Commercial Motor Vehicle Direct Observation of Safety Belt Use

Final Report

Prepared for:
Office of Highway Safety Planning
333 South Grand Avenue
Lansing, MI

Prepared by:
Wayne State University
Transportation Research Group
Detroit, MI

Date: September 2012

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1.0   INTRODUCTION

Increasing the use of safety restraint systems by motor vehicle occupants is one of the most effective ways of reducing injuries and fatalities on the nation's highways. Yet, approximately twenty-seven percent of the country's commercial motor vehicle (CMV) drivers and passengers continue to travel unrestrained [1]. In 2010, a national study from the Federal Motor Carrier Safety Administration (FMCSA) collected data from a nationally representative sample of commercial motor vehicles at 998 sites throughout the country. A total of 26,830 commercial motor vehicles were observed and the overall safety belt use rate was found to be 78% and 64% for drivers and passengers, respectively [1]. The last time a direct observation study of CMV safety belt use was conducted in the State of Michigan was in 2006 when the overall CMV safety belt use rate was found to be 73.9% [2].

Past safety belt use studies of passenger vehicles indicate that the overall use by drivers and front seat passengers has been increasing consistently from 83.5 percent in 2000 to 95.2 percent in 2010 [3]. It should be noted that the rate of passenger vehicle safety belt usage in Michigan is far ahead of the national average of 85 percent [4]. While a considerably high proportion of motorists of passenger vehicles buckle up as a safety precaution, the usage rate is quite low among drivers of commercial motor vehicles. It is important to note that Michigan has been a "primary law" state since the year 2000, which means a motorist can be stopped and cited for the sole reason of not wearing a safety belt. Although Michigan practices zero-tolerance as a safety belt usage policy, high numbers of citations are issued to drivers of commercial motor vehicles on an annual basis.

The use of safety belts is the single most effective means of reducing fatal and non-fatal injuries in vehicular crashes. This holds true for commercial motor vehicles as well. The National Highway Traffic Safety Administration (NHTSA) estimates that 147,000 lives have been saved between 1975 and 2001 due to the use of safety belts [5]. NHTSA also estimates that the non-use of safety belts may result in an overall societal cost of 26 billion dollars in the US each year [5].

Considering the historically lower safety belt usage rate among occupants of commercial motor vehicles, the Office of Highway Safety Planning (OHSP), Michigan State Police (MSP), Federal Motor Carrier Safety Administration (FMCSA), and other stakeholders could realize substantial benefits from even incremental improvements in CMV belt use. By determining the current safety belt usage rate among CMV occupants, these agencies will be able to monitor progress and assess the effectiveness of any educational or enforcement programs that are implemented aimed at increasing belt use. Apart from determining the overall safety belt use rate, it is also valuable to obtain usage rates for various geographic regions and demographic groups in order to assist in identifying areas of opportunity for future resource allocation.

1.1   Study Purpose and Objectives

The purpose of this statewide study was to perform observational surveys for 210 intersections, freeway ramps, and rest areas to determine the percentage of drivers and front-seat passengers in commercial motor vehicles utilizing their safety belts.

The specific objectives of this project were as follows:

1. Develop a probability-based methodology for collecting data for a representative sample of locations throughout the State, which will ensure reliable statewide statistics, in an economically feasible manner.

2. Perform sampling to identify the geographic areas and specific locations where observational surveys need to be performed within the state.

3. Provide training to all staff conducting the direct observation surveys and conduct Quality Assurance/Quality Control (QA/QC) of the data collection efforts.

4. Conduct direct observation surveys and record data regarding seat belt use, non-use or misuse by the drivers and front seat passengers of commercial motor vehicles along with other relevant factors for each day of the week and each hour of the day.

5. Summarize and cross-tabulate the observational data in a spreadsheet format and analyze the data indicating overall safety belt use, safety belt use by stratum, safety belt use by type of commercial motor vehicle, safety belt use by time of day and day of week, and safety belt use by gender, age and other demographic characteristics.

1.2   Study Area

The study area for the statewide CMV observational survey included 35 counties that represented more than 85 percent of the population in the State of Michigan, as well as the ten counties recording the highest frequency of commercial motor vehicle crashes based on 2010 crash data obtained from the statewide crash database.

2.0   METHODOLOGY

In order to develop targeted awareness programs to increase safety belt use among drivers of commercial motor vehicles, one must know the distribution of use rates in various parts of the state and among various demographic groups, in addition to knowing the overall safety belt use rate in the state. It is important to capture the statewide use rate following a sampling strategy and data collection procedure that results in a representative sample of observations. The methodologies used in past direct observation surveys of safety belt use/non-use in the State of Michigan were examined as well as the uniform criteria presented by NHTSA. The methodology used for the selection of the 210 observation sites is described as follows:

- A 35-county statewide sample selected for this survey represents 87.46% of the state's population based on 2010 U.S. Bureau of Census Data estimates as shown in Table 1.

Table 1. US. Census Bureau 2010 Census Data for Michigan by County

Total State of Michigan Population: 9,883,640

Name of County	Percent Population Statewide for Michigan		Cumulative Percent Population Statewide for Michigan	County Ranking By Population	County Included in Study
Wayne	1,820,584	18.42%	18.42%	1	Yes
Oakland	1,202,362	12.17%	30.59%	2	Yes
Macomb	840,978	8.51%	39.09%	3	Yes
Kent	602,622	6.10%	45.19%	4	Yes
Genesee	425,790	4.31%	49.50%	5	Yes
Washtenaw	344,791	3.49%	52.99%	6	Yes
Ingham	280,895	2.84%	55.83%	7	Yes
Ottawa	263,801	2.67%	58.50%	8	Yes
Kalamazoo	250,331	2.53%	61.03%	9	Yes
Saginaw	200,169	2.03%	63.06%	10	Yes
Livingston	180,967	1.83%	64.89%	11	Yes
Muskegon	172,188	1.74%	66.63%	12	Yes
Saint Clair	163,040	1.65%	68.28%	13	Yes
Jackson	160,248	1.62%	69.90%	14	Yes
Berrien	156,813	1.59%	71.49%	15	Yes
Monroe	152,021	1.54%	73.03%	16	Yes
Calhoun	136,146	1.38%	74.40%	17	Yes
Allegan	111,408	1.13%	75.53%	18	Yes
Bay	107,771	1.09%	76.62%	19	Yes
Eaton	107,759	1.09%	77.71%	20	Yes
Lenawee	99,892	1.01%	78.72%	21	Yes
Lapeer	88,319	0.89%	79.62%	22	Yes
Grand Traverse	86,986	0.88%	80.50%	23	Yes
Midland	83,629	0.85%	81.34%	24	Yes
Van Buren	76,258	0.77%	82.11%	25	Yes
Clinton	75,382	0.76%	82.88%	26	Yes
Shiawassee	70,648	0.71%	83.59%	27	Yes
Isabella	70,311	0.71%	84.30%	28	Yes
Marquette	67,077	0.68%	84.98%	29	Yes
Ionia	63,905	0.65%	85.63%	30	Yes
Montcalm	63,342	0.64%	86.27%	31	Yes
Saint Joseph	61,295	0.62%	86.89%	32	Yes
Additional U.P. Counties					
Delta	37,069	0.38%	87.26%	43	Yes
Mackinac	11,113	0.11%	87.38%	74	Yes
Schoolcraft	8,485	0.09%	87.46%	80	Yes

- In addition, the ten counties representing the highest frequency of commercial motor vehicle crashes in the state based on 2010 crash data are included. These counties are as follows and were also represented in the 35-county statewide sample:
    - Wayne County, Oakland County, Macomb County, Kent County, Washtenaw County, Genesee County, Kalamazoo County, Ingham County, Monroe County and Ottawa County.

- Three counties were added to the statewide sample to better represent commercial motor vehicle travel across Michigan's Upper Peninsula. The additional counties that were selected in the Upper Peninsula include Delta County, Mackinac County and Schoolcraft County.

- The counties included in the 35-county statewide survey are listed below and depicted in Figure 1.

1. Allegan
2. Bay
3. Berrien
4. Calhoun
5. Clinton
6. Eaton
7. Genesee
8. Grand Traverse
9. Ingham
10. Ionia
11. Isabella
12. Jackson
13. Kalamazoo
14. Kent
15. Lapeer
16. Lenawee
17. Livingston
18. Macomb
19. Marquette
20. Midland
21. Monroe
22. Montcalm
23. Muskegon
24. Oakland
25. Ottawa
26. Saginaw
27. St. Clair
28. St. Joseph
29. Shiawassee
30. Van Buren
31. Washtenaw
32. Wayne
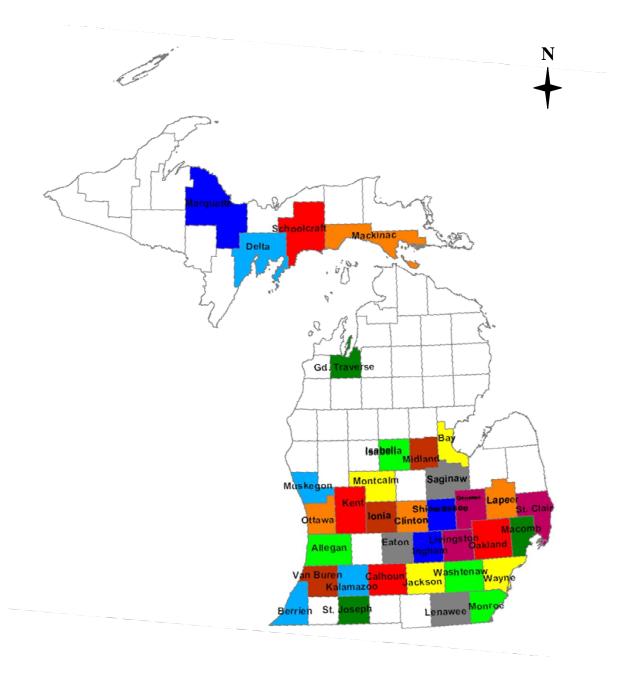33. Delta
34. Schoolcraft
35. Mackinac

Figure 1. 35-County Sample for the Direct Observation Safety Belt Surveys

- A system for partitioning the candidate counties into various strata, based upon safety belt use rate, vehicle miles traveled (VMT), and commercial motor vehicle miles traveled (CMVMT) was utilized for this study. This system has been used previously for direct observation passenger vehicle safety belt studies in the State of Michigan [3]. The number of observation sites for each county within a stratum was based

upon the 2010 commercial motor vehicle miles traveled within that county as a proportion of the total commercial VMT for all counties in the sample. The minimum number of freeway survey locations and non-freeway survey locations was determined for each county separately for limited access freeways and non-freeway roads; again based on the county's proportion of commercial VMT within the particular roadway category. Freeway survey locations were randomly selected from the list of service interchanges and rest areas on all freeways within the county. The exit ramp terminals were typically utilized for the interchange locations, although nearby signalized intersections were selected in cases where the exit ramps were free-flowing. Non-freeway survey locations were selected from a comprehensive list of surface street intersections that were located at least one mile from a limited access freeway. Forty-six (46) sites were selected for observation from Stratum 1, 55 sites from Stratum 2, 72 sites from Stratum 3, 33 sites from Stratum 4, and 4 sites from Stratum 5. The 2010 commercial motor vehicle miles traveled for each county and stratum as well as the number and type of sites selected for each stratum can be found in Table 2. A complete listing of the 210 sites is provided in Appendix I.

- The sites selected for this observational study include rest areas and exit ramps of limited access highways and signalized or stop controlled intersections of surface roads. When possible, exit ramps that were located near adjacent truck stops were selected as these locations were expected to have a higher volume of CMV's. Weigh stations along highways were avoided because driver behavior may differ due to the presence of police at these locations. A listing of eligible sites meeting the above criteria was assembled and then the sites were chosen in a random manner using a method that ensured an equal probability of selection. Specifically, the sites were numbered sequentially and a random number generator was used to determine which sites would be selected as observation locations.

- Upon determination of the sites, the direction of traffic flow, day of the week, and time of day at each observation site was determined using a similar random method that ensured equal probability.

Table 2. 2010 CMVMT by County and Stratum and Number and Type of Sites Selected
[CMVMT Source: Michigan Department of Transportation]

Stratum and County	Freeway CMVMT (2010) In Thousands		Non-Freeway CMVMT (2010) In Thousands		Total CMVMT (2010) In Thousands		Number and Type of Sites for Each Stratum
	Freeway CMVMT	% of Sample Freeway CMVMT	Non-Freeway CMVMT	% of Sample Non-Freeway CMVMT	Total CMVMT	% of Sample Total CMVMT	
Stratum 1							
Ingham	65,068	2.5%	49,685	2.0%	114,753	2.3%	29 Intersections, 7 Rest Areas, 10 Freeway Exit Ramps
Kalamazoo	99,858	3.9%	76,063	3.1%	175,921	3.5%	
Oakland	189,345	7.4%	348,878	14.2%	538,223	10.7%	
Washtenaw	164,262	6.4%	95,418	3.9%	259,679	5.2%	
Total Stratum 1	**518,533**	**20.2%**	**570,044**	**23.2%**	**1,088,577**	**21.6%**	**46 Sites (21.9%)**
Stratum 2							
Allegan	73,848	2.9%	36,746	1.5%	110,594	2.2%	33 Intersections, 10 Rest Areas, 12 Freeway Exit Ramps
Bay	27,521	1.1%	29,605	1.2%	57,126	1.1%	
Eaton	65,237	2.5%	30,131	1.2%	95,368	1.9%	
Grand Traverse	0	0.0%	32,806	1.3%	32,806	0.7%	
Jackson	99,951	3.9%	43,734	1.8%	143,685	2.9%	
Kent	138,217	5.4%	165,229	6.7%	303,446	6.0%	
Livingston	90,886	3.5%	45,296	1.8%	136,181	2.7%	
Macomb	67,812	2.6%	226,367	9.2%	294,178	5.8%	
Midland	9,753	0.4%	27,051	1.1%	36,804	0.7%	
Ottawa	46,271	1.8%	78,980	3.2%	125,251	2.5%	
Total Stratum 2	**619,495**	**24.1%**	**715,946**	**29.1%**	**1,335,440**	**26.6%**	**55 Sites (26.2%)**

Table 2. 2010 CMVMT by County and Stratum and Number and Type of Sites Selected (Continued)

Stratum and County	Freeway CMVMT (2010) In Thousands		Non-Freeway CMVMT (2010) In Thousands		Total CMVMT (2010) In Thousands		Number and Type of Sites for Each Stratum
	Freeway CMVMT	% of Sample Freeway CMVMT	Non-Freeway CMVMT	% of Sample Non-Freeway CMVMT	Total CMVMT	% of Sample Total CMVMT	
Stratum 3							
Berrien	192,444	7.5%	46,399	1.9%	238,843	4.7%	
Calhoun	138,571	5.4%	41,317	1.7%	179,888	3.6%	
Clinton	55,800	2.2%	23,13	0.9%	78,922	1.6%	
Genesee	109,408	4.3%	116,025	4.7%	225,433	4.5%	
Ionia	40,231	1.6%	19,264	0.8%	59,495	1.2%	
Isabella	11,526	0.4%	20,571	0.8%	32,096	0.6%	
Lapeer	28,288	1.1%	32,577	1.3%	60,865	1.2%	
Lenawee	0	0.0%	43,881	1.8%	43,881	0.9%	34 Intersections, 11 Rest Areas, 27 Freeway Exit Ramps
Marquette	0	0.0%	24,062	1.0%	24,062	0.5%	
Monroe	211,912	8.3%	36,528	1.5%	248,440	4.9%	
Montcalm	10,347	0.4%	23,149	0.9%	33,496	0.7%	
Muskegon	16,741	0.7%	54,400	2.2%	71,140	1.4%	
Saginaw	38,724	1.5%	67,47	2.7%	106,201	2.1%	
Shiawassee	42,171	1.6%	22,003	0.9%	64,174	1.3%	
St. Clair	53,974	2.1%	43,67	1.8%	97,654	1.9%	
St. Joseph	0	0.0%	33,134	1.3%	33,134	0.7%	
Van Buren	78,160	3.0%	24,301	1.0%	102,461	2.0%	
Total Stratum 3	**1,028,295**	**40.0%**	**671,891**	**27.3%**	**1,700,187**	**33.8%**	**72 Sites (34.3%)**
Statum 4							
Wayne	397,583	15.5%	447,886	18.2%	84,469	16.8%	19 Intersections, 2 Rest Areas, 12 Freeway Exit Ramps
Total Stratum 4	**397,583**	**15.5%**	**447,886**	**18.2%**	**845,469**	**16.8%**	**33 Sites (15.7%)**
Stratum 5							
Delta	0	0.0%	25,679	1.0%	25,679	0.5%	
Mackinac	4,132	0.2%	15,720	0.6%	19,853	0.4%	3 Intersections, 1 Rest Area
Schoolcraft	0	0.0%	14,575	0.6%	14,575	0.3%	
Total Stratum 5	**4,132**	**0.2%**	**55,974**	**2.3%**	**6,106**	**1.2%**	**4 Sites (1.9%)**
Total All Strata	**2,568,039**	**100%**	**2,461,740**	**100%**	**5,029,779**	**100%**	**210 Sites**

- It was anticipated that for each selected observation site, a minimum of 5 CMV's would be observed for intersections and exit ramps not located near truck stops, and a minimum of 10 CMV's would be observed for rest areas and exit ramps located near truck stops during the 50-minute observation period. It was anticipated that, for this project, there would be a minimum of 200 individual observation sites; however the final site selection included a total of 210 observation sites. The data collected for the 210 statewide observation sites should provide an accurate representation for each day of the week and each hour of the day during the daylight hours for the safety belt use characteristics of the state.

- A 10-minute traffic count of commercial motor vehicles was conducted before and after each 50-minute observation period to form a basis for estimating the number of such vehicles passing the direct observation site per unit time. During the observational survey, all of the commercial motor vehicles passing the observer at each site may not be observable and, as such, the traffic count data will introduce a weighting factor for each study site. Further detail on this weighting procedure is found in section 5.1.

- In addition to the primary set of direct observation survey sites, alternate locations were selected near the primary observation sites. When the field observers faced difficulty in observing commercial motor vehicles at the sites selected as primary sites due to low traffic, weather, or various other adverse conditions, the field observers were relocated to alternative locations for observations.

- In order to minimize the travel time and distance required to conduct this study, the observation sites were clustered into geographic regions upon final selection without compromising the randomness of the data.

3.0   OBSERVER TRAINING

Several staff members from the WSU-TRG participated in the data collection for this project. Each of these staff members has or is pursuing an engineering degree and has been trained in general traffic data collection methods and procedures. For this project, each data collector received specific training comprised of technical assistance and field data collection.

Each member of the data collection team participated in reliability and repeatability studies prior to being deployed for data collection. The reliability and repeatability studies were performed at sample locations in Southeastern Michigan. Over a two week period, observers were randomly grouped and assigned to collect safety belt use and non-use data and commercial motor vehicle observational data for one direction of traffic flow at one of the selected intersections. Although the observers were observing the same traffic flow direction, they did not interact; however, they were generally able to observe the same vehicles due to the low volume of commercial vehicular traffic.

The data was then summarized for each group of individuals to determine the consistency of their observations.   Safety belt use, gender, age, race and commercial motor vehicle characteristics were compared for consistency between the observers as well. This exercise was performed during the two weeks week prior to field data collection which started on May 30, 2012.

Upon completion of training for the data collection, each member of the team received a training manual comprised of the information received during the training session, the schedule of data collection and all necessary field supplies. Two field supervisors monitored the performance of the field observers. The field data collectors submitted their observation data on a daily basis and it was immediately entered and compiled on spreadsheets at the WSU campus office.

4.0   DATA COLLECTION

Data collection for the commercial motor vehicle safety belt observations occurred between May 30th and July 23, 2012. The driver and passenger of each commercial vehicle were observed for safety belt use and non-use. Both the driver and passenger were separately identified based upon their gender, estimated age and race.

The majority of commercial motor vehicles use the 3-point safety belt system, which was developed in the 1980's and went through major design modifications in the 1990's. This type of safety belt assembly has now been adopted across the industry and may be considered as standard equipment. There is a lap belt and a shoulder belt in this seat belt assembly. The lap belt was not visible by the observer, but it was possible to record if the commercial motor vehicle driver or passenger was using their shoulder belt. Therefore, the data recorded for safety belt use only refers to the usage of the shoulder belt by the driver or passenger of the commercial motor vehicle.

For each selected observation site, a minimum of 5 CMV's were observed for intersections and those exit ramps that were not located near truck stops. Due to higher expected volumes, a minimum of 10 CMV's were observed for rest areas and exit ramps that were located near truck stops. Observers collected data for at least 50 minutes at each site. If the minimum number of observations were not completed in 50 minutes, the observer stayed longer at the same location and collected CMV safety belt use data until the minimum number of CMV's had been observed. These observations were appropriately reweighted, as explained in the Data Analysis Section of this report. The data collected for the 210 observation sites provided a representative sample for each day of the week and each hour of the day for the CMV safety belt use characteristics of the state.

Only stopped or slowly moving CMV's were observed at each site. CMV's were observed from the driver's side, as this provides the best angle of viewing to determine safety belt use for CMV occupants.   Since it is not always possible to accurately observe all CMV's passing the observation site while collecting the safety belt use data, a 20-minute traffic count of all CMV's

passing the observation point was used as the basis for estimating the total number of CMV's passing the observation site per unit of time. This data introduced a weighting factor for each observation site. The 20-minute count was collected in two 10-minute intervals; ten minutes prior to the safety belt use observational period and ten minutes following the observational period.

Commercial motor vehicles subject to Federal Motor Carrier Safety Regulations were included in this survey. The vehicles were first categorized by whether they were single unit CMV's or tractor-trailer type CMV's. They were then further categorized based on the specific type of CMV. For single unit CMV's the categories were: box truck, dump truck, flatbed truck, concrete mixer, garbage truck, tanker truck, and 'other'. For tractor-trailer type CMV's the categories were: box trailer, container trailer, flatbed trailer, gravel train, tanker trailer, auto transporter, rig-only, and 'other'. The vehicles were identified and categorized depending on fleet type (national and regional or local/individual ownership), and the type of load transported (hazardous or non-hazardous material). For tractor-trailer type CMV's, the trailer type was marked as either 'single' or 'double' trailer. The carrier names were also recorded as stated on the individual commercial motor vehicle's power units.

The driver of each CMV and the passenger in the front right seat of the vehicle were observed for safety belt use, non-use and misuse. The driver and passenger belt observational categories included: Not Belted, Belted, Shoulder Belt Behind Back, and Should Belt Under Arm. In the surveys, both the driver and front-seat passenger were separately identified based upon their gender, estimated age and race. The driver age categories included 18-29, 30-59, and 60 and over. The passenger age categories included under 15, 16-29, 30-59, and 60 and over. The driver and passenger races were categorized as Caucasian, African American, Asian or Pacific Islander, Hispanic, and Native American.

The observations collected in the field were manually recorded on survey forms and returned back to the office within 24 hours of the data collection. If an observer was on an overnight trip, they entered the data the night of the collection and sent it electronically. The survey forms were then returned as soon as the observer returned from the overnight trip.

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5.0   DATA ANALYSIS

The data collected in the field was computerized by the office staff and verified for accuracy by senior staff.   Rates for safety belt use were determined at the statewide, stratum, and county level. In order to analyze and cross-tabulate the data, SPSS, a statistical and data management software package was utilized.   Each Commercial vehicle observation was entered into the software and categorized by location, such as stratum and county, commercial vehicle data, such as type of vehicle, and driver and passenger data, such as gender and safety belt use.

5.1   Weighted CMV Safety Belt Use Calculations

A weighting procedure was performed when determining the belt use rates as described in the following sample calculations.   First, the number of CMV's observed at each intersection was divided by the length of the observation period and then multiplied by a standard 50-minute observational period   This was done to estimate the total number of CMV's that would be observed during a standard 50-minute period. The number of vehicles observed during the 20-minute volume count was then multiplied by 2.5 to estimate the total number of CMV's that passed the observation location during a standard 50-minute survey period.   The total number of CMV's available for observation was then divided by the adjusted number of CMV's that were actually observed.   The resulting calculation produced the volume weighting factor for that particular site.   If the calculations produced a weighting factor below 1.0, then the weighting for that location was simply taken as 1.0 (as it would be assumed all CMV's that passed through this location were observed).   The total number of drivers and passengers belted and not belted were then multiplied by the weighting factor to obtain the total number of weighted drivers and passengers that were belted and not belted.   The weighted overall safety belt use rate by stratum was then determined by dividing the total (weighted) number of belted drivers and passengers by the total (weighted) number of drivers and passengers.   The following calculations further describe the procedure outlined above.

Oakland County, Novi Road and 12 Mile Road,

> Survey length = 50 minutes
>
> Number of CMV's observed in 50 minutes = 13 CMV's
>
> 20-minute volume count = 9 CMV's

Standard 50-minute observational frequency (Adjusted number of CMV's) =

$$\frac{Number\ of\ CMV\ Observed}{Survey\ Length} \times 50\ minutes = \frac{13\ CMV}{50\ minutes} \times 50\ minutes = 13\ CMV\ in\ 50\ minutes$$

Total number of CMV's available for observation = 20-minute CMV count x 2.5 =

> 9 CMV x 2.5 intervals = 22.5 CMV's in 50 minutes

Intersection volume weighting factor = $\dfrac{Total\ Number of\ CMV}{Adjusted\ Number of\ CMV} = \dfrac{22.5}{13} = 1.73$

The variance for each stratum was determined by following Cochran's techniques [6] using the following equation:

$$Variance_j = \frac{n_j}{n_j - 1} \sum_{i=1}^{n_j} \left[\left(\frac{g_{ij}}{\sum_{i=1}^{n_j} g_{ij}} \right)^2 \left(r_{ij} - r_j \right)^2 \right]$$

Where,

n_j = number of observation locations stratum j

g_{ij} = number of observations at location i in stratum j

r_i = safety belt use rate for location i in stratum j

r_j = overall safety belt use rate for stratum j

5.2   Overall Statewide CMV Safety Belt Use Calculations

The statewide weighted CMV safety belt use rate was calculated by summing up the strata safety belt use rates, each multiplied by a commercial vehicle miles of travel weighting factor for that stratum, divided by the sum of the vehicle miles of travel weighting factor. The 2010 commercial vehicle miles of travel from the Michigan Department of Transportation, as shown in Table 2, were used for these calculations. The five stratum CVMT totals were compared and Stratum 3 had the highest total with 1,700,186,676 and was therefore assigned a weight factor of 1.0. The other three strata weight factors were determined by dividing the commercial vehicle miles of travel for that stratum by Stratum 3's commercial vehicle miles of travel. Stratum 1 was assigned a weight factor equal to 0.6403 (1,088,576,659 divided by 1,700,186,676). Stratum 2 was assigned a weight factor equal to 0.7855 (1,335,440,416 divided by 1,700,186,676). Stratum 4 was assigned a weight factor equal to 0.4973 (845,468,815 divided by 1,700,186,676). Stratum 5 was assigned a weight factor equal to 0.0354 (60,106,269 divided by 1,700,186,676). The sum of the weight factors for all four strata equaled 2.9584.

The overall statewide variance was calculated using the following formula:

$$Variance_{TOTAL} = \frac{\sum_{\forall j}\left(w_j^2 Var_j\right)}{\left(\sum_{\forall j} w_j\right)^2}$$

Where, w_j = VMT weight factor for stratum j.

The 95 percent confidence interval is equal to the weighted safety belt use rate plus/minus 1.96 (for the Z-test at alpha = 0.05) multiplied by the square root of the stratum's or statewide variance expressed as a percent. The standard error is equal to the square root of the variance. The following section provides the results of the data analysis and cross-tabulation.

6.0   RESULTS AND CONCLUSIONS

The observational survey for the CMV statewide sample was performed between Wednesday, May 30th and Monday, July 23rd of 2012. During this observation period, a total of 2,899 CMV's were observed at 210 observation sites randomly selected to represent the statewide CMV safety belt use. The total number of safety belt observations, including drivers and passengers, was 3,028.

6.1   Results

The overall weighted statewide safety belt use rate for CMV's, determined on a strata-basis, was found to be 84.9% and is shown in Table 3. The overall weighted statewide safety belt use rate was calculated based upon the procedure described in the "Overall Statewide Safety Belt Use Calculations" section in the Data Analysis section of the report. When the safety belt usage rates were calculated, belted occupants included all drivers and front-seat passengers who were belted appropriately. The "not belted" occupants included drivers and front-seat passengers who were not belted or who were wearing the belt either under their arm or behind their back.

Table 3. Statewide CMV Safety Belt Use Rate for Drivers and Front Seat Passengers

Survey	Safety Belt Use Rate*	Standard Error
Michigan Statewide CMV Safety Belt Survey	84.9 ± 2.02%	1.03%

* Weighted Safety Belt Usage ± 95% Confidence Band

The findings for the statewide CMV observational survey, by strata, for driver and passenger safety belt usage are shown in Table 4. Strata 1 and 3 produced the two highest safety belt usage rates with 86.7% and 87.3% respectively, whereas Strata 2 and 5 produced the two lowest safety belt use rates with 80.7% and 64.4% respectively. It should be noted that Stratum 5 had a very low sample size compared with the other Strata. Stratum 4 yielded the median safety belt usage rate for drivers and passengers with 85.6%.

Table 4. CMV Safety Belt Use Rate for Drivers and Front Seat Passengers by Stratum

Stratum	Weighted Total No. of Obs.	Weighted No. of Belted Obs.	Weighted No. of Unbelted Obs.	Weighted Safety Belt Use Rate*	Standard Error
Stratum 1	1,042	904	138	86.7 ± 3.92%	2.00%
Stratum 2	1,398	1,128	270	80.7 ± 4.75%	2.42%
Stratum 3	1,286	1,123	163	87.3 ± 2.90%	1.48%
Stratum 4	861	737	124	85.6 ± 5.28%	2.69%
Stratum 5	85	54	30	64.4 ± 3.89%	1.98%

 * Weighted Safety Belt Usage ± 95% Confidence Band

Table 5 summarizes the descriptive statistics regarding the CMV safety belt survey in terms of day of the week and time of the day.

Table 5. Statewide Descriptive Statistics

Day of the Week	No. of Sites Observations	Percent of Sites in Day of Week	Total No. of CMV Observed	Percent of Observations in Day of Week
Sunday	23	11.0%	145	5.0%
Monday	21	10.0%	366	12.6%
Tuesday	27	12.9%	421	14.5%
Wednesday	23	11.0%	363	12.5%
Thursday	38	18.1%	581	20.0%
Friday	48	22.9%	772	26.6%
Saturday	30	14.3%	251	8.7%
TOTAL	**210**	**100%**	**2,899**	**100%**
Time of the Day	No. of Sites Observed	Percent of Sites in Time of Day	Total No. of CMV Observed	Percent of Observations in Time of Day
7 AM - 8 AM	6	2.9%	76	2.6%
8 AM - 9 AM	11	5.2%	165	5.7%
9 AM - 10 AM	14	6.7%	232	8.0%
10 AM - 11 AM	17	8.1%	270	9.3%
11 AM - 12 PM	28	13.3%	484	16.7%
12 PM - 1 PM	23	11.0%	274	9.5%
1 PM - 2 PM	21	10.0%	233	8.0%
2 PM - 3 PM	26	12.4%	439	15.1%
3 PM - 4 PM	19	9.0%	249	8.6%
4 PM - 5 PM	26	12.4%	271	9.3%
5 PM - 6 PM	11	5.2%	129	4.4%
6 PM - 7 PM	8	3.8%	77	2.7%
Total	**210**	**100%**	**2,899**	**100%**

In terms of day of the week selected for the observational survey, Mondays through Fridays were sampled at a higher rate in terms of percent of total observations based upon the random selection process. Saturdays and Sundays were the two lowest sampled days in terms of percent of total observations as CMV volumes were found to be significantly lower on the weekends. However, the number of sites selected per day was fairly consistent between all days of the week except for Fridays and Saturdays which had higher number of sites than the other days of the week.

In terms of the time of day selected for the sample, the hours of the day between 11 AM to 12 PM and 2 PM to 3 PM produced the highest number of commercial motor vehicles than other times. The other hours of the day produced roughly the same number of CMV's in terms of percent of total observations with the exception of 7 AM to 8 AM and 6 PM to 7 PM which had a lower number of observations.

The safety belt use rate can be described by the overall use rate, as well as by vehicle type and various demographics. Table 6 summarizes the CMV safety belt use rate for the statewide survey by driver, front-seat passenger and total observations. It should be noted that the overall safety belt use rates presented in Tables 6 through 10 vary from those provided in Tables 3 and 4. The overall statewide weighted safety belt use percentages provided in Tables 3 and 4 were calculated by weighting the safety belt use rates at each location by an intersection weighting factor and then by a strata-based CMVMT weighting factor (as described in Section 5.2 Overall Statewide Safety Belt Use Calculations). As the data presented in Tables 6 through 10 are not aggregated at the strata level, no weighting factor was utilized.

Table 6. Statewide CMV Safety Belt Use Summary

Driver Belt Use	Total Observations	Percent of Observations by Category
Not Belted	426	14.7%
Belted	2,470	85.2%
Shoulder Belt Under Arm	2	0.1%
Shoulder Belt Behind Back	1	0.0%
Total	**2,899**	**100%**
Passenger Belt Use	Total Observations	Percent of Observations by Category
No Passenger	2,770	N/A
Not Belted	30	23.3%
Belted	98	76.0%
Shoulder Belt Under Arm	1	0.8%
Shoulder Belt Behind Back	0	0.0%
Total	**2,899**	**100%**
Total Belt Use	Total Observations	Percent of Observations by Category
Not Belted	456	15.1%
Belted	2,568	84.8%
Shoulder Belt Under Arm	3	0.1%
Shoulder Belt Behind Back	1	0.0%
Total	**3,028**	**100%**

Table 7 summarizes the statewide driver and front-seat passenger safety belt use rates by county. In Table 7, the counties are listed by stratum. Because of the relatively low number of sites and/or observations in many counties, the safety belt use rates listed may not be fully representative of each county.

Table 7. Statewide CMV Safety Belt Use Rates by Stratum and County

All Commercial Vehicle Types Safety Belt Use			
Stratum 1	**Total No. of Observations**	**Belted Observations**	**Safety Belt Use Rate**
Ingham County	62	57	91.9%
Kalamazoo County	119	97	81.5%
Oakland County	316	266	84.2%
Washtenaw County	159	146	91.8%
Total	**656**	**566**	**86.3%**
Stratum 2	**Total No. of Observations**	**Belted Observations**	**Safety Belt Use Rate**
Allegan County	76	67	88.2%
Bay County	37	32	86.5%
Eaton County	31	24	77.4%
Grand Traverse County	25	23	92.0%
Jackson County	65	62	95.4%
Kent County	137	102	74.5%
Livingston County	70	56	80.0%
Macomb County	238	182	76.5%
Midland County	20	17	85.0%
Ottawa County	118	106	89.8%
Total	**817**	**671**	**82.1%**
Stratum 3	**Total No. of Observations**	**Belted Observations**	**Safety Belt Use Rate**
Berrien County	133	129	97.0%
Calhoun County	94	84	89.4%
Clinton County	47	40	85.1%
Genesee County	109	86	78.9%
Ionia County	31	23	74.2%
Isabella County	28	20	71.4%
Lapeer County	26	21	80.8%
Lenawee County	44	42	95.5%
Marquette County	11	7	63.6%
Monroe County	192	164	85.4%
Montcalm County	15	11	73.3%
Muskegon County	41	34	82.9%
Saginaw County	65	55	84.6%
Shiawassee County	34	31	91.2%
St. Clair County	48	40	83.3%
St. Joseph County	27	27	100.0%
Van Buren County	36	34	94.4%
Total	**981**	**848**	**86.4%**

Table 7. Statewide CMV Safety Belt Use Rates by Stratum and County (Continued)

Stratum 4	Total No. of Observations	Belted Observations	Safety Belt Use Rate
Wayne County	510	442	86.7%
Stratum 5	**Total No. of Observations**	**Belted Observations**	**Safety Belt Use Rate**
Delta County	5	4	80.0%
Mackinac County	48	30	62.5%
Schoolcraft County	11	7	63.6%
Total	**64**	**41**	**64.1%**
Grand Strata Total	**3,028**	**2,568**	**84.8%**

Table 8 summarizes driver and passenger safety belt use by survey day, time, gender, age and race for the statewide commercial motor vehicle survey. Drivers and passengers of commercial motor vehicles have lower safety belt usage rates on Fridays and Sundays compared to other days of the week and Tuesday recorded the highest safety belt usage rate. Safety belt usage rates are lowest during the hours of 9 AM to 10 AM, 12 PM to 2 PM, and 3 PM to 4 PM. Safety belt usage rates are highest between the hours of 7 AM to 8 AM, and 5 PM to 7 PM. However, it should be noted there were a low number of observations between the hours of 7 AM to 8 AM and 6 PM to 7 PM. Gender does not seem to impact the choice of the driver or passenger to utilize their safety belt, as the safety belt usage rates for males and females only differs by 0.8%. However, the vast majority of commercial motor vehicle drivers and passengers are male representing 97.5% of the driver and passenger population.

As age increases, the tendency for drivers and passengers to utilize their safety belts increases from 82.9% for ages under 29, to 86.4% for drivers and passengers over the age of 60. Roughly 72% percent of the drivers and passengers of commercial motor vehicles are between the ages of 30 and 59 based upon the observational sample and this age group exhibited a safety belt usage rate of 85.1%. Although the rates for drivers and passengers of races other than Caucasian vary slightly than those of the Caucasian race, those observations only account for only thirteen percent of the total observations. Roughly Eighty-seven (87) percent of the drivers and passengers of commercial motor vehicles are Caucasian and utilize their safety belts at a rate of 85.3%. African Americans exhibited the lowest safety belt usage rate with 80.0% of occupants utilizing their safety belts.

Table 8. All Commercial Vehicles Statewide Safety Belt Usage Summary

All Commercial Motor Vehicle Types Safety Belt Use			
Day of The Week	**Total No. of Observations**	**Belted Observations**	**Safety Belt Use Rate**
Sunday	151	125	82.8%
Monday	374	324	86.6%
Tuesday	439	392	89.3%
Wednesday	382	322	84.3%
Thursday	601	523	87.0%
Friday	815	653	80.1%
Saturday	266	229	86.1%
Total	**3,028**	**2,568**	**84.8%**
Time of Day	**Total No. of Observations**	**Belted Observations**	**Safety Belt Use Rate**
7 AM - 8 AM	80	75	93.8%
8 AM - 9 AM	169	142	84.0%
9 AM - 10 AM	250	208	83.2%
10 AM - 11 AM	280	242	86.4%
11 AM - 12 PM	502	440	87.6%
12 PM - 1 PM	294	243	82.7%
1 PM - 2 PM	240	196	81.7%
2 PM - 3 PM	452	380	84.1%
3 PM - 4 PM	266	212	79.7%
4 PM - 5 PM	284	244	85.9%
5 PM - 6 PM	133	118	88.7%
6 PM - 7 PM	78	68	87.2%
Total	**3,028**	**2,568**	**84.8%**
Gender	**Total No. of Observations**	**Belted Observations**	**Safety Belt Use Rate**
Male	2953	2505	84.8%
Female	75	63	84.0%
Total	**3,028**	**2,568**	**84.8%**
Age	**Total No. of Observations**	**Belted Observations**	**Safety Belt Use Rate**
Under 29	549	455	82.9%
30-59	2185	1859	85.1%
60+	294	254	86.4%
Total	**3,028**	**2,568**	**84.8%**

Table 8. All Commercial Vehicles Statewide Safety Belt Usage Summary (Continued)

Race	Total No. of Observations	Belted Observations	Safety Belt Use Rate
Caucasian	2646	2258	85.3%
African American	305	244	80.0%
Asian or Pacific Islander	28	24	85.7%
Hispanic	38	33	86.8%
Native American	0	0	N/A
Unknown	11	9	81.8%
Total	**3,028**	**2,568**	**84.8%**

Table 9 depicts the safety belt usage rates for the various types of commercial vehicles observed in the survey. Overall, drivers and passengers of single unit truck types represented about 43% of the total observations and exhibited a much lower safety belt usage rate (81.0%) than drivers and passengers of tractor-trailer type trucks (87.7%). This result is to be expected, as drivers or passengers of some types of smaller single unit trucks may be entering and exiting their vehicles several times throughout their shift, and may have to make many short trips between local sites as compared with drivers and passengers of long-haul tractor-trailer type trucks. Among single unit truck types, drivers and passengers of concrete mixers had a significantly lower belt usage rate than the rest of the single unit truck types with 33.3%. However, the sample size for concrete mixers was very small compared to most of the other single unit truck types. Box type trucks accounted for about 53% of the single unit truck type observations and the drivers and passengers of these box type single unit trucks exhibited the highest safety belt usage rate of the single unit truck types with 87.3%.

Among tractor-trailer type CMV's, drivers and passengers of gravel trains exhibited the lowest safety belt use rate with 78.4%. Drivers and passengers of container trucks and auto transporters exhibited the highest safety belt use rate among tractor-trailer type CMV's with usage rates of 93.2% and 91.5% respectively. Drivers and passengers of box type tractor trailer trucks made up about 68% of the total tractor trailer type CMV observations and exhibited a safety belt usage rate of 89.0%.

Table 9. Type of Commercial Motor Vehicles Statewide Safety Belt Usage

Single Unit Truck Type	Total No. of Observations	Belted Observations	Safety Belt Use Rate
Box Truck	692	604	87.3%
Dump Truck	105	70	66.7%
Flatbed Truck	246	194	78.9%
Concrete Mixer	27	9	33.3%
Garbage Truck	49	42	85.7%
Tanker Truck	27	20	74.1%
Other	152	112	73.7%
Total	**1,298**	**1,051**	**81.0%**
Tractor-Trailer Truck Type	**Total No. of Observations**	**Belted Observations**	**Safety Belt Use Rate**
Box Truck	1,179	1,049	89.0%
Container Truck	59	55	93.2%
Flatbed Truck	156	133	85.3%
Gravel Train	97	76	78.4%
Tanker Truck	116	99	85.3%
Auto Transporter	47	43	91.5%
Rig Only (Bobtail)	59	47	79.7%
Other	17	15	88.2%
Total	**1,730**	**1,517**	**87.7%**
Grand Total	**3,028**	**2,568**	**84.8%**

Table 10 shows the CMV safety belt usage rate based fleet type, cargo type, trailer type, and location type. Drivers and passengers of a CMV are belonging to a national or regional fleet exhibited a higher safety belt usage rate (89.6%) than drivers and passengers of a local fleet or a CMV with individual ownership (81.9%). Drivers and passengers of CMV's hauling hazardous cargo represented only 3% of the total observations and exhibited a safety belt usage rate of 86.7%, which is slightly higher than drivers and passengers of CMV's hauling non-hazardous cargo (84.9%). A small number of observations for both 'fleet type' and 'cargo type' were unknown as observers could not make the determination in the field.

Tractor trailer type CMV's were categorized as either 'single trailer' (rig only observations were combined with 'single trailer') or 'double trailer'. CMV's with double trailers constituted only 6% of the tractor trailer type CMV observations and drivers and passengers of 'double trailer' CVM's exhibited a lower safety belt use rate (83.3%) than drivers and passengers of 'single trailer' tractor trailer type CMV's (88.0%).

As far as the type of data collection location, drivers and passengers of CMV's observed at an intersection exhibited a much lower safety belt usage rate (82.4%) than those observed at rest areas (87.7%) or exit ramps (87.8%). Approximately 44% of the observations were collected from CMV's at rest areas or exit ramps while the remaining 56% were observed at intersections. CMV's that were observed at rest areas or exit ramps were observed as they were traveling from a limited access freeway (i.e. Interstate or US-Route), while the CMV's observed at intersections were traveling on surface roads which may be a Michigan Route, county road or city road.

Table 10. Commercial Motor Vehicles Statewide Safety Belt Usage by Fleet Type, Cargo Type, Trailer Type, and Observation Location Type

Fleet Type	Total No. of Observations	Belted Observations	Safety Belt Use Rate
National/Regional Fleet	1283	1149	89.6%
Local Fleet/Individual Ownership	1561	1279	81.9%
Unknown	184	140	76.1%
Total	**3028**	**2568**	**84.8%**
Cargo Type	Total No. of Observations	Belted Observations	Safety Belt Use Rate
Non-Hazardous	2885	2449	84.9%
Hazardous	98	85	86.7%
Unknown	45	34	75.6%
Total	**3028**	**2568**	**84.8%**
Trailer Type (Tractor-Trailer Type CMV's Only)	Total No. of Observations	Belted Observations	Safety Belt Use Rate
Single Trailer (or No Trailer)	1628	1432	88.0%
Double Trailer	102	85	83.3%
Total	**1730**	**1517**	**87.7%**
Observation Location Type	Total No. of Observations	Belted Observations	Safety Belt Use Rate
Intersection	1685	1389	82.4%
Rest Area	383	336	87.7%
Exit Ramp	960	843	87.8%
Total	**3028**	**2568**	**84.8%**

6.2   Conclusions and Comparisons

A total of 3,028 driver and passenger observations were collected at 210 observation sites throughout Michigan and the overall weighted statewide safety belt use rate for all types of CMV's was found to be 84.9 ± 2.02%. This represents an 11.3% increase in CMV safety belt usage since the last survey was completed in Michigan in 2006 when the overall statewide CMV safety belt usage rate was found to be 73.6% [2].

Overall, Strata 1 and 3 produced the two highest weighted safety belt usage rates with 86.7% and 87.3% respectively, whereas Strata 2 and 5 produced the two lowest weighted safety belt use rates with 80.7% and 64.4% respectively. Stratum 4 yielded the median weighted safety belt usage rate for drivers and passengers with 85.6%. CMV drivers and passengers traveling on Mondays through Thursdays and on Saturdays have higher safety belt use rates than those traveling on Sundays or Fridays. Those traveling on Tuesdays had the highest safety belt usage rate with 89.3% while those traveling on Fridays had the lowest rate with 80.1%. CMV safety belt use rates were found to be highest during the early morning and late afternoon hours (7 to 8 AM and 6 to 7 PM) while rates were the lowest during the time periods from 9 to 10 AM, 12 to 2 PM, and 3 to 4 PM.

Males and females tend to utilize their safety belts at similar usage rates, although the frequency of female commercial vehicle drivers and passengers is very low. In terms of age, older drivers and passengers tend to utilize their safety belts at higher rates than their younger counterparts. Drivers or passengers of Hispanic race utilized their safety belts at higher rate than any other ethnicity, while African American drivers and passengers exhibited the lowest safety belt usage rate. The vast majority of commercial vehicle drivers are Caucasian males between the ages of 30 and 59.

Overall, drivers and passengers of single unit truck types represented about 43% of the total observations and exhibited a much lower safety belt usage rate (81.0%) than drivers and passengers of tractor-trailer type trucks (87.7%). With respect to single unit truck types, drivers and passengers of concrete mixers and dump trucks exhibited the lowest safety belt usage rates.

With respect to tractor trailer type CMV's, drivers and passengers of gravel trains and 'rig-only' trucks exhibited the lowest safety belt usage rate. The most represented vehicle for both single unit and tractor trailer type CMV's was the box type cargo truck. Drivers and passengers of CMV's that were part of a national or regional fleet exhibited a higher safety belt usage rate than drivers and passengers of CMV's that were part of a local fleet or were individually owned. In terms of the observation location type, drivers and passengers of CMV's observed at surface street intersections exhibited a much lower safety belt usage rate than those observed at rest areas or freeway exit ramps.

In 2010, a study was completed for the Federal Motor Carrier Safety Administration (FMCSA) which included a nationally representative sample of commercial motor vehicle safety belt use observations at 998 sites throughout the country [1]. A total of 26,830 commercial motor vehicles were observed with an overall safety belt usage rate of 77% percent. Michigan's CMV safety belt use rate of 84.9% is significantly higher than the national rate of 77%. This is to be expected as Michigan is a 'primary use' state which means drivers or passengers may be stopped and issued a citation for the sole reason of not using a safety belt. However, Michigan also has a higher usage rate than the average usage rate of the 'primary use' states (80% usage rate) that were sampled in the national study. This implies Michigan is one of the more successful states in the country with respect to encouraging drivers and passengers of commercial motor vehicles to use safety belts.

With the current success of relatively higher CMV safety belt usage rates in Michigan, future programs focusing on CMV safety belt usage should be successful based upon the past achievements of campaigns to increase passenger vehicle safety belt usage rates. Based on the results of the observational data, future programs should be targeted towards local fleets and CMV's under individual ownership, as well as single unit type CMV's. Specifically, truck types related construction activities such as concrete mixers, dump trucks, and gravel trains should be targeted as drivers and passengers of these types exhibited the lowest safety belt usage. CMV's traveling in the Upper Peninsula should also be targeted as the stratum comprised of Upper Peninsula counties (stratum 5) had a significantly lower safety belt usage rate than other 4 strata.

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APPENDIX I – LIST OF OBSERVATION LOCATIONS

Location Number	Strata	County	Location	Type of Location
1	1	Ingham	Abbott and Saginaw	Intersection
2	1	Ingham	I-96 and M-53	Exit Ramp
3	1	Ingham	I-96 and M-99 (Eaton Rapids Rd)	Exit Ramp
4	1	Ingham	Larch and Saginaw	Intersection
5	1	Ingham	Okemos Rest Area	Rest Area
6	1	Kalamazoo	Alamo Rest Area	Rest Area
7	1	Kalamazoo	Dickman and Helmer	Intersection
8	1	Kalamazoo	Galesburg Rest Area	Rest Area
9	1	Kalamazoo	I-94 and Westnedge	Exit Ramp
10	1	Kalamazoo	Michigan and M-43	Intersection
11	1	Kalamazoo	Sprinkle and Romence	Intersection
12	1	Kalamazoo	US-131 and D Ave.	Exit Ramp
13	1	Kalamazoo	Westnedge and Whites	Intersection
14	1	Oakland	12 Mile and Novi Rd	Intersection
15	1	Oakland	Beck and Grand River	Intersection
16	1	Oakland	Clarkston Rest Area	Rest Area
17	1	Oakland	Davisburg Rest Area	Rest Area
18	1	Oakland	Dixie Highway and Highland Lake	Intersection
19	1	Oakland	Grand River and 8 Mile Rd	Intersection
20	1	Oakland	Haggerty and Pontiac Trail	Intersection
21	1	Oakland	Highland and Williams Lake	Intersection
22	1	Oakland	I-696 and Orchard Lake	Exit Ramp
23	1	Oakland	I-696 and Woodward	Intersection
24	1	Oakland	I-75 and Rochester Rd	Exit Ramp
25	1	Oakland	I-96 and Wixom Rd	Exit Ramp
26	1	Oakland	M-10 and 8 Mile Rd, Southfield	Intersection
27	1	Oakland	Main and Commerce	Intersection
28	1	Oakland	Northwestern and 14 Mile	Intersection
29	1	Oakland	Orchard Lake and Maple	Intersection
30	1	Oakland	Pontiac Trail and 9 Mile Rd	Intersection
31	1	Oakland	Rochester Rd and Avon	Intersection
32	1	Oakland	Telegraph and 14 Mile	Intersection
33	1	Oakland	Woodward and 9 Mile Rd	Intersection
34	1	Oakland	Woodward and Long Lake	Intersection
35	1	Washtenaw	Chelsea Rest Area	Rest Area
36	1	Washtenaw	Huron & Main	Intersection
37	1	Washtenaw	I-94 and Baker Rd	Exit Ramp
38	1	Washtenaw	Michigan & Huron	Intersection
39	1	Washtenaw	Northfield Church Rest Area	Rest Area
40	1	Washtenaw	US 12 and Maple Rd	Intersection
41	1	Washtenaw	US 12 and State Rd/Moon Rd	Intersection
42	1	Washtenaw	US-12 & Ann Arbor	Intersection
43	1	Washtenaw	US-23 & US-12	Intersection
44	1	Washtenaw	US-23 and 6 Mile Rd	Exit Ramp
45	1	Washtenaw	US-23 and North Territorial Rd (Exit 49)	Exit Ramp
46	1	Washtenaw	Washtenaw & US-23	Intersection

Location Number	Strata	County	Location	Type of Location
1	2	Allegan	Glenn Rest Area	Rest Area
2	2	Allegan	M-40 and US-31	Intersection
3	2	Allegan	Saugatuck Rest Area	Rest Area
4	2	Allegan	US-131 and 142nd Ave	Exit Ramp
5	2	Bay	Linwood Rest Area	Rest Area
6	2	Bay	Wilder and Euclid	Intersection
7	2	Eaton	I-69/96 and M-43 (Saginaw Hwy)	Exit Ramp
8	2	Eaton	M-43 and Elmwood	Intersection
9	2	Eaton	M-43 and S M100 (Bridge & Jefferson)	Intersection
10	2	Eaton	Potterville Rest Area	Rest Area
11	2	Grand Traverse	M-37 and US-31 S	Intersection
12	2	Grand Traverse	US 31 and M-72	Intersection
13	2	Jackson	Cooper and Michigan	Intersection
14	2	Jackson	Grass Lake Rest Area	Rest Area
15	2	Jackson	I-94 and Ann Arbor Rd	Exit Ramp
16	2	Jackson	I-94 E and Cooper	Exit Ramp
17	2	Jackson	N. West and W. Monroe	Intersection
18	2	Jackson	Sandstone Rest Area	Rest Area
19	2	Kent	44th and Ivanrest Ave	Intersection
20	2	Kent	52nd and Broadmoor	Intersection
21	2	Kent	Chicago and Burlingame	Intersection
22	2	Kent	I-196 and College Ave	Exit Ramp
23	2	Kent	I-96 and 28th Street	Exit Ramp
24	2	Kent	Lake Michigan Dr. and Wilson	Intersection
25	2	Kent	M-37 and 84th	Intersection
26	2	Kent	M-37 and Henze	Intersection
27	2	Kent	M-44 and Knapp	Intersection
28	2	Kent	Rockford Rest Area	Rest Area
29	2	Kent	US-131 and 76th Street	Exit Ramp
30	2	Kent	US-131 and Market Ave	Exit Ramp
31	2	Livingston	Howell Rest Area	Rest Area
32	2	Livingston	I-96 and Fowlerville	Exit Ramp
33	2	Livingston	I-96 and Grand River (Livingston)	Exit Ramp
34	2	Livingston	Lake Chemung Rest Area	Rest Area
35	2	Livingston	M-59 and Byron Rd	Intersection
36	2	Livingston	Main and Grand River	Intersection
37	2	Macomb	10 Mile and Van Dyke	Intersection
38	2	Macomb	12 Mile & Gratiot	Intersection
39	2	Macomb	12 Mile & Groesbeck	Intersection
40	2	Macomb	16 Mile and Mound	Intersection
41	2	Macomb	23 Mile and Gratiot	Intersection
42	2	Macomb	23 Mile and I-94	Exit Ramp
43	2	Macomb	32 Mile and Romeo Plank	Intersection
44	2	Macomb	9 Mile and Mound	Intersection
45	2	Macomb	Hall and Groesbeck	Intersection
46	2	Macomb	Hall Rd and Van Dyke	Intersection
47	2	Macomb	Hall Road and Gratiot	Intersection
48	2	Macomb	I-696 & M-53	Intersection
49	2	Midland	Buttles and Jerome	Intersection
50	2	Midland	M-20 and Coleman Road	Intersection
51	2	Ottawa	I-96 and 68th Ave	Exit Ramp
52	2	Ottawa	Michigan and W 32nd St	Intersection
53	2	Ottawa	US-31 and 16th St	Intersection
54	2	Ottawa	US-31 and James St	Intersection
55	2	Ottawa	Zeeland Rest Area	Rest Area

Location Number	Strata	County	Location	Type of Location
1	3	Berrien	I-94 and M-239 (LaPorte Rd)	Exit Ramp
2	3	Berrien	I-94 and Napier Rd	Exit Ramp
3	3	Berrien	I-94 and Pipestone Rd	Exit Ramp
4	3	Berrien	I-94 and Sawyer Rd	Exit Ramp
5	3	Berrien	M-51 and M-60	Intersection
6	3	Berrien	M-63 and Port St.	Intersection
7	3	Berrien	New Buffalo Welcome Center	Rest Area
8	3	Berrien	US 31 and US 12/Pulaski Hwy	Exit Ramp
9	3	Berrien	US-31 and M-139(Old US 31)	Exit Ramp
10	3	Calhoun	Battle Creek Rest Area	Rest Area
11	3	Calhoun	I-69 and M-60	Exit Ramp
12	3	Calhoun	I-94 and M-311 (Wheatfield/11 Mile)	Exit Ramp
13	3	Calhoun	I-94 and Old 27	Exit Ramp
14	3	Calhoun	Turkeyville Rest Area	Rest Area
15	3	Calhoun	Washington and Hamblin	Intersection
16	3	Clinton	I-96 and Grand River (Clinton)	Exit Ramp
17	3	Clinton	I-96 and M-100 (Wright Rd)	Exit Ramp
18	3	Clinton	M-21 and Business US-127	Intersection
19	3	Genesee	Dort & Atherton	Intersection
20	3	Genesee	I-69 and W County Line Rd/Sheridan	Exit Ramp
21	3	Genesee	I-75 and Bristol	Exit Ramp
22	3	Genesee	I-75 and M-57	Exit Ramp
23	3	Genesee	I-475 & Bristol	Exit Ramp
24	3	Genesee	M-21 and Linden	Intersection
25	3	Genesee	M-21 and Saginaw	Intersection
26	3	Genesee	M-54 and Mount Morris	Intersection
27	3	Genesee	M54 & Saginaw	Intersection
28	3	Ionia	Grand River and Kent St	Intersection
29	3	Ionia	I-96 and State Rd	Exit Ramp
30	3	Ionia	Saranac Rest Area	Rest Area
31	3	Isabella	M-20 and Mission	Intersection
32	3	Isabella	N Mission and High	Intersection
33	3	Lapeer	Five Lakes Rest Area	Rest Area
34	3	Lapeer	M24 & Genesee	Intersection
35	3	Lenawee	M-34 and M-52	Intersection
36	3	Lenawee	M-50 and Evans St.	Intersection
37	3	Lenawee	M-52 (Adrian Hwy) and M-50 (Monroe Rd)	Intersection
38	3	Lenawee	M-52 and US-223	Intersection
39	3	Marquette	US-41 & McClellan	Intersection
40	3	Monroe	Carleton Rest Area	Rest Area
41	3	Monroe	Dundee Rest Area	Rest Area
42	3	Monroe	I-275 and Will Carleton Rd	Exit Ramp
43	3	Monroe	I-75 and Dixie Hwy (Monroe Co.)	Exit Ramp
44	3	Monroe	I-75 and Nadeau	Exit Ramp
45	3	Monroe	M-50 and Helle Blvd	Intersection
46	3	Monroe	Michigan (Monroe) Welcome Center	Rest Area
47	3	Monroe	US 23 and M-50 (Tecumseh Rd)	Exit Ramp
48	3	Monroe	US 23 and US 223 (St. Anthony Rd)	Exit Ramp
49	3	Monroe	US-24 and M-50	Intersection
50	3	Montcalm	M-46 and M-91	Intersection
51	3	Montcalm	M-57 and M-91	Intersection
52	3	Montcalm	M-57 and S. Division	Intersection
53	3	Muskegon	M-46 and Wood	Intersection
54	3	Muskegon	US 31 and M-46	Intersection
55	3	Muskegon	US-31 and Laketon	Intersection
56	3	Saginaw	Bay and Vogue	Intersection
57	3	Saginaw	I-75 and Dixie Hwy (Saginaw Co.)	Exit Ramp
58	3	Saginaw	I-75 and Main St	Exit Ramp
59	3	Saginaw	M-46 and Center	Intersection
60	3	Saginaw	M-84 and McCarty	Intersection
61	3	Shiawasee	I-69 and M-71	Exit Ramp
62	3	Shiawasee	M-52 and M-21	Intersection
63	3	Shiawasee	Woodbury Rest Area	Rest Area
64	3	St. Clair	Adair Rest Area	Rest Area
65	3	St. Clair	I-94 and Waddams	Exit Ramp
66	3	St. Clair	M-29 and Gratiot	Intersection
67	3	St. Clair	M-29 and West	Intersection
68	3	St. Joseph	US 131 and M-60	Intersection
69	3	Van Buren	I-94 and M-40	Exit Ramp
70	3	Van Buren	I-94 and M-51	Exit Ramp
71	3	Van Buren	M-140 and Blue Star Highway	Intersection
72	3	Van Buren	Watervliet Rest Area	Rest Area

Location Number	Strata	County	Location	Type of Location
1	4	Wayne	6 Mile and Haggerty Rd	Intersection
2	4	Wayne	8 Mile and Greenfield Rd	Intersection
3	4	Wayne	Ann Arbor Rd and Sheldon Rd	Intersection
4	4	Wayne	Bagley and Rosaparks	Intersection
5	4	Wayne	Belleville Rest Area	Rest Area
6	4	Wayne	Dix-Toledo and Northline	Intersection
7	4	Wayne	Eureka and Middlebelt	Intersection
8	4	Wayne	Eureka and Telegraph	Intersection
9	4	Wayne	Farmington and Plymouth	Intersection
10	4	Wayne	Ford Rd and Lilley	Intersection
11	4	Wayne	Ford Rd and Wayne Rd	Intersection
12	4	Wayne	Fort and Schaefer	Intersection
13	4	Wayne	Fort and Southfield	Intersection
14	4	Wayne	Fort(Fisher) and Grand Boulevard	Intersection
15	4	Wayne	I-275 and Ann Arbor Rd	Exit Ramp
16	4	Wayne	I-275 and Ecourse Rd	Exit Ramp
17	4	Wayne	I-275 and Huron Rd	Exit Ramp
18	4	Wayne	I-75 and Northline Rd	Exit Ramp
19	4	Wayne	I-75 and Sibley Rd	Exit Ramp
20	4	Wayne	I-75 and West Rd	Exit Ramp
21	4	Wayne	I-94 and Ecourse Rd	Exit Ramp
22	4	Wayne	I-94 and Greenfield	Exit Ramp
23	4	Wayne	I-94 and Middlebelt	Exit Ramp
24	4	Wayne	I-94 and Telegraph	Exit Ramp
25	4	Wayne	I-94 and US 12 (Michigan Ave)	Exit Ramp
26	4	Wayne	Jefferson and Woodward (Randolph)	Intersection
27	4	Wayne	M 39 and Oakwood	Exit Ramp
28	4	Wayne	Michigan and Washington	Intersection
29	4	Wayne	Telegraph and Van Born	Intersection
30	4	Wayne	US 12 and Sheldon Rd	Intersection
31	4	Wayne	US-12 and Venoy	Intersection
32	4	Wayne	Westland Rest Area	Rest Area
33	4	Wayne	Woodward and Warren	Intersection

Location Number	Strata	County	Location	Type of Location
1	5	Delta	US-41 & US-2	Intersection
2	5	Mackinac	BP Pit Stop, St. Ignace (US-2 and I-75)	Intersection
3	5	Mackinac	St. Ignace Welcome Center	Rest Area
4	5	Schoolcraft	BP Pit Stop Manistique	Intersection