matter
6. Building Materials	Clay, Concrete, Glass or Stone Products
7. Machinery	Manufactured Goods/Equipment
8. Miscellaneous	Wastes, Miscellaneous Shipments
9. Secondary	Unclassified Cargo
10. 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 12. Equivalency between Land Use Category and Survey Type of Place.

Land Use Category	Type of Place
1. Office	Office Building
2. Retail	Retail/Shopping
3. Industrial	Industrial/Manufacturing
4. Medical	Medical/Hospital
5. Education	Educational (12th grade or less and college, trade, etc.)
6. Government	Government Office/Building
7. Residential	Residential
-- Other	Airport, Inter-modal Facility, Warehouse, Distribution Center, Construction Site, Other
-- Unknown	Land use category not provided, Omitted, Driver refused to answer

Table 13 shows the distribution of cargo trips by commodity group and land use type at trip destinations. Nearly 33 percent of the trips occurred at “Other” land use types, which were mainly warehouses, distribution centers and construction sites. Approximately 28 percent of the trips occurred at retail sites, and 13 percent occurred at residential locations. By commodity group, approximately 24 percent of the trips were transporting machinery, and about 13 percent were transporting wood products. Around 12 percent were not transporting cargo.

Table 13. Cargo Trips by Commodity Group and Land Use Destinations.

SAM Commodity Group	Land Use								Total Trips	% of Total
	Office	Retail	Ind'l	Med	Edu	Gov't	Res	Other		
Agriculture	1	1	3	0	0	0	1	23	29	2.2
Raw Materials	1	7	9	2	1	1	10	34	65	4.9
Food	5	108	1	0	0	0	0	11	125	9.4
Textiles	14	46	17	3	2	2	33	29	146	11.0
Wood	25	19	8	32	5	7	6	69	171	12.8
Building Materials	0	14	19	0	1	13	16	28	91	6.8
Miscellaneous	8	2	0	0	0	7	5	59	81	6.1
Machinery	17	101	14	2	6	14	79	91	324	24.3
Secondary	0	4	2	37	0	0	13	4	60	4.5
Hazardous Materials	1	0	1	9	1	0	0	3	15	1.1
Transportation	0	7	3	0	0	0	7	3	20	1.5
Empty	27	49	11	5	4	0	3	55	154	11.6
Unknown	3	8	2	0	1	0	0	36	50	3.8
Total	102	366	90	90	21	44	173	445	1,331	100.0
Percent of Total	7.7	27.5	6.8	6.8	1.6	3.3	13.0	33.4	100.0	---

Table 14 shows a detailed summary of trips by commodity group and trip purpose. Approximately 48 percent of the total cargo vehicle trips were delivery, with machinery and wood products as the most frequent delivered among the commodity groups. The trip purpose “base” made up nearly 26 percent of the total cargo trips. Nearly 36 percent of those trips were made by vehicles not carrying any cargo.

Table 14. Cargo Trips by Commodity Group and Trip Purpose at the Trip Destinations.

SAM Commodity Group	Trip Purpose										Total Trips	% of Total
	Base	Delivery	Pick-Up	Pick-Up & Delivery	Main-tenance	Driver Needs	Service	Sales	Govt.	Other		
Agriculture	6	13	10	0	0	0	0	0	0	0	29	2.2
Raw Materials	16	40	7	1	1	0	0	0	0	0	65	4.9
Food	21	95	6	0	1	0	0	2	0	0	125	9.4
Textiles	25	64	12	40	0	2	0	2	0	1	146	11.0
Wood	38	105	13	7	3	5	0	0	0	0	171	12.8
Building	11	51	28	0	0	0	0	0	0	1	91	6.8
Misc.	2	31	45	3	0	0	0	0	0	0	81	6.1
Machinery	65	180	60	6	2	2	4	2	0	3	324	24.3
Secondary	9	28	23	0	0	0	0	0	0	0	60	4.5
Hazardous	3	3	1	8	0	0	0	0	0	0	15	1.1
Transportation	7	4	9	0	0	0	0	0	0	0	20	1.5
Empty	124	0	0	0	13	6	7	4	0	0	154	11.6
Unknown	17	27	1	1	1	0	0	0	0	3	50	3.8
Total	344	641	215	66	21	15	11	10	0	8	1,331	100.0
Percent of Total	25.8	48.2	16.2	5.0	1.6	1.1	0.8	0.8	0.0	0.6	100.0	---

The analysis of cargo weights by cargo type provides information on the volume and type of commodities being moved from the time the surveyed cargo vehicle left its base location, began its trip, continued making trips until it reached its destination(s), and returned to its base location. The net cargo weight for each trip was estimated based on the cargo weight being picked-up and/or being dropped-off, consistent with the reported trip purpose for each stop. There were several cases when cargo types were changed between trips (i.e. reported as empty cargo or food type), even if the same cargo was being transported either for delivery or pick-up. The driver of the surveyed cargo vehicle reported a different trip purpose during a particular stop (i.e. driver needs - lunch, etc.), which indicated that no cargo was either delivered and/or picked-up but the cargo remained in transit. In such cases, the cargo weight from the trip origin should be the net cargo weight at that particular stop or trip destination with its corresponding cargo type. If a delivery occurred during that particular stop, the cargo weight for that particular drop-off should be deducted from the current weight load, and if cargo was picked-up, the cargo weight should be added to the current weight load, thus resulting to an estimated net cargo weight for that particular trip.

Table 15 shows the distribution of average net cargo weight per trip by commodity group and land use type at destination locations and Table 16 shows the distribution by commodity group and trip purpose. Building materials being transported to residential sites showed the highest average net cargo weight, followed by unknown materials being delivered to educational land use sites. Agricultural materials and unknown cargos had the highest average net cargo weights for deliveries.

Table 15. Average Net Cargo Weight (lbs.) by Commodity Group and Land Use at Trip Destinations.

SAM Commodity Group	Land Use							
	Office	Retail	Ind'l	Med	Edu	Gov't	Res	Other
Agriculture	0	0	0	0	0	0	150	14,479
Raw Materials	0	160	131	50	241	5	55	6,211
Food	21	932	0	0	0	0	0	0
Textiles	33	201	4,166	4	250	268	13	133
Wood	91	5,405	5,785	755	780	476	250	1,599
Building Materials	0	17	3,347	0	40	9	16,384	7,460
Miscellaneous	0	0	0	0	0	0	0	1,350
Machinery	105	106	179	350	158	2,167	436	2,274
Secondary	0	4	0	4	0	0	27	5
Hazardous Materials	0	0	338	300	507	0	0	676
Transportation	0	1,654	0	0	0	0	0	0
Empty	0	0	0	0	0	0	0	0
Unknown	0	2,625	0	0	15,000	0	0	7,901

Table 16. Average Net Cargo Weight (lbs.) by Commodity Group and Trip Purpose at Trip Destinations.

SAM Commodity Group	Trip Purpose							
	Base Location	Delivery	Pick-Up	Pick-Up & Delivery	Maintenance	Driver Needs	Service	Other
Agriculture	0	25,629	0	0	0	0	0	0
Raw Materials	0	5,330	0	1,176	0	0	0	0
Food	0	1,061	0	0	0	0	0	0
Textiles	0	692	0	1,040	0	0	0	0
Wood	0	2,661	0	2,153	0	0	0	0
Building Materials	0	10,491	0	0	0	0	0	0
Miscellaneous	0	2,517	0	533	0	0	0	0
Machinery	0	1,596	0	195	0	0	0	0
Secondary	0	19	0	0	0	0	0	0
Hazardous Material	0	958	0	338	0	0	0	0
Transportation	0	2,895	0	0	0	0	0	0
Empty	0	0	0	0	0	0	0	0
Unknown	0	11,867	0	20	0	0	0	0

Table 17 shows the distribution of cargo trips and average net cargo weights at trip destinations by commodity group. Overall, the average net cargo weight per trip was about 1,900 lbs. Of the classified commodity groups, agricultural products showed the highest average net cargo weight at approximately 11,500 lbs. per trip. However, machinery and wood products were the most frequently transported commodity groups, with average net cargo weights of about 890 lbs. and 1,700 lbs. per trip, respectively.

Table 17. Cargo Trips and Net Cargo Weight by Commodity Group at Trip Destinations.

SAM Commodity Group	Total Cargo Trips	Total Net Cargo Weight (lbs)	Number of Trips¹	Average Net Cargo Weight (lbs)¹
Agriculture	29	333,174	29	11,489
Raw Materials	65	214,380	65	3,298
Food	125	100,784	125	806
Textiles	146	85,879	146	588
Wood	171	294,446	171	1,722
Building Materials	91	535,031	91	5,879
Miscellaneous	81	79,625	81	983
Machinery	324	288,365	324	890
Secondary	60	535	60	9
Hazardous Materials	15	5,577	15	372
Transportation	20	11,578	20	579
Empty	154	0	0	0
Unknown	51	320,430	51	6,283
Total	1,332	2,269,804	1,178	1,927

¹ Excluding trips with empty cargo.

Table 18 shows the number of trips and net cargo weights at trip destinations by land use type. The land use type “Other” showed the highest average net cargo weight of approximately 3,700 lbs. per trip. Cargo trips to industrial locations showed the next highest average net cargo weight at nearly 2,300 lbs. per trip.

Table 18. Cargo Trips and Average Net Cargo Weights by Land Use at Trip Destinations.

Land Use	Total Cargo Trips	Total Net Cargo Weight (lbs)	Number of Trips ¹	Average Net Cargo Weight (lbs) ¹
Office	102	4,625	75	62
Retail	366	257,293	317	812
Industrial	90	184,722	79	2,338
Medical	90	27,827	85	327
Education	21	21,138	17	1,243
Government	44	34,326	44	780
Residential	173	299,548	170	1,762
Other	445	1,440,325	390	3,693
Refused/Unknown	1	0	1	0
Total	1,332	2,269,804	1,178	1,927

¹ Excluding trips with empty cargo.

Table 19 shows the distribution of cargo trips and net cargo weights by trip purpose at trip destinations. The trip purpose “delivery” had the highest average net weight at 10,000 lbs. per trip.

Table 19. Cargo Trips and Average Net Cargo Weights by Trip Purpose at Trip Destinations.

Trip Purpose	Total Cargo Trips	Total Net Cargo Weight (lbs)	Number of Trips ¹	Average Net Cargo Weight (lbs) ¹
Return to Base Location	337	0	0	0
Delivery	631	2,206,485	220	10,029
Pick-Up	226	0	641	0
Pick-Up and Delivery	68	63,319	215	295
Maintenance (fuel, oil, etc.)	25	0	66	0
Driver Needs (lunch, etc.)	15	0	8	0
Service-Related	10	0	9	0
Sales	10	0	1	0
Government	0	0	6	0
Other	9	0	4	0
Unknown	1	0	0	0
Total	1,332	2,269,804	1,170	1,940

¹ Excluding trips with empty cargo.

Trip Length

Odometer readings at the beginning and end of the trip are useful in estimating travel distances for external and intra-zonal trips. The El Paso commercial vehicle survey, however, only provided odometer mileage on each vehicle for the beginning of the trip and not for the end of the trip. Because this incomplete information makes odometer readings not particularly useful for trip length measurement in the analysis, network matrices available for the study area were used to estimate trip lengths. The network matrices provide travel distance and time estimates from one zone to all other zones in the EUTS study area. Since each reported trip in the survey was coded with a traffic analysis zone (TAZ) number assigned to the study area, it was then possible to estimate the trip length based on the distance provided in the network matrix.

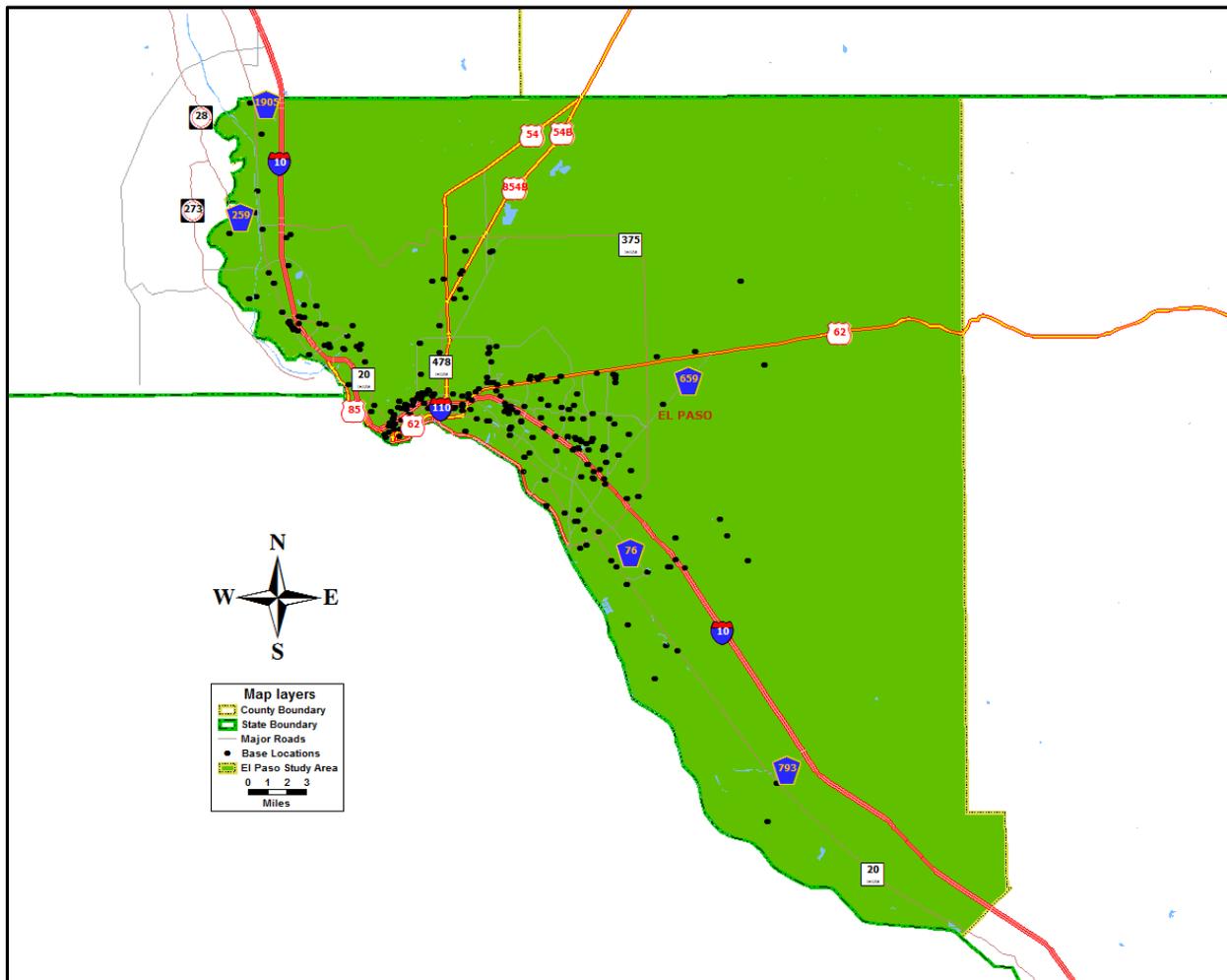


Figure 8. TAZ Boundary and Base Locations of Surveyed Commercial Vehicles.

Figure 8 shows the TAZ boundary and base locations of surveyed vehicles within the El Paso study area, while Figure 9 shows the origin and destination locations of trips made by the surveyed vehicles. Any trip that had at least one trip end outside of the EUTS study area was considered an external trip.

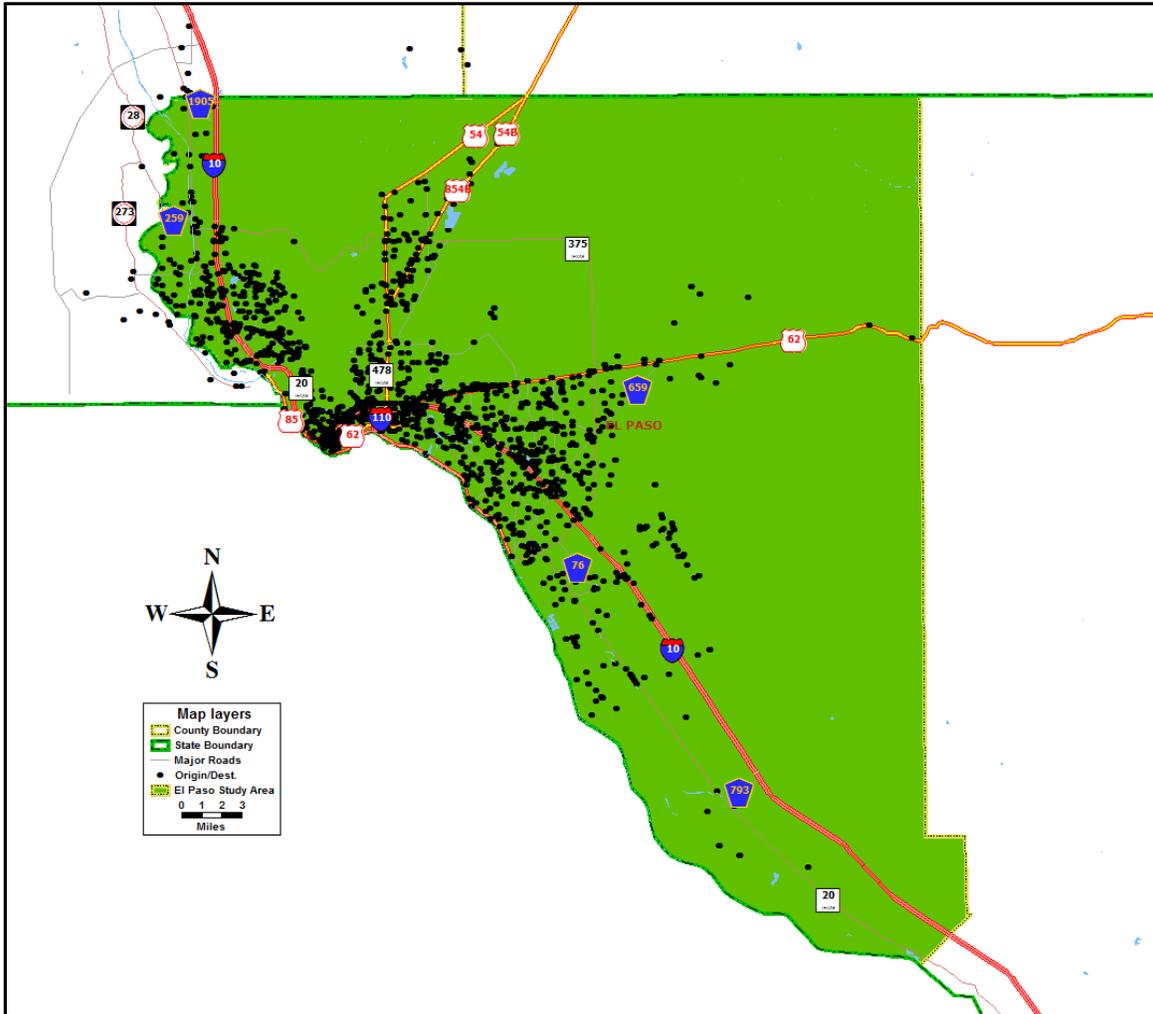


Figure 9. Trip Origins and Destinations of Surveyed Commercial Vehicles.

The results presented in this section pertain to trip length characteristics for 2,431 inter-zonal trips only. Table 20 shows the trip length frequency distribution (TLFD), grouped at five-mile intervals, while Figure 10 and Table 21 show the ungrouped TLFD. Approximately 40 percent of the cargo and 51 percent of the service vehicle trips had trip lengths less than five miles, and 29 percent of the cargo vehicle trips and 24 percent of the service vehicles had trip lengths between six miles and ten miles. The longest trip lengths reported by cargo and service vehicles were 48

and 44 miles, respectively. There was one reported inter-zonal trip with unknown origin/destination zones. This trip was not included in the analysis and estimation of average trip lengths.

Table 20. Trip Length Frequency Distribution (Grouped Interval).

Trip Length (miles)	Cargo		Service		All Vehicles	
	# of Trips	% of Total	# of Trips	% of Total	# of Trips	% of Total
Less than 5	457	40.4	662	51.0	1,119	46.0
6 to 10	324	28.6	312	24.0	636	26.2
11 to 15	167	14.8	178	13.7	345	14.2
16 to 20	86	7.6	84	6.5	170	7.0
21 to 25	46	4.1	44	3.4	90	3.7
26 to 30	38	3.4	12	0.9	50	2.1
31 to 35	7	0.6	5	0.4	12	0.5
36 to 40	4	0.4	1	0.1	5	0.2
41 to 45	2	0.2	1	0.1	3	0.1
Over 45	1	0.1	0	0.0	1	0.0
Total	1,132	100.0	1,299	100.0	2,431	100.0

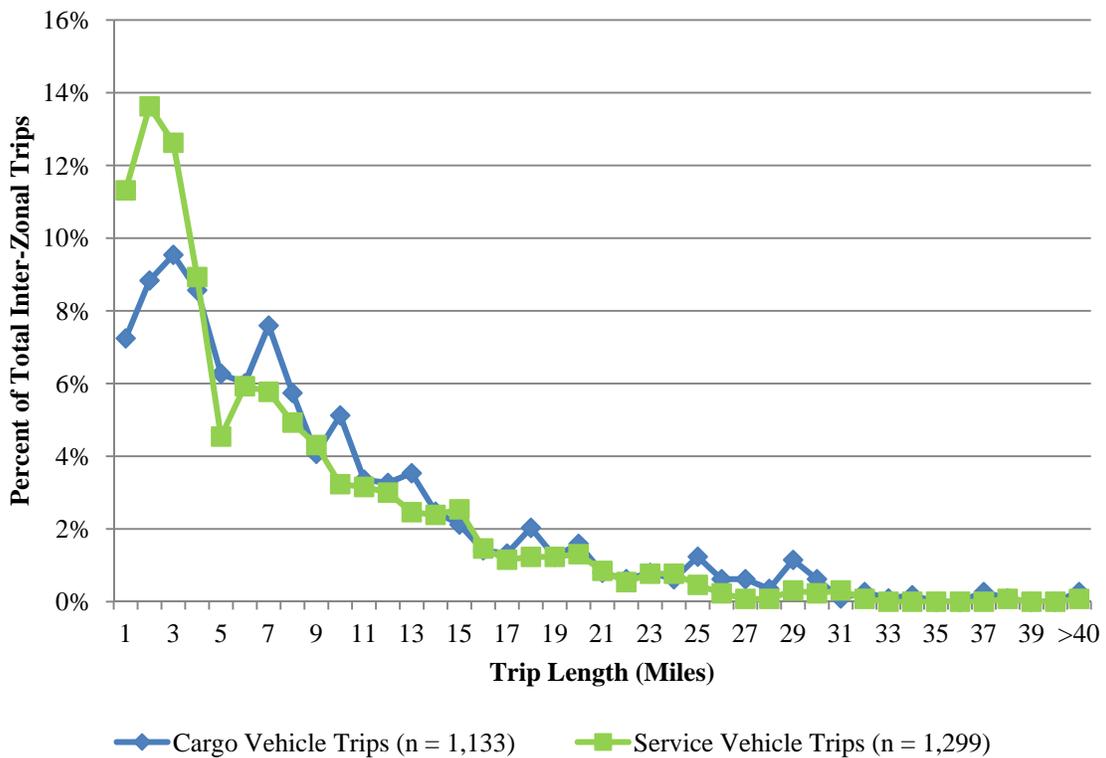


Figure 10. Surveyed Commercial Vehicle Trips TLFD.

Table 21. Trip Length Frequency Distribution (Ungrouped).

Trip Length (miles)	Cargo Vehicles		Service Vehicles		All Vehicles	
	# of Trips	% of Total	# of Trips	% of Total	# of Trips	% of Total
1	82	7.2	147	11.3	229	9.4
2	100	8.8	177	13.6	277	11.4
3	108	9.5	164	12.6	272	11.2
4	97	8.6	116	8.9	213	8.8
5	71	6.3	59	4.5	130	5.3
6	68	6.0	77	5.9	145	6.0
7	86	7.6	75	5.8	161	6.6
8	65	5.7	64	4.9	129	5.3
9	46	4.1	56	4.3	102	4.2
10	58	5.1	42	3.2	100	4.1
11	38	3.4	41	3.2	79	3.2
12	37	3.3	39	3.0	76	3.1
13	40	3.5	32	2.5	72	3.0
14	28	2.5	31	2.4	59	2.4
15	24	2.1	33	2.5	57	2.3
16	16	1.4	19	1.5	35	1.4
17	15	1.3	15	1.2	30	1.2
18	23	2.0	16	1.2	39	1.6
19	14	1.2	16	1.2	30	1.2
20	18	1.6	17	1.3	35	1.4
21	9	0.8	11	0.8	20	0.8
22	7	0.6	7	0.5	14	0.6
23	9	0.8	10	0.8	19	0.8
24	7	0.6	10	0.8	17	0.7
25	14	1.2	6	0.5	20	0.8
26	7	0.6	3	0.2	10	0.4
27	7	0.6	1	0.1	8	0.3
28	4	0.4	1	0.1	5	0.2
29	13	1.1	4	0.3	17	0.7
30	7	0.6	3	0.2	10	0.4
31	1	0.1	4	0.3	5	0.2
32	3	0.3	1	0.1	4	0.2
33	1	0.1	0	0.0	1	0.0
34	2	0.2	0	0.0	2	0.1
35	0	0.0	0	0.0	0	0.0
36	0	0.0	0	0.0	0	0.0
37	3	0.3	0	0.0	3	0.1
38	1	0.1	1	0.1	2	0.1
39	0	0.0	0	0.0	0	0.0
40	0	0.0	0	0.0	0	0.0
> 40	3	0.3	1	0.1	4	0.2
Total	1,132	100.0	1,299	100.0	2,431	100.0

Table 22 shows the average trip length to destinations by land use type for cargo and service vehicle trips. Overall, the average distance per trip traveled by the surveyed vehicles was 7.6 miles, with cargo vehicles averaging 8.5 miles and service vehicles averaging 6.8 miles. The most number of trips by cargo vehicles occurred at “other” land use types, with an average trip length of 9.4 miles, followed by retail and residential sites with average trip lengths of 7.4 and 8.1 miles, respectively. For service vehicles, the highest frequency of trips occurred at residential land use types, with an average trip length of 7.1 miles. Over half of the trips made by service vehicles (53 percent) occurred at residential, office, and retail land use sites.

Table 22. Average Trip Length to Destinations by Land Use Type.

Land Use	Cargo			Service			All Vehicles		
	Number of Trips	Total Trip Length (miles)	Average Trip Length (miles)	Number of Trips	Total Trip Length (miles)	Average Trip Length (miles)	Number of Trips	Total Trip Length (miles)	Average Trip Length (miles)
Office	91	801	8.8	238	1,727	7.3	329	2,527	7.7
Retail	301	2,238	7.4	209	1,419	6.8	510	3,657	7.2
Industrial	66	638	9.7	28	294	10.5	94	933	9.9
Medical	82	533	6.5	69	505	7.3	151	1,038	6.9
Education	14	105	7.5	193	807	4.2	207	912	4.4
Government	40	480	12.0	78	595	7.6	118	1,075	9.1
Residential	169	1,370	8.1	244	1,728	7.1	413	3,098	7.5
Other	369	3,484	9.4	240	1,787	7.4	609	5,271	8.7
Total	1,132	9,649	8.5	1,299	8,861	6.8	2,431	18,510	7.6

Table 23 shows the average trip length to destinations by commodity group for trips made by cargo vehicles only. Unclassified secondary cargo was the most frequently transported commodity group, with an average trip length of 9.8 miles per trip. Trips transporting building materials showed the longest average trip length of 14.9 miles per trip. The average trip length for trips with empty cargo was 11.1 miles.

Table 23. Average Trip Length to Destinations by Commodity Group.

SAM Commodity Group	Cargo		
	Number of Trips	Total Trip Length (miles)	Average Trip Length (miles)
Agriculture	29	234	8.1
Raw Materials	56	601	10.7
Food	93	587	6.3
Textiles	114	606	5.3
Wood	136	1,146	8.4
Building Materials	82	1,151	14.0
Machinery	292	2,493	8.5
Miscellaneous	78	944	12.1
Hazardous Materials	15	111	7.4
Transportation	16	239	14.9
Secondary	54	291	5.4
Empty	35	250	7.1
Unknown	133	997	7.5
Total	1,133	9,649	8.5

Travel Time and Speed

The EUTS commercial vehicle survey provided travel logs on the arrival and departure times for each trip made by the surveyed commercial vehicles. The travel logs can be compared with the network travel time matrix table available for the study area. However, some of the reported travel logs had missing departure or arrival times, which rendered them unreliable in generating accurate estimate. Hence, as has been done in the estimation of trip lengths, travel time estimates were generated from the network travel time matrix table available for the EUTS study area, and travel speed estimates were derived from the estimated trip lengths.

Table 24 shows the travel time frequency distribution of inter-zonal trips, grouped at five-mile intervals, while Figure 11 and Table 25 show the ungrouped TLFD. Approximately 17 percent of the trips made by cargo vehicles were less than five minutes, 25 percent were between 6-and-10 minutes, and 21 percent were between 11-and-15 minutes. For service vehicles, approximately 26 percent of the trips were less than five minutes, 26 percent were between 6-and-10 minutes, and 18 percent were between 11-and-15 minutes. The longest duration of travel time for cargo vehicles was 66 minutes, while the longest travel duration for service vehicles was 62 minutes.

Table 24. Travel Time Frequency Distribution (Grouped Interval).

Travel Time (minutes)	Cargo		Service		All Vehicles	
	# of Trips	% of Total	# of Trips	% of Total	# of Trips	% of Total
Less than 5	187	16.5	341	26.3	528	21.7
6 to 10	281	24.8	343	26.4	624	25.7
11 to 15	236	20.8	234	18.0	470	19.3
16 to 20	149	13.2	151	11.6	300	12.3
21 to 25	110	9.7	101	7.8	211	8.7
26 to 30	67	5.9	63	4.8	130	5.3
31 to 35	32	2.8	32	2.5	64	2.6
36 to 40	26	2.3	18	1.4	44	1.8
41 to 45	32	2.8	12	0.9	44	1.8
Over 45	12	1.1	4	0.3	16	0.7
Total	1,132	100.0	1,299	100.0	2,431	100.0

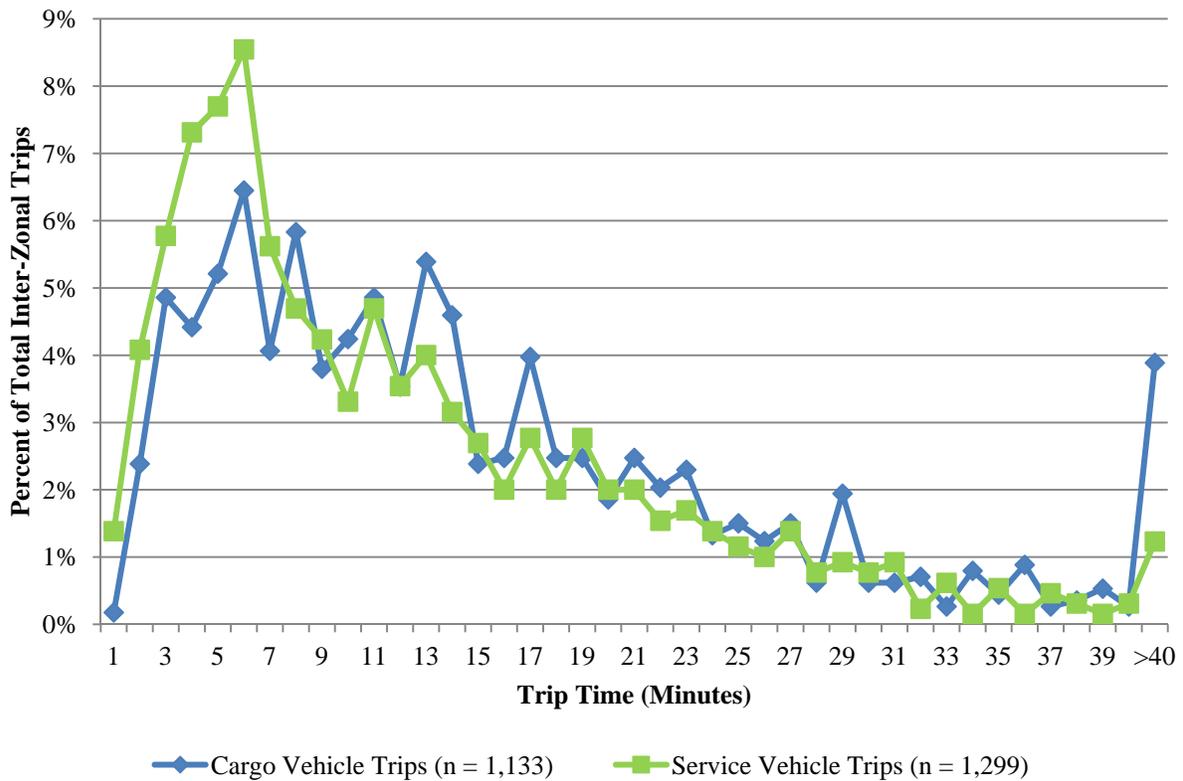


Figure 11. Surveyed Commercial Vehicle Trips Travel Time.

Table 25. Travel Time Frequency Distribution (Ungrouped).

Travel Time (minutes)	Cargo Vehicles		Service Vehicles		All Vehicles	
	# of Trips	% of Total	# of Trips	% of Total	# of Trips	% of Total
1	2	0.2	18	1.4	20	0.8
2	27	2.4	53	4.1	80	3.3
3	55	4.9	75	5.8	130	5.3
4	50	4.4	95	7.3	145	6.0
5	59	5.2	100	7.7	159	6.5
6	73	6.4	111	8.5	184	7.6
7	46	4.1	73	5.6	119	4.9
8	66	5.8	61	4.7	127	5.2
9	43	3.8	55	4.2	98	4.0
10	48	4.2	43	3.3	91	3.7
11	55	4.9	61	4.7	116	4.8
12	40	3.5	46	3.5	86	3.5
13	61	5.4	52	4.0	113	4.6
14	52	4.6	41	3.2	93	3.8
15	27	2.4	35	2.7	62	2.6
16	28	2.5	26	2.0	54	2.2
17	45	4.0	36	2.8	81	3.3
18	28	2.5	26	2.0	54	2.2
19	28	2.5	36	2.8	64	2.6
20	21	1.9	26	2.0	47	1.9
21	28	2.5	26	2.0	54	2.2
22	23	2.0	20	1.5	43	1.8
23	26	2.3	22	1.7	48	2.0
24	15	1.3	18	1.4	33	1.4
25	17	1.5	15	1.2	32	1.3
26	14	1.2	13	1.0	27	1.1
27	17	1.5	18	1.4	35	1.4
28	7	0.6	10	0.8	17	0.7
29	22	1.9	12	0.9	34	1.4
30	7	0.6	10	0.8	17	0.7
31	7	0.6	12	0.9	19	0.8
32	8	0.7	3	0.2	11	0.5
33	3	0.3	8	0.6	11	0.5
34	9	0.8	2	0.2	11	0.5
35	5	0.4	7	0.5	12	0.5
36	10	0.9	2	0.2	12	0.5
37	3	0.3	6	0.5	9	0.4
38	4	0.4	4	0.3	8	0.3
39	6	0.5	2	0.2	8	0.3
40	3	0.3	4	0.3	7	0.3
> 40	44	3.9	16	1.2	60	2.5
Total	1,132	100.0	1,299	100.0	2,431	100.0

Table 26 shows the average travel time and speed to destinations by land use for cargo and service vehicles. Overall, the average travel time for all surveyed vehicles was 13.1 minutes, with cargo vehicles averaging 14.5 minutes and service vehicles averaging 11.8 minutes. By land use types, trips made by cargo vehicles to government locations had the longest average travel duration of 19.7 minutes, with an average travel speed of 36.5 mph. For service vehicles, trips to industrial sites also had the highest average travel time at 17.5 minutes, with an average travel speed of 36.0 mph.

Table 26. Average Travel Time and Speed to Destinations by Land Use Type.

Land Use	Cargo			Service			All Vehicles		
	Number of Trips	Average Travel Time (minutes)	Average Travel Speed (mph)	Number of Trips	Average Travel Time (minutes)	Average Travel Speed (mph)	Number of Trips	Average Travel Time (minutes)	Average Travel Speed (mph)
Office	91	14.7	36.0	238	12.5	34.8	329	13.1	35.1
Retail	301	12.8	35.0	209	11.8	34.4	510	12.4	34.7
Industrial	66	15.7	37.0	28	17.5	36.0	94	16.2	36.7
Medical	82	11.7	33.5	69	12.5	35.2	151	12.0	34.3
Education	14	12.3	36.5	193	8.1	31.0	207	8.4	31.6
Government	40	19.7	36.5	78	12.8	35.7	118	15.2	36.0
Residential	169	13.8	35.3	244	12.4	34.2	413	13.0	34.7
Other	369	16.0	35.3	240	12.4	35.9	609	14.6	35.5
Total	1,132	14.5	35.4	1,299	11.8	34.6	2,431	13.1	35.0

Table 27 shows the average travel time and speed to destinations by commodity group for trips made by cargo vehicles only. Vehicles carrying transportation products had the longest average trip duration of 23.3 minutes, with an average travel speed of 38.5 mph. The commodity group “machinery” had the highest number of trips, with an average travel time of 14.4 minutes and 35.7 mph.

Table 27. Average Travel Time and Speed to Destinations by Commodity Group.

SAM Commodity Group	Cargo		
	Number of Trips	Average Travel Time (minutes)	Average Travel Speed (mph)
Agriculture	29	13.9	34.9
Raw Materials	56	17.6	36.6
Food	93	11.1	34.0
Textiles	114	9.6	33.2
Wood	136	14.5	34.9
Building Materials	82	22.1	38.2
Machinery	292	14.4	35.7
Miscellaneous	78	20.2	36.0
Hazardous Materials	15	13.0	34.3
Transportation	16	23.3	38.5
Secondary	54	10.1	32.0
Empty	35	12.8	33.6
Unknown	133	13.2	34.1
Total	1,133	14.5	35.4

Trip Tours

The analyses of trip tours show the amount of circuitous travel undertaken by commercial vehicles in the study area. Trip tours are 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 trip tours, external trips had to be included in the analysis. This is done because it is possible for trip tours to begin within the study area, then travel outside the study area, and then end or return to the study area. Therefore, to exclude external trips in the analysis could result in not capturing those trips that occur outside the study area that take place within the trip tour.

There were 2,738 trips observed in the EUTS commercial vehicle survey. Each trip in the survey provided information on whether or not the origin of the trip 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. A base trip was defined as when either trip ends (origin or destination) began or ended at the base location. If neither trip end was at the base location, then the trip was considered as a non-base trip.

As Table 28 shows, approximately 52 percent of the total trips generated by cargo vehicles were non-base trips and 48 percent were base trips. For trips made by service vehicles, 39 percent were non-base trips and 61 percent were base trips.

Table 28. Base and Non-Base Trips.

Trip Type	Cargo Vehicles		Service Vehicles		All Vehicles	
	Number of Trips	Percent of Total	Number of Trips	Percent of Total	Number of Trips	Percent of Total
Base	644	48.35	853	60.67	1,497	54.67
Non-Base	688	51.65	553	39.33	1,241	45.33
Total	1,332	100.00	1,406	100.00	2,738	100.00

Table 29 shows the distribution of trip tours for cargo and service vehicles. There were 714 trip tours generated by 549 vehicles making at least one trip tour. Cargo vehicles made 299 tours and service vehicles produced 415 tours. The number of tours varied from one-to-six tours for both cargo vehicles and service vehicles. The majority of cargo and service vehicles made only one trip tour (86 percent and 76 percent, respectively). For those cargo and service vehicles making only one trip tour, they averaged 4.6 and 3.6 trips within the tour, respectively. For all vehicles combined, the average number of tours per vehicle was 1.3 and the average number of trips per tour was 3.6.

Table 29. Trip Tours per Vehicle.

Cargo Vehicles				
Total Number of Trip Tours	Number of Vehicles	Number of Tours	Number of Trips	Average Trips per Tour
1	211	211	975	4.6
2	22	44	158	3.6
3	7	21	63	3.0
4	3	12	38	3.2
5	1	5	10	2.0
6	1	6	13	2.2
Cargo Total	245	299	1,257	4.2
Service Vehicles				
Total Number of Trip Tours	Number of Vehicles	Number of Tours	Number of Trips	Average Trips per Tour
1	230	230	823	3.6
2	50	100	276	2.8
3	13	39	97	2.5
4	10	40	127	3.2
5	0	0	0	0.0
6	1	6	18	3.0
Service Total	304	415	1,341	3.2
Grand Total	549	714	2,598	3.6

The analyses of trip tours also involved counting the number of non-base trips, external trips, inter-zonal trips and intra-zonal trips within trip tours to determine the total amount and types of travel that occur during the course of the tour. There were 2,598 trips observed within the total 714 trip tours. For all vehicles, 141 were external trips (5 percent), 2,377 were inter-zonal trips (91 percent), and 80 were intra-zonal trips (4 percent).

Table 30 shows the distribution of these trips for cargo and service vehicles. Table 31 shows the number of non-base trips within trip tours separately since non-base trips are not mutually exclusive of the other trip types (i.e., a non-base trip may also be an inter-zonal or external trip).

Table 30. External, Inter-Zonal and Intra-Zonal Trips within Trip Tours.

No. of Trip Tours	External		Inter-Zonal		Intra-Zonal		Total Trips	
	Cargo Vehicles	Service Vehicles						
1	92	35	855	764	28	24	975	823
2	8	2	149	265	1	9	158	276
3	2	0	56	91	5	6	63	97
4	0	2	38	122	0	3	38	127
5	0	0	10	0	0	0	10	0
6	0	0	12	15	1	3	13	18
Total	102	39	1,120	1,257	35	45	1,257	1,341

Table 31. Non-Base Trips within Trip Tours.

No. of Trip Tours	Non-Base Trips within Trip Tours			Total Trips within Trip Tours					
	Cargo Vehicles	Service Vehicles	All Vehicles	Cargo Vehicles	Percent of Total	Service Vehicles	Percent of Total	All Vehicles	Percent of Total
1	553	369	922	975	77.6	823	61.4	1,798	69.2
2	70	84	154	158	12.6	276	20.6	434	16.7
3	23	23	46	63	5.0	97	7.2	160	6.2
4	14	47	61	38	3.0	127	9.5	165	6.4
5	0	0	0	10	0.8	0	0.0	10	0.4
6	1	6	7	13	1.0	18	1.3	31	1.2
Total	661	529	1,190	1,257	100.0	1,341	100.0	2,598	100.0

Figure 12 and Figure 13 show the percentage distribution of non-base trips, external trips, inter-zonal trips and intra-zonal trips within trip tours for cargo vehicles and service vehicles, respectively. Those cargo vehicles that completed five or more tours made trips that were all inter-zonal trips. For service vehicles that completed four or more tours, all of the trips were inter-zonal trips.

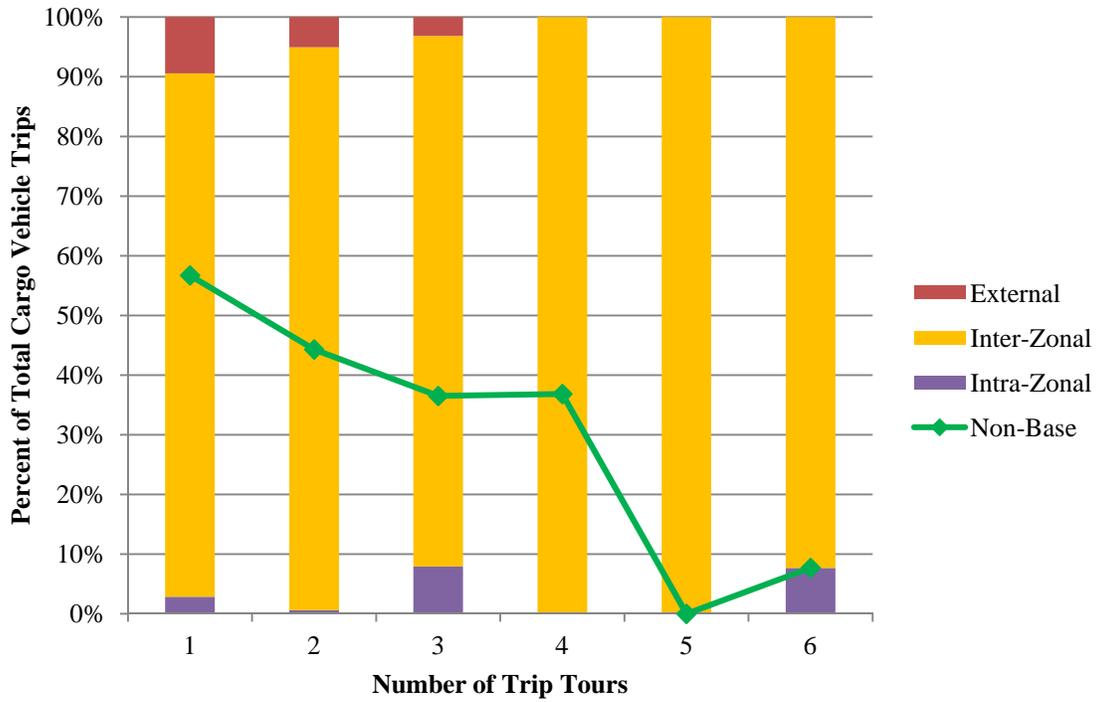


Figure 12. Cargo Vehicle Trips within Trip Tours by Trip Type.

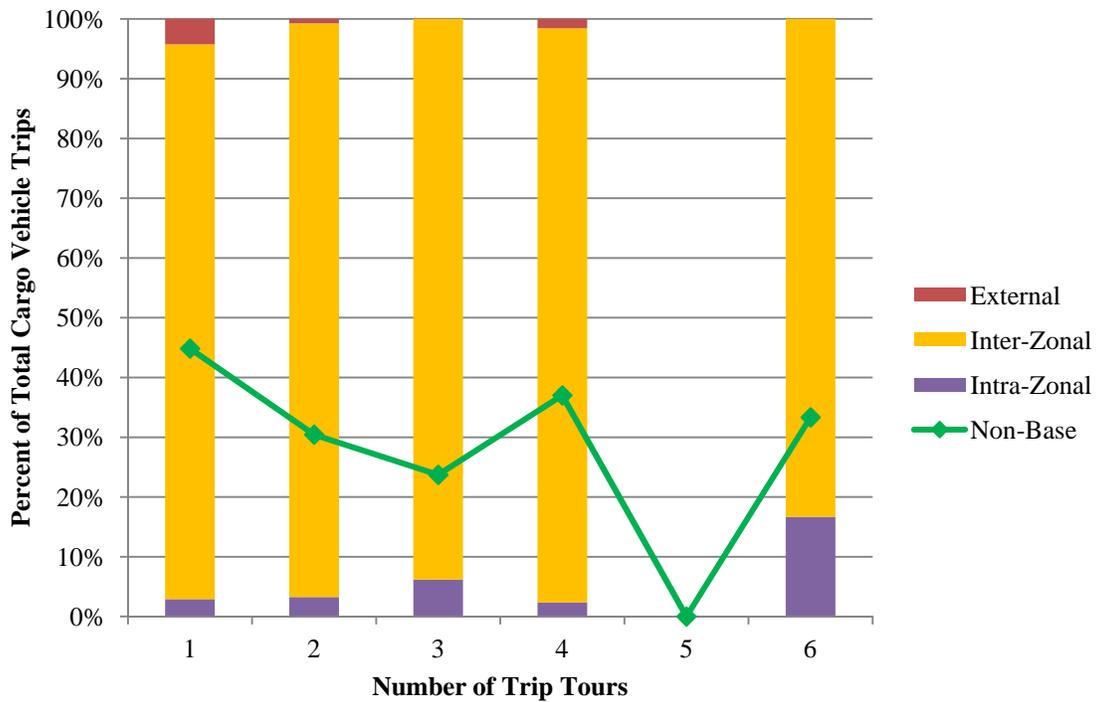


Figure 13. Service Vehicle Trips within Trip Tours by Trip Type.

The analyses of trip tours involved counting all the trips that began at the base location until the vehicle returned to its base location. Those trip chains that did not start and/or end at their base location, as well as those that only went to the base one time on the survey day, were considered open tours. Due to the number of trips that were made in open tours, a review of when these trips occurred was performed. Table 32 provides an overview of when trips that are not part of tours were made relative to trip tours. Roughly one percent of the trips made by cargo and service vehicles combined were before the first trip tour or after the last completed trip tour. Nearly four percent of the trips made by surveyed vehicles did not have any trip tours.

Table 32. Summary of Open Tour Trips.

Trip Type	Cargo		Service		All Vehicles	
	# of Trips	% of Total	# of Trips	% of Total	# of Trips	% of Total
Before start of first tour	1	0.08	12	0.85	13	0.47
After end of last tour	3	0.23	11	0.78	14	0.51
No tour (base only once)	70	5.26	42	2.99	112	4.09
Total (non-tour trips)	74	5.56	65	4.62	139	5.08
Within a tour	1,258	94.44	1,341	95.38	2,599	94.92
Total (all trips)	1,332	100.00	1,406	100.00	2,738	100.00

SURVEY EXPANSION

The expansion of commercial vehicle survey data is conducted in an indirect manner. In typical travel surveys, an estimate of the population being sampled is known and data are then expanded to represent that population. In the case of commercial vehicle surveys, the population of vehicles operating in the study area is unknown. Vehicle registration data are not considered a viable basis to estimate the number of commercial vehicles in the study area because other vehicles operating in the area may be registered in neighboring counties. However, in the EUTS commercial vehicle survey analysis, information on registered trucks has been included to show how the survey data compare with existing vehicle registration data.

The methodology currently used to expand commercial vehicle survey data is based on vehicle miles of travel (VMT) estimates from the Highway Performance Monitoring System (HPMS), and vehicle classification counts by functional classification for the study area. In essence, 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 functionally classified facilities such as freeways, arterials, collectors, and local roadways. Since AADT includes weekend traffic, a correction factor is applied to the data to obtain average weekday VMT by functional classification. Table 33 provides the adjusted 2010 HPMS VMT estimates for the EUTS study area.

Table 33. 2008 HPMS Estimates of Weekday VMT in the EUTS Study Area.

Functional Classification	Total Weekday VMT
Freeway	6,277,467
Arterial	6,800,187
Collector	1,554,402
Local	1,014,066
Total	15,646,122

The percentage of commercial and non-commercial vehicles by functional classification are generally determined by utilizing vehicle classification counts obtained during the conduct of an external survey and vehicle classification counts conducted at randomly selected locations within the study area. The percentage of commercial vehicles for internal sites for each functional classification were combined with the corresponding percentage for external sites based on the percentage of regional VMT estimated as external travel. Based on the 2002 El Paso external survey, external VMT for the study area amounted to 14 percent of the total VMT. Therefore, it was reasonable to assume that 86 percent of the total VMT was internal travel. These percentages were applied to obtain the weighted average for each functional classification.

Table 34 provides the internal, external, and weighted percentages of commercial and non-commercial vehicles by functional classification. The weighted percentages were applied to the HPMS estimated weekday VMT shown in Table 33 to estimate the total commercial and non-commercial VMT. Table 35 shows the estimated VMT for commercial and non-commercial vehicles.

Table 34. Percentage of Commercial and Non-Commercial Vehicles by Functional Classification.

Functional Classification	Percent of Commercial Vehicles			Percent of Non-Commercial Vehicles		
	Internal Sites (86%)	External Sites (14%)	Weighted Average	Internal Sites (86%)	External Sites (14%)	Weighted Average
Freeway	12	38	16	88	62	84
Arterial	5	32	9	95	68	91
Collector	3	10	4	97	90	96
Local	4	11	5	96	89	95

Table 35. Estimated VMT for Commercial and Non-Commercial Vehicles.

Functional Classification	Commercial VMT	Non-Commercial VMT	Total VMT
Freeway	974,381	5,303,085	6,277,466
Arterial	582,277	6,217,909	6,800,186
Collector	60,431	1,493,971	1,554,402
Local	51,405	962,661	1,014,066
Total	1,668,494	13,977,626	15,646,120

The total commercial VMT of 1,668,494 miles represented all commercial vehicles that traveled within and to the boundary of the EUTS study area. To properly expand the survey data and determine the total internal commercial vehicle trips generated in the study area, commercial external VMT estimates had to be subtracted from the total commercial VMT. Using the external VMT estimate of 30 percent that was derived from the external trip tables, the total internal commercial VMT was determined to be 1,173,584 miles.

The total internal VMT observed from the commercial vehicle survey was 18,472 miles, of which 9,639 miles were cargo VMT and 8,833 were service VMT. This estimate was based on 2,433 inter-zonal trips (1,134 cargo vehicle trips and 1,299 service vehicle trips), multiplied by the average trip length (8.5 miles for cargo and 6.8 miles for service vehicles).

The total internal commercial VMT (1,173,584 miles) represented all commercial vehicles and is not distinguished by cargo or service vehicles. It was assumed that the distribution of cargo and service vehicle types operating in the EUTS study area was consistent with the distribution observed in the survey sample. In the survey, 52.2 percent of the observed commercial vehicle VMT was attributable to cargo vehicles and 47.8 percent was attributable to service vehicles.

Therefore, to establish the VMT estimates by commercial cargo and service types, it was deemed reasonable to apply these percentages to the total internal commercial VMT. The resulting VMT estimates were 612,389 miles for cargo vehicles and 561,195 miles for service vehicles.

Expansion factors were derived based on the quotient between total internal VMT and observed internal VMT (from the survey) for each commercial vehicle type. The expansion factor (63.53) was then multiplied by the observed number of inter-zonal and intra-zonal trips to estimate the total vehicle trips. The resulting trip estimates were approximately 74,269 cargo vehicle trips and 85,388 service vehicle trips. Based on the average number of internal trips per day of 4.0 trips for cargo vehicles and 4.2 trips for service vehicles, 38,898 commercial vehicles (18,567 cargo vehicles and 20,331 service vehicles) were estimated to be operating within the EUTS study area on a daily basis. This estimate is over six times the 6,328 trucks registered in the study area in 2010. Table 36 provides a summary of key results from the EUTS commercial vehicle survey and data expansion.

Table 36. Key Survey Results and Expanded Trip and VMT Data.

Indicator	Cargo Vehicles	Service Vehicles	All Vehicles
Sample Size	295	321	616
Total Inter-Zonal Trips	1,134	1,299	2,433
Total Intra-Zonal Trips	35	45	80
Total Internal Trips	1,169	1,344	2,513
Total External Trips	163	62	225
Total Internal and External Trips	1,332	1,406	2,738
Average Total Trips per Vehicle	4.52	4.38	4.44
Average Total Internal Trips per Vehicle ¹	3.96	4.2	4.08
Average Trip Length	8.50	6.80	7.60
Observed Internal VMT (miles)	9,639	8,833	18,472
Total Internal Commercial VMT (miles)	612,389	561,195	1,173,584
Survey Expansion Factor	63.53	63.53	63.53
Total Expanded Inter-Zonal Commercial Vehicle Trips	72,045	82,529	154,574
Total Expanded Intra-Zonal Commercial Vehicle Trips	2,224	2,859	5,083
Total Expanded Commercial Vehicle Trips	74,269	85,388	159,657
Number of Commercial Vehicles Operating on a Daily Basis	18,567	20,330	38,898
Attraction Rate to Households	-	-	0.106

¹ Based on internal trips of 616 surveyed commercial vehicles (295 cargo vehicles and 321 service vehicles).

One final calculation was the determination of the commercial vehicle attraction rate to households. In the survey, approximately 17 percent of the trips went to residential land use types. This percentage was applied to the total, expanded commercial vehicle trips within the study area to obtain an estimated 27,317 trips to residential locations. The residential trip estimate was divided by the estimated number of households in the EUTS area (256,557) to obtain an attraction rate of 0.106.

SURVEY SUMMARY

This section provides a summary of vehicle and trip characteristics of 616 commercial vehicles that participated in the 2010 EUTS commercial vehicle survey. Based on the results from the survey, significant differences as well as similarities on travel characteristics were observed between cargo vehicles and service vehicles.

The average vehicle age for cargo vehicles was 8.7 years compared to 6.9 years for service vehicles. The odometer readings reported by cargo vehicles indicated an average mileage of 207,100 miles, which was nearly double the reported average mileage of 99,000 miles by service vehicles. In terms of fuel use, around 61 percent of cargo vehicles used diesel and 39 percent used unleaded gasoline, while 91 percent of service vehicles used unleaded gasoline and nine percent used diesel.

The analyses of trip characteristics included in-depth examination of trip frequency, trip type, average trip length, trip purpose, and land use activity at trip destinations by commercial vehicle type. Surveyed cargo vehicles made an average of 4.5 total trips per day, compared to 4.4 trips per day for service vehicles. Excluding the trips made outside of the study area (external trips), cargo vehicles produced 4.0 internal trips per day, with average travel distance of 8.5 miles, compared to service vehicles which made 4.2 internal trips per day, with average trip length of 6.8 miles. The average travel time per trip for cargo vehicles was 14.5 minutes and for service vehicles the average travel time per trip was 11.8 minutes.

In terms of trip purpose at trip destinations, approximately 50 percent of the cargo vehicle trips were delivery, 24 percent were base-related, and 17 percent were pick-up. For trips made by service vehicles, approximately 31 percent were base-related, 28 percent were sales, and 17 percent were service.

In terms of land use activity, approximately 26 percent of the trips made by cargo vehicles occurred at retail/shopping places, 15 percent occurred at residential locations, and 14 percent occurred at warehouses. For service vehicles, nearly 19 percent of the trips took place at residential sites, 18 percent occurred at office sites, and 16 percent occurred at retail locations.

The analyses of cargo characteristics were exclusive to trips made by cargo vehicles only and involved examining the types of cargo/commodities being transported at trip destinations, the trip purposes and land use activity at each stop, and the net weight of cargo being picked-up and/or dropped off for each trip. Overall, the average net cargo weight per trip was around 1,900 pounds. Agricultural products showed the highest average net cargo weight of around 11,500 pounds per trip, but the most frequently transported commodity was machinery with a net cargo weight of 890 pounds per trip. The land use “other” showed the highest average net cargo weight

of around 3,700 pounds per trip, and it had the most number of trips. Delivery trip purpose had the highest average net cargo weight of around 10,000 pounds per trip and it had the highest number of trip occurrences.

The analyses of trip tours involved examining the amount of circuitous travel performed by the commercial vehicles in the study area. It also involved counting the number of non-base trips, external trips, inter-zonal trips, and intra-zonal trips within trip tours to determine the total amount and types of travel that occur during the course of the tour. A total of 714 trip tours were generated by the surveyed vehicles, with cargo vehicles making 299 tours and service vehicles producing 415 tours. The number of trip tours per vehicle varied from one to six tours for both cargo and service vehicles. The average number of trips tours for all vehicles was 1.3 and the average number of trips per tour was 3.6. Trips made as part of trip tours accounted for 2,598 trips (1,257 trips by cargo vehicles and 1,341 trips by service vehicles). Within the trip tours, approximately 91 percent were inter-zonal trips, five percent were external trips and the remaining four percent were intra-zonal trips. Non-base trips (which were not mutually-exclusive of the other trip types) made up approximately 52 percent of the trips within the tours.

Lastly, the expansion of commercial vehicle survey data were based on vehicle miles of travel (VMT) estimates and vehicle classification counts for the EUTS study area. The commercial VMT estimates represented all commercial vehicles and do not distinguish by cargo and service vehicle types. Therefore, the estimation of VMT and volume of cargo and service vehicles operating within the study area were mainly based on key findings from the survey, such as the total number of internal cargo and service vehicle trips, the average number of trips per cargo and service vehicle, and the average trip lengths per cargo and service vehicle. Based on these findings, approximately 38,900 commercial vehicles (18,550 cargo vehicles and 20,350 service vehicles) were estimated to be operating within the EUTS study area on a daily basis, roughly six times the volume of trucks registered in the study area in 2010.

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) Cargo / Freight Transport Vehicle
 2) Service Vehicle (vehicle is not used to transport cargo or freight)

Vehicle Fuel: 1) Unleaded Gas 2) Diesel 3) Propane 4) Hybrid
 5) Other _____ (Specify)

Vehicle Classification:

- | | |
|---|---|
| 1) <input type="checkbox"/> Passenger Car | 5) <input type="checkbox"/> Single Unit 2-axle (6 wheels) |
| 2) <input type="checkbox"/> Pick-up | 6) <input type="checkbox"/> Single Unit 3-axle (10 wheels) |
| 3) <input type="checkbox"/> Van (Cargo or Mini) | 7) <input type="checkbox"/> Single Unit 4-axle (14 wheels) |
| 4) <input type="checkbox"/> Sport Utility Vehicle (SUV) | 8) <input type="checkbox"/> Semi (all Tractor-Trailer combinations) |
| | 9) <input type="checkbox"/> 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 th grade or less)	(10) Intermodal Facility	(99) Refused / Unknown

Commercial Vehicle Survey Travel (continued)

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

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

Commercial Vehicle Survey (continued)

	RECORD the following information about each place <i>NAME of Place:</i> _____ <i>Address including city, state, and zip</i> <i>OR</i> <i>Nearest street intersection or Landmark</i> _____	What time did you arrive and depart this location? (record exact times)	Activity What are you doing at this location? (see options below)	What type of place is this? (see options below)	Is this the work / base location for this vehicle? <input type="checkbox"/> - Yes <input type="checkbox"/> - No	Type of Cargo What is it?	Cargo Weight (in Pounds)
PLACE 15		Arrive: _____ am/pm Depart: _____ am/pm					_____ Delivery _____ Picked Up
PLACE 16		Arrive: _____ am/pm Depart: _____ am/pm					_____ Delivery _____ Picked Up
PLACE 17		Arrive: _____ am/pm Depart: _____ am/pm					_____ Delivery _____ Picked Up
PLACE 18		Arrive: _____ am/pm Depart: _____ am/pm					_____ Delivery _____ Picked Up
PLACE 19		Arrive: _____ am/pm Depart: _____ am/pm					_____ Delivery _____ Picked Up

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

