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**DIRECT OBSERVATION OF SAFETY
BELT USE IN MICHIGAN: SPRING 2002**

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July 2002

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| 16. Abstract A direct observation survey of safety belt use in Michigan was conducted in the spring of 2002. In this study, 15,106 occupants traveling in four vehicle types (passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks) were surveyed between May 23 and June 5, 2002. Belt use was estimated for all commercial/noncommercial vehicle types combined (the statewide safety belt use rate) and separately for each vehicle type. Within and across each vehicle type, belt use by age, sex, road type, day of week, time of day, and seating position were calculated. Statewide belt use was 80.0 percent. When compared with last year's rate, the current rate shows that safety belt use in Michigan has remained about the same. However, a comparison with the highest rate observed before the introduction of standard enforcement reveals that the current rate reflects a 9.9 percentage point increase. Belt use was 82.8 percent for passenger cars, 83.1 percent for sport-utility vehicles, 80.5 percent for vans/minivans, and 69.3 percent for pickup trucks. For all vehicle types combined, belt use was higher for females than for males, and higher for drivers than for passengers. In general, belt use was high during the morning and evening rush hours. Belt use did not vary systematically by day of week. Belt use was lowest among 16-to-29 year olds, and highest among the 4-to-15 and 60-and-older age groups. Survey results suggest that the implementation of standard enforcement safety belt use laws and the accompanying enforcement and public information efforts have been very effective in increasing safety belt use in Michigan. | | | | | |
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INTRODUCTION

The correct use of a safety belt reduces the risk of fatal injury to front seat passenger car occupants by 45 percent, and the risk of moderate to critical injury by 50 percent (National Highway Traffic Safety Administration, NHTSA, 1999a). According to the Michigan Office of Highway Safety Planning (OHSP, 2001), occupants in automobile crashes in Michigan during 2000 were thirty times more likely to be killed if they were not wearing safety belts. The total economic loss in motor vehicle crashes in Michigan has been estimated at nearly \$10 million (OHSP, 2001). NHTSA has suggested that as much as 85 percent of these costs are absorbed by society (1999a) through taxes, insurance premiums, lost wages, and lost productivity (United States General Accounting Office, U.S. GAO, 1992). The cost for an individual can increase by as much as 50 percent when the individual is not wearing a safety belt (NHTSA, 1999a). In the 424,852 automobile crashes reported in Michigan during 2000, safety belt use was directly related to the level of injury sustained. The obvious decrease in loss of life and economic loss that would occur from higher safety belt use in Michigan underscores the importance of implementing and continuing programs designed to increase belt use.

The largest increase in safety belt use in Michigan was observed directly after the mandatory safety belt use law was implemented in 1985. In December, 1984, belt use in Michigan was 19.8 percent. In the statewide direct observation survey conducted in July, 1985 however, the safety belt use rate had increased to 58.4 percent. Over the next five months, this rate decreased to 43.0 percent, and essentially leveled off around this rate for the next several years (Wagenaar, Molnar, & Businski, 1988). Throughout the 1990s, with the assistance of Public Information and Education (PI&E) programs, and heightened enforcement of the safety belt law, the rate of belt use in Michigan gradually rose to about 70 percent (Eby, Vivoda, & Fordyce, 1999). By 1999 however, the rate had apparently reached a plateau, and it was suggested that this was the highest level of safety belt use that could be reached without changing the enforcement provision of the safety belt law to allow for standard enforcement (Wortham, 1998).

It has been demonstrated that the most significant and cost effective way for states with secondary enforcement to increase their safety belt use rate is to upgrade to standard enforcement (Russell, Dreyfuss, & Cosgrove, 1999). After a multiyear struggle by state safety officials and community members, Michigan's standard enforcement law (Senate Bill 335) was signed on May 26, 1999, seven years after it was first proposed (Winnicki, 1995). This change was implemented on March 10, 2000. The second largest increase in statewide safety belt use was observed following this change in the law. In September, 1999, the belt use rate in Michigan was 70.1 percent. In a study conducted in March, 2000 however, the rate had increased to 83.5 percent, the highest belt use rate ever observed in Michigan.

The current survey represents the sixth statewide direct observation survey of safety belt use since the change to standard enforcement. Since March 2000, when the highest use rate of 83.5 percent was observed, there appears to be a slight downward trend in belt use. The two surveys that followed the March, 2000 study each reported slightly lower belt use rates, but these numbers were not significantly different from the survey conducted immediately following the change in the belt use law. However, in a study conducted exactly one year after the legislative change, the use rate was observed to be 79.4 percent. This rate was significantly lower than the highest observed use rate. However, the study conducted in September, 2001 showed a belt use rate of 82.3 percent; this rate was not significantly different than the rate observed in March, 2000.

The notable increase in belt use to 83.5 percent, and the similar rate of 82.3 percent observed in September, 2001, were not only the result of the change to standard enforcement, but also the intensive and carefully scheduled enforcement campaigns and PI&E programs that were implemented throughout the state. This concerted effort was made in an attempt to stabilize and continue to increase safety belt use in Michigan. These programs were designed to change the usual trend that occurs when a new law is implemented or an existing law is changed. Often these legislative changes result in a large initial increase, followed by a decline, and then a leveling off at a rate higher than the prelaw level. This is the same pattern that was observed in Michigan during the introduction of the original safety belt law, and in other states during implementation of

mandatory use laws and when states have changed from secondary to standard enforcement (see e.g., Eby, Molnar, & Olk, 2000; NHTSA, 2001b).

While the largest increases in belt use have been observed both in Michigan and other states directly following safety belt legislative changes, PI&E programs, as well as enforcement campaigns, are necessary to maintain the high levels of belt use that follow these legislative changes, and to continue to increase belt use further to reach state and national goals. Many studies have shown that special safety belt PI&E programs and enforcement efforts can be particularly effective in raising safety belt use rates in states without a standard safety belt use law (see e.g., Evans, 1991; Foss, Bierness, & Sprattler, 1994; Mortimer, 1992; NHTSA, 2001a; Streff, Molnar, & Christoff, 1993), as well as in states that have changed to standard enforcement (NHTSA, 1999c, 2001b).

Incentive funding for states to implement innovative projects designed to increase safety belt use, including media campaigns and enforcement programs, is available under Section 157 of the Highway Safety Act of 1966 through the Transportation Equity Act for the 21st Century (TEA-21). Under this section, Michigan received funding to implement a paid media campaign using advertisements on broadcast television, cable television, radio, and outdoor bulletins/posters. Concurrent with the media campaign, Michigan also implemented increased police enforcement of the safety belt law. The purpose of the current survey was to measure the statewide level of safety belt use in Michigan in order to track changes that have occurred as a result of efforts designed to increase belt use, such as the Section 157 paid media and enforcement campaign. The current study was the twenty-eighth wave in a series of direct observation surveys designed to track changes in belt use across Michigan since 1984. To continue to maintain and increase safety belt use, it is essential to understand the effect standard enforcement, PI&E programs, and enforcement campaigns have on overall safety belt use, and on specific groups within Michigan's driving population.

METHODS

Sample Design

The sample design for the present survey was closely based upon the one used by Streff, Eby, Molnar, Joksch, and Wallace (1993). While the entire sampling procedure is presented in the previous report, it is repeated here for completeness, with the modifications noted.

The goal of this sample design was to select observation sites that accurately represent front-outboard vehicle occupants in eligible commercial and noncommercial vehicles (i.e., passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) in Michigan, while following federal guidelines for safety belt survey design (NHTSA, 1992, 1998). An ideal sample minimizes total survey error while providing sites which can be surveyed efficiently and economically. To achieve this goal, the following sampling procedure was used.

To reduce the costs associated with direct observation of remote sites, NHTSA guidelines allow states to omit from their sample space the lowest population counties, provided these counties collectively account for 15 percent or less of the state's total population. Therefore, all 83 Michigan counties were rank ordered by population (U.S. Bureau of the Census, 1992) and the low population counties were eliminated from the sample space. This step reduced the sample space to 28 counties.

These 28 counties were then separated into four strata. The strata were constructed by obtaining historical belt use rates and vehicle miles of travel (VMT) for each county. Historical belt use rates were determined by averaging results from three previous University of Michigan Transportation Research Institute (UMTRI) surveys (Wagenaar & Molnar, 1989; Wagenaar, Molnar, & Businski, 1987b, 1988). Since no historical data were available for six of the counties, belt use rates for these counties were estimated using multiple regression based on per capita income and education for the other 22 counties

($r^2 = .56$; U.S. Bureau of the Census, 1992).¹ These factors have been shown previously to correlate positively with belt use (e.g., Wagenaar, Molnar, & Businski, 1987a). Wayne County was chosen as a separate stratum because of its disproportionately high VMT, and because we wanted to ensure that observation sites were selected within this county. Three other strata were constructed by rank ordering each county by historical belt use rates and then adjusting the stratum boundaries until the total VMT was roughly equal within each stratum. The stratum boundaries were high belt use (greater than 54.0 percent), medium belt use (45.0 percent to 53.0 percent), low belt use (44.9 percent or lower), and Wayne County (41.9 percent belt use). The historical belt use rates and VMT by county and strata are shown in Table 1.

To achieve the NHTSA required precision of less than 5 percent relative error, the minimum number of observation sites for the survey ($N = 56$) was determined based on within- and between-county variances from previous belt use surveys and on an estimated 50 vehicles per observation period in the current survey. This minimum number was then increased ($N = 168$) to get an adequate representation of belt use for each day of the week and for all daylight hours.

Because total VMT within each stratum was roughly equal, observation sites were evenly divided among the strata (42 each). In addition, since an estimated 23 percent of all traffic in Michigan occurs on limited-access roadways (Federal Highway Administration, 1982), 10 (24 percent) of the sites within each stratum were freeway exit ramps, while the remaining 32 were roadway intersections.

¹ Education was defined as the proportion of population in the county over 25 years of age with a professional or graduate degree.

| Table 1. Descriptive Characteristics of the Four Strata ² | | | | | |
|--|--------------|------------------------------|---------------------------|------------------------|------------------------------|
| Strata | County | Historical Belt Use, Percent | Belt Use Average, Percent | VMT, billions of miles | Total VMT, billions of miles |
| 1 | | | 56.3 | | 17.48 |
| | Ingham | 54.3 | | 1.98 | |
| | Kalamazoo | 54.3 | | 1.98 | |
| | Oakland | 54.5 | | 10.66 | |
| | Washtenaw | 62.0 | | 2.86 | |
| 2 | | | 48.8 | | 17.42 |
| | Allegan | 45.2 | | 0.86 | |
| | Bay | 53.7 | | 1.13 | |
| | Eaton | 52.5 | | 0.90 | |
| | Gr. Traverse | 47.2 | | 0.63 | |
| | Jackson | 46.2 | | 1.41 | |
| | Kent | 48.9 | | 4.07 | |
| | Livingston | 48.7 | | 1.44 | |
| | Macomb | 48.0 | | 4.83 | |
| | Midland | 50.7 | | 0.68 | |
| | Ottawa | 47.4 | | 1.45 | |
| 3 | | | 40.9 | | 17.15 |
| | Berrien | 41.6 | | 1.68 | |
| | Calhoun | 43.2 | | 1.40 | |
| | Genesee | 42.8 | | 4.12 | |
| | Lapeer | 39.6 | | 0.71 | |
| | Lenawee | 44.4 | | 0.82 | |
| | Marquette | 39.6 | | 0.56 | |
| | Monroe | 44.2 | | 1.53 | |
| | Muskegon | 41.8 | | 1.11 | |
| | Saginaw | 40.7 | | 1.86 | |
| | Shiawassee | 41.6 | | 0.64 | |
| | St. Clair | 34.1 | | 1.38 | |
| | St. Joseph | 41.6 | | 0.51 | |
| | Van Buren | 36.7 | | 0.83 | |
| 4 | | | | | |
| | Wayne | 41.9 | 41.9 | 15.29 | 15.29 |

²Note: Boldface italic type indicates values estimated from multiple regression. The belt use percentages were used only for statistical purposes in this design. Caution should be taken in interpreting these values.

Within each stratum, observation sites were randomly assigned to a location using different methods for intersections and freeway exit ramps. The intersection sites were chosen using a method that ensured each intersection within a stratum an equal probability of selection. Detailed, equal-scale road maps for each county were obtained and a grid pattern was overlaid on each county map. The grid dimensions were 62 lines horizontally and 42 lines vertically. The lines of the grid were separated by 1/4 inch. With the 3/8 *inch:mile* scale of the maps, this created grid squares that were .67 miles per side. (Because Marquette County is so large, it was divided into four maps and each part was treated as a separate county.) Each grid square was uniquely identified by two numbers, a horizontal (x) coordinate and a vertical (y) coordinate.

The 42 sites for each stratum were sampled sequentially. The 32 local intersection sites were chosen by first randomly selecting a grid number containing a county within a stratum.³ This was achieved by generating a random number between 1 and the number of grids within the stratum. So, for example, since the high belt use stratum had four grid patterns overlaying four counties, a random number between 1 and 4 was generated to determine which grid would be selected. Thus, each grid had an equal probability of selection at this step. Once the grid was selected, a random x and a random y coordinate were chosen and the corresponding grid square identified. Thus, each intersection had an equal probability of selection. If a single intersection was contained within the square, that intersection was chosen as an observation site. If the square did not fall within the county, there was no intersection within the square, or there was an intersection but it was located one road link from an already selected intersection, then a new grid number and x, y coordinate were randomly selected. If more than one intersection was within the grid square, the grid square was subdivided into four equal sections and a random number between 1 and 4 was selected until one of the intersections was randomly chosen. This happened for only two of the sites.

³ It is important to note that grids were selected during this step rather than counties. This was necessary only because it was impractical to construct a single grid that was large enough to cover all of the counties in the largest stratum when they were laid side by side.

Once a site was chosen, the following procedure was used to determine the particular street and direction of traffic flow that would be observed. For each intersection, all possible combinations of street and traffic flow were determined. From this set of observer locations, one location was randomly selected with a probability equal to 1/number of locations. For example, if the intersection, was a "+" intersection, as shown in Figure 1, there would then be four possible combinations of street and direction of traffic flow to be observed (observers watched traffic only on the side of the street on which they were standing). In Figure 1, observer location number one indicates that the observer would watch southbound traffic and stand next to Main Street. For observer location number two, the observer would watch eastbound traffic and stand next to Second Street, and so on. In this example, a random number between 1 and 4 would be selected to determine the observer location for this specific site. The probability of selecting an intersection approach is dependent upon the type of intersection. Four-legged intersections like that shown in Figure 1 have four possible observer locations, while three-legged intersections like "T" and "Y" intersections have only three possible observer locations. The effect of this slight difference in probability accounts for .01 percent or less of the standard error in the belt use estimate.

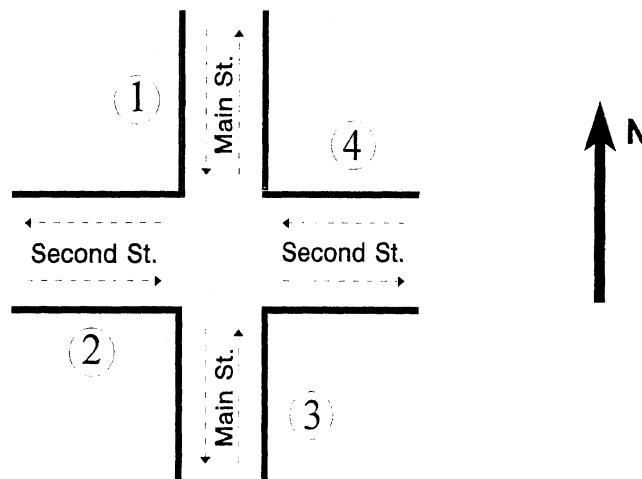


Figure 1. An Example "+" Intersection Showing 4 Possible Observer Locations.

For each chosen primary intersection site, an alternate site was also selected. The alternate sites were chosen within a 20 x 20 square unit area around the grid square containing the original intersection, corresponding to a 13.4 square mile area around the site. This was achieved by randomly picking an x, y grid coordinate within the alternate site area. Grid coordinates were selected until a grid square containing an intersection was found. No grid squares were found that contained more than one intersection. The observer location at the alternate intersection was determined in the same way as at the primary site.⁴

The 10 freeway exit ramp sites within each stratum also were selected so that each exit ramp had an equal probability of selection.⁵ This was done by enumerating all of the exit ramps within a stratum and randomly selecting without replacement 10 numbers between 1 and the number of exit ramps in the stratum. For example, in the high belt use stratum there were a total of 109 exit ramps. To select an exit ramp, a random number between 1 and 109 was generated. This number corresponded to a specific exit ramp. To select the next exit ramp, another random number between 1 and 109 was selected with the restriction that no previously selected numbers could be chosen. Once the exit ramps were determined, the observer location for the actual observation was determined by enumerating all possible combinations of direction of traffic flow and sides of the ramp on which to stand. As in the determination of the observer locations at the roadway intersections, the possibilities were then randomly sampled with equal probability. The alternate exit ramp sites were selected by taking the first interchange encountered after randomly selecting a direction of travel along the freeway from the primary site. If this alternate site was outside of the county or if it was already selected as a primary site, then the other direction of travel along the freeway was used. If the exit ramp had no traffic control device on the selected direction of travel, then a researcher visited the site and randomly picked a travel direction and lane that had such a device.

⁴ For those interested in designing a safety belt survey for their county or region, a guidebook and software for selecting and surveying sites for safety belt use is available (Eby, 2000) by contacting UMTRI -SBA, 2901 Baxter Rd., Ann Arbor, MI 48109-2150, or accessing <http://www-personal.umich.edu/~eby/sbs.html/>.

⁵ An exit ramp is defined here as egress from a limited-access freeway, irrespective of the direction of travel. Thus, on a north-south freeway corridor, the north and south bound exit ramps at a particular cross street are considered a single exit ramp location.

The day of week and time of day for site observations were quasirandomly assigned to sites in such a way that all days of the week and all daylight hours (7:00 am - 7:00 pm) had essentially equal probability of selection. The sites were observed using a clustering procedure. That is, sites that were located spatially adjacent to each other were considered to be a cluster. Within each cluster, a shortest route between all of the sites was decided (essentially a loop) and each site was numbered. An observer watched traffic at all sites in the cluster during a single day. The day in which the cluster was to be observed was randomly determined. After taking into consideration the time required to finish all sites before darkness, a random starting time for the day was selected. In addition, a random number between one and the number of sites in the cluster was selected. This number determined the site within the cluster where the first observation would take place. The observer then visited sites following the loop in either a clockwise or counterclockwise direction (whichever direction left them closest to UMTRI at the end of the day). This direction was determined by the project manager prior to sending the observer into the field. Because of various scheduling limitations (e.g., observer availability, number of hours worked per week) certain days and/or times were selected that could not be observed. When this occurred, a new day and/or time was randomly selected until a usable one was found. The important issue about the randomization is that the day and time assignments for observations at the sites were not correlated with belt use at a site. This quasirandom method is random with respect to this issue.

The sample design was constructed so that each observation site was self-weighted by VMT within each stratum. This was accomplished by selecting sites with equal probability and by setting the observation interval to a constant duration (50 minutes) for each site.⁶ Thus the number of vehicles observed at an observation site reflected safety belt use by VMT; that is, the higher the VMT at a site, the greater the number of vehicles that would pass during the 50-minute observation period. However, since all vehicles passing an observer could not be surveyed, a vehicle count of all eligible vehicles (i.e., passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) on the traffic leg

⁶ Because of safety considerations, sites in the city of Detroit were observed for a different duration. See data collection section for more information.

under observation was conducted for a set duration (5 minutes) immediately prior to and immediately following the observation period (10 minutes total).

Table 2 shows descriptive statistics for the 168 observation sites. As shown in this table, the observations were fairly well distributed over day of week and time of day. Note that an observation session was included in the time slot that represented the majority of the observation period. If the observation period was evenly distributed between two time slots, then it was included in the later time slot. This table also shows that nearly every site observed was the primary site and that observations were well distributed between sunny and cloudy weather conditions, with a smaller percentage conducted during rain.

| Table 2. Descriptive Statistics for the 168 Observation Sites | | | | | | | |
|--|-------------|---------------------------|-------------|--------------------|-------------|----------------|-------------|
| Day of Week | | Observation Period | | Site Choice | | Weather | |
| Monday | 13.1% | 7-9 a.m. | 12.5% | Primary | 99.4% | Sunny | 46.4% |
| Tuesday | 14.3% | 9-11 a.m. | 19.1% | Alternate | 0.6% | Cloudy | 37.5% |
| Wednesday | 11.9% | 11-1 p.m. | 15.5% | | | Rain | 16.1% |
| Thursday | 17.2% | 1-3 p.m. | 20.8% | | | Snow | 0.0% |
| Friday | 13.7% | 3-5 p.m. | 19.0% | | | | |
| Saturday | 16.7% | 5-7 p.m. | 13.1% | | | | |
| Sunday | 13.1% | | | | | | |
| TOTALS | 100% | | 100% | | 100% | | 100% |

Data Collection

Data collection for the study involved direct observation of shoulder belt use, estimated age, and sex. Trained field staff observed shoulder belt use of drivers and front-right passengers traveling in passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks during daylight hours from May 23 through June 5, 2002. Observations of safety belt use, sex, age, vehicle type, and vehicle purpose (commercial or noncommercial) were conducted when a vehicle came to a stop at a traffic light or a stop sign.

Data Collection Forms

Two forms were used for data collection: a site description form and an observation form. The site description form (see Appendix A) provided descriptive information about the site including the site number, location, site type (freeway exit ramp or intersection), site choice (primary or alternate), observer number, date, day of week, time of day, weather, and a count of eligible vehicles traveling on the proper traffic leg. A place on the form was also furnished for observers to sketch the intersection and to identify observation locations and traffic flow patterns. Finally, a comments section was available for observers to identify landmarks that might be helpful in characterizing the site (e.g., school, shopping mall) and to discuss problems or issues relevant to the site or study.

A second form, the observation form, was used to record safety belt use, passenger information, and vehicle information (see Appendix A). Each observation form was divided into four boxes, with each box having room for the survey of a single vehicle. For each vehicle surveyed, shoulder belt use, sex, and estimated age of the driver as well as vehicle type were recorded on the upper half of the box, while the same information for the front-outboard passenger could be recorded in the lower half of the box if there was a front-outboard passenger present. Children riding in child safety seats (CSSs) were recorded but not included in any part of the analysis. Occupants observed with their shoulder belt worn under the arm or behind the back were noted but considered as belted in the analysis. Based upon NHTSA (1999b) guidelines, the observer also recorded whether the vehicle was commercial or noncommercial. A commercial vehicle is defined as a vehicle that is used for business purposes and may or may not contain company logos. This classification includes vehicles marked with commercial lettering or logos, or vehicles with ladders or other tools on them. At each site, the observer carried several data collection forms and completed as many as were necessary during the observation period.

Procedures at Each Site

All sites in the sample were visited by one observer for a period of 1 hour, with the exception of sites in the city of Detroit. To address potential security concerns, these sites were visited by two-person teams of observers for a period of 30 minutes. Observations at other Wayne County sites scheduled to be observed on the same day as Detroit sites

were also completed by two observers. Because each team member at these sites recorded data for different lanes of traffic, the total amount of data collection time was equivalent to that at single observer sites.

Upon arriving at a site, observers determined whether observations were possible at the site. If observations were not possible (e.g., due to construction), observers proceeded to the alternate site. Otherwise, observers completed the site description form and then moved to their observation position near the traffic control device.

Observers were instructed to observe only the lane immediately adjacent to the curb for safety belt use, regardless of the number of lanes present. At sites visited by two-person teams, team members observed different lanes of the same traffic leg with one observer on the curb and one observer on the median (if there was more than one traffic lane and a median). If no median was present, observers were instructed to stand on diagonally opposite corners of the intersection.

At each site, observers conducted a 5-minute count of all eligible vehicles in the designated traffic leg before beginning safety belt observations. Observations began immediately after completion of the count and continued for 50 minutes at sites with one observer and 25 minutes at sites with two observers. During the observation period, observers recorded data for as many eligible vehicles as they could observe. If traffic flow was heavy, observers were instructed to record data for the first eligible vehicle they saw, and then look up and record data for the next eligible vehicle they saw, continuing this process for the remainder of the observation period. At the end of the observation period, a second 5-minute vehicle count was conducted at one-observer sites.

Observer Training

Prior to data collection, field observers participated in 5 days of intensive training including both classroom review of data collection procedures and practice field observations. Each observer received a training manual containing detailed information on field procedures for observations, data collection forms, and administrative policies and procedures. A site schedule identifying the location, date, time, and traffic leg to be

observed for each site was included in the manual (see Appendix B for a listing of the sites).

After intensive review of the manual, observers conducted practice observations at several sites chosen to represent the types of sites and situations that would actually be encountered in the field. None of the locations of the practice sites were the same as sites observed during the study. Training at each practice site focused on completing the site description form, determining where to stand and which lanes to observe, conducting the vehicle count, recording safety belt use, and estimating age and sex. Observers worked in teams of two, observing the same vehicles, but recording data independently on separate data collection forms. The forms were then compared for accuracy. Teams were rotated throughout the training to ensure that each observer was paired with every other observer. Each observer pair practiced recording safety belt use, sex, and age until there was an interobserver reliability of at least 85 percent for all measures on drivers and front-right passengers for each pair of observers.

Each observer was provided with an atlas of Michigan county maps and all necessary field supplies. Observers were given time to locate their assigned sites on the appropriate maps and plan travel routes to the sites. After marking the sites on their maps, the marked locations were compared to a master map of locations to ensure that the correct sites had been pinpointed. Field procedures were reviewed for the final time and observers were informed that unannounced site visits would be made by the field supervisor during data collection to ensure adherence to study protocols.

Observer Supervision and Monitoring

During data collection, each observer was spot checked in the field on at least two occasions by the field supervisor. Contact between the field supervisor and field staff was also maintained on a regular basis through staff visits to the UMTRI office to drop off completed forms and through telephone calls from staff to report progress and discuss problems encountered in the field. Field staff were instructed to call the field supervisor's home or cellular phone if problems arose during evening hours or on weekends.

Incoming data forms were examined by the field supervisor and problems (e.g., missing data, discrepancies between the site description form and site listing or schedule) were noted and discussed with field staff. Attention was also given to comments on the site description form about site-specific characteristics that might affect future surveys (e.g., traffic flow patterns, traffic control devices, site access).

Data Processing and Estimation Procedures

The site description form and observation form data were entered into an electronic format. The accuracy of the data entry was verified in two ways. First, all data were entered twice and the data sets were compared for consistency. Second, the data from randomly selected sites were reviewed for accuracy by a second party and all site data were checked for inconsistent codes (e.g., the observation end time occurring before the start time). Errors were corrected after consultation with the original data forms.

For each site, computer analysis programs determined the number of observed vehicles, belted and unbelted drivers, and belted and unbelted passengers. Separate counts were made for each independent variable in the survey (i.e., site type, time of day, day of week, weather, sex, age, seating position, and vehicle type). This information was combined with the site information to create a file used for generating study results.

As mentioned earlier, our goal in this safety belt survey was to estimate belt use for the state of Michigan based on VMT. As also discussed, the self-weighting-by-VMT scheme employed is limited by the number of vehicles for which an observer can accurately record information. To correct for this limitation, the vehicle count information was used to weight the observed traffic volumes so they would more accurately reflect VMT.

This weighting was done by first adding each of the two 5-minute counts and then multiplying this number by five so that it would represent a 50-minute duration.⁷ The resulting number was the estimated number of vehicles passing the site if all eligible

⁷ As mentioned previously, the Detroit sites were visited by pairs of observers for half as long. For these sites, the single 5-minute count was multiplied by five to represent the 25-minute observation period.

vehicles had been included in the survey during the observation period at that site. The estimated count for each site is divided by the actual number of vehicles observed there to obtain a volume weighting factor for that site. These weights are then applied to the number of actual vehicles of each type observed at each site to yield the weighted N for the total number of drivers and passengers, and total number of belted drivers and passengers for each vehicle type. Unless otherwise indicated, all analyses reported are based upon the weighted values.

The overall estimate of belt use per VMT in Michigan was determined by first calculating the belt use rate within each stratum for observed vehicle occupants in all vehicle types using the following formula:

$$r_i = \frac{\text{Total Number of Belted Occupants, weighted}}{\text{Total Number of Occupants, weighted}}$$

where r_i refers to the belt use rate within any of the four strata. The totals are the sums across all 42 sites within the stratum after weighting, and occupants refers to only front-outboard occupants. The overall estimate of belt use was computed by averaging the belt use rates for each stratum. However, comparing total VMT among the strata, one finds that the Wayne County stratum is only 88 percent as large as the total VMT for the other three strata (see Table 1). In order to represent accurately safety belt use for Michigan by VMT, the Wayne County stratum was multiplied by 0.88 during the averaging to correct for its lower total VMT. The overall belt use rate was determined by the following formula:

$$r_{all} = \frac{r_1 + r_2 + r_3 + (0.88 * r_4)}{3.88}$$

where r_i is the belt use rate for a certain vehicle type within each stratum and r_4 the Wayne County stratum.

The estimates of variance and the calculation of the confidence bands for the belt use estimates are complex. See Appendix C for a detailed description of the formulas and procedures. The same use rate and variance equations were utilized for the calculation of use rates for each vehicle type separately.

RESULTS

As discussed previously, the current direct observation survey of safety belt use in Michigan reports statewide use for four vehicle types combined (passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks), in addition to reporting use rates for occupants in each vehicle type separately. Following NHTSA (1999b) guidelines, this survey included commercial vehicles. In the sample, only 4.6 percent of occupants were in commercial vehicles. In order to determine if the inclusion of commercial vehicles significantly changed statewide belt use rates, the statewide rate was calculated separately both with and without commercial vehicles. Analysis showed that there was no difference between the rates. Thus, all rates shown in this report include occupants from both commercial and noncommercial vehicles.

Overall Safety Belt Use

As shown in Figure 2, 80.0 percent \pm 1.2 percent of all front-outboard occupants traveling in either passenger cars, sport-utility vehicles, vans/minivans, or pickup trucks in Michigan between May 23 and June 5, 2002 were restrained with shoulder belts. The " \pm " value following the use rate indicates a 95 percent confidence band around the percentage. This value should be interpreted to mean that we are 95 percent sure that the actual safety belt use rate falls somewhere between 78.8 percent and 81.2 percent. When compared with the September, 2001 rate of 82.3 \pm 1.4 percent, this spring's estimated safety belt use rate shows that belt use in Michigan has remained about the same over the last nine months.

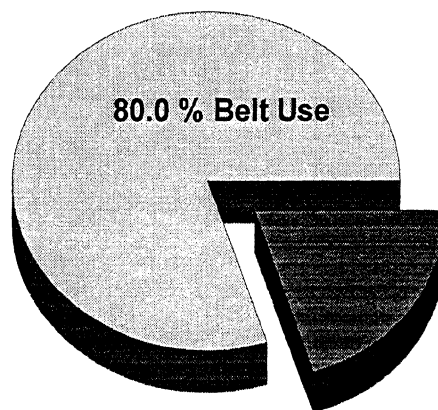


Figure 2. Front-Outboard Shoulder Belt Use in Michigan (All Vehicle Types and Commercial/Noncommercial Combined).

Estimated belt use rates and unweighted numbers of occupants (N) by stratum are shown in Table 3. As is typically found in Michigan, the safety belt use rate for Stratum 1 was the highest in the state. Belt use in Stratum 2 was slightly lower, followed by the use rates for Strata 3 and 4. There were no differences in the belt use rates for Strata 3 and 4. When compared with last September's stratum belt use rates of 85.1, 81.5, 81.3, and 81.1 percent for Strata 1 through 4, respectively, we find little change in Strata 1 and 2, and a slight decline in Strata 3 and 4, over the last nine months.

| Table 3. Percent Shoulder Belt Use by Stratum (All Vehicle Types) | | |
|--|---------------------|---------------------|
| | Percent Use | Unweighted N |
| Stratum 1 | 83.1 | 4,625 |
| Stratum 2 | 81.7 | 3,161 |
| Stratum 3 | 77.5 | 2,155 |
| Stratum 4 | 77.5 | 5,165 |
| STATE OF MICHIGAN | 80.0 ± 1.2 % | 15,106 |

Estimated belt use rates and unweighted numbers of occupants by stratum and vehicle type are shown in Table 4a to 4d. Within each vehicle type we find no systematic differences in safety belt use by stratum. When compared with last September's results (Eby & Vivoda, 2001), we find little change in shoulder belt use for occupants of passenger cars, sport-utility vehicles and pickup trucks. However, belt use in the current survey for occupants of vans/minivans is significantly lower than the observed use rate in September, 2001. There is no obvious explanation for this finding, but it is interesting to note that in the September study, the belt use rate for vans/minivans was unusually high. As expected from previous surveys (e.g., Eby, Fordyce, & Vivoda, 2000b; Eby & Hopp, 1997; Eby & Olk, 1998; Eby & Vivoda, 2001; Eby, Vivoda, & Fordyce, 1999), the overall belt use rate of 69.3 ± 2.4 percent for pickup trucks was significantly lower than for any other vehicle type (Table 4d). Thus, enforcement and PI&E programs should continue to target pickup truck occupants.

| Table 4a. Percent Shoulder Belt Use by Stratum (Passenger Cars) | | |
|--|---------------------|--------------|
| | Percent Use | Unweighted N |
| Stratum 1 | 86.2 | 2,341 |
| Stratum 2 | 85.1 | 1,504 |
| Stratum 3 | 79.7 | 1,014 |
| Stratum 4 | 79.8 | 2,952 |
| STATE OF MICHIGAN | 82.8 ± 1.2 % | 7,811 |

| Table 4b. Percent Shoulder Belt Use by Stratum (Sport-Utility Vehicles) | | |
|--|---------------------|--------------|
| | Percent Use | Unweighted N |
| Stratum 1 | 81.8 | 753 |
| Stratum 2 | 84.2 | 476 |
| Stratum 3 | 85.6 | 288 |
| Stratum 4 | 80.3 | 792 |
| STATE OF MICHIGAN | 83.1 ± 2.2 % | 2,309 |

| Table 4c. Percent Shoulder Belt Use by Stratum (Vans/Minivans) | | |
|---|---------------------|--------------|
| | Percent Use | Unweighted N |
| Stratum 1 | 81.7 | 704 |
| Stratum 2 | 81.8 | 482 |
| Stratum 3 | 81.3 | 328 |
| Stratum 4 | 76.8 | 766 |
| STATE OF MICHIGAN | 80.5 ± 2.9 % | 2,280 |

| Table 4d. Percent Shoulder Belt Use by Stratum (Pickup Trucks) | | |
|---|---------------------|--------------|
| | Percent Use | Unweighted N |
| Stratum 1 | 75.5 | 827 |
| Stratum 2 | 70.9 | 699 |
| Stratum 3 | 64.6 | 525 |
| Stratum 4 | 65.9 | 655 |
| STATE OF MICHIGAN | 69.3 ± 2.4 % | 2,706 |

Safety Belt Use by Subgroup

Site Type. Estimated safety belt use by type of site is presented in Table 5 as a function of vehicle type and all vehicles combined. As is typically found in safety belt use surveys in Michigan (Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002), use was higher for occupants in vehicles leaving limited access roadways (exit ramps) than for occupants in vehicles on surface streets. This effect was consistent across all vehicle types.

Time of Day. Estimated safety belt use by time of day, vehicle type, and all vehicles combined is shown in Table 5. Note that these data were collected only during daylight hours. For all vehicles combined, belt use was generally highest during the morning and evening rush hours.

Day of Week. Estimated safety belt use by day of week, vehicle type, and all vehicles combined is shown in Table 5. Note that the survey was conducted over a 3-week period that included Memorial Day. Belt use clearly varied from day to day, but no systematic differences were evident.

Weather. Estimated belt use by prevailing weather conditions, vehicle type, and all vehicles combined is shown in Table 5. There was essentially no difference in belt use between weather conditions.

Sex. Estimated safety belt use by occupant sex, type of vehicle, and all vehicles combined is shown in Table 5. Estimated safety belt use is higher for females than for males in all four vehicle types studied, and for all vehicle types combined. Similar results have been found in every Michigan safety belt survey conducted by UMTRI (see, e.g., Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002).

Age. Estimated safety belt use by age, vehicle type, and all vehicle types combined is shown in Table 5. As there were only six 0-to-3 year olds observed in the current study, the estimated safety belt use rate for this age group is not meaningful. Excluding the 0-to-3-year-old age group, safety belt use for all vehicles combined is generally highest for the

4-to-15 and the 60-and-over age groups. Belt use for the 16-to-29-year-old age group consistently shows the lowest belt use rate, with rates for the 30-to-59-year-old age group below that of occupants older than 59 years of age. As expected from previous UMTRI safety belt studies (see, e.g., Eby, Molnar, & Oik, 2000; Eby, Vivoda, & Fordyce, 2002), this pattern was observed in the current survey, and shows that new drivers and young drivers (16-to-29 years of age) should be one focus of safety belt use messages and programs. Comparing these results with last year's safety belt use rates by age, we find that belt use has remained essentially the same across all age groups. There was a decline of 6.6 percentage points for the 4-15 year old age group, but due to the low number of occupants from this age group in our sample, this finding may not be meaningful. The belt use rate of 77.1 for the 16-to-29-year-old age group continues to be lower than belt use in the other age groups.

Seating Position. Estimated safety belt use by position in vehicle, vehicle type, and all vehicles combined is shown in Table 5. This table shows that for all vehicle types combined, safety belt use for drivers is slightly higher than use by front-outboard passengers. This trend was observed in occupants of passenger cars, sport-utility vehicles, and pickup trucks, but not in occupants of van/minivans.

| Table 5. Percent Shoulder Belt Use and Unweighted N by Vehicle Type and Subgroup | | | | | | | | | | |
|---|--------------|--------|---------------|-------|-----------------------|-------|-------------|-------|--------------|-------|
| | All Vehicles | | Passenger Car | | Sport-Utility Vehicle | | Van/Minivan | | Pickup Truck | |
| | Percent Use | N | Percent Use | N | Percent Use | N | Percent Use | N | Percent Use | N |
| <u>Site Type</u> | | | | | | | | | | |
| Intersection | 78.6 | 10,586 | 81.4 | 5,436 | 82.3 | 1,586 | 79.8 | 1,605 | 67.8 | 1,959 |
| Exit Ramp | 82.9 | 4,520 | 85.3 | 2,375 | 85.1 | 723 | 82.1 | 675 | 73.7 | 747 |
| <u>Time of Day</u> | | | | | | | | | | |
| 7 - 9 a.m. | 78.6 | 1,443 | 83.7 | 705 | 81.9 | 242 | 80.7 | 214 | 63.5 | 282 |
| 9 - 11 a.m. | 81.8 | 2,174 | 84.3 | 1,018 | 83.9 | 305 | 83.8 | 379 | 70.7 | 472 |
| 11 - 1 p.m. | 75.1 | 2,202 | 80.6 | 1,073 | 80.3 | 316 | 73.1 | 379 | 61.2 | 434 |
| 1 - 3 p.m. | 81.7 | 3,184 | 85.9 | 1,672 | 79.9 | 543 | 83.7 | 472 | 69.8 | 497 |
| 3 - 5 p.m. | 80.1 | 3,915 | 82.2 | 2,109 | 84.3 | 553 | 78.3 | 586 | 72.4 | 667 |
| 5 - 7 p.m. | 80.3 | 2,188 | 81.6 | 1,234 | 83.8 | 350 | 82.6 | 250 | 73.0 | 354 |
| <u>Day of Week</u> | | | | | | | | | | |
| Monday | 74.6 | 2,354 | 79.5 | 1,503 | 74.5 | 332 | 69.0 | 277 | 64.2 | 242 |
| Tuesday | 82.3 | 2,215 | 86.3 | 1,105 | 86.7 | 339 | 81.9 | 345 | 70.1 | 426 |
| Wednesday | 79.7 | 1,243 | 81.2 | 625 | 83.7 | 177 | 85.6 | 178 | 68.8 | 263 |
| Thursday | 81.4 | 2,320 | 85.3 | 1,150 | 87.0 | 315 | 79.9 | 369 | 70.5 | 486 |
| Friday | 81.1 | 3,226 | 83.0 | 1,689 | 86.5 | 461 | 84.8 | 506 | 69.9 | 570 |
| Saturday | 79.6 | 1,880 | 84.1 | 855 | 76.3 | 295 | 78.2 | 311 | 74.4 | 419 |
| Sunday | 82.3 | 1,868 | 85.8 | 884 | 80.3 | 390 | 83.9 | 294 | 66.6 | 300 |
| <u>Weather</u> | | | | | | | | | | |
| Sunny | 80.3 | 7,116 | 82.8 | 3,647 | 82.9 | 1,141 | 83.1 | 1,092 | 69.8 | 1,236 |
| Cloudy | 81.4 | 5,863 | 83.3 | 3,107 | 86.0 | 798 | 81.5 | 849 | 72.6 | 1,109 |
| Rainy | 77.6 | 2,127 | 82.6 | 1,057 | 61.5 | 370 | 78.6 | 339 | 61.6 | 361 |
| <u>Sex</u> | | | | | | | | | | |
| Male | 75.1 | 8,159 | 79.4 | 3,791 | 79.6 | 1,113 | 73.7 | 1,124 | 66.3 | 2,131 |
| Female | 85.6 | 6,947 | 85.8 | 4,020 | 86.4 | 1,196 | 86.6 | 1,156 | 80.7 | 575 |
| <u>Age</u> | | | | | | | | | | |
| 0 - 3 | 48.5 | 6 | 46.8 | 3 | — | 0 | — | 0 | 33.3 | 3 |
| 4 - 15 | 81.4 | 565 | 79.6 | 266 | 80.1 | 104 | 85.2 | 109 | 84.0 | 86 |
| 16 - 29 | 77.1 | 4,496 | 80.3 | 2,710 | 79.7 | 653 | 74.9 | 341 | 64.6 | 792 |
| 30 - 59 | 80.4 | 8,124 | 83.9 | 3,661 | 84.1 | 1,409 | 80.8 | 1,508 | 69.1 | 1,546 |
| 60 - Up | 85.1 | 1,914 | 86.1 | 1,170 | 87.8 | 143 | 83.3 | 322 | 81.0 | 279 |
| <u>Position</u> | | | | | | | | | | |
| Driver | 80.4 | 11,831 | 83.6 | 6,137 | 83.2 | 1,825 | 80.2 | 1,705 | 69.4 | 2,164 |
| Passenger | 78.8 | 3,275 | 80.0 | 1,674 | 83.0 | 484 | 81.2 | 575 | 69.1 | 542 |

Age and Sex. Table 6 shows estimated safety belt use rates and unweighted numbers (N) of occupants for all vehicle types combined by age and sex. The belt use rates for the two youngest age groups should be interpreted with caution because the unweighted number of occupants is quite low. Excluding these age groups, belt use for females in all age groups was higher than for males. However, the absolute difference in belt use rates between sexes varied depending upon the age group. The most notable difference is found in the 16-to-29-year-old age group and the 30-to-59-year-old age group, where the estimated belt use rate is 13.3 percentage points and 10.3 percentage points higher respectively, for females than for males. In fact, the belt use rate for the lowest female age group (16-to-29 year olds) was higher than the rate for the highest male age group (60-up age group). These results argue strongly for statewide efforts to be directed toward persuading young males, and males in general, to use their safety belts. A comparison of the current safety belt use rates by age and sex with last year's rates reveals that while belt use appears to have declined somewhat, these differences are not statistically significant.

| Table 6. Percent Shoulder Belt Use and Unweighted N by Age and Sex (All Vehicle Types Combined) | | | | |
|--|--------------------|---------------------|--------------------|---------------------|
| Age Group | Male | | Female | |
| | Percent Use | Unweighted N | Percent Use | Unweighted N |
| 0 - 3 | 50.0 | 3 | 46.8 | 3 |
| 4 - 15 | 82.3 | 287 | 81.0 | 278 |
| 16 - 29 | 70.8 | 2,395 | 84.1 | 2,101 |
| 30 - 59 | 75.6 | 4,445 | 85.9 | 3,679 |
| 60 - Up | 81.2 | 1,029 | 89.4 | 885 |

Historical Trends

The current direct observation survey is the fourteenth statewide survey that utilizes the sampling design and procedures implemented in 1993 (Streff, Eby, Molnar, Joksch, & Wallace, 1993). As such, it is possible to investigate safety belt use trends over the last several years.

Overall Belt Use Rate. Figure 3 shows the statewide safety belt use rate for all vehicles combined over the last 8 years, 9 months. The safety belt use rate has shown a consistent increase over this time. Since 1994, the safety belt use rate has increased by 17.3 percentage points, with an increase of 9.9 percentage points over the highest rate observed before the introduction of standard enforcement. This finding indicates that efforts to increase safety belt use in Michigan, have been effective and should be continued.

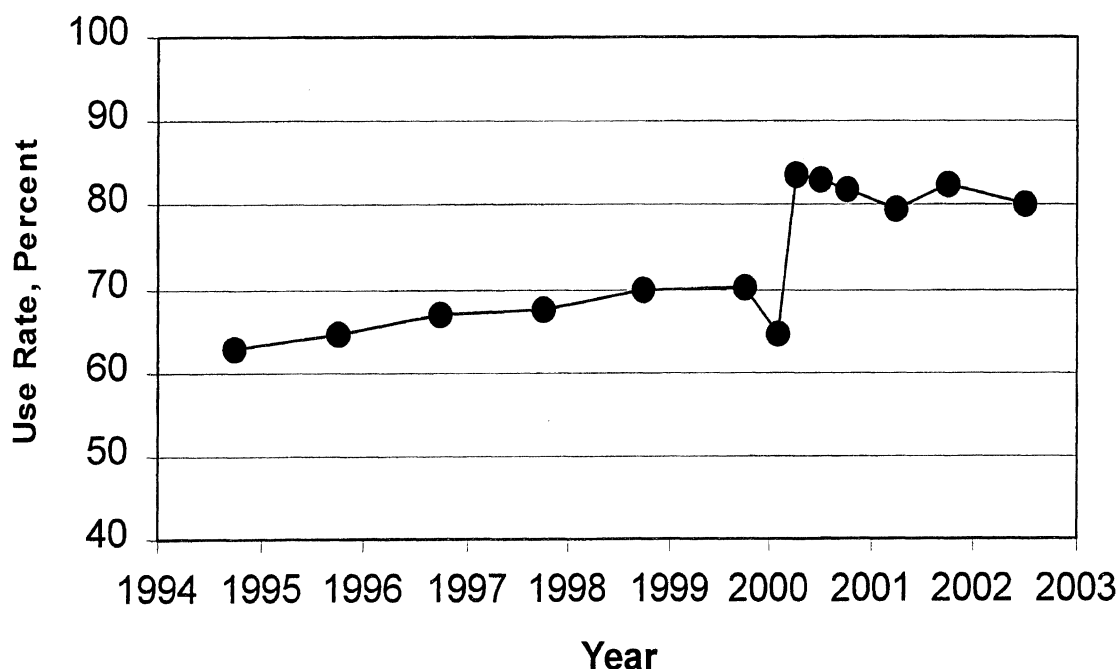


Figure 3. Front-Outboard Shoulder Belt Use by Year (All Vehicle Types Combined).

Overall Belt Use Rate by Stratum. Figure 4 shows the statewide safety belt use rate for all vehicles combined since 1994 by stratum. For all strata, there is a general upward trend in safety belt use from 1994 to 2002, with the greatest increase in use (22.3 percentage points) found in Stratum 4. Stratum 4 also experienced the largest increase in belt use immediately following the implementation of standard enforcement. In March, 2000, the belt use rate in Stratum 4 was 83.6 percent. However, since that time Stratum 4 has experienced a steady decline in belt use with each consecutive statewide survey (except for the one conducted in September, 2001). The current rate of 77.5 percent is 6.1 percentage points lower than the highest reported rate for this stratum. Since the implementation of standard enforcement legislation and other efforts to increase safety belt use over the last two years, overall increases in the belt use rates can still be observed in all strata, however continued programs are necessary to maintain and increase current rates.

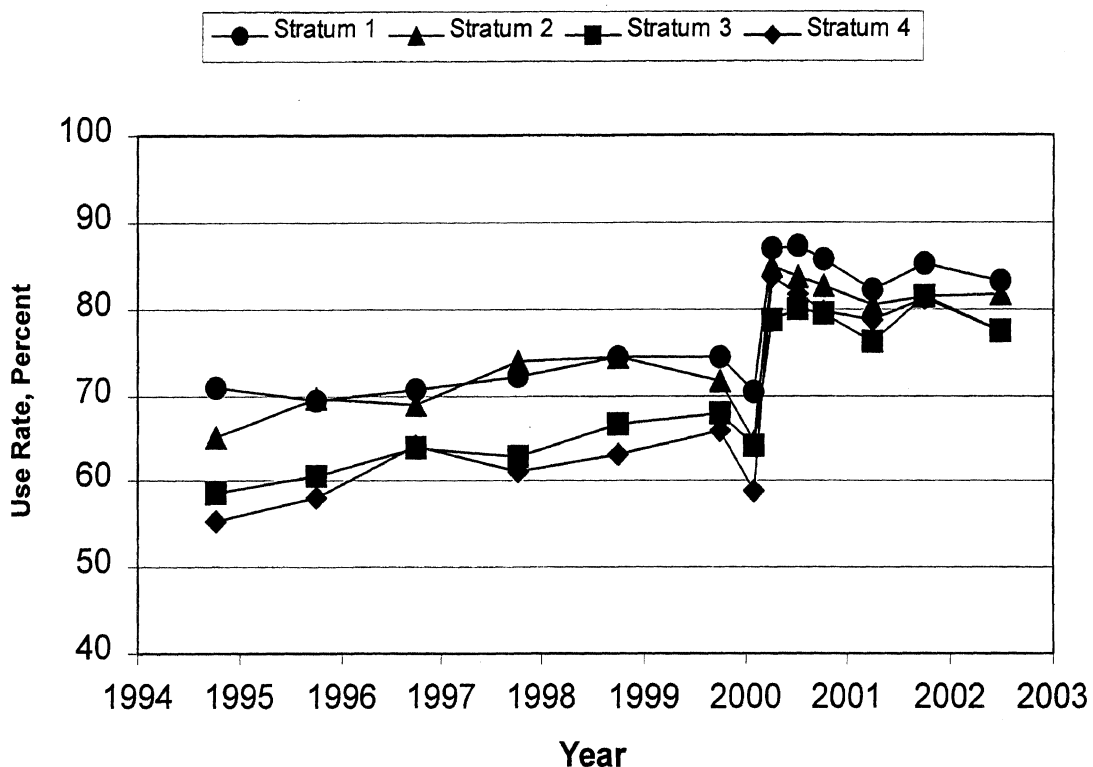


Figure 4. Front-Outboard Shoulder Belt Use by Year and Stratum (All Vehicle Types Combined).

Belt Use by Site Type. Figure 5 shows the estimated safety belt use rates for all vehicles combined as a function of whether the site was a freeway exit ramp or a local intersection. The difference in use rates has remained fairly consistent since 1994, with the use rate for freeway exit ramps higher than for local intersections.

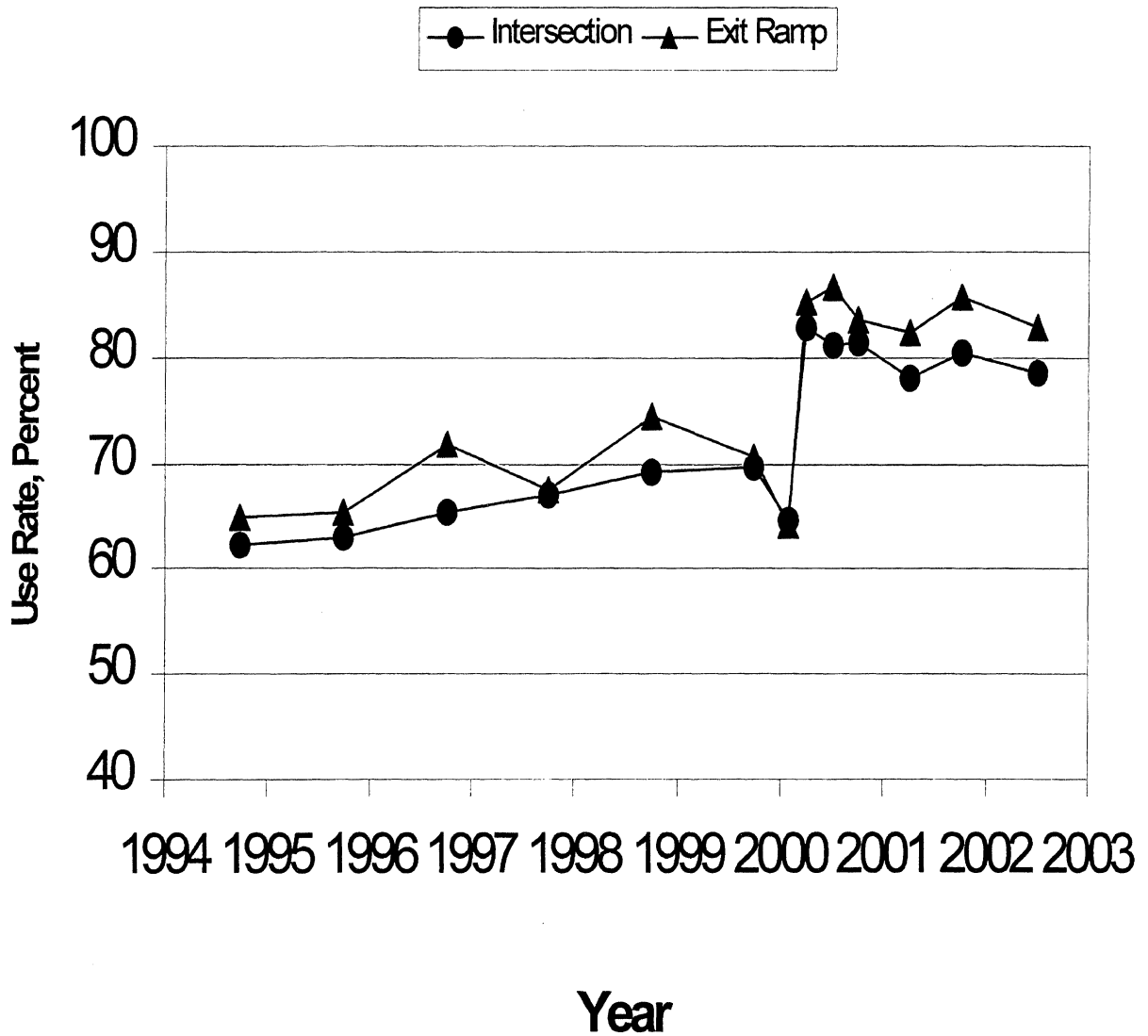


Figure 5. Front Outboard Shoulder Belt Use by Site Type and Year (All Vehicle Types Combined).

Belt Use By Sex. Figure 6 shows front-outboard safety belt use by sex since 1994. Safety belt use by females for every survey is significantly higher than for males. Significant increases in belt use, related to the introduction of standard enforcement legislation, were observed within each sex.

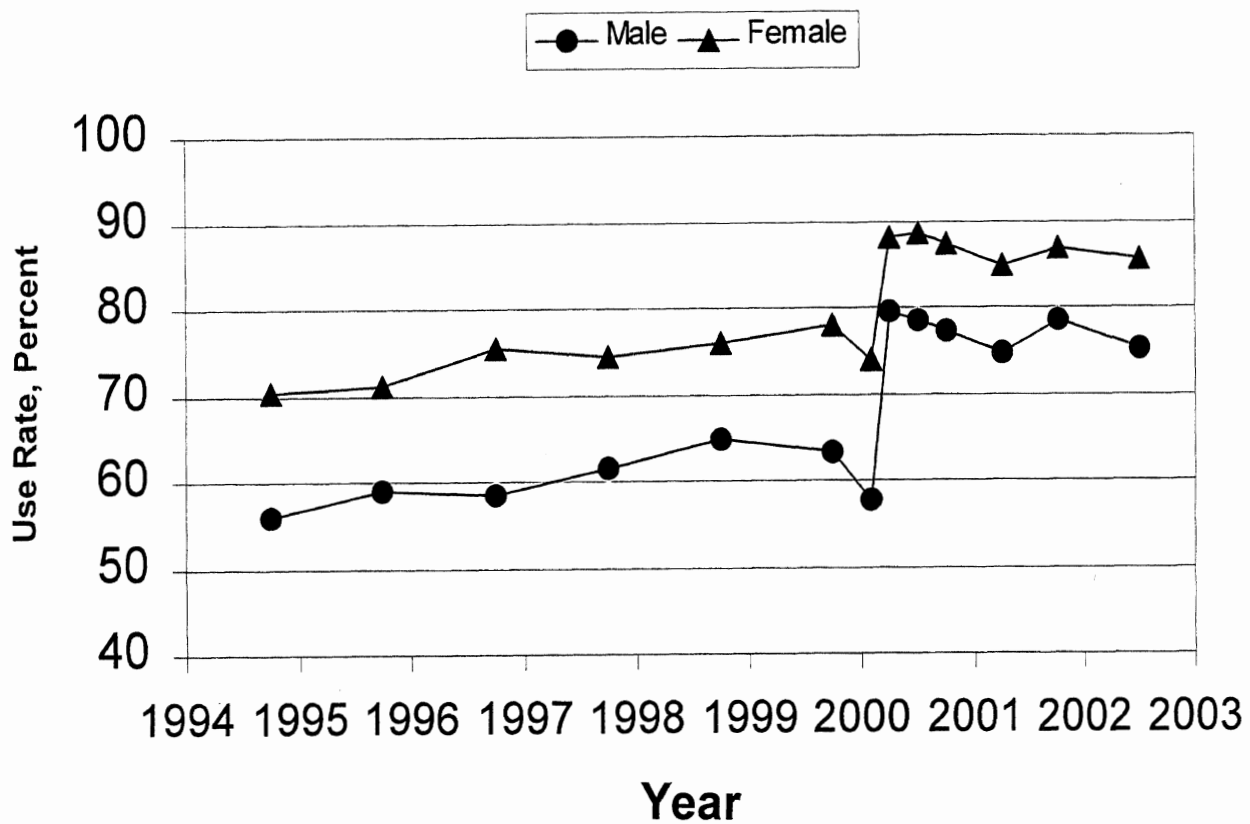


Figure 6. Front-Outboard Shoulder Belt Use by Sex and Year (All Vehicle Types Combined).

Belt Use By Seating Position. Figure 7 shows front-outboard safety belt use by seating position and year. Safety belt use by drivers has been consistently higher than for front-outboard passengers since 1994, with little change in the absolute difference between the two.

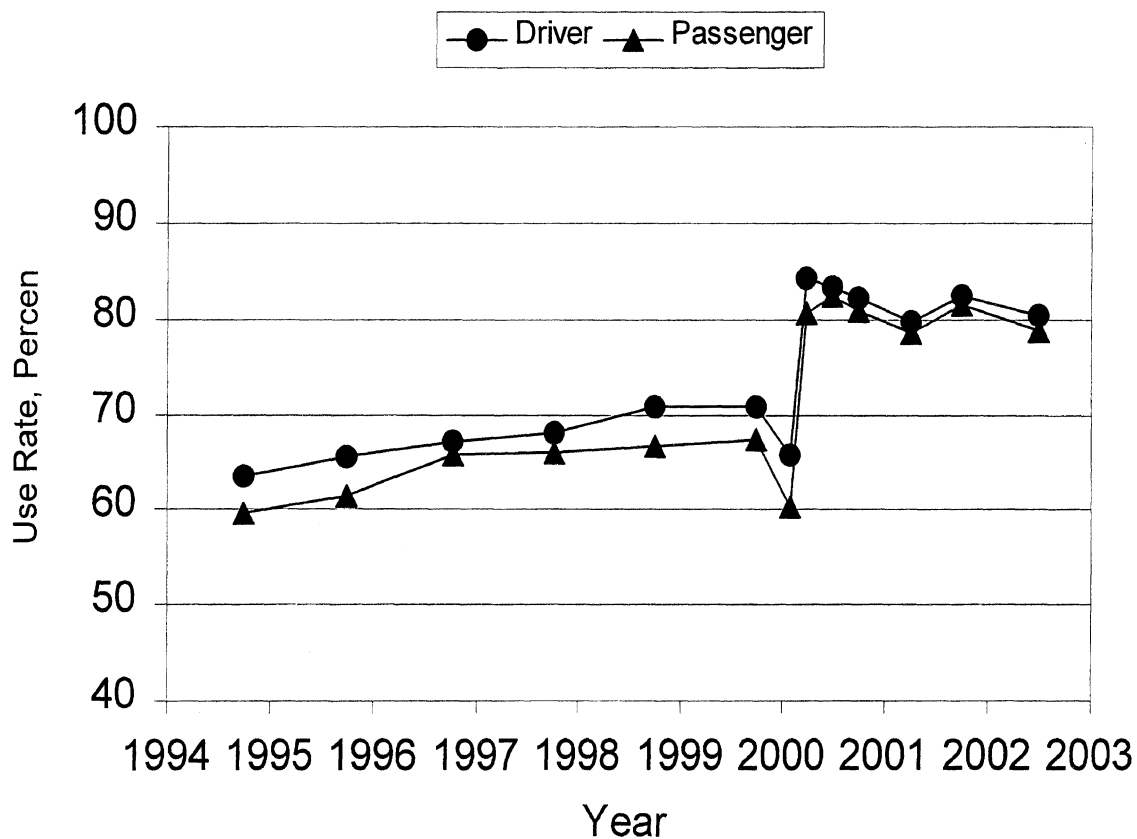


Figure 7. Front-Outboard Shoulder Belt Use by Seating Position (All Vehicle Types Combined).

Belt Use by Age. Figure 8 shows front-outboard safety belt use by age group since 1994 for all vehicles combined. The youngest age group is typically excluded from comparisons due to the very small numbers in our sample. Conclusions about the 4-to-15-year-old age group should also be made with caution as the number of occupants within this age group is quite low. Excluding these age groups, the use rates by age have been ordered consistently each year with the 16-to-29-year-old age group having the lowest safety belt use rates, followed by the 30-to-59 year olds. The highest belt use is observed within the 60-up age group. These trends continue to be evident in the current survey, with significant increases noted within all of the age groups since the introduction of standard enforcement.

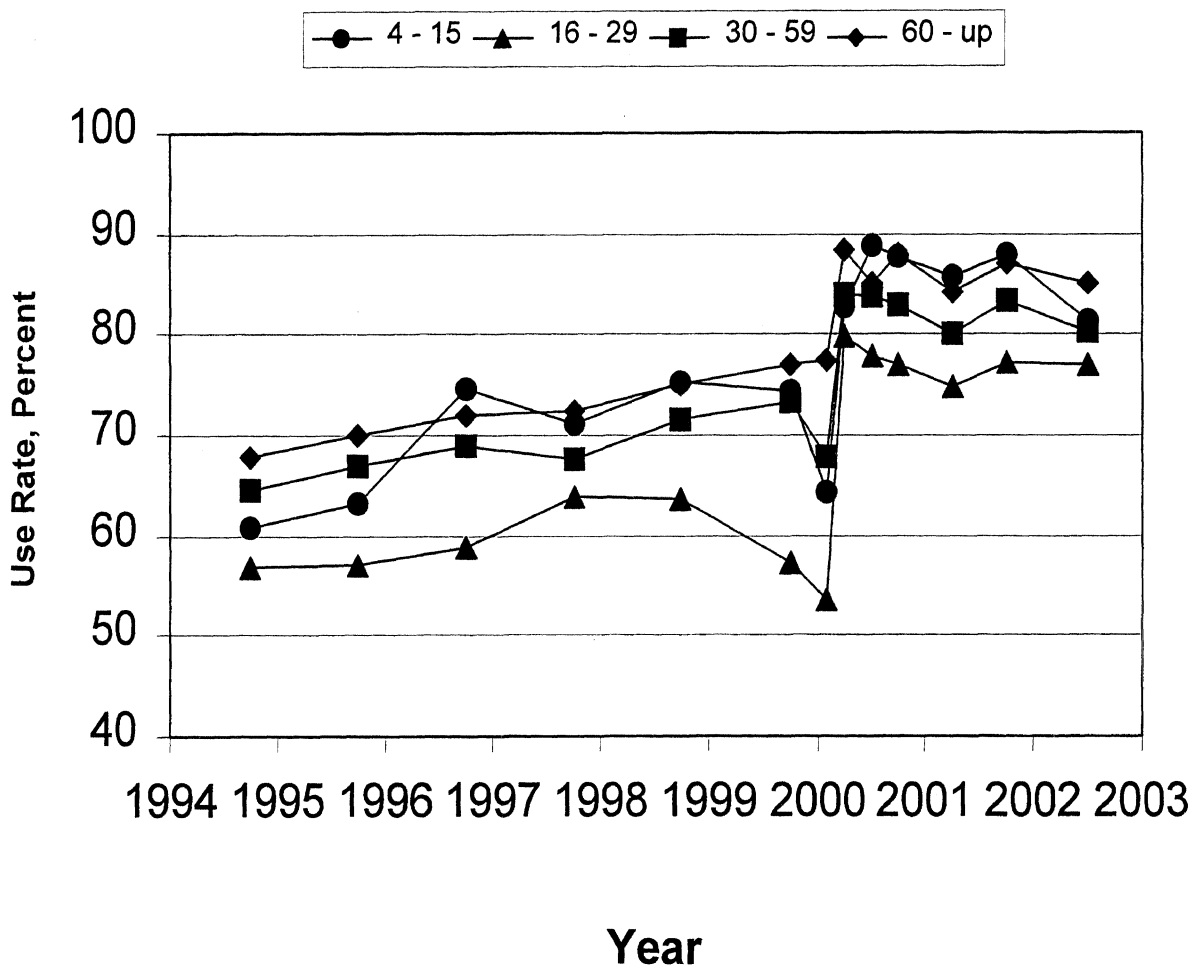


Figure 8. Front-Outboard Shoulder Belt Use by Age and Year (All Vehicle Types Combined).

Belt Use by Vehicle Type and Year. Figure 9 shows motor vehicle occupant belt use by the type of vehicle since 1993. Belt use for 1993 only shows passenger vehicles because only this vehicle type was observed in that year. Figure 9 reveals that significant increases have been observed in safety belt use rates for occupants in all vehicle types. The most notable increase (24.4 percentage points since 1994) has been observed in the belt use rates of pickup truck occupants. However, these occupants continue to be less likely to use a safety belt than occupants of other types of vehicles.

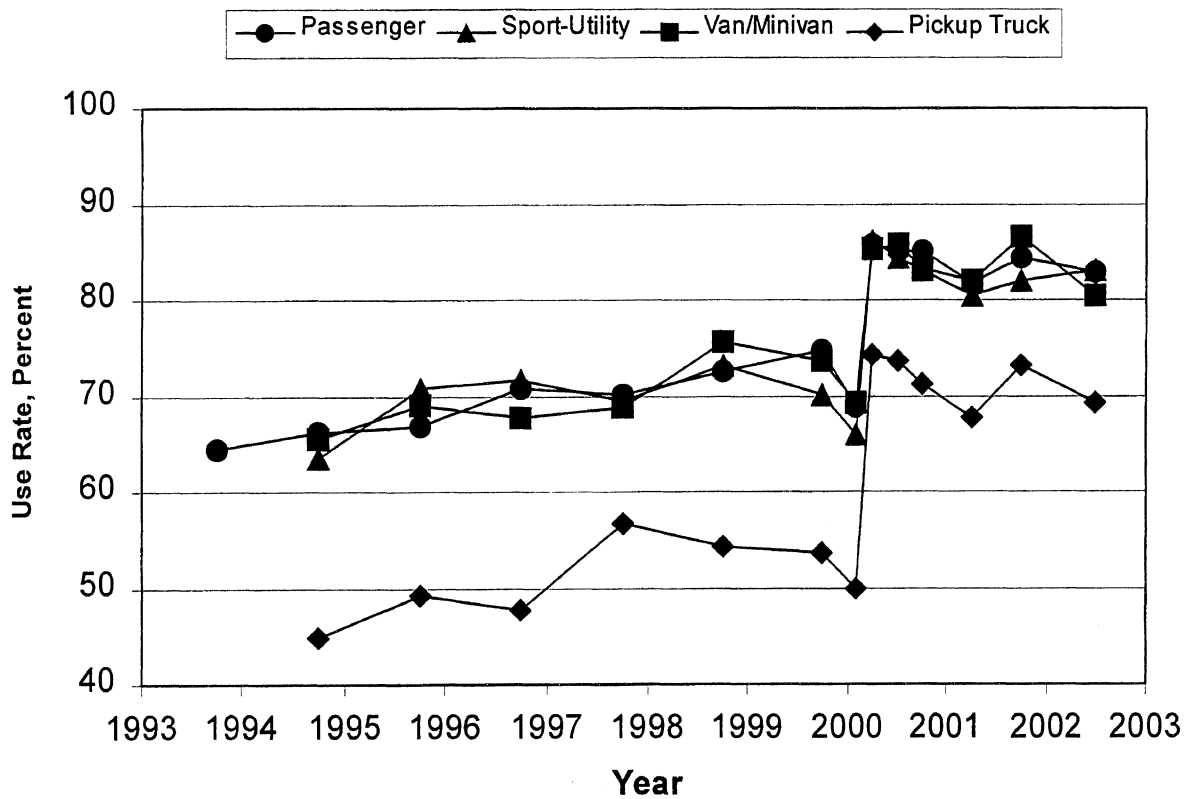


Figure 9. Front-Outboard Shoulder Belt Use by Vehicle Type and Year.

DISCUSSION

The estimated statewide safety belt use rate for front-outboard occupants of passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks combined was 80.0 ± 1.2 percent. While belt use appears to have declined slightly when compared with the September, 2001 use rate of 82.3 ± 1.4 percent (Eby & Vivoda, 2001), this difference is not statistically significant. A comparison with the highest rate observed before the introduction of standard enforcement (70.1 ± 2.2 percent; Eby, Vivoda, & Fordyce, 1999) reveals that the current rate reflects a 9.9 percentage point increase. Furthermore, the safety belt use rate for all vehicle types combined from 1994 until now (see Figure 3), shows that belt use in Michigan has increased by 17.3 percentage points. This finding indicates that efforts to increase safety belt use in Michigan, particularly the implementation of standard enforcement legislation in March, 2000, have been effective.

Since the introduction of standard enforcement, several statewide direct observation surveys of safety belt use have been completed in order to track the effects of the new legislation as well as PI&E programs and enforcement campaigns designed to increase belt use. A study conducted immediately following the change in the law revealed a rate of 83.5 ± 1.3 percent; this was the highest safety belt use rate ever observed in Michigan (Eby, Fordyce, & Vivoda, 2000a). In the two years that followed, the statewide surveys have revealed a general downward trend in belt use (with the exception of the study conducted in September, 2001). While the belt use rates reported in each of these studies did not statistically differ from the preceding study, the rate reported in the current safety belt survey is significantly lower than the use rate reported in March, 2000, immediately following the implementation of standard enforcement.

Although the overall difference between the two rates is only 3.5 percentage points, and the current rate still represents an increase of almost 10 percentage points over the pre-standard enforcement level, it is important that belt use across the state continues to move in an upward direction rather than what appears to be a downward turn. In order to continue to increase belt use in Michigan, it is essential to understand the differences in belt use rates among specific groups within the state, as well as the changes that have

occurred within these groups since the implementation of standard enforcement, when the highest belt use rates in Michigan were observed.

As has been noted in previous safety belt surveys conducted in Michigan, there are certain groups in the driving population that tend to wear safety belts less often than other groups (see e.g., Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002). While it is important to focus Public Information and Education (PI&E) programs and enforcement campaigns on the entire driving population, it is also critical to concentrate efforts towards these historically low belt use groups. In the current survey, and when comparing results over survey years, the groups least likely to buckle up include pickup truck occupants, travelers in Wayne County, 16-to-29 year olds, and males.

Of these low belt use groups, the most notable difference has been observed in the safety belt use rate of pickup truck occupants when compared with occupants of other vehicle types. While there has been a dramatic increase of 24.4 percentage points since 1994, the overall difference in the current survey between pickup truck occupants and occupants of the other three vehicle types continues to be more than 11 percentage points. This drastic and consistent difference suggests that occupants of pickup trucks may represent a unique population in Michigan, and therefore could benefit from specially designed programs. Research has shown that the main demographic differences between the driver/owners of pickup trucks and passenger cars is that driver/owners of pickup trucks are more likely to be male, have higher household incomes, and lower educational levels (Anderson, Winn, & Agran, 1999). This information provides a starting point for the development of programs designed to influence the safety belt use of pickup truck occupants, as well as programs designed to learn more about the cause of safety belt nonuse in this group.

To focus efforts effectively, it is also important to understand how specific groups were differentially affected by the change to standard enforcement, and what changes have occurred in belt use in these different groups in the two years since standard enforcement was implemented. Occupants of pickup trucks experienced a larger increase in belt use than occupants in any other vehicle types. In fact, the increase of 20.5

percentage points from September, 1999 to March, 2000 was more than double that of any other vehicle type. Since the study conducted in March, 2000 (just after standard enforcement was implemented), the belt use rate of pickup truck occupants has declined by nearly 5 percentage points, more than the rates of any other vehicle types. Collectively, these results suggest that changes in the enforcement provision of the safety belt law, and other efforts to increase belt use may have a greater effect on occupants of pickup trucks; however this population may require continuous exposure to both increased enforcement and PI&E programs in order to maintain any increases that result from these programs.

Another group of occupants that tend to wear safety belts less often than other groups are occupants traveling in Wayne County (Stratum 4). This stratum has traditionally had the lowest belt use in the state of Michigan (see e.g., Eby, Molnar, & Olk, 2000). Similar to the trend observed within the population of pickup truck drivers when the enforcement provision of the safety belt law was changed, Stratum 4 also experienced a very large increase, followed by a decline in belt use. In the study conducted in March, 2000, the observed belt use rate in Wayne County was 83.6 percent. This was an increase of 17.8 percentage points over the rate observed in September, 1999. Since that time however, the belt use rate observed in Stratum 4 has decreased to the current rate of 77.5 percent. Again, this is a larger decrease than in any of the other strata. These results suggest that programs designed to increase belt use that are focused specifically in the Wayne County area may be effective in increasing safety belt use. Given the apparent decline in belt use over time within this area, it is imperative that programs continue in Wayne County, in order to return to, and maintain the high level of belt use that has been observed here.

Analyses in the current survey by age reveal a trend similar to previous safety belt surveys conducted in Michigan (see e.g., Eby, Molnar, & Olk, 2000). Belt use rates of motorists in the 16-to-29-year-old age group have consistently been the lowest of any age group. While some progress has been made in reaching this group of motorists, the current survey revealed that this age group continues to have the lowest belt use rate. NHTSA has recognized that current traffic safety messages for this age group may not be cognitively appropriate and has begun an effort to better understand cognitive development

and the factors which influence thinking in young drivers (see, e.g., Eby & Molnar, 1999). For instance, arguments should be presented in a positive framework. For example, it is more effective to say, "drive while you are alert and conscientious" than to say "do not drink and drive." Additionally, young drivers, in particular males, tend to overestimate their driving skills and underestimate the skills of others (optimism bias), and, therefore tend to perceive their crash risk as less than others; inclusion of peer-group testimonials that address this optimism bias might be effective in overcoming this incorrect reasoning. Such information may allow for the development of more appropriate traffic safety messages to continue to increase safety belt use among this age group.

When standard enforcement was introduced in Michigan, the belt use rate for males increased by 16.3 percentage points. Female belt use also increased between September, 1999 and March, 2000, by 10.0 percentage points. Since this time however, male belt use has declined by 4.5 percentage points, and female belt use has declined by 2.5 percentage points. These changes have resulted in the current rates of 75.1 percent and 85.6 percent belt use for males and females, respectively. Although the difference between the declines in belt use of males and females is not that large (2 percentage points), the overall difference between the two groups remains quite noticeable. When examining belt use by both sex and age, this difference is even more remarkable. Excluding the two youngest age groups (because of the previously discussed low representation in the sample), the female age group with the lowest belt use (16-to-29-year-olds) actually has a higher belt use rate than the male age group with the highest belt use (60-up age group). These findings suggest that statewide efforts to increase belt use for young males and males in general must be continued and intensified.

Belt use by the other subcategories showed the usual trends that have been observed in Michigan (Eby, Molnar, & Olk, 2000; Eby, Vivoda, & Fordyce, 2002). Belt use was higher for exit ramps than for intersections. This difference in use rates has remained consistent since 1994. As discussed by Slovic (1984; see also Eby & Molnar, 1999), this finding may show that people judge whether to use a safety belt on a trip-by-trip basis and erroneously consider travel on limited-access roadways as less safe than travel on other roadways. Such erroneous reasoning could be addressed in PI&E programs.

Safety belt use for drivers has been consistently higher than for passengers since 1994, although both have increased. Our analysis indicates that new efforts should be made to encourage passengers to use safety belts. Further research is essential to better understand the dynamics of passenger belt use in order to develop appropriate and effective PI&E programs.

Creating a new law, or changing an existing law, often results in a predictable pattern of behavior. For example, when Michigan first implemented a mandatory safety belt use law in 1985, there was a dramatic increase in belt use, followed by a decline in use to a level that remained substantially higher than the prelaw level (see, e.g., Eby, Molnar, & Olk, 2000). The apparent downward trend in safety belt use may be a result of the same pattern, with a leveling off of belt use near 80 percent. While this level of belt use does not meet all of the goals set for the state of Michigan, it is substantially higher than the highest level reported before standard enforcement.

The purpose of the current survey was to assess the statewide effects of the Section 157 paid media and enforcement campaign. Based on the current statewide safety belt use rates compared to the rates that were observed in September, 2001, the Section 157 efforts do not appear to have been effective. However, it is important to note that a statewide survey to determine the baseline belt use rate immediately prior to the beginning of the Section 157 efforts was not conducted. It is possible that the statewide rate had already declined and the comparison of the current rate with the use rate observed in September, 2001 would not capture this difference.

Collectively, these findings suggest that the change to standard enforcement, along with enforcement efforts and PI&E programs by local and state police agencies, have generally been effective in increasing safety belt use in Michigan. Programs that have specifically focused upon groups identified as having low safety belt use rates (OHSP, 2000), seem to have had a positive effect. However, in the two years since the change to standard enforcement, the largest declines in belt use have occurred in these same groups. Promising increases in belt use within these groups were observed at the implementation of standard enforcement. These findings suggest that strong enforcement

efforts coupled with effective PI&E campaigns aimed at the low belt use groups can effectively raise and maintain the belt use rates to those high levels once again.

REFERENCES

- Anderson, C.L., Winn, D.G., & Agran, P.F. (1999). Differences between pickup truck and automobile driver-owners. *Accident Analysis & Prevention*, 31, 67-76.
- Cochran, W. W. (1977). *Sampling Techniques*, 3rd ed. New York, NY: Wiley.
- Eby, D.W. (2000). *How Often Do People Use Safety Belts in Your Community? A Step-by-Step Guide for Assessing Community Safety Belt Use*. (Report No. UMTRI-2000-19). Ann Arbor, MI: University of Michigan Transportation Research Institute.
- Eby, D.W., Fordyce, T.A., & Vivoda, J.M. (2000a). *Michigan Safety Belt Use Immediately Following Implementation of Standard Enforcement*. (Report No. UMTRI-2000-25). Ann Arbor, MI: University of Michigan Transportation Research Institute.
- Eby, D.W., Fordyce, T.A., & Vivoda, J.M. (2000b). *Direct Observation of Safety Belt Use in Michigan: Fall 2000*. (Report No. UMTRI-2000-45). Ann Arbor, MI: University of Michigan Transportation Research Institute.
- Eby, D.W. & Hopp, M.L. (1997). *Direct Observation of Safety Belt Use in Michigan: Fall 1997*. (Report No. UMTRI-97-41). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- Eby, D.W. & Molnar, L.J. (1999). *Matching Safety Strategies to Youth Characteristics: A Literature Review of Cognitive Development*. (Report No. DOT-HS-808-927). Washington, DC: US Department of Transportation.
- Eby, D.W., Molnar, L.J., & Olk, M.L. (2000). Trends in driver and front-right passenger safety belt use in Michigan: 1984-1998. *Accident Analysis & Prevention*, 32, 837-843.
- Eby, D.W. & Olk, M.L. (1998). *Direct Observation of Safety Belt Use in Michigan: Fall 1997*. (Report No. UMTRI-98-46). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- Eby, D.W. & Vivoda, J.M. (2001b). *Direct Observation of Safety Belt Use in Michigan: Fall 2001*. (Report No. UMTRI-2001-36). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- Eby, D.W., Vivoda, J.M., & Fordyce, T.A. (1999). *Direct Observation of Safety Belt Use in Michigan: Fall 1999*. (Report No. UMTRI-99-33). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- Eby, D.W., Vivoda, J.M., & Fordyce, T.A. (2002). The effects of standard enforcement on Michigan safety belt use. *Accident Analysis and Prevention*.

- Evans, L. (1991). *Traffic Safety and the Driver*. New York, NY: Van Nostrand Reinhold.
- Federal Highway Administration (1982). *Highway Statistics 1982*. Washington, DC: US Department of Transportation.
- Foss, R.D., Bierness, D.J., & Sprattler, K. (1994). Seat belt use among drinking drivers in Minnesota. *American Journal of Public Health, 84*, 1732-1737.
- Michigan Office of Highway Safety Planning. (2000). *State of Michigan 2001 Highway Safety Plan*. Lansing, MI: Michigan Office of Highway Safety Planning.
- Michigan Office of Highway Safety Planning. (2001). *2000 Michigan Traffic Crash Facts*. Lansing, MI: Office of Highway Safety Planning, Michigan State Police.
- Mortimer, R.G. (1992). Extra enforcement and the use of seat belts by drivers in Illinois. *Accident Analysis & Prevention, 24*, 661-666.
- National Highway Traffic Safety Administration. (1992). Guidelines for State Observational Surveys of Safety Belt and Motorcycle Helmet Use. *Federal Register, 57*(125), 28899-28904.
- National Highway Traffic Safety Administration. (1998). *Uniform Criteria for State Observational Surveys of Seat Belt Use*. (Docket No. NHTSA-98-4280). Washington, DC: US Department of Transportation.
- National Highway Traffic Safety Administration. (1999a). *Standard Enforcement Saves Lives: The Case for Strong Seat Belt Laws*. (Report No. DOT HS 808 846). Washington, DC: US Department of Transportation.
- National Highway Traffic Safety Administration. (1999b, personal communication). Letter to the Executive Director of the Michigan Office of Highway Safety Planning outlining federal regulations regarding inclusion of commercial/noncommercial vehicle occupants. April, 1999.
- National Highway Traffic Safety Administration. (1999c). Buckle UP! New York. Retrieved July 25, 2001, from <http://www.nhtsa.dot.gov/people/injury/airbags/buckleplan/BUABulletins/bua99-16.html>.
- National Highway Traffic Safety Administration. (2001a, Spring). Missouri: Special Traffic Enforcement Project (STEP) and Safety Belt Survey. Retrieved July 25, 2001, from <http://www.nhtsa.dot.gov/people/outreach/safedige/Spring2001/sp01-1.html>.
- National Highway Traffic Safety Administration. (2001b, Spring). Oklahoma: What's Holding You Back, Oklahoma? Campaign. Retrieved July 25, 2001, from <http://www.nhtsa.dot.gov/people/outreach/safedige/Spring2001/sp01-6.html>.

- Russell, N., Dreyfuss, P., & Cosgrove, M. (1999). *Legislative History of Recent Primary Safety Belt Laws*. (Report No. DOT HS 808 833). Washington, DC: US Department of Transportation.
- Slovic, P. (1984). Risk theory: Conceptual frames for understanding risk taking in young drivers. In R. Blackman, G. Brown, D. Cox, S. Sheps, & R. Tonkin (Eds.), *Adolescent Risk Taking Behavior*. British Columbia, Canada: University of British Columbia.
- Streff, F. M., Eby, D. W., Molnar, L. J., Joksich, H. C., & Wallace, R. R. (1993). *Direct Observation of Safety Belt and Motorcycle Helmet Use in Michigan: Fall 1993*. (Report No. UMTRI-93-44). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- Streff, F. M., Molnar, L. J., & Christoff, C. (1993). *Direct Observation of Safety Belt Use in Michigan: Summer 1992*. (Report No. UMTRI-93-04). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- U.S. Bureau of the Census. (1992). *1990 Census of Population and Housing* (from University of Michigan UM-ULibrary Gopher-computer datafile).
- U.S. General Accounting Office. (1992). *Safety Belt Use Laws Save Lives and Reduce Costs to Society*. (Report No. GAO/RCED-92-106). Washington, D.C.: United States General Accounting Office.
- Wagenaar, A. C. & Molnar, L. J. (1989). *Direct Observation of Safety Belt Use in Michigan: Spring 1989*. (Report No. UMTRI-89-12). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- Wagenaar, A. C., Molnar, L. J., & Businski, K. L. (1987a). *Direct Observation of Safety Belt Use in Michigan: December 1986*. (Report No. UMTRI-87-03). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- Wagenaar, A. C., Molnar, L. J., & Businski, K. L. (1987b). *Direct Observation of Safety Belt Use in Michigan: April 1987*. (Report No. UMTRI-87-25). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- Wagenaar, A. C., Molnar, L. J., & Businski, K. L. (1988). *Direct Observation of Safety Belt Use in Michigan: Spring 1988*. (Report No. UMTRI-88-24). Ann Arbor, MI: The University of Michigan Transportation Research Institute.
- Wortham, S. (1998). Making the case for stronger safety-belt laws. *Traffic Safety*, 98(2), 8-11.
- Winnicki, J. (1995). *Safety Belt Use Laws: Evaluation of Primary Enforcement and Other Provisions*. (Report No. DOT-HS-808-324). Washington, DC: US Department of Transportation.

APPENDIX A
Data Collection Forms

SITE DESCRIPTION DO - MAY/JUNE 2002

SITE #
1 2 3

SITE LOCATION _____

SITE TYPE

1 Intersection

2 Freeway

4

Exit No. _____

SITE CHOICE

1 Primary

2 Alternate

5

TRAFFIC CONTROL

1 Traffic Light

2 Stop sign

3 None

4 Other _____

6

DATE (month/day): / / /2002
7 8 9 10

OBSERVER

1 Brenda

2 Dave

3 Laura

4 Steve

5 Jonathon

6 Dave

11

DAY OF WEEK

1 Monday

2 Tuesday

3 Wednesday

4 Thursday

5 Friday

6 Saturday

7 Sunday

12

WEATHER

1 Mostly Sunny

2 Mostly Cloudy

3 Rain

4 Snow

13

START TIME: : (24 hour clock)
14 15 16 17

END TIME: : (24 hour clock)
18 19 20 21

INTERRUPTION (total number of minutes during observation period):

22 23

MEDIAN:

1 Yes

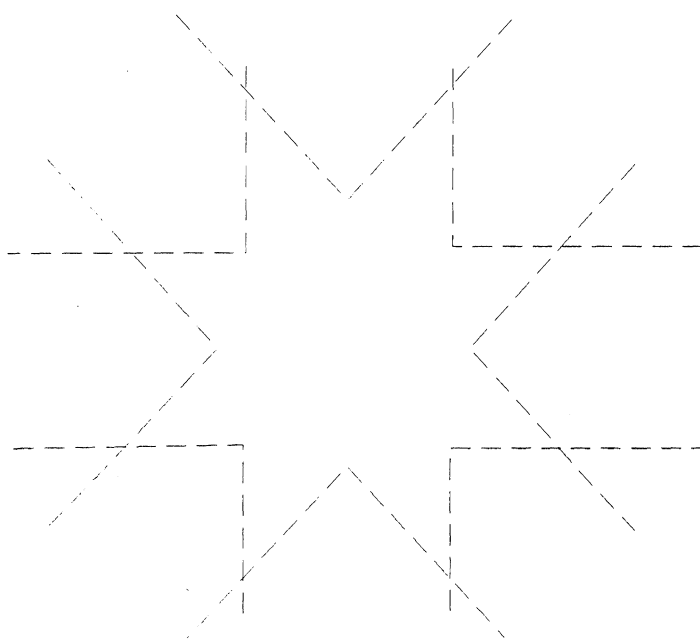
2 No

24

TRAFFIC COUNT 1:
25 26 27

TRAFFIC COUNT 2:
28 29 30

COMMENTS::



ATTENTION CODING: DUPLICATE COL 1 - 3 FOR ALL VEHICLES

| | | | | | |
|-----------------------|--|---|---|---|--|
| DRIVER | 1 <input type="checkbox"/> Not belted 2 <input type="checkbox"/> Belted 3 <input type="checkbox"/> B Back 4 <input type="checkbox"/> U Arm 4 | 1 <input type="checkbox"/> Male 2 <input type="checkbox"/> Female 5 | 2 <input type="checkbox"/> 4 - 15 3 <input type="checkbox"/> 16 - 29 4 <input type="checkbox"/> 30 - 59 5 <input type="checkbox"/> 60+ 6 | VEHICLE TYPE 1 <input type="checkbox"/> Passenger car 2 <input type="checkbox"/> Van 3 <input type="checkbox"/> Utility 4 <input type="checkbox"/> Pick-up 7 | |
| FRONT-RIGHT PASSENGER | 1 <input type="checkbox"/> Not belted 2 <input type="checkbox"/> Belted 3 <input type="checkbox"/> B Back 4 <input type="checkbox"/> U Arm 5 <input type="checkbox"/> CRD 8 | 1 <input type="checkbox"/> Male 2 <input type="checkbox"/> Female 9 | 1 <input type="checkbox"/> 0 - 3 2 <input type="checkbox"/> 4 - 15 3 <input type="checkbox"/> 16 - 29 4 <input type="checkbox"/> 30 - 59 5 <input type="checkbox"/> 60+ 10 | Office Use Only _____ 11 12 13 | COMM. VEHICLE 1 <input type="checkbox"/> No 2 <input type="checkbox"/> Yes 14 |

| | | | | | |
|-----------------------|--|---|---|---|--|
| DRIVER | 1 <input type="checkbox"/> Not belted 2 <input type="checkbox"/> Belted 3 <input type="checkbox"/> B Back 4 <input type="checkbox"/> U Arm 4 | 1 <input type="checkbox"/> Male 2 <input type="checkbox"/> Female 5 | 2 <input type="checkbox"/> 4 - 15 3 <input type="checkbox"/> 16 - 29 4 <input type="checkbox"/> 30 - 59 5 <input type="checkbox"/> 60+ 6 | VEHICLE TYPE 1 <input type="checkbox"/> Passenger car 2 <input type="checkbox"/> Van 3 <input type="checkbox"/> Utility 4 <input type="checkbox"/> Pick-up 7 | |
| FRONT-RIGHT PASSENGER | 1 <input type="checkbox"/> Not belted 2 <input type="checkbox"/> Belted 3 <input type="checkbox"/> B Back 4 <input type="checkbox"/> U Arm 5 <input type="checkbox"/> CRD 8 | 1 <input type="checkbox"/> Male 2 <input type="checkbox"/> Female 9 | 1 <input type="checkbox"/> 0 - 3 2 <input type="checkbox"/> 4 - 15 3 <input type="checkbox"/> 16 - 29 4 <input type="checkbox"/> 30 - 59 5 <input type="checkbox"/> 60+ 10 | Office Use Only _____ 11 12 13 | COMM. VEHICLE 1 <input type="checkbox"/> No 2 <input type="checkbox"/> Yes 14 |

| | | | | | |
|-----------------------|--|---|---|---|--|
| DRIVER | 1 <input type="checkbox"/> Not belted 2 <input type="checkbox"/> Belted 3 <input type="checkbox"/> B Back 4 <input type="checkbox"/> U Arm 4 | 1 <input type="checkbox"/> Male 2 <input type="checkbox"/> Female 5 | 2 <input type="checkbox"/> 4 - 15 3 <input type="checkbox"/> 16 - 29 4 <input type="checkbox"/> 30 - 59 5 <input type="checkbox"/> 60+ 6 | VEHICLE TYPE 1 <input type="checkbox"/> Passenger car 2 <input type="checkbox"/> Van 3 <input type="checkbox"/> Utility 4 <input type="checkbox"/> Pick-up 7 | |
| FRONT-RIGHT PASSENGER | 1 <input type="checkbox"/> Not belted 2 <input type="checkbox"/> Belted 3 <input type="checkbox"/> B Back 4 <input type="checkbox"/> U Arm 5 <input type="checkbox"/> CRD 8 | 1 <input type="checkbox"/> Male 2 <input type="checkbox"/> Female 9 | 1 <input type="checkbox"/> 0 - 3 2 <input type="checkbox"/> 4 - 15 3 <input type="checkbox"/> 16 - 29 4 <input type="checkbox"/> 30 - 59 5 <input type="checkbox"/> 60+ 10 | Office Use Only _____ 11 12 13 | COMM. VEHICLE 1 <input type="checkbox"/> No 2 <input type="checkbox"/> Yes 14 |

| | | | | | |
|-----------------------|--|---|---|---|--|
| DRIVER | 1 <input type="checkbox"/> Not belted 2 <input type="checkbox"/> Belted 3 <input type="checkbox"/> B Back 4 <input type="checkbox"/> U Arm 4 | 1 <input type="checkbox"/> Male 2 <input type="checkbox"/> Female 5 | 2 <input type="checkbox"/> 4 - 15 3 <input type="checkbox"/> 16 - 29 4 <input type="checkbox"/> 30 - 59 5 <input type="checkbox"/> 60+ 6 | VEHICLE TYPE 1 <input type="checkbox"/> Passenger car 2 <input type="checkbox"/> Van 3 <input type="checkbox"/> Utility 4 <input type="checkbox"/> Pick-up 7 | |
| FRONT-RIGHT PASSENGER | 1 <input type="checkbox"/> Not belted 2 <input type="checkbox"/> Belted 3 <input type="checkbox"/> B Back 4 <input type="checkbox"/> U Arm 5 <input type="checkbox"/> CRD 8 | 1 <input type="checkbox"/> Male 2 <input type="checkbox"/> Female 9 | 1 <input type="checkbox"/> 0 - 3 2 <input type="checkbox"/> 4 - 15 3 <input type="checkbox"/> 16 - 29 4 <input type="checkbox"/> 30 - 59 5 <input type="checkbox"/> 60+ 10 | Office Use Only _____ 11 12 13 | COMM. VEHICLE 1 <input type="checkbox"/> No 2 <input type="checkbox"/> Yes 14 |

APPENDIX B
Site Listing

Survey Sites By Number

| No. | County | Site Location | Type | Str |
|-----|------------|---|------|-----|
| 001 | Oakland | EB Whipple Lake Rd. & Eston Rd. | I | 1 |
| 002 | Kalamazoo | EB S Ave. & 29 th St. | I | 1 |
| 003 | Oakland | SB Pontiac Trail & 10 Mile Rd. | I | 1 |
| 004 | Washtenaw | SB Moon Rd. & Ann Arbor-Saline Rd./Saline-Milan Rd. | I | 1 |
| 005 | Oakland | WB Drahnert Rd. & Baldwin Rd. | I | 1 |
| 006 | Oakland | SB Rochester Rd. & 32 Mile Rd./Romeo Rd. | I | 1 |
| 007 | Oakland | SB Williams Lake Rd. & Elizabeth Lake Rd. | I | 1 |
| 008 | Ingham | SB Searles Rd. & Iosco Rd. | I | 1 |
| 009 | Kalamazoo | WB D Ave. & Riverview Dr. | I | 1 |
| 010 | Washtenaw | EB N. Territorial Rd. & Dexter-Pinckney Rd. | I | 1 |
| 011 | Washtenaw | NB Schleeweis Rd./Macomb St. & W. Main St. | I | 1 |
| 012 | Ingham | NB Shaftsbury Rd. & Haslett Rd. | I | 1 |
| 013 | Oakland | NB Middlebelt Rd. & 9 Mile Rd. | I | 1 |
| 014 | Washtenaw | WB Packard Rd. & Carpenter Rd. | I | 1 |
| 015 | Ingham | EB Haslett Rd. & Marsh Rd. | I | 1 |
| 016 | Washtenaw | NB Jordan Rd./Monroe St. & US-12/Michigan Ave. | I | 1 |
| 017 | Washtenaw | SB M-52/Main St. & Old US-12 | I | 1 |
| 018 | Kalamazoo | SB 8th St. & Q Ave. | I | 1 |
| 019 | Washtenaw | WB 8 Mile Rd. & Pontiac Trail | I | 1 |
| 020 | Oakland | SB Lahser Rd. & 11 Mile Rd. | I | 1 |
| 021 | Kalamazoo | NB Ravine Rd. & D Ave. | I | 1 |
| 022 | Washtenaw | EB Glacier Way/Glazier Way & Huron Pkwy. | I | 1 |
| 023 | Washtenaw | WB Bethel Church Rd. & M-52 | I | 1 |
| 024 | Washtenaw | SB Platt Rd. & Willis Rd. | I | 1 |
| 025 | Ingham | WB Fitchburg Rd. & Williamston Rd. | I | 1 |
| 026 | Washtenaw | EB Merritt Rd. & Stoney Creek Rd. | I | 1 |
| 027 | Oakland | SB Hickory Ridge Rd. & M-59/Highland Rd. | I | 1 |
| 028 | Kalamazoo | SB Douglas Ave. & D Ave. | I | 1 |
| 029 | Oakland | WB Walnut Lake Rd. & Haggerty Rd. | I | 1 |
| 030 | Oakland | NB Jossman Rd. & Grange Hall Rd. | I | 1 |
| 031 | Kalamazoo | EB H Ave. & 3rd St. | I | 1 |
| 032 | Kalamazoo | EB TU Ave. & 24th St./Sprinkle Rd. | I | 1 |
| 033 | Oakland | WBD I-96 & Milford Rd.. (Exit 155B) | ER | 1 |
| 034 | Washtenaw | WBP I-94 & Whittaker Rd./Huron St. (Exit 183) | ER | 1 |
| 035 | Kalamazoo | SBP US-131 & M-43 (Exit 38B) | ER | 1 |
| 036 | Washtenaw | SBD US-23 & N. Territorial Rd. | ER | 1 |
| 037 | Kalamazoo | EBP I-94 & Portage Rd. | ER | 1 |
| 038 | Oakland | EBP I-696 & Orchard Lake Rd. (Exit 5) | ER | 1 |
| 039 | Kalamazoo | WBP I-94 & 9th St. (Exit 72) | ER | 1 |
| 040 | Washtenaw | WBD I-94 & Jackson Rd. | ER | 1 |
| 041 | Kalamazoo | NBD US-131 & Stadium Dr./Business I-94 | ER | 1 |
| 042 | Kalamazoo | NBP US-131 & Q Ave./Centre Ave. | ER | 1 |
| 043 | Livingston | SB County Farm Rd. & Coon Lake Rd. | I | 2 |
| 044 | Bay | WB Nebodish Rd. & Knight Rd. | I | 2 |

| | | | | |
|-----|--------------|--|----|---|
| 045 | Macomb | SB Camp Ground Rd. & 31 Mile Rd. | I | 2 |
| 046 | Jackson | SB Benton Rd./Moon Lake Rd. & M-50/ Brooklyn Rd. | I | 2 |
| 047 | Allegan | SB 6th St. & M-89 | I | 2 |
| 048 | Kent | EB 36th St. & Snow Ave. | I | 2 |
| 049 | Livingston | EB Chase Lake Rd. & Fowlerville Rd. | I | 2 |
| 050 | Allegan | WB 144th Ave. & 2nd St. | I | 2 |
| 051 | Livingston | SB Cedar Lake Rd. & Coon Lake Rd. | I | 2 |
| 052 | Jackson | NB Mt. Hope Rd. & Waterloo-Munith Rd. | I | 2 |
| 053 | Kent | WB Cascade Rd. & Thornapple River Dr. | I | 2 |
| 054 | Allegan | NB 62nd St. & 102nd Ave. | I | 2 |
| 055 | Kent | SB Meddler Ave. & 18 Mile Rd. | I | 2 |
| 056 | Eaton | SB Houston Rd. & Kinneville Rd. | I | 2 |
| 057 | Macomb | SB M-19/Memphis Ridge Rd. & 32 Mile Rd./ Division Rd. | I | 2 |
| 058 | Allegan | NB 66th St. & 118th Ave. | I | 2 |
| 059 | Grn Traverse | NB Silver Lake Rd./County Rd. 633 & US-31 | I | 2 |
| 060 | Grn Traverse | EB Riley Rd./Tenth St. & M-137 | I | 2 |
| 061 | Bay | SB 9 Mile Rd. & Beaver Rd. | I | 2 |
| 062 | Kent | SB Ramsdell Dr. & M-57/14 Mile Rd. | I | 2 |
| 063 | Eaton | NB Ionia Rd. & M-50/Ciinton Trail | I | 2 |
| 064 | Macomb | EB 23 Mile Rd. & Romeo Plank Rd. | I | 2 |
| 065 | Livingston | NB Old US-23/Whitmore Lake Rd. & Grand River Rd. | I | 2 |
| 066 | Jackson | SWB Horton Rd. & Badgley Rd. | I | 2 |
| 067 | Kent | SB Belmont Ave. & West River Dr. | I | 2 |
| 068 | Eaton | EB 5 Point Hwy. & Ionia Rd. | I | 2 |
| 069 | Allegan | WB 129th Ave. & 10th St. | I | 2 |
| 070 | Eaton | EB M-43 & M-100 | I | 2 |
| 071 | Ottawa | WB Taylor St. & 72nd Ave. | I | 2 |
| 072 | Bay | EB Cass Rd. & Farley Rd. | I | 2 |
| 073 | Allegan | EB 126th Ave. & 66th St. | I | 2 |
| 074 | Bay | NB Mackinaw Rd. & Cody-Estey Rd. | I | 2 |
| 075 | Jackson | EBD I-94 & Elm Ave. (Exit 141) | ER | 2 |
| 076 | Kent | NBD US-131 & 100th St. (Exit 72) | ER | 2 |
| 077 | Ottawa | NBD I-196 & Byron Rd. | ER | 2 |
| 078 | Kent | SBP US-131 & Hall St. | ER | 2 |
| 079 | Macomb | SBP M-53 & 26 Mile Rd. | ER | 2 |
| 080 | Bay | NBD I-75 & Wilder Rd. (Exit 164) | ER | 2 |
| 081 | Livingston | EBD I-96 & Fowlerville Rd. (Exit 129) | ER | 2 |
| 082 | Macomb | EBP I-94 & 12 Mile Rd. (Exit 231) | ER | 2 |
| 083 | Jackson | WBD I-94 & Sargent Rd. (Exit 145) | ER | 2 |
| 084 | Allegan | NBP US-31/I-196 & Washington Rd./ Blue Star Hwy (Exit 47A) | ER | 2 |
| 085 | Genesee | SB Van Slyke Rd. & Maple Ave. | I | 3 |
| 086 | Monroe | WB Ida Center Rd. & Summerfield Rd. | I | 3 |
| 087 | Saginaw | WB Baldwin Rd. & Fowler Rd. | I | 3 |
| 088 | Calhoun | NB 23 Mile Rd. & V Drive N. | I | 3 |
| 089 | Saginaw | WB Wadsworth Rd. & Portsmouth Rd. | I | 3 |
| 090 | Lenawee | WB Slee Rd. & US-223 | I | 3 |
| 091 | Van Buren | WB 36th Ave. & M-40 | I | 3 |

| | | | | |
|-----|------------|---|----|---|
| 092 | Van Buren | EB 63rd Ave. & County Rd. 652 | I | 3 |
| 093 | Lapeer | WB McKeen Lake Rd. & Flint River Rd. | I | 3 |
| 094 | St. Joseph | NB Thomas Rd. & US-12 | I | 3 |
| 095 | Saginaw | WB Rathbun Rd. & Moorish Rd. | I | 3 |
| 096 | Berrien | NB Fikes Rd. & Coloma Rd. | I | 3 |
| 097 | Genesee | WB Hegal Rd. & M-15/State Rd. | I | 3 |
| 098 | Lapeer | EB M-90 & M-90/M-53 | I | 3 |
| 099 | Saginaw | NB Thomas Rd. & Swan Creek Rd. | I | 3 |
| 100 | Lenawee | WB Pixley Rd. & Deer Field Rd./Beaver Rd. | I | 3 |
| 101 | Van Buren | NB County Rd. 665 & M-40 | I | 3 |
| 102 | Van Buren | WB County Rd. 374 & Red Arrow Hwy./St Joseph Rd.. | I | 3 |
| 103 | Calhoun | SEB Michigan Ave./Austin Rd. & 28 Mile Rd./N. Eaton Rd. | I | 3 |
| 104 | St. Clair | WB Norman Rd. & M-19/Emmett Rd. | I | 3 |
| 105 | Monroe | EB Oakville-Waltz Rd. & Sumpter Rd. | I | 3 |
| 106 | Berrien | WB Glenlord Rd. & Washington Ave. | I | 3 |
| 107 | Muskegon | NB Whitbeck Rd. & Fruitvale Rd. | I | 3 |
| 108 | Monroe | SB Petersburg Rd. & Ida West Rd./Division Rd. | I | 3 |
| 109 | St. Clair | WB Masters Rd. & M-19 | I | 3 |
| 110 | St. Joseph | SB Zinmaster Rd. & M-60 | I | 3 |
| 111 | Shiawassee | NB State Rd. & Lansing Rd. | I | 3 |
| 112 | Van Buren | EB Celery Center Rd. & M-51 | I | 3 |
| 113 | Shiawassee | SB Geeck Rd. & M-21 | I | 3 |
| 114 | Muskegon | SB Holton Duck Lake Rd. & Ryerson Rd./ Fourth St. | I | 3 |
| 115 | Berrien | WB Glenlord Ave. & Hollywood Rd. | I | 3 |
| 116 | Lenawee | SB S. Piotter Hwy & Deer Field Rd. | I | 3 |
| 117 | Monroe | SBP I-75 & Front St./Monroe St. (Exit 13) | ER | 3 |
| 118 | Lapeer | WBD I-96 & Nepessing Rd. (Exit 153) | ER | 3 |
| 119 | Lapeer | EBP I-69 & Lake Pleasant Rd. (Exit 163) | ER | 3 |
| 120 | Berrien | WBD I-94 & US-33/M-63/Niles Rd. (Exit 27) | ER | 3 |
| 121 | Van Buren | EBP I-94 & 64th St. (Exit 46, Hartford) | ER | 3 |
| 122 | Van Buren | EBD I-94 & County Rd. 652/Main St.(Exit 66) | ER | 3 |
| 123 | Muskegon | NBD US-31 & M-46/Apple St. | ER | 3 |
| 124 | Van Buren | NBP I-196 & M-140 (Exit 18) | ER | 3 |
| 125 | Calhoun | WBD I-94 & 26 Mile Rd. | ER | 3 |
| 126 | Monroe | NBP US-23 & Ida-West Rd. (Exit 13) | ER | 3 |
| 127 | Wayne | WB 8 Mile Rd. & Beck Rd. | I | 4 |
| 128 | Wayne | EB Warren Rd. & Wayne Rd. | I | 4 |
| 129 | Wayne | EB McNichols Rd. & Woodward Ave. | I | 4 |
| 130 | Wayne | NB Canton Center Rd. & Cherry Hill Rd. | I | 4 |
| 131 | Wayne | WB Ecorse Rd. & Pardee Rd. | I | 4 |
| 132 | Wayne | EB Michigan Ave. & Sheldon Rd. | I | 4 |
| 133 | Wayne | EB Ecorse Rd. & Middlebelt Rd. | I | 4 |
| 134 | Wayne | NB M-85/Fort Rd. & Emmons Rd. | I | 4 |
| 135 | Wayne | WB Glenwood Rd. & Wayne Rd. | I | 4 |
| 136 | Wayne | NB Haggerty Rd. & 7 Mile Rd. | I | 4 |
| 137 | Wayne | WB 6 Mile Rd. & Inkster Rd. | I | 4 |
| 138 | Wayne | SB Inkster Rd. & Goddard Rd. | I | 4 |

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| 139 | Wayne | SB Merriman Rd. & Cherry Hill Rd. | I | 4 |
| 140 | Wayne | SEB Outer Dr. & Pelham Rd. | I | 4 |
| 141 | Wayne | NB Meridian Rd. & Macomb Rd. | I | 4 |
| 142 | Wayne | WB Ford Rd. & Venoy Rd. | I | 4 |
| 143 | Wayne | SWB Vernor Rd. & Gratiot Rd. | I | 4 |
| 144 | Wayne | WB 5 Mile Rd. & Beck Rd. | I | 4 |
| 145 | Wayne | EB 7 Mile Rd. & Livernois Rd. | I | 4 |
| 146 | Wayne | NB Gunston/Hoover Rd. & McNichols Rd. | I | 4 |
| 147 | Wayne | SB W. Jefferson/ Biddle Ave. & Southfield Rd. | I | 4 |
| 148 | Wayne | EB Goddard Rd. & Wayne Rd. | I | 4 |
| 149 | Wayne | WB 8 Mile Rd. & Kelly Rd. | I | 4 |
| 150 | Wayne | SB Merriman Rd. & US-12/Michigan Ave. | I | 4 |
| 151 | Wayne | SB Telegraph Rd. & Plymouth Rd. | I | 4 |
| 152 | Wayne | WB Sibley Rd. & Inkster Rd. | I | 4 |
| 153 | Wayne | NEB Mack Rd. & Moross Rd. | I | 4 |
| 154 | Wayne | WB Annapolis Rd. & Inkster Rd. | I | 4 |
| 155 | Wayne | SB Greenfield Rd. & Grand River Rd. | I | 4 |
| 156 | Wayne | EB Joy Rd. & Livernois Rd. | I | 4 |
| 157 | Wayne | SEB Conner Ave. & Gratiot Rd. | I | 4 |
| 158 | Wayne | NWB Grand River Rd. & Wyoming Ave. | I | 4 |
| 159 | Wayne | WBP I-96 & Evergreen Rd. | ER | 4 |
| 160 | Wayne | WBP I-94 & Haggerty Rd. (Exit 192) | ER | 4 |
| 161 | Wayne | NBD I-75 & Gibraltar Rd. (Exit 29) | ER | 4 |
| 162 | Wayne | SBP I-75 & Southfield Rd. | ER | 4 |
| 163 | Wayne | NBD I-275 & 6 Mile Rd. (Exit 170) | ER | 4 |
| 164 | Wayne | NBP I-275 & M-153/Ford Rd. (Exit 25) | ER | 4 |
| 165 | Wayne | NBD I-275 & Eureka Rd. (Exit 15) | ER | 4 |
| 166 | Wayne | NBP I-75 & Springwells Ave. (Exit 45) | ER | 4 |
| 167 | Wayne | WBD I-94 & Pelham Rd. (Exit 204) | ER | 4 |
| 168 | Wayne | SBD I-75 & Sibley Rd. | ER | 4 |

APPENDIX C

Calculation of Variances, Confidence Bands, and Relative Error

The variances for the belt use estimates were calculated using an equation derived from Cochran's (1977) equation 11.30 from section 11.8. The resulting formula was:

$$var(r) \approx \frac{n}{n-1} \sum_i \left(\frac{g_i}{\sum g_k} \right)^2 (r_i - r)^2 + \frac{n}{N} \sum_i \left(\frac{g_i}{\sum g_k} \right)^2 \frac{s_i^2}{g_i}$$

where $var(r_i)$ equals the variance within a stratum and vehicle type, n is the number of observed intersections, g_i is the weighted number of vehicle occupants at intersection i , g_k is the total weighted number of occupants for a certain vehicle type at all 42 sites within the stratum, r_i is the weighted belt use rate at intersection i , r is the stratum belt use rate, N is the total number of intersections within a stratum, and $s_i = r_i(1-r_i)$. In the actual calculation of the stratum variances, the second term of this equation is negligible. If we conservatively estimate N to be 2000, the second term only adds 2.1×10^{-6} units to the largest variance (Stratum 4). This additional variance does not significantly add to the variance captured in the first term. Therefore, since N was not known exactly, the second term was dropped in the variance calculations. The overall estimated variance for each vehicle type was calculated using the formula:

$$var(r_{all}) = \frac{var(r_1) + var(r_2) + var(r_3) + 0.88^2 \times var(r_4)}{3.88^2}$$

The Wayne County stratum variance was multiplied by 0.88 to account for the similar weighting that was done to estimate overall belt use. The 95 percent confidence bands were calculated using the formula:

$$95\% \text{ Confidence Band} = r_{all} \pm 1.96 \times \sqrt{\text{Variance}}$$

where r is the belt use of interest. This formula is used for the calculation of confidence bands for each stratum and for the overall belt use estimate.

Finally, the relative error or precision of the estimate was computed using the formula:

$$RelativeError = \frac{StandardError}{r_{all}}$$

The federal guidelines (NHTSA, 1992, 1998) stipulate that the relative error of the belt use estimate must be under 5 percent.