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

TECHNICAL SUMMARY

Texas Department of Transportation Travel Survey Program

Prepared by

Steve Farnsworth
Associate Research Scientist

and

Jack Bauer
Graduate Assistant Researcher

of the
Texas A&M Transportation Institute

November 2012

TEXAS A&M TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135
DISCLAIMER
The contents of this report reflect the views of the authors who are responsible for the data, findings, and conclusions presented herein. The contents do not necessarily reflect the official views or policies of the Federal Highway Administration or the Texas Department of Transportation (TxDOT). This report does not constitute a standard, specification, or regulation.

ACKNOWLEDGEMENTS
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.
# TABLE OF CONTENTS

List of Figures ............................................................................................................................... vii
List of Tables ............................................................................................................................... viii
Introduction ..................................................................................................................................... 1
Survey Methodology ....................................................................................................................... 2
Survey Results ................................................................................................................................ 4
  Vehicle Characteristics ............................................................................................................... 4
    Registered Commercial Vehicles ............................................................................................ 4
    Surveyed Commercial Vehicles ............................................................................................. 5
Trip Frequency ............................................................................................................................ 11
Trip Characteristics .................................................................................................................... 13
Cargo Characteristics ................................................................................................................ 15
Trip Length ..................................................................................................................................... 27
Travel Time and Speed ............................................................................................................. 32
Trip Tours ..................................................................................................................................... 36
Survey Expansion ......................................................................................................................... 41
Survey Summary ........................................................................................................................... 45
Appendix ......................................................................................................................................... 49
LIST OF FIGURES

Figure 1. El Paso Study Area........................................................................................................... 1
Figure 2. Model Year of Registered Trucks in the EUTS Study Area. .................................. 5
Figure 3. Type of Fuel Used by Surveyed Commercial Vehicles. ............................................ 7
Figure 4. Vehicle Model Year. .................................................................................................... 9
Figure 5. Inter-Zonal, Intra-Zonal, and External Trips. ............................................................ 11
Figure 6. Total Trips per Vehicle. ............................................................................................ 12
Figure 7. Total Internal Trips per Vehicle. .............................................................................. 13
Figure 8. TAZ Boundary and Base Locations of Surveyed Commercial Vehicles. .......... 27
Figure 9. Trip Origins and Destinations of Surveyed Commercial Vehicles. ................. 28
Figure 10. Surveyed Commercial Vehicle Trips TLFD. .......................................................... 29
Figure 11. Surveyed Commercial Vehicle Trips Travel Time. .............................................. 33
Figure 12. Cargo Vehicle Trips within Trip Tours by Trip Type............................................ 40
Figure 13. Service Vehicle Trips within Trip Tours by Trip Type........................................... 40
LIST OF TABLES

Table 1. Survey Participation Rates ................................................................................... 3
Table 2. Gross Vehicle Weight of Registered Trucks in the EUTS Study Area ............... 4
Table 3. Vehicle Classification Type of Surveyed Commercial Vehicles ......................... 6
Table 4. Gross Vehicle Weight .......................................................................................... 8
Table 5. Average of Reported Odometer Readings by Model Year ................................ 10
Table 6. Total Internal and External Trips ....................................................................... 12
Table 7. Distribution of Internal Trips by Land Use Type at Trip Destinations .............. 14
Table 8. Trip Purposes at Destination Locations ............................................................. 15
Table 9. Cargo Classification Types ................................................................................ 16
Table 10. Distribution of Trips by Cargo Type at Destinations ........................................ 17
Table 11. Equivalency between SAM Commodity Groups and Survey Classifications ... 18
Table 12. Equivalency between Land Use Category and Survey Type of Place ............ 19
Table 13. Cargo Trips by Commodity Group and Land Use Destinations .................... 20
Table 14. Cargo Trips by Commodity Group and Trip Purpose at the Trip Destinations ...21
Table 15. Average Net Cargo Weight (lbs.) by Commodity Group and Land Use at Trip Destinations ............................................................. 22
Table 16. Average Net Cargo Weight (lbs.) by Commodity Group and Trip Purpose at Trip Destinations ...................................................................................................... 23
Table 17. Cargo Trips and Net Cargo Weight by Commodity Group at Trip Destinations. ............................................................. 25
Table 18. Cargo Trips and Average Net Cargo Weights by Land Use at Trip Destinations. ........................................................................................................................... 26
Table 19. Cargo Trips and Average Net Cargo Weights by Trip Purpose at Trip Destinations ........................................................................................................................... 26
Table 20. Trip Length Frequency Distribution (Grouped Interval) ................................ 29
Table 21. Trip Length Frequency Distribution (Ungrouped) ........................................... 30
Table 22. Average Trip Length to Destinations by Land Use Type .................................. 31
Table 23. Average Trip Length to Destinations by Commodity Group ............................ 32
Table 24. Travel Time Frequency Distribution (Grouped Interval) ................................ 33
Table 25. Travel Time Frequency Distribution (Ungrouped) ........................................... 34
Table 26. Average Travel Time and Speed to Destinations by Land Use Type .............. 35
Table 27. Average Travel Time and Speed to Destinations by Commodity Group ........ 36
Table 28. Base and Non-Base Trips .................................................................................. 37
Table 29. Trip Tours per Vehicle ...................................................................................... 38
Table 30. External, Inter-Zonal and Intra-Zonal Trips within Trip Tours .......................... 39
Table 31. Non-Base Trips within Trip Tours ..................................................................... 39
Table 32. Summary of Open Tour Trips ......................................................................... 41
Table 33. 2008 HPMS Estimates of Weekday VMT in the EUTS Study Area ............... 42
Table 34. Percentage of Commercial and Non-Commercial Vehicles by Functional Classification .................................................................................................................. 43
Table 35. Estimated VMT for Commercial and Non-Commercial Vehicles .................. 43
Table 36. Key Survey Results and Expanded Trip and VMT Data ......................... 45
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 out.

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.

---

Table 1. Survey Participation Rates.

<table>
<thead>
<tr>
<th>Category</th>
<th>Contact Calls</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent of Total</td>
<td></td>
</tr>
<tr>
<td>Agreed to Participate</td>
<td>322</td>
<td>38.6</td>
<td></td>
</tr>
<tr>
<td>Refused to Participate</td>
<td>397</td>
<td>47.6</td>
<td></td>
</tr>
<tr>
<td>Not participating</td>
<td>115</td>
<td>13.8</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>834</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

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.

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

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.](source)

**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.

<table>
<thead>
<tr>
<th>Vehicle Classification</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>Total Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Vehicles</td>
<td>Percent of Cargo</td>
<td>Number of Vehicles</td>
</tr>
<tr>
<td>Passenger Car</td>
<td>5</td>
<td>1.7</td>
<td>39</td>
</tr>
<tr>
<td>Pickup Truck</td>
<td>76</td>
<td>25.7</td>
<td>162</td>
</tr>
<tr>
<td>Van (passenger or mini)</td>
<td>43</td>
<td>14.5</td>
<td>92</td>
</tr>
<tr>
<td>Sport Utility Vehicle</td>
<td>2</td>
<td>0.7</td>
<td>23</td>
</tr>
<tr>
<td>Single Unit 2-axle (6 wheels)</td>
<td>61</td>
<td>20.6</td>
<td>2</td>
</tr>
<tr>
<td>Single Unit 3-axle (10 wheels)</td>
<td>20</td>
<td>6.8</td>
<td>0</td>
</tr>
<tr>
<td>Single Unit 4-axle (14 wheels)</td>
<td>6</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>Semi (Tractor-Trailer)</td>
<td>77</td>
<td>26.0</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>2.0</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>296</strong></td>
<td><strong>100.0</strong></td>
<td><strong>321</strong></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Gross Vehicle Weight (lbs.)</th>
<th>Cargo</th>
<th>Service</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Vehicles</td>
<td>% of Cargo Vehicles</td>
<td>Number of Vehicles</td>
</tr>
<tr>
<td>0 / 10,000</td>
<td>135</td>
<td>45.6</td>
<td>311</td>
</tr>
<tr>
<td>10,001 / 14,000</td>
<td>15</td>
<td>5.1</td>
<td>4</td>
</tr>
<tr>
<td>14,001 / 16,000</td>
<td>16</td>
<td>5.4</td>
<td>2</td>
</tr>
<tr>
<td>16,001 / 19,500</td>
<td>6</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>19,501 / 26,000</td>
<td>24</td>
<td>8.1</td>
<td>1</td>
</tr>
<tr>
<td>26,001 / 33,000</td>
<td>8</td>
<td>2.7</td>
<td>3</td>
</tr>
<tr>
<td>33,001 / 60,000</td>
<td>34</td>
<td>11.5</td>
<td>0</td>
</tr>
<tr>
<td>&gt; 60,000</td>
<td>58</td>
<td>19.6</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>296</td>
<td>100.0</td>
<td>321</td>
</tr>
</tbody>
</table>

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.
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.

<table>
<thead>
<tr>
<th>Model Year</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>Total Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Vehicles</td>
<td>Avg. Odometer Reading</td>
<td>Number of Vehicles</td>
</tr>
<tr>
<td>2011</td>
<td>8</td>
<td>24,976</td>
<td>16</td>
</tr>
<tr>
<td>2010</td>
<td>7</td>
<td>21,072</td>
<td>16</td>
</tr>
<tr>
<td>2009</td>
<td>11</td>
<td>33,199</td>
<td>25</td>
</tr>
<tr>
<td>2008</td>
<td>20</td>
<td>115,601</td>
<td>32</td>
</tr>
<tr>
<td>2007</td>
<td>29</td>
<td>293,747</td>
<td>19</td>
</tr>
<tr>
<td>2006</td>
<td>24</td>
<td>145,929</td>
<td>15</td>
</tr>
<tr>
<td>2005</td>
<td>24</td>
<td>104,101</td>
<td>27</td>
</tr>
<tr>
<td>2004</td>
<td>12</td>
<td>200,551</td>
<td>26</td>
</tr>
<tr>
<td>2003</td>
<td>22</td>
<td>235,654</td>
<td>36</td>
</tr>
<tr>
<td>2002</td>
<td>10</td>
<td>138,272</td>
<td>25</td>
</tr>
<tr>
<td>2001</td>
<td>18</td>
<td>175,741</td>
<td>11</td>
</tr>
<tr>
<td>2000</td>
<td>23</td>
<td>195,205</td>
<td>23</td>
</tr>
<tr>
<td>1999</td>
<td>21</td>
<td>265,451</td>
<td>7</td>
</tr>
<tr>
<td>1998</td>
<td>13</td>
<td>410,730</td>
<td>17</td>
</tr>
<tr>
<td>1997</td>
<td>11</td>
<td>326,504</td>
<td>6</td>
</tr>
<tr>
<td>1996</td>
<td>4</td>
<td>198,578</td>
<td>7</td>
</tr>
<tr>
<td>1995</td>
<td>3</td>
<td>404,799</td>
<td>3</td>
</tr>
<tr>
<td>1994</td>
<td>10</td>
<td>337,456</td>
<td>3</td>
</tr>
<tr>
<td>1993</td>
<td>1</td>
<td>N/A</td>
<td>0</td>
</tr>
<tr>
<td>1992</td>
<td>4</td>
<td>419,720</td>
<td>2</td>
</tr>
<tr>
<td>1991</td>
<td>2</td>
<td>208,395</td>
<td>0</td>
</tr>
<tr>
<td>Older</td>
<td>13</td>
<td>299,897</td>
<td>1</td>
</tr>
<tr>
<td>Unknown</td>
<td>6</td>
<td>205,646</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>296</td>
<td>207,053</td>
<td>321</td>
</tr>
</tbody>
</table>
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.](image-url)
Table 6. Total Internal and External Trips.

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>Total Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>% of Total</td>
<td>Number</td>
</tr>
<tr>
<td>Inter-zonal</td>
<td>1,134</td>
<td>85.2</td>
<td>1,299</td>
</tr>
<tr>
<td>Intra-zonal</td>
<td>35</td>
<td>2.6</td>
<td>45</td>
</tr>
<tr>
<td><strong>Total Internal</strong></td>
<td><strong>1,169</strong></td>
<td><strong>87.8</strong></td>
<td><strong>1,344</strong></td>
</tr>
<tr>
<td>External</td>
<td>163</td>
<td>12.2</td>
<td>62</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,332</strong></td>
<td><strong>100.0</strong></td>
<td><strong>1,406</strong></td>
</tr>
</tbody>
</table>

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 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.](image)

**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.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Cargo</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>Office Building (Non-government)</td>
<td>93</td>
<td>8.0</td>
</tr>
<tr>
<td>Retail/Shopping</td>
<td>309</td>
<td>26.4</td>
</tr>
<tr>
<td>Industrial/Manufacturing</td>
<td>69</td>
<td>5.9</td>
</tr>
<tr>
<td>Medical/Hospital</td>
<td>87</td>
<td>7.4</td>
</tr>
<tr>
<td>Education (&lt; 12th grade)</td>
<td>6</td>
<td>0.5</td>
</tr>
<tr>
<td>Education (College, Trade)</td>
<td>13</td>
<td>1.1</td>
</tr>
<tr>
<td>Government Office/Building</td>
<td>41</td>
<td>3.5</td>
</tr>
<tr>
<td>Residential</td>
<td>171</td>
<td>14.6</td>
</tr>
<tr>
<td>Airport</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Intermodal Facility</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Warehouse</td>
<td>161</td>
<td>13.8</td>
</tr>
<tr>
<td>Distribution Center</td>
<td>63</td>
<td>5.4</td>
</tr>
<tr>
<td>Construction Site</td>
<td>87</td>
<td>7.4</td>
</tr>
<tr>
<td>Other</td>
<td>67</td>
<td>5.7</td>
</tr>
<tr>
<td>Refused/Unknown</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total Trips</strong></td>
<td><strong>1,169</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>Cargo</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent of Cargo</td>
</tr>
<tr>
<td>Return to Base Location</td>
<td>285</td>
<td>24.4</td>
</tr>
<tr>
<td>Maintenance (Fuel, oil, etc.)</td>
<td>12</td>
<td>1.0</td>
</tr>
<tr>
<td>Driver Needs (Lunch, etc.)</td>
<td>10</td>
<td>0.9</td>
</tr>
<tr>
<td>Delivery</td>
<td>579</td>
<td>49.5</td>
</tr>
<tr>
<td>Pick-up</td>
<td>199</td>
<td>17.0</td>
</tr>
<tr>
<td>Pick-up and Delivery</td>
<td>63</td>
<td>5.4</td>
</tr>
<tr>
<td>Government</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Service-Related</td>
<td>11</td>
<td>0.9</td>
</tr>
<tr>
<td>Sales</td>
<td>8</td>
<td>0.7</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>Refused / Unknown</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Total Trips</strong></td>
<td>1,169</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**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.

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

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.

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

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.

<table>
<thead>
<tr>
<th>SAM Commodity Group</th>
<th>Survey Cargo Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Agriculture</td>
<td>Farm Products, Forest Products, Marine Products</td>
</tr>
<tr>
<td>2. Raw Materials</td>
<td>Metals and Minerals, Chemical Products, Refined Petroleum or Coal Products</td>
</tr>
<tr>
<td>3. Food</td>
<td>Food, Health and Beauty Products, Tobacco Products</td>
</tr>
<tr>
<td>4. Textiles</td>
<td>Textiles, Rubber, Plastic, and Styrofoam Products</td>
</tr>
<tr>
<td>5. Wood</td>
<td>Wood Products, Printed Matter</td>
</tr>
<tr>
<td>6. Building Materials</td>
<td>Clay, Concrete, Glass or Stone Products</td>
</tr>
<tr>
<td>7. Machinery</td>
<td>Manufactured Goods/Equipment</td>
</tr>
<tr>
<td>8. Miscellaneous</td>
<td>Wastes, Miscellaneous Shipments</td>
</tr>
<tr>
<td>9. Secondary</td>
<td>Unclassified Cargo</td>
</tr>
<tr>
<td>--- Transportation</td>
<td>Transportation</td>
</tr>
<tr>
<td>--- Empty</td>
<td>Empty</td>
</tr>
<tr>
<td>--- Unknown</td>
<td>Unknown to Driver/ Driver Refused to Answer</td>
</tr>
</tbody>
</table>
Table 12. Equivalency between Land Use Category and Survey Type of Place.

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

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.

<table>
<thead>
<tr>
<th>SAM Commodity Group</th>
<th>Land Use</th>
<th>Total Trips</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Office</td>
<td>Retail</td>
<td>Ind’l</td>
</tr>
<tr>
<td>Agriculture</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Raw Materials</td>
<td>1</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Food</td>
<td>5</td>
<td>108</td>
<td>1</td>
</tr>
<tr>
<td>Textiles</td>
<td>14</td>
<td>46</td>
<td>17</td>
</tr>
<tr>
<td>Wood</td>
<td>25</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>Building Materials</td>
<td>0</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>8</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Machinery</td>
<td>17</td>
<td>101</td>
<td>14</td>
</tr>
<tr>
<td>Secondary</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Transportation</td>
<td>0</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Empty</td>
<td>27</td>
<td>49</td>
<td>11</td>
</tr>
<tr>
<td>Unknown</td>
<td>3</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>102</td>
<td>366</td>
<td>90</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>SAM Commodity Group</th>
<th>Trip Purpose</th>
<th>Total Trips</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base</td>
<td>Delivery</td>
<td>Pick-Up</td>
</tr>
<tr>
<td>Agriculture</td>
<td>6</td>
<td>13</td>
<td>10</td>
</tr>
<tr>
<td>Raw Materials</td>
<td>16</td>
<td>40</td>
<td>7</td>
</tr>
<tr>
<td>Food</td>
<td>21</td>
<td>95</td>
<td>6</td>
</tr>
<tr>
<td>Textiles</td>
<td>25</td>
<td>64</td>
<td>12</td>
</tr>
<tr>
<td>Wood</td>
<td>38</td>
<td>105</td>
<td>13</td>
</tr>
<tr>
<td>Building</td>
<td>11</td>
<td>51</td>
<td>28</td>
</tr>
<tr>
<td>Misc.</td>
<td>2</td>
<td>31</td>
<td>45</td>
</tr>
<tr>
<td>Machinery</td>
<td>65</td>
<td>180</td>
<td>60</td>
</tr>
<tr>
<td>Secondary</td>
<td>9</td>
<td>28</td>
<td>23</td>
</tr>
<tr>
<td>Hazardous</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Transportation</td>
<td>7</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>Empty</td>
<td>124</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>17</td>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>344</td>
<td>641</td>
<td>215</td>
</tr>
<tr>
<td>Percent of Total</td>
<td>25.8</td>
<td>48.2</td>
<td>16.2</td>
</tr>
</tbody>
</table>

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.**

<table>
<thead>
<tr>
<th>SAM Commodity Group</th>
<th>Office</th>
<th>Retail</th>
<th>Ind’l</th>
<th>Med</th>
<th>Edu</th>
<th>Gov’t</th>
<th>Res</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>150</td>
<td>14,479</td>
</tr>
<tr>
<td>Raw Materials</td>
<td>0</td>
<td>160</td>
<td>131</td>
<td>50</td>
<td>241</td>
<td>5</td>
<td>55</td>
<td>6,211</td>
</tr>
<tr>
<td>Food</td>
<td>21</td>
<td>932</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Textiles</td>
<td>33</td>
<td>201</td>
<td>4,166</td>
<td>4</td>
<td>250</td>
<td>268</td>
<td>13</td>
<td>133</td>
</tr>
<tr>
<td>Wood</td>
<td>91</td>
<td>5,405</td>
<td>5,785</td>
<td>755</td>
<td>780</td>
<td>476</td>
<td>250</td>
<td>1,599</td>
</tr>
<tr>
<td>Building Materials</td>
<td>0</td>
<td>17</td>
<td>3,347</td>
<td>0</td>
<td>40</td>
<td>9</td>
<td>16,384</td>
<td>7,460</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1,350</td>
</tr>
<tr>
<td>Machinery</td>
<td>105</td>
<td>106</td>
<td>179</td>
<td>350</td>
<td>158</td>
<td>2,167</td>
<td>436</td>
<td>2,274</td>
</tr>
<tr>
<td>Secondary</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>27</td>
<td>5</td>
</tr>
<tr>
<td>Hazardous Materials</td>
<td>0</td>
<td>0</td>
<td>333</td>
<td>300</td>
<td>507</td>
<td>0</td>
<td>0</td>
<td>676</td>
</tr>
<tr>
<td>Transportation</td>
<td>0</td>
<td>1,654</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Empty</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
<td>2,625</td>
<td>0</td>
<td>0</td>
<td>15,000</td>
<td>0</td>
<td>0</td>
<td>7,901</td>
</tr>
</tbody>
</table>
Table 16. Average Net Cargo Weight (lbs.) by Commodity Group and Trip Purpose at Trip Destinations.

<table>
<thead>
<tr>
<th>SAM Commodity Group</th>
<th>Trip Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base Location</td>
</tr>
<tr>
<td>Agriculture</td>
<td>0</td>
</tr>
<tr>
<td>Raw Materials</td>
<td>0</td>
</tr>
<tr>
<td>Food</td>
<td>0</td>
</tr>
<tr>
<td>Textiles</td>
<td>0</td>
</tr>
<tr>
<td>Wood</td>
<td>0</td>
</tr>
<tr>
<td>Building Materials</td>
<td>0</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>0</td>
</tr>
<tr>
<td>Machinery</td>
<td>0</td>
</tr>
<tr>
<td>Secondary</td>
<td>0</td>
</tr>
<tr>
<td>Hazardous Material</td>
<td>0</td>
</tr>
<tr>
<td>Transportation</td>
<td>0</td>
</tr>
<tr>
<td>Empty</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>0</td>
</tr>
</tbody>
</table>
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.

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

\(^1\) 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.

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Total Cargo Trips</th>
<th>Total Net Cargo Weight (lbs)</th>
<th>Number of Trips¹</th>
<th>Average Net Cargo Weight (lbs)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>102</td>
<td>4,625</td>
<td>75</td>
<td>62</td>
</tr>
<tr>
<td>Retail</td>
<td>366</td>
<td>257,293</td>
<td>317</td>
<td>812</td>
</tr>
<tr>
<td>Industrial</td>
<td>90</td>
<td>184,722</td>
<td>79</td>
<td>2,338</td>
</tr>
<tr>
<td>Medical</td>
<td>90</td>
<td>27,827</td>
<td>85</td>
<td>327</td>
</tr>
<tr>
<td>Education</td>
<td>21</td>
<td>21,138</td>
<td>17</td>
<td>1,243</td>
</tr>
<tr>
<td>Government</td>
<td>44</td>
<td>34,326</td>
<td>44</td>
<td>780</td>
</tr>
<tr>
<td>Residential</td>
<td>173</td>
<td>299,548</td>
<td>170</td>
<td>1,762</td>
</tr>
<tr>
<td>Other</td>
<td>445</td>
<td>1,440,325</td>
<td>390</td>
<td>3,693</td>
</tr>
<tr>
<td>Refused/Unknown</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,332</strong></td>
<td><strong>2,269,804</strong></td>
<td><strong>1,178</strong></td>
<td><strong>1,927</strong></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>Total Cargo Trips</th>
<th>Total Net Cargo Weight (lbs)</th>
<th>Number of Trips¹</th>
<th>Average Net Cargo Weight (lbs)¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to Base Location</td>
<td>337</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Delivery</td>
<td>631</td>
<td>2,206,485</td>
<td>220</td>
<td>10,029</td>
</tr>
<tr>
<td>Pick-Up</td>
<td>226</td>
<td>0</td>
<td>641</td>
<td>0</td>
</tr>
<tr>
<td>Pick-Up and Delivery</td>
<td>68</td>
<td>63,319</td>
<td>215</td>
<td>295</td>
</tr>
<tr>
<td>Maintenance (fuel, oil, etc.)</td>
<td>25</td>
<td>0</td>
<td>66</td>
<td>0</td>
</tr>
<tr>
<td>Driver Needs (lunch, etc.)</td>
<td>15</td>
<td>0</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Service-Related</td>
<td>10</td>
<td>0</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Sales</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Government</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,332</strong></td>
<td><strong>2,269,804</strong></td>
<td><strong>1,170</strong></td>
<td><strong>1,940</strong></td>
</tr>
</tbody>
</table>

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.

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).

<table>
<thead>
<tr>
<th>Trip Length (miles)</th>
<th>Cargo</th>
<th>Service</th>
<th>All Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># of Trips</td>
<td>% of Total</td>
<td># of Trips</td>
</tr>
<tr>
<td>Less than 5</td>
<td>457</td>
<td>40.4</td>
<td>662</td>
</tr>
<tr>
<td>6 to 10</td>
<td>324</td>
<td>28.6</td>
<td>312</td>
</tr>
<tr>
<td>11 to 15</td>
<td>167</td>
<td>14.8</td>
<td>178</td>
</tr>
<tr>
<td>16 to 20</td>
<td>86</td>
<td>7.6</td>
<td>84</td>
</tr>
<tr>
<td>21 to 25</td>
<td>46</td>
<td>4.1</td>
<td>44</td>
</tr>
<tr>
<td>26 to 30</td>
<td>38</td>
<td>3.4</td>
<td>12</td>
</tr>
<tr>
<td>31 to 35</td>
<td>7</td>
<td>0.6</td>
<td>5</td>
</tr>
<tr>
<td>36 to 40</td>
<td>4</td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td>41 to 45</td>
<td>2</td>
<td>0.2</td>
<td>1</td>
</tr>
<tr>
<td>Over 45</td>
<td>1</td>
<td>0.1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>1,132</td>
<td>100.0</td>
<td>1,299</td>
</tr>
</tbody>
</table>

Figure 10. Surveyed Commercial Vehicle Trips TLFD.
Table 21. Trip Length Frequency Distribution (Ungrouped).

<table>
<thead>
<tr>
<th>Trip Length (miles)</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>All Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># of Trips</td>
<td>% of Total</td>
<td># of Trips</td>
</tr>
<tr>
<td>1</td>
<td>82</td>
<td>7.2</td>
<td>147</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>8.8</td>
<td>177</td>
</tr>
<tr>
<td>3</td>
<td>108</td>
<td>9.5</td>
<td>164</td>
</tr>
<tr>
<td>4</td>
<td>97</td>
<td>8.6</td>
<td>116</td>
</tr>
<tr>
<td>5</td>
<td>71</td>
<td>6.3</td>
<td>59</td>
</tr>
<tr>
<td>6</td>
<td>68</td>
<td>6.0</td>
<td>77</td>
</tr>
<tr>
<td>7</td>
<td>86</td>
<td>7.6</td>
<td>75</td>
</tr>
<tr>
<td>8</td>
<td>65</td>
<td>5.7</td>
<td>64</td>
</tr>
<tr>
<td>9</td>
<td>46</td>
<td>4.1</td>
<td>56</td>
</tr>
<tr>
<td>10</td>
<td>58</td>
<td>5.1</td>
<td>42</td>
</tr>
<tr>
<td>11</td>
<td>38</td>
<td>3.4</td>
<td>41</td>
</tr>
<tr>
<td>12</td>
<td>37</td>
<td>3.3</td>
<td>39</td>
</tr>
<tr>
<td>13</td>
<td>40</td>
<td>3.5</td>
<td>32</td>
</tr>
<tr>
<td>14</td>
<td>28</td>
<td>2.5</td>
<td>31</td>
</tr>
<tr>
<td>15</td>
<td>24</td>
<td>2.1</td>
<td>33</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
<td>1.4</td>
<td>19</td>
</tr>
<tr>
<td>17</td>
<td>15</td>
<td>1.3</td>
<td>15</td>
</tr>
<tr>
<td>18</td>
<td>23</td>
<td>2.0</td>
<td>16</td>
</tr>
<tr>
<td>19</td>
<td>14</td>
<td>1.2</td>
<td>16</td>
</tr>
<tr>
<td>20</td>
<td>18</td>
<td>1.6</td>
<td>17</td>
</tr>
<tr>
<td>21</td>
<td>9</td>
<td>0.8</td>
<td>11</td>
</tr>
<tr>
<td>22</td>
<td>7</td>
<td>0.6</td>
<td>7</td>
</tr>
<tr>
<td>23</td>
<td>9</td>
<td>0.8</td>
<td>10</td>
</tr>
<tr>
<td>24</td>
<td>7</td>
<td>0.6</td>
<td>10</td>
</tr>
<tr>
<td>25</td>
<td>14</td>
<td>1.2</td>
<td>6</td>
</tr>
<tr>
<td>26</td>
<td>7</td>
<td>0.6</td>
<td>3</td>
</tr>
<tr>
<td>27</td>
<td>7</td>
<td>0.6</td>
<td>1</td>
</tr>
<tr>
<td>28</td>
<td>4</td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td>29</td>
<td>13</td>
<td>1.1</td>
<td>4</td>
</tr>
<tr>
<td>30</td>
<td>7</td>
<td>0.6</td>
<td>3</td>
</tr>
<tr>
<td>31</td>
<td>1</td>
<td>0.1</td>
<td>4</td>
</tr>
<tr>
<td>32</td>
<td>3</td>
<td>0.3</td>
<td>1</td>
</tr>
<tr>
<td>33</td>
<td>1</td>
<td>0.1</td>
<td>0</td>
</tr>
<tr>
<td>34</td>
<td>2</td>
<td>0.2</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>36</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>37</td>
<td>3</td>
<td>0.3</td>
<td>0</td>
</tr>
<tr>
<td>38</td>
<td>1</td>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>39</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>&gt; 40</td>
<td>3</td>
<td>0.3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,132</strong></td>
<td><strong>100.0</strong></td>
<td><strong>1,299</strong></td>
</tr>
</tbody>
</table>
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>
<thead>
<tr>
<th>Land Use</th>
<th>Cargo</th>
<th>Service</th>
<th>All Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Trips</td>
<td>Total Trip Length (miles)</td>
<td>Average Trip Length (miles)</td>
</tr>
<tr>
<td>Office</td>
<td>91</td>
<td>801</td>
<td>8.8</td>
</tr>
<tr>
<td>Retail</td>
<td>301</td>
<td>2,238</td>
<td>7.4</td>
</tr>
<tr>
<td>Industrial</td>
<td>66</td>
<td>638</td>
<td>9.7</td>
</tr>
<tr>
<td>Medical</td>
<td>82</td>
<td>533</td>
<td>6.5</td>
</tr>
<tr>
<td>Education</td>
<td>14</td>
<td>105</td>
<td>7.5</td>
</tr>
<tr>
<td>Government</td>
<td>40</td>
<td>480</td>
<td>12.0</td>
</tr>
<tr>
<td>Residential</td>
<td>169</td>
<td>1,370</td>
<td>8.1</td>
</tr>
<tr>
<td>Other</td>
<td>369</td>
<td>3,484</td>
<td>9.4</td>
</tr>
<tr>
<td>Total</td>
<td>1,132</td>
<td>9,649</td>
<td>8.5</td>
</tr>
</tbody>
</table>

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.

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

### 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).

<table>
<thead>
<tr>
<th>Travel Time (minutes)</th>
<th>Cargo</th>
<th>Service</th>
<th>All Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># of Trips</td>
<td>% of Total</td>
<td># of Trips</td>
</tr>
<tr>
<td>Less than 5</td>
<td>187</td>
<td>16.5</td>
<td>341</td>
</tr>
<tr>
<td>6 to 10</td>
<td>281</td>
<td>24.8</td>
<td>343</td>
</tr>
<tr>
<td>11 to 15</td>
<td>236</td>
<td>20.8</td>
<td>234</td>
</tr>
<tr>
<td>16 to 20</td>
<td>149</td>
<td>13.2</td>
<td>151</td>
</tr>
<tr>
<td>21 to 25</td>
<td>110</td>
<td>9.7</td>
<td>101</td>
</tr>
<tr>
<td>26 to 30</td>
<td>67</td>
<td>5.9</td>
<td>63</td>
</tr>
<tr>
<td>31 to 35</td>
<td>32</td>
<td>2.8</td>
<td>32</td>
</tr>
<tr>
<td>36 to 40</td>
<td>26</td>
<td>2.3</td>
<td>18</td>
</tr>
<tr>
<td>41 to 45</td>
<td>32</td>
<td>2.8</td>
<td>12</td>
</tr>
<tr>
<td>Over 45</td>
<td>12</td>
<td>1.1</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>1,132</td>
<td>100.0</td>
<td>1,299</td>
</tr>
</tbody>
</table>

Figure 11. Surveyed Commercial Vehicle Trips Travel Time.
Table 25. Travel Time Frequency Distribution (Ungrouped).

<table>
<thead>
<tr>
<th>Travel Time (minutes)</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>All Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># of Trips</td>
<td>% of Total</td>
<td># of Trips</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>0.2</td>
<td>18</td>
</tr>
<tr>
<td>2</td>
<td>27</td>
<td>2.4</td>
<td>53</td>
</tr>
<tr>
<td>3</td>
<td>55</td>
<td>4.9</td>
<td>75</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>4.4</td>
<td>95</td>
</tr>
<tr>
<td>5</td>
<td>59</td>
<td>5.2</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>73</td>
<td>6.4</td>
<td>111</td>
</tr>
<tr>
<td>7</td>
<td>46</td>
<td>4.1</td>
<td>73</td>
</tr>
<tr>
<td>8</td>
<td>66</td>
<td>5.8</td>
<td>61</td>
</tr>
<tr>
<td>9</td>
<td>43</td>
<td>3.8</td>
<td>55</td>
</tr>
<tr>
<td>10</td>
<td>48</td>
<td>4.2</td>
<td>43</td>
</tr>
<tr>
<td>11</td>
<td>55</td>
<td>4.9</td>
<td>61</td>
</tr>
<tr>
<td>12</td>
<td>40</td>
<td>3.5</td>
<td>46</td>
</tr>
<tr>
<td>13</td>
<td>61</td>
<td>5.4</td>
<td>52</td>
</tr>
<tr>
<td>14</td>
<td>52</td>
<td>4.6</td>
<td>41</td>
</tr>
<tr>
<td>15</td>
<td>27</td>
<td>2.4</td>
<td>35</td>
</tr>
<tr>
<td>16</td>
<td>28</td>
<td>2.5</td>
<td>26</td>
</tr>
<tr>
<td>17</td>
<td>45</td>
<td>4.0</td>
<td>36</td>
</tr>
<tr>
<td>18</td>
<td>28</td>
<td>2.5</td>
<td>26</td>
</tr>
<tr>
<td>19</td>
<td>28</td>
<td>2.5</td>
<td>36</td>
</tr>
<tr>
<td>20</td>
<td>21</td>
<td>1.9</td>
<td>26</td>
</tr>
<tr>
<td>21</td>
<td>28</td>
<td>2.5</td>
<td>26</td>
</tr>
<tr>
<td>22</td>
<td>23</td>
<td>2.0</td>
<td>20</td>
</tr>
<tr>
<td>23</td>
<td>26</td>
<td>2.3</td>
<td>22</td>
</tr>
<tr>
<td>24</td>
<td>15</td>
<td>1.3</td>
<td>18</td>
</tr>
<tr>
<td>25</td>
<td>17</td>
<td>1.5</td>
<td>15</td>
</tr>
<tr>
<td>26</td>
<td>14</td>
<td>1.2</td>
<td>13</td>
</tr>
<tr>
<td>27</td>
<td>17</td>
<td>1.5</td>
<td>18</td>
</tr>
<tr>
<td>28</td>
<td>7</td>
<td>0.6</td>
<td>10</td>
</tr>
<tr>
<td>29</td>
<td>22</td>
<td>1.9</td>
<td>12</td>
</tr>
<tr>
<td>30</td>
<td>7</td>
<td>0.6</td>
<td>10</td>
</tr>
<tr>
<td>31</td>
<td>7</td>
<td>0.6</td>
<td>12</td>
</tr>
<tr>
<td>32</td>
<td>8</td>
<td>0.7</td>
<td>3</td>
</tr>
<tr>
<td>33</td>
<td>3</td>
<td>0.3</td>
<td>8</td>
</tr>
<tr>
<td>34</td>
<td>9</td>
<td>0.8</td>
<td>2</td>
</tr>
<tr>
<td>35</td>
<td>5</td>
<td>0.4</td>
<td>7</td>
</tr>
<tr>
<td>36</td>
<td>10</td>
<td>0.9</td>
<td>2</td>
</tr>
<tr>
<td>37</td>
<td>3</td>
<td>0.3</td>
<td>6</td>
</tr>
<tr>
<td>38</td>
<td>4</td>
<td>0.4</td>
<td>4</td>
</tr>
<tr>
<td>39</td>
<td>6</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>40</td>
<td>3</td>
<td>0.3</td>
<td>4</td>
</tr>
<tr>
<td>&gt; 40</td>
<td>44</td>
<td>3.9</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>1,132</td>
<td>100.0</td>
<td>1,299</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Cargo</th>
<th>Service</th>
<th>All Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Trips</td>
<td>Average Travel Time (minutes)</td>
<td>Average Travel Speed (mph)</td>
</tr>
<tr>
<td>Office</td>
<td>91</td>
<td>14.7</td>
<td>36.0</td>
</tr>
<tr>
<td>Retail</td>
<td>301</td>
<td>12.8</td>
<td>35.0</td>
</tr>
<tr>
<td>Industrial</td>
<td>66</td>
<td>15.7</td>
<td>37.0</td>
</tr>
<tr>
<td>Medical</td>
<td>82</td>
<td>11.7</td>
<td>33.5</td>
</tr>
<tr>
<td>Education</td>
<td>14</td>
<td>12.3</td>
<td>36.5</td>
</tr>
<tr>
<td>Government</td>
<td>40</td>
<td>19.7</td>
<td>36.5</td>
</tr>
<tr>
<td>Residential</td>
<td>169</td>
<td>13.8</td>
<td>35.3</td>
</tr>
<tr>
<td>Other</td>
<td>369</td>
<td>16.0</td>
<td>35.3</td>
</tr>
<tr>
<td>Total</td>
<td>1,132</td>
<td>14.5</td>
<td>35.4</td>
</tr>
</tbody>
</table>

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.

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

**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.

<table>
<thead>
<tr>
<th>Trip Type</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>All Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Trips</td>
<td>Percent of Total</td>
<td>Number of Trips</td>
</tr>
<tr>
<td>Base</td>
<td>644</td>
<td>48.35</td>
<td>853</td>
</tr>
<tr>
<td>Non-Base</td>
<td>688</td>
<td>51.65</td>
<td>553</td>
</tr>
<tr>
<td>Total</td>
<td>1,332</td>
<td>100.00</td>
<td>1,406</td>
</tr>
</tbody>
</table>

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.

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

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.

<table>
<thead>
<tr>
<th>No. of Trip Tours</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>92</td>
<td>35</td>
<td>855</td>
<td>764</td>
<td>28</td>
<td>24</td>
<td>975</td>
<td>823</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>2</td>
<td>149</td>
<td>265</td>
<td>1</td>
<td>9</td>
<td>158</td>
<td>276</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>0</td>
<td>56</td>
<td>91</td>
<td>5</td>
<td>6</td>
<td>63</td>
<td>97</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>2</td>
<td>38</td>
<td>122</td>
<td>0</td>
<td>3</td>
<td>38</td>
<td>127</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>15</td>
<td>1</td>
<td>3</td>
<td>13</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>102</td>
<td>39</td>
<td>1,120</td>
<td>1,257</td>
<td>35</td>
<td>45</td>
<td>1,257</td>
<td>1,341</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 31. Non-Base Trips within Trip Tours.

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

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.

<table>
<thead>
<tr>
<th>Trip Type</th>
<th>Cargo</th>
<th>Service</th>
<th>All Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># of Trips</td>
<td>% of Total</td>
<td># of Trips</td>
</tr>
<tr>
<td>Before start of first tour</td>
<td>1</td>
<td>0.08</td>
<td>12</td>
</tr>
<tr>
<td>After end of last tour</td>
<td>3</td>
<td>0.23</td>
<td>11</td>
</tr>
<tr>
<td>No tour (base only once)</td>
<td>70</td>
<td>5.26</td>
<td>42</td>
</tr>
<tr>
<td>Total (non-tour trips)</td>
<td>74</td>
<td>5.56</td>
<td>65</td>
</tr>
<tr>
<td>Within a tour</td>
<td>1,258</td>
<td>94.44</td>
<td>1,341</td>
</tr>
<tr>
<td>Total (all trips)</td>
<td>1,332</td>
<td>100.00</td>
<td>1,406</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Functional Classification</th>
<th>Total Weekday VMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway</td>
<td>6,277,467</td>
</tr>
<tr>
<td>Arterial</td>
<td>6,800,187</td>
</tr>
<tr>
<td>Collector</td>
<td>1,554,402</td>
</tr>
<tr>
<td>Local</td>
<td>1,014,066</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>15,646,122</strong></td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Functional Classification</th>
<th>Percent of Commercial Vehicles</th>
<th>Percent of Non-Commercial Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Internal Sites (86%)</td>
<td>External Sites (14%)</td>
</tr>
<tr>
<td>Freeway</td>
<td>12</td>
<td>38</td>
</tr>
<tr>
<td>Arterial</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>Collector</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Local</td>
<td>4</td>
<td>11</td>
</tr>
</tbody>
</table>

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

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

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.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Cargo Vehicles</th>
<th>Service Vehicles</th>
<th>All Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample Size</td>
<td>295</td>
<td>321</td>
<td>616</td>
</tr>
<tr>
<td>Total Inter-Zonal Trips</td>
<td>1,134</td>
<td>1,299</td>
<td>2,433</td>
</tr>
<tr>
<td>Total Intra-Zonal Trips</td>
<td>35</td>
<td>45</td>
<td>80</td>
</tr>
<tr>
<td>Total Internal Trips</td>
<td>1,169</td>
<td>1,344</td>
<td>2,513</td>
</tr>
<tr>
<td>Total External Trips</td>
<td>163</td>
<td>62</td>
<td>225</td>
</tr>
<tr>
<td>Total Internal and External Trips</td>
<td>1,332</td>
<td>1,406</td>
<td>2,738</td>
</tr>
<tr>
<td>Average Total Trips per Vehicle</td>
<td>4.52</td>
<td>4.38</td>
<td>4.44</td>
</tr>
<tr>
<td>Average Total Internal Trips per Vehicle¹</td>
<td>3.96</td>
<td>4.2</td>
<td>4.08</td>
</tr>
<tr>
<td>Average Trip Length</td>
<td>8.50</td>
<td>6.80</td>
<td>7.60</td>
</tr>
<tr>
<td>Observed Internal VMT (miles)</td>
<td>9,639</td>
<td>8,833</td>
<td>18,472</td>
</tr>
<tr>
<td>Total Internal Commercial VMT (miles)</td>
<td>612,389</td>
<td>561,195</td>
<td>1,173,584</td>
</tr>
<tr>
<td>Survey Expansion Factor</td>
<td>63.53</td>
<td>63.53</td>
<td>63.53</td>
</tr>
<tr>
<td>Total Expanded Inter-Zonal Commercial Vehicle Trips</td>
<td>72,045</td>
<td>82,529</td>
<td>154,574</td>
</tr>
<tr>
<td>Total Expanded Intra-Zonal Commercial Vehicle Trips</td>
<td>2,224</td>
<td>2,859</td>
<td>5,083</td>
</tr>
<tr>
<td>Total Expanded Commercial Vehicle Trips</td>
<td>74,269</td>
<td>85,388</td>
<td>159,657</td>
</tr>
<tr>
<td>Number of Commercial Vehicles Operating on a Daily Basis</td>
<td>18,567</td>
<td>20,330</td>
<td>38,898</td>
</tr>
<tr>
<td>Attraction Rate to Households</td>
<td>-</td>
<td>-</td>
<td>0.106</td>
</tr>
</tbody>
</table>

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 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:
_________________________________________________________________________________________
_________________________________________________________________________________________
_________________________________________________________________________________________
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) □ Passenger Car
2) □ Pick-up
3) □ Van (Cargo or Mini)
4) □ Sport Utility Vehicle (SUV)
5) □ Single Unit 2-axle (6 wheels)
6) □ Single Unit 3-axle (10 wheels)
7) □ Single Unit 4-axle (14 wheels)
8) □ Semi (all Tractor-Trailer combinations)
9) □ Other ______________________

Gross Vehicle Weight: ____________ pounds

Beginning Odometer Reading: _______________   Number of Trips Total: _______________

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

PART 2: Travel Log

THE PLACE MY TRAVEL BEGAN TODAY WAS:
- Work / Base Location
- Other Location (Please describe) ______________________

Type of Place (Specify Type of Place 1-14 or 99, see codes below) ____________________

(Street address or nearest intersection for place travel began) ______________________

(City, state, zip code)

When you left the above location was your vehicle:
- Fully Loaded
- Partially Loaded
- Empty
- Not Applicable (Service Vehicle)

If loaded, what is the total weight in pounds of the cargo being transported? (Please provide an estimate if unsure of exact weight) ___________________

RECORD EVERY PLACE YOU GO, INCLUDING QUICK STOPS

<table>
<thead>
<tr>
<th>PLACE</th>
<th>NAME of Place:</th>
<th>Address including city, state, and zip OR Nearest street intersection or Landmark</th>
<th>Activity Options</th>
<th>Type of Place Options</th>
<th>Cargo Weight (in Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>Delivery</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>Delivery</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>Delivery</td>
<td></td>
</tr>
</tbody>
</table>
## Commercial Vehicle Survey Travel

(continued)

<table>
<thead>
<tr>
<th>NAME of Place:</th>
<th>Address including city, state, and zip OR Nearest street intersection or Landmark</th>
<th>What time did you arrive and depart this location? (record exact times)</th>
<th>Activity What are you doing at this location? (see options below)</th>
<th>What type of place is this? (see options below)</th>
<th>Is this the work / base location for this vehicle?</th>
<th>Type of Cargo What is it?</th>
<th>Cargo Weight (in Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLACE 4</td>
<td></td>
<td>Arrive: ________ am/pm  &lt;br&gt; Depart: ________ am/pm</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>Delivery</td>
<td>Picked Up</td>
</tr>
<tr>
<td>PLACE 5</td>
<td></td>
<td>Arrive: ________ am/pm  &lt;br&gt; Depart: ________ am/pm</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>Delivery</td>
<td>Picked Up</td>
</tr>
<tr>
<td>PLACE 6</td>
<td></td>
<td>Arrive: ________ am/pm  &lt;br&gt; Depart: ________ am/pm</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>Delivery</td>
<td>Picked Up</td>
</tr>
<tr>
<td>PLACE 7</td>
<td></td>
<td>Arrive: ________ am/pm  &lt;br&gt; Depart: ________ am/pm</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>Delivery</td>
<td>Picked Up</td>
</tr>
<tr>
<td>PLACE 8</td>
<td></td>
<td>Arrive: ________ am/pm  &lt;br&gt; Depart: ________ am/pm</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>Delivery</td>
<td>Picked Up</td>
</tr>
<tr>
<td>PLACE 9</td>
<td></td>
<td>Arrive: ________ am/pm  &lt;br&gt; Depart: ________ am/pm</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>□ - Yes  &lt;br&gt; □ - No</td>
<td>Delivery</td>
<td>Picked Up</td>
</tr>
</tbody>
</table>

### ACTIVITY 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)  
9. Office Building (non-government)  
10. Retail / Shopping  
11. Industrial / Manufacturing  
12. Medical / Hospital  
13. Education (12th grade or less)  
14. Education (college, trade)  
15. Government Office / Building  
16. Residential  
17. Airport  
18. Intermodal Facility  
19. Warehouse  
20. Distribution Center  
21. Construction Site  
22. Other (specify)  
23. Refused / Unknown
### Commercial Vehicle Survey Travel (continued)

**RECORD** the following information about each place

<table>
<thead>
<tr>
<th>NAME of Place:</th>
<th>Address including city, state, and zip OR Nearest street intersection or Landmark</th>
<th>What time did you arrive and depart this location? (record exact times)</th>
<th>Activity: What are you doing at this location? (see options below)</th>
<th>What type of place is this? (see options below)</th>
<th>Is this the work / base location for this vehicle?</th>
<th>Type of Cargo: What is it?</th>
<th>Cargo Weight (in Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLACE 10</td>
<td></td>
<td>Arrive: __________ am/pm</td>
<td>Depart: __________ am/pm</td>
<td>□ - Yes   □ - No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Delivery</td>
<td>Pick Up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLACE 11</td>
<td></td>
<td>Arrive: __________ am/pm</td>
<td>Depart: __________ am/pm</td>
<td>□ - Yes   □ - No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Delivery</td>
<td>Pick Up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLACE 12</td>
<td></td>
<td>Arrive: __________ am/pm</td>
<td>Depart: __________ am/pm</td>
<td>□ - Yes   □ - No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Delivery</td>
<td>Pick Up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLACE 13</td>
<td></td>
<td>Arrive: __________ am/pm</td>
<td>Depart: __________ am/pm</td>
<td>□ - Yes   □ - No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Delivery</td>
<td>Pick Up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PLACE 14</td>
<td></td>
<td>Arrive: __________ am/pm</td>
<td>Depart: __________ am/pm</td>
<td>□ - Yes   □ - No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Delivery</td>
<td>Pick Up</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ACTIVITY 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)

**TYPE OF PLACE OPTIONS**

1. Office Building (non-government)
2. Retail / Shopping
3. Industrial / Manufacturing
4. Medical / Hospital
5. Education (12th 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)
15. Refused / Unknown
## Commercial Vehicle Survey

(continued)

**RECORD the following information about each place**

<table>
<thead>
<tr>
<th>NAME of Place:</th>
<th>Address including city, state, and zip or Nearest street intersection or Landmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLACE 15</td>
<td></td>
</tr>
<tr>
<td>PLACE 16</td>
<td></td>
</tr>
<tr>
<td>PLACE 17</td>
<td></td>
</tr>
<tr>
<td>PLACE 18</td>
<td></td>
</tr>
<tr>
<td>PLACE 19</td>
<td></td>
</tr>
</tbody>
</table>

**What time did you arrive and depart this location?**

<table>
<thead>
<tr>
<th>PLACE 15</th>
<th>Arrive: _______ am/pm</th>
<th>Depart: _______ am/pm</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLACE 16</td>
<td>Arrive: _______ am/pm</td>
<td>Depart: _______ am/pm</td>
</tr>
<tr>
<td>PLACE 17</td>
<td>Arrive: _______ am/pm</td>
<td>Depart: _______ am/pm</td>
</tr>
<tr>
<td>PLACE 18</td>
<td>Arrive: _______ am/pm</td>
<td>Depart: _______ am/pm</td>
</tr>
<tr>
<td>PLACE 19</td>
<td>Arrive: _______ am/pm</td>
<td>Depart: _______ am/pm</td>
</tr>
</tbody>
</table>

**Activity**

What are you doing at this location? (see options below)

- [ ] - Yes
- [ ] - No

**What type of place is this?**

- [ ] Delivery
- [ ] Picked Up

**Is this the work / base location for this vehicle?**

- [ ] - Yes
- [ ] - No

**Type of Cargo**

- [ ] - Box
- [ ] - Liquid
- [ ] - Other

**Cargo Weight**

- (in Pounds)

**ACTIVITY OPTIONS**

- (1) Base Location / Return to Base Location
- (2) Delivery
- (3) Pick-Up
- (4) Pick-Up and Delivery
- (5) Maintenance (fuel, oil, etc.)
- (6) Office Building (non-government)
- (7) Retail / Shopping
- (8) Industrial / Manufacturing
- (9) Medical / Hospital
- (10) Education (12th grade or less)
- (11) Government Office / Building
- (12) Residential
- (13) Airports
- (14) Intermodal Facility
- (15) Refused / Unknown