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**Minnesota Safety Belt and Motorcycle  
Helmet Use: August, 2007**

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**September, 2007**

**Consultant's Report**

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## INTRODUCTION

In 2006, Minnesota experienced 373 traffic deaths of drivers and passengers in safety belt equipped vehicles, marking a 15 percent decrease from the previous year. Of those killed, 52 percent (194 people) were not wearing safety belts (Minnesota Crash Facts, 2006). Motor vehicle crashes not only affect those immediately involved, but the economic costs resulting from crashes have a large impact on society as a whole. Between 1998 and 2002 the estimated cost to Minnesota residents for motor-vehicle-related crash injuries was \$1.9 billion. According to the National Highway Traffic Safety Administration (NHTSA, 2006), 85 percent of all medical costs incurred by crash victims fall on society, not the individuals involved. When crash victims are not properly restrained by a safety belt, their medical treatment costs are 50 percent higher than those who were buckled-up (Blincoe et al., 2002).

Currently, 49 states<sup>1</sup> and the District of Columbia have mandatory safety belt laws (Insurance Institute for Highway Safety, IIHS, 2007). However, only 25 states and the District of Columbia have primary enforcement laws where motorists can be stopped and ticketed solely for not using safety belts. The remaining states, including Minnesota, have secondary enforcement laws where a vehicle must be pulled over for another infraction before a safety belt citation can be issued. In June 2006, safety belt use in the United States was 81 percent (Glassbrenner & Ye, 2006). States with primary enforcement had a use rate of 85 percent, while secondary states had use rates of 74 percent, an average of 11 percentage points lower. In general, research has shown that for every percentage point increase in safety belt use, approximately 270 lives are saved (NHTSA, 2006). Significant increases are often observed when states upgrade their laws from secondary to primary (see e.g., Cosgrove, Preusser, Preusser, & Ulmer, 1998; Eby, Vivoda, & Fordyce, 2002; Houston & Richardson, 2006; Preusser & Preusser, 1997). The most recent example of this took place in Mississippi. Mississippi strengthened its belt law to allow for primary enforcement and saw a jump in belt use from 60.8 percent in 2005 to 73.6 percent in 2006 (NHTSA, 2007). Allowing for primary enforcement enhances the perceived importance of a safety belt use law by both the public and law enforcement community. This enhanced perception ultimately

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<sup>1</sup> This excludes New Hampshire where an adult safety belt law does not exist.

leads to greater compliance (NHTSA, 2006).

Secondary belt use states must rely exclusively on safety belt media and enforcement campaigns to continue to increase belt use. High-visibility police enforcement of the safety belt law is paired with these media messages to get the word out about zero-tolerance enforcement. The most common high-visibility safety belt law enforcement method consists of short-term, intense, highly publicized periods of increased safety belt law enforcement called Selective Traffic Enforcement Programs (sTEPs) (Solomon, Compton, & Preusser, 2004). The most successful sTEP program is the widely publicized Click It or Ticket (CIOT) campaign. In 1993, North Carolina became the first state to use the "Click it or Ticket" slogan. Following the program's success, the slogan was adopted by many other states interested in increasing their belt use rate. A recent evaluation of the CIOT campaign in Minnesota showed that belt use significantly increased after the campaign to the highest level ever observed in the state (Eby, Vivoda, & Cavanagh, 2007).

Although the Minnesota CIOT campaign activities took place in May 2007, it is important to continue to track statewide trends in safety belt use. The study reported here is the ninth full Minnesota statewide survey of safety belt use conducted since the state redesigned the survey in 2003. This survey wave will also provide additional information to track longitudinal changes in safety belt use in Minnesota by several demographic and vehicle characteristics. In addition, the current survey wave will collect information about how many motorcyclists are wearing helmets on Minnesota roadways allowing us to continue tracking helmet use trends in order to understand the scope of this potential problem in the state.

# METHODS

## Sample Design

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 Minnesota, while following federal guidelines for safety belt survey design (NHTSA, 1992, 1998). An ideal sample minimizes total survey error while providing sites that can be surveyed efficiently and economically. To achieve this goal, 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 87 Minnesota counties were rank ordered by population (US Census Bureau, 2003) and the low population counties were eliminated from the sample space. This step reduced the sample space to 37 counties.

These 37 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 examining results from three previous statewide safety belt surveys conducted in Minnesota. Since no historical data were available for 22 of the counties, belt use rates for these counties were estimated using multiple regression based on educational attainment for the other 15 counties ( $r^2 = .35$ ; US Census Bureau, 2003).<sup>2</sup> This factor has been shown previously to correlate positively with belt use. Hennepin County was chosen as a separate stratum because of its disproportionately high VMT. 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, medium belt use, low belt use, and Hennepin County. Hennepin County VMT was slightly lower than the collective VMTs in the other strata (94%). Stratum boundaries for the sample space are shown in Table 1.

To achieve the NHTSA required precision of less than 5 percent relative error,

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<sup>2</sup> Educational attainment was defined as the proportion of population in the county over 25 years of age with a bachelor degree.

the minimum number of observation sites for the survey 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 number was then increased ( $N = 240$ ) to get an adequate representation of belt use for each day of the week and for all daylight hours.

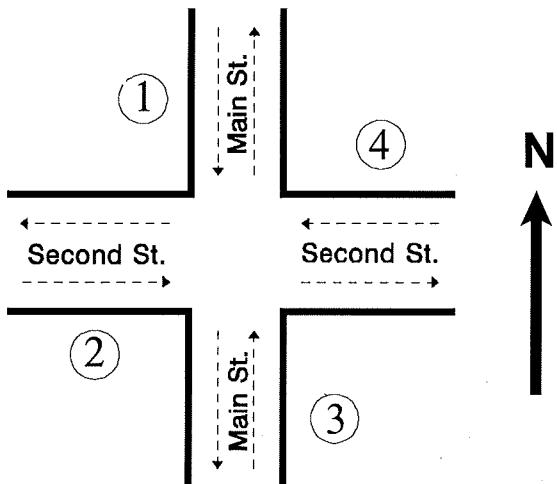
Because total VMT within each stratum was roughly equal, observation sites were evenly divided among the strata (60 each). In addition, since an estimated 29 percent of all traffic in Minnesota occurs on limited-access roadways (Federal Highway Administration, 2002), each stratum was further divided into two strata, one of which contained 17 limited access sites (exit ramps) to represent the 29% of VMT on limited access roadways and one that contained 43 roadway intersections. Thus, the sample design had a total of 8 strata.

| Table 1: Listing of the Counties Within Each Stratum                                      |   |
|---|---|
| Stratum   | Counties  |
| <b>High Belt Use</b><br><b>Stratum 1: intersections</b><br><b>Stratum 5: exit ramps</b>   | Carver, Dakota, Olmsted, Ramsey, Wright   |
| <b>Hennepin</b><br><b>Stratum 2: intersections</b><br><b>Stratum 6: exit ramps</b>        | Hennepin  |
| <b>Medium Belt Use</b><br><b>Stratum 3: intersections</b><br><b>Stratum 7: exit ramps</b> | Beltrami, Blue Earth, Clay, Crow Wing, Freeborn, Goodhue, Kandiyohi, Nicollet, Rice, Scott, Sherburne, St. Louis, Steele, Washington      |
| <b>Low Belt Use</b><br><b>Stratum 4: intersections</b><br><b>Stratum 8: exit ramps</b>    | Anoka, Becker, Benton, Brown, Carlton, Cass, Chisago, Douglas, Isanti, Itasca, McLeod, Morrison, Mower, Otter Tail, Polk, Stearns, Winona |

Within each intersection stratum, observation sites were randomly assigned to a location using a method that ensured each intersection within a stratum an equal probability of selection. Detailed, equal-scale road maps for each county within the sample space were obtained and a grid pattern was overlaid on the maps. The lines of the grid were separated by 1/4 inch, thus creating grid squares that were about 3/4 of a mile per side. The grid patterns were created by printing a grid design onto transparencies and uniquely identifying each grid square by two numbers, a horizontal (x) coordinate and a vertical (y) coordinate. Additional grid transparencies were printed until enough were available to cover all counties within the stratum. Each transparency was numbered to allow for a simpler grid square numbering scheme.

The 43 local intersection sites were chosen by first randomly selecting a transparency number and then a random  $x$  and a random  $y$  coordinate within the identified transparency grid sheet. 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 stratum, or there was no intersection within the square, then a new transparency 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 chosen. Thus, each intersection within the stratum had an equal probability of selection.

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 a given standing location 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 primary intersection site, an alternate site was also selected. The alternate sites were chosen within a five square mile area around the grid square containing the original intersection. This was achieved by randomly picking an  $x, y$  grid coordinate within an alternate site grid transparency consisting of 7 squares horizontally by 7 squares vertically, centered around the primary site. Coordinates were selected until a grid square containing an intersection was found. The observer location at the alternate intersection was determined in the same way as at the primary site.

The 17 freeway exit ramp sites for the exit ramp strata were also selected using a method that allowed equal probability of selection for each exit ramp within the stratum.<sup>3</sup> This was done by enumerating all of the exit ramps within a stratum and randomly selecting, without replacement, 17 numbers between 1 and the number of exit ramps in the stratum. For example, in the low belt use stratum there were a total of 75 exit ramps; therefore a random number between 1 and 75 was generated. This number corresponded to a specific exit ramp within the stratum. To select the next exit ramp, another random number between 1 and 75 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

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<sup>4</sup> 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.

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 the county or if it was already selected as a primary site, then the other direction of travel along the freeway was used.

After all sites and standing locations were randomly selected, all intersection and exit ramp sites were visited by a researcher prior to the beginning of data collection to determine their usability. If an intersection site had no traffic control device on the selected direction of travel, but had traffic control on the intersecting street, the researcher randomly picked a new standing location using a coin flip. If an exit ramp site had no traffic control on the selected direction of travel, the researcher randomly picked a travel direction and lane that had such a device.

The day of week and time of day for site observations were quasi-randomly assigned to sites in such a way that all days of the week and all daylight hours (7:00 am - 6:00 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 dark, 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 a clockwise or counter-clockwise loop. The direction of the loop was determined by the project manager prior to sending the observers 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 quasi-random method is random with respect to this issue.

The observation interval was a constant duration (50 minutes) for each site. 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 under observation was conducted for a set duration (5 minutes) immediately prior to and immediately following the observation period (10 minutes total). These counts were used to estimate the number of possible observations so that sites could be weighted by traffic volume.

### **Data Collection**

Data collection for the survey 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 August 3-18, 2007. 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. Vehicles were included without regard to the state in which the vehicle was registered.

#### *Data Collection Forms*

Data were collected using personal digital assistants (PDAs). For a more detailed description of the PDA data collection process, see Appendix A. To begin, an electronic form was developed for data collection containing: a site description section and a safety belt observation section. For each site surveyed, separate electronic copies of the form were created in advance. The site description form section allowed observers to provide descriptive information including the site 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 electronically sketch the intersection and to identify observation location. Finally, a comments section was available 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.

The safety belt observation section of the form was used to record safety belt use or motorcycle helmet use, passenger information, and vehicle information. For each vehicle surveyed, shoulder belt use or helmet use, sex, and estimated age of the driver and the front-outboard passenger (or motorcycle passenger) were recorded along with vehicle type. Children riding in child restraint devices (CRDs) 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 belted in the analysis. 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.

#### *Procedures at Each Site*

All sites in the sample were visited by one observer for a period of one hour. Upon arriving at a site, the observer determined whether observations were possible at the site. If observations were not possible (e.g., due to construction), the observer proceeded to the alternate site. Otherwise, the observer completed the site description form and then moved to their observation position near the traffic control device. Observers were instructed to observe only vehicles in the lane immediately adjacent to the curb, regardless of the number of lanes present.

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. 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.

#### *Observer Training*

Prior to data collection, members of the Minnesota Department of Public Safety,

Office of Traffic Safety staff were trained on field data collection procedures. The training of OTS staff included both classroom review of data collection procedures and practice field observations. Field observers were then hired and trained by OTS staff on the proper procedures for data collection. 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). During data collection, observers were spot checked in the field by a field supervisor to ensure adherence to study protocols.

### *Descriptive Statistics*

Table 2 shows descriptive statistics for the survey. As shown in this table, the observations were fairly well distributed over day of week. Observations were also well distributed by time of day except for the earliest and latest time periods. 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 the majority of sites observed were the primary sites and that observations were mostly conducted during sunny or cloudy conditions. A small number of observations were conducted during rain, and none during snow.

| Table 2. Descriptive Statistics for the 240 Observation Sites |                    |           |             |           |         |              |
|---|--------------------|-----------|-------------|-----------|---------|--------------|
| Day of Week   | Observation Period |           | Site Choice |           | Weather |              |
| Monday  | 13.6%              | 7-9 a.m.  | 10.2%       | Primary   | 95.8%   | Sunny 58.9%  |
| Tuesday   | 17.4%              | 9-11 a.m. | 24.1%       | Alternate | 4.2%    | Cloudy 34.7% |
| Wednesday   | 8.9%               | 11-1 p.m. | 23.7%       |           |         | Rain 6.4%    |
| Thursday  | 14.4%              | 1-3 p.m.  | 21.6%       |           |         | Snow 0.0%    |
| Friday  | 20.3%              | 3-5 p.m.  | 15.7%       |           |         |              |
| Saturday  | 13.6%              | 5-7 p.m.  | 4.7%        |           |         |              |
| Sunday  | 11.8%              |           |             |           |         |              |
| TOTALS  | 100.0%             |           | 100.0%      |           | 100.0%  | 100.0%       |

### **Data Processing and Estimation Procedures**

The safety belt data were entered into PDAs directly, so no additional data entry

was required. For each site, computer analysis programs determined the number of observed vehicles, belted and unbelted drivers, belted and unbelted passengers, and use and nonuse of motorcycle helmets for drivers and 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 Minnesota based on VMT. As also discussed, not all eligible vehicles passing the observer could be included in the survey. To correct for this limitation, the vehicle count information was used to weight the observed traffic volumes so that an estimate of traffic volume at the site could be derived.

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. The resulting number was the estimated number of vehicles passing through the site if all eligible 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. All analyses reported are based upon the weighted values.

#### *Estimation of Safety Belt Use Rates*

The overall safety belt use rate for Minnesota was calculated utilizing the following procedure. The safety belt use rate for each stratum was calculated using the following formula:

$$R_s = \sum \frac{est_i}{obs_i} belted_i / \sum \frac{est_i}{obs_i} occs_i$$

Where  $R_s$  is the use rate for a stratum,  $i$  is a site in the stratum,  $est_i$  is the estimated number of possible observations had every eligible vehicle been recorded (based on the vehicle counts),  $obs_i$  is the actual number of people observed,  $belted_i$  is the number of people observed using a safety belt, and  $occ_i$  is the number of occupants.

Because the number of intersections among the first four strata and the number of exit ramps among the last four strata differed, the probability of an intersection or exit ramp being randomly selected differed between strata. Therefore, we painstakingly counted all intersections in the first four strata and all exit ramps in the last four strata and used these counts to weight use rates when combining them. The first four strata (intersections) were combined using the following formula:

$$R_i = \frac{\frac{4N_1}{N_{all}}R_1 + \frac{4N_2}{N_{all}}R_2 + \frac{4N_3}{N_{all}}R_3 + \frac{4N_4}{N_{all}}R_4}{\frac{4N_1}{N_{all}} + \frac{4N_2}{N_{all}} + \frac{4N_3}{N_{all}} + \frac{4N_4}{N_{all}}}$$

$$R_i = \frac{N_1R_1 + N_2R_2 + N_3R_3 + N_4R_4}{N_1 + N_2 + N_3 + N_4}$$

where  $R_i$  is the combined use rate for the first four strata (intersections),  $N_1$  is the total number of intersections in stratum 1 and so on, and  $N_{all}$  is the total number of intersections among all four strata.. The use rate for the exit ramp strata (strata 5-8) was calculated using the following formula:

$$R_e = \frac{\frac{4N_5}{N_{all}}R_5 + \frac{4N_6}{N_{all}}R_6 + \frac{4N_7}{N_{all}}R_7 + \frac{4N_8}{N_{all}}R_8}{\frac{4N_5}{N_{all}} + \frac{4N_6}{N_{all}} + \frac{4N_7}{N_{all}} + \frac{4N_8}{N_{all}}}$$

$$R_e = \frac{N_5R_5 + N_6R_6 + N_7R_7 + N_8R_8}{N_5 + N_6 + N_7 + N_8}$$

where  $R_e$  is the combined use rate for strata 5-8 (exit ramps),  $N_5$  is the total number of exit ramps in stratum 5 and so on, and  $N_{all}$  is the total number of exit ramps among all four strata.

Because only statewide VMT for limited access roadways was available and because only 29 percent of Minnesota travel is on limited access roadways, the statewide safety belt rate was determined weighting  $R_e$  and  $R_i$  by their VMT using the following equation:

$$R_{MN} = \frac{VMT_i R_i + VMT_e R_e}{VMT_i + VMT_e}$$

### *Estimation of Variance*

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

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

where  $\text{var}(r_i)$  equals the variance within a stratum,  $n$  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 at all 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 was negligible and was dropped in the variance calculations as is common practice.

Again because the number of intersections and exit ramps differed among the strata, when the variances were combined, they were weighted by the number of intersection/exit ramps within each strata. The variances for the first four (intersection) strata were combined using the following formula:

$$\text{var}(R_i) = \left( \frac{N_1}{N_{all}} \right)^2 \text{var}(R_1) + \left( \frac{N_2}{N_{all}} \right)^2 \text{var}(R_2) + \left( \frac{N_3}{N_{all}} \right)^2 \text{var}(R_3) + \left( \frac{N_4}{N_{all}} \right)^2 \text{var}(R_4)$$

The variance for the exit ramp strata were combined using the following formula:

$$\text{var}(R_e) = \left( \frac{N_5}{N_{all}} \right)^2 \text{var}(R_5) + \left( \frac{N_6}{N_{all}} \right)^2 \text{var}(R_6) + \left( \frac{N_7}{N_{all}} \right)^2 \text{var}(R_7) + \left( \frac{N_8}{N_{all}} \right)^2 \text{var}(R_8)$$

The overall variance was determined by weighting the intersection and exit ramp variances relative to the statewide VMT for these types of roadways using the following equation:

$$\text{var}(R) = \frac{(VMT_i)^2 \text{var}(R_i) + (VMT_e)^2 \text{var}(R_e)}{(VMT_i + VMT_e)^2}$$

The 95 percent confidence band was calculated using the formula:

$$95\% \text{ ConfidenceBand} = R \pm 1.96\sqrt{\text{var}(R)}$$

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

$$\text{RelativeError} = \frac{SE}{R}$$

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

## RESULTS

This survey reports statewide safety belt use for four vehicle types combined (passenger cars, vans/minivans, sport-utility vehicles, and pickup trucks) and use rates for occupants in each vehicle type separately. In addition, motorcycle helmet use data are reported on motorcycle riders. Following NHTSA (1998) guidelines, the survey included commercial vehicles. Thus, all rates shown in this report include occupants from both commercial and noncommercial vehicles.

### Overall Safety Belt Use

Table 3 shows that the estimated safety belt use rate in Minnesota for all front-outboard occupants traveling in passenger cars, sport-utility vehicles, vans/minivans, and pickup trucks in the front-outboard positions in Minnesota during August 2007 was **87.8 ± 1.4** percent. The "±" value following the use rate indicates a 95 percent confidence interval around the percentage. The relative error for the statewide safety belt use rate of 0.9 percent was well below the 5 percent maximum level required by NHTSA.

**Table 3: Safety Belt Use Rates and Unweighted Ns as a function of Stratum, Roadway Type, and Overall Statewide Safety Belt Use**

|                                     | Percent Use        | Unweighted N  |
|-------------------------------------|--------------------|---------------|
| Stratum 1 (High, Intersections)     | 87.8               | 1,327         |
| Stratum 2 (Hennepin, Intersections) | 89.2               | 2,663         |
| Stratum 3 (Medium, Intersections)   | 87.8               | 1,251         |
| Stratum 4 (Low, Intersections)      | 85.6               | 1,558         |
| Stratum 5 (High, Exit Ramps)        | 91.0               | 1,854         |
| Stratum 6 (Hennepin, Exit Ramps)    | 89.7               | 1,560         |
| Stratum 7 (Medium, Exit Ramps)      | 87.1               | 1,421         |
| Stratum 8 (Low, Exit Ramps)         | 90.6               | 776           |
| Minnesota, Intersections            | 87.0               | 6,799         |
| Minnesota, Exit Ramps               | 89.8               | 5,611         |
| STATE OF MINNESOTA                  | <b>87.8 ± 1.4%</b> | <b>12,410</b> |

### **Safety Belt Use by Subcategory**

*Vehicle Type and Stratum.* Estimated belt use rates and unweighted numbers of occupants by stratum and vehicle type are shown in Tables 4a through 4d. Within each vehicle type we find little systematic differences in safety belt use by stratum. However, comparing across vehicle types and strata, we find that safety belt use is lower for pickup truck occupants in nearly all cases. Thus, enforcement and public information and education (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          | 88.3               | 624          |
| Stratum 2          | 90.0               | 1,365        |
| Stratum 3          | 89.2               | 529          |
| Stratum 4          | 88.2               | 698          |
| Stratum 5          | 89.9               | 1,011        |
| Stratum 6          | 90.7               | 902          |
| Stratum 7          | 88.2               | 677          |
| Stratum 8          | 90.0               | 403          |
| STATE OF MINNESOTA | <b>89.1 ± 1.6%</b> | 6,209        |

**Table 4b. Percent Shoulder Belt Use by Stratum (Sport-Utility Vehicles)**

|                    | Percent Use         | Unweighted N |
|--------------------|---------------------|--------------|
| Stratum 1          | 91.9                | 257          |
| Stratum 2          | 92.2                | 616          |
| Stratum 3          | 86.6                | 246          |
| Stratum 4          | 91.8                | 275          |
| Stratum 5          | 93.8                | 357          |
| Stratum 6          | 88.2                | 269          |
| Stratum 7          | 89.2                | 243          |
| Stratum 8          | 91.6                | 139          |
| STATE OF MINNESOTA | <b>90.1 ± 2.0 %</b> | 2,402        |

**Table 4c. Percent Shoulder Belt Use by Stratum (Vans/Minivans)**

|                    | Percent Use        | Unweighted N |
|--------------------|--------------------|--------------|
| Stratum 1          | 92.0               | 222          |
| Stratum 2          | 88.5               | 343          |
| Stratum 3          | 93.2               | 187          |
| Stratum 4          | 84.8               | 229          |
| Stratum 5          | 95.3               | 258          |
| Stratum 6          | 90.6               | 219          |
| Stratum 7          | 89.1               | 214          |
| Stratum 8          | 96.6               | 107          |
| STATE OF MINNESOTA | <b>90.3 ± 2.3%</b> | 1,779        |

**Table 4d. Percent Shoulder Belt Use by Stratum (Pickup Trucks)**

|                    | Percent Use        | Unweighted N |
|--------------------|--------------------|--------------|
| Stratum 1          | 76.9               | 224          |
| Stratum 2          | 80.6               | 339          |
| Stratum 3          | 82.9               | 289          |
| Stratum 4          | 75.7               | 356          |
| Stratum 5          | 85.9               | 228          |
| Stratum 6          | 85.1               | 170          |
| Stratum 7          | 81.4               | 287          |
| Stratum 8          | 86.2               | 127          |
| STATE OF MINNESOTA | <b>80.6 ± 2.9%</b> | 2,020        |

**Site Type.** Estimated safety belt use by type of site, vehicle type, and all vehicles combined is shown in Table 5. For all vehicles combined and for each vehicle type, safety belt use was higher for exit ramp sites than for local intersection sites, indicating that belt use for freeway travel was higher than for travel on local roads.

**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. Little systematic difference in belt use was found by time of day.

*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 2-week period. Belt use clearly varied from day to day, few systematic differences were evident.

*Weather.* Estimated belt use by prevailing weather conditions, vehicle type, and all vehicles combined is shown in Table 5. Very few sites were conducted during rainy weather conditions, yet these sites showed extremely low use of safety belts. There was essentially no difference in belt use whether it was sunny or cloudy during data collection; a common finding in safety belt research.

*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 for all vehicle types combined and for each separate vehicle type.

*Age.* Estimated safety belt use by age, vehicle type, and all vehicle types combined is shown in Table 5. As there were very few 0-10-year olds observed in the current study, the estimated safety belt use rate for this age group is not meaningful. Excluding this group, we found that belt use was high for the 11-15-year olds. Belt use rates for the 16-29-year old age group were consistently the lowest, while rates for the 30-64-year old age group are generally the same or higher than those of occupants older than 64 years of age. This pattern shows that new drivers and young drivers (16-29 years of age) should be a focus of safety belt use messages and programs.

*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 there was little systematic difference in belt use by seating position.

*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, and will be excluded from the following discussion, because the unweighted number of occupants is quite low. 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 was found in the 16-29-year old age group where the estimated belt use rate was 13 percentage points higher for females than for males. While still large, this difference in belt use is shrinking. During last year's survey we found a difference of 16 percentage points (Eby, Vivoda, & Cavanagh, 2006). Still, these results

argue strongly for statewide efforts to continue to be directed toward persuading young males, and males in general, to wear their safety belts.

**Table 5. Percent Shoulder Belt Use and Unweighted N by Vehicle Type and Subgroup**

|                    | All Vehicles |        | Car         |       | SUV         |       | Van/Minivan |       | Pickup Truck |       |
|--------------------|--------------|--------|-------------|-------|-------------|-------|-------------|-------|--------------|-------|
|                    | Percent Use  | N      | Percent Use | N     | Percent Use | N     | Percent Use | N     | Percent Use  | N     |
| <u>Overall</u>     | 87.8         | 12,410 | 89.1        | 6,209 | 90.1        | 2,402 | 90.3        | 1,779 | 80.6         | 2,020 |
| <u>Site Type</u>   |              |        |             |       |             |       |             |       |              |       |
| Intersection       | 87.0         | 6,799  | 88.7        | 3,216 | 89.9        | 1,394 | 89.2        | 981   | 78.9         | 1,208 |
| Exit Ramp          | 89.8         | 5,611  | 89.9        | 2,993 | 90.6        | 1,008 | 93.0        | 798   | 84.9         | 812   |
| <u>Time of Day</u> |              |        |             |       |             |       |             |       |              |       |
| 7 - 9 a.m.         | 78.1         | 1,804  | 86.5        | 975   | 63.0        | 309   | 92.1        | 228   | 45.2         | 292   |
| 9 - 111 a.m.       | 86.7         | 2,234  | 86.9        | 1,111 | 89.5        | 419   | 92.7        | 336   | 79.1         | 368   |
| 11 - 1 p.m.        | 90.7         | 3,173  | 90.8        | 1,619 | 93.5        | 573   | 94.2        | 492   | 84.7         | 489   |
| 1 - 3 p.m.         | 86.9         | 3,163  | 89.5        | 1,470 | 97.6        | 684   | 88.5        | 455   | 78.4         | 554   |
| 3 - 5 p.m.         | 89.5         | 1,480  | 89.6        | 711   | 90.6        | 309   | 89.2        | 224   | 87.8         | 236   |
| 5 - 7 p.m.         | 67.1         | 556    | 64.9        | 323   | 96.4        | 108   | 100         | 44    | 46.8         | 81    |
| <u>Day of Week</u> |              |        |             |       |             |       |             |       |              |       |
| Monday             | 88.5         | 1,578  | 93.4        | 785   | 93.5        | 271   | 93.1        | 230   | 73.7         | 292   |
| Tuesday            | 83.6         | 1,674  | 85.6        | 806   | 88.9        | 331   | 80.7        | 213   | 77.4         | 324   |
| Wednesday          | 76.8         | 792    | 82.2        | 313   | 81.6        | 166   | 77.7        | 120   | 67.6         | 193   |
| Thursday           | 88.6         | 1,915  | 89.8        | 1,029 | 89.6        | 334   | 88.2        | 277   | 82.7         | 275   |
| Friday             | 85.6         | 3,876  | 89.9        | 2,087 | 87.6        | 735   | 81.6        | 546   | 73.2         | 508   |
| Saturday           | 87.6         | 2,044  | 89.3        | 959   | 85.3        | 468   | 94.1        | 304   | 80.1         | 313   |
| Sunday             | 87.8         | 531    | 86.2        | 230   | 90.7        | 97    | 98.3        | 89    | 76.7         | 115   |
| <u>Weather</u>     |              |        |             |       |             |       |             |       |              |       |
| Sunny              | 87.5         | 7,340  | 87.8        | 3,767 | 90.6        | 1,348 | 92.6        | 1,070 | 80.8         | 1,155 |
| Cloudy             | 87.5         | 4,234  | 90.2        | 2,047 | 88.9        | 849   | 87.7        | 583   | 79.2         | 755   |
| Rainy              | 70.0         | 836    | 75.6        | 395   | 76.1        | 205   | 50.1        | 126   | 65.1         | 110   |
| <u>Sex</u>         |              |        |             |       |             |       |             |       |              |       |
| Male               | 84.2         | 6,738  | 86.0        | 3,021 | 85.6        | 1,147 | 87.0        | 921   | 79.4         | 1,649 |
| Female             | 92.0         | 5,627  | 91.6        | 3,162 | 93.7        | 1,248 | 93.5        | 854   | 86.6         | 363   |
| <u>Age</u>         |              |        |             |       |             |       |             |       |              |       |
| 0 - 10             | 88.0         | 69     | 94.0        | 31    | 97.8        | 14    | 92.0        | 13    | 74.3         | 11    |
| 11 - 15            | 88.4         | 177    | 96.5        | 61    | 90.8        | 47    | 84.1        | 50    | 77.4         | 19    |
| 16 - 29            | 83.5         | 3,192  | 85.7        | 1,991 | 83.3        | 513   | 84.9        | 255   | 74.2         | 433   |
| 30 - 64            | 89.2         | 7,610  | 89.9        | 3,279 | 92.3        | 1,650 | 92.7        | 1,278 | 82.3         | 1,403 |
| 65 - Up            | 89.4         | 1,350  | 92.8        | 841   | 88.9        | 174   | 84.3        | 182   | 77.1         | 153   |
| <u>Position</u>    |              |        |             |       |             |       |             |       |              |       |
| Driver             | 87.2         | 10,236 | 88.7        | 5,177 | 89.5        | 1,996 | 90.3        | 1,382 | 79.8         | 1,681 |
| Passenger          | 89.8         | 2,174  | 90.4        | 1,032 | 91.4        | 406   | 89.8        | 397   | 84.4         | 339   |

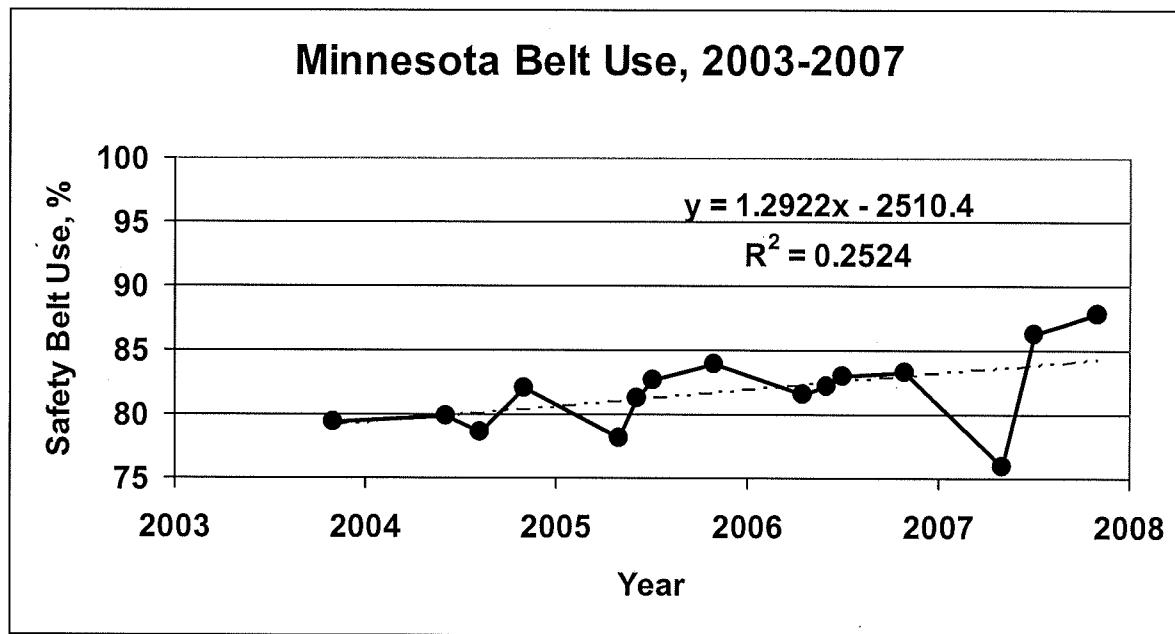
**Table 6. Percent Shoulder Belt Use and Unweighted N by Age and Sex  
(All Vehicle Types Combined)**

| Age Group | Male        |              | Female      |              |
|-----------|-------------|--------------|-------------|--------------|
|           | Percent Use | Unweighted N | Percent Use | Unweighted N |
| 0 - 10    | 88.1        | 41           | 97.6        | 27           |
| 11 - 15   | 81.6        | 96           | 93.2        | 80           |
| 16 - 29   | 76.6        | 1,622        | 89.6        | 1,558        |
| 30 - 64   | 86.6        | 4,223        | 92.8        | 3,362        |
| 65 - up   | 86.1        | 752          | 92.7        | 596          |

## Safety Belt Use Trends

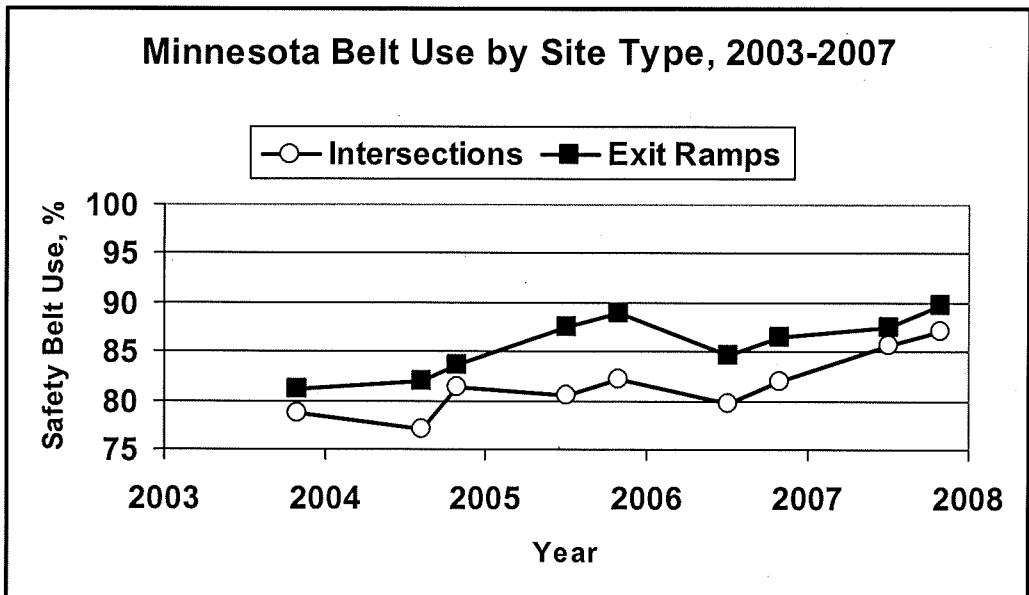
The current survey marks the ninth full statewide survey that has utilized the survey designed approved by NHTSA in 2003. In addition to the full surveys, the authors have also conducted several mini-surveys that yielded overall statewide belt use estimates only. This section examines trends in Minnesota belt use since August 2003.

*Statewide Belt Use:* Figure 2 shows the estimated overall statewide safety belt use rate for Minnesota from August, 2003 to the present survey conducted in August, 2007. As can be seen in this figure, safety belt use has steadily increased over the past several years.



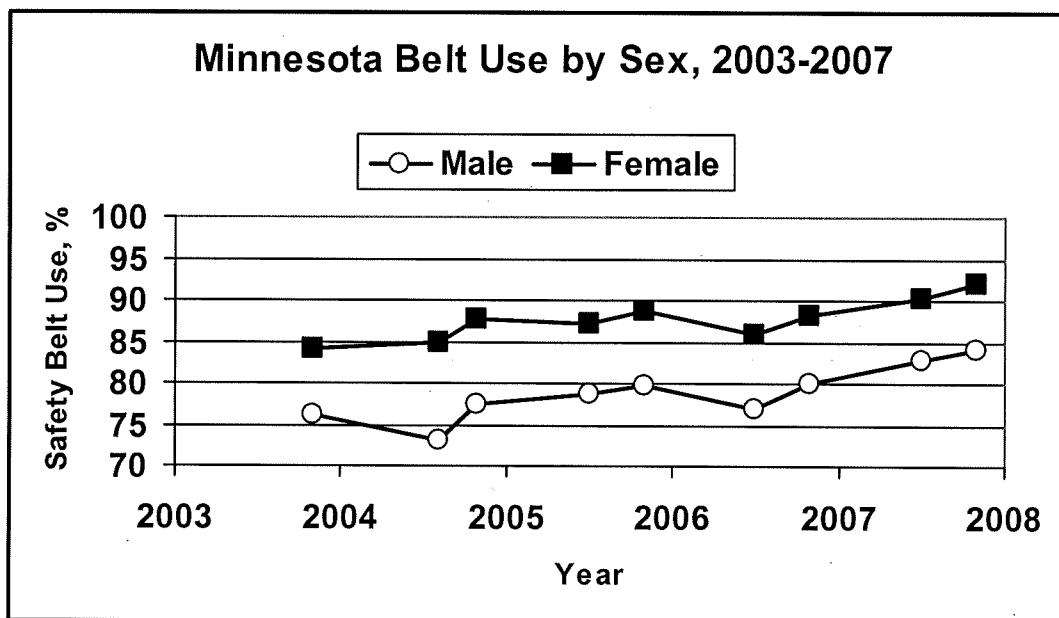
**Figure 2: Minnesota safety belt use from 2003 to 2007 and best fitting trend line.**

*Site Type:* Figure 3 shows the estimated statewide safety belt use rates by site type for Minnesota since 2003. Only data from full surveys have been included in this graph, since the mini-surveys have too few observations to make solid estimates of belt use by this variable. As can be seen in this figure, safety belt use at exit ramps has been consistently higher than use at intersections. Although there has been a fair amount of variability from survey-to-survey, belt use at both types of sites has increased gradually at about the same rate since 2003.



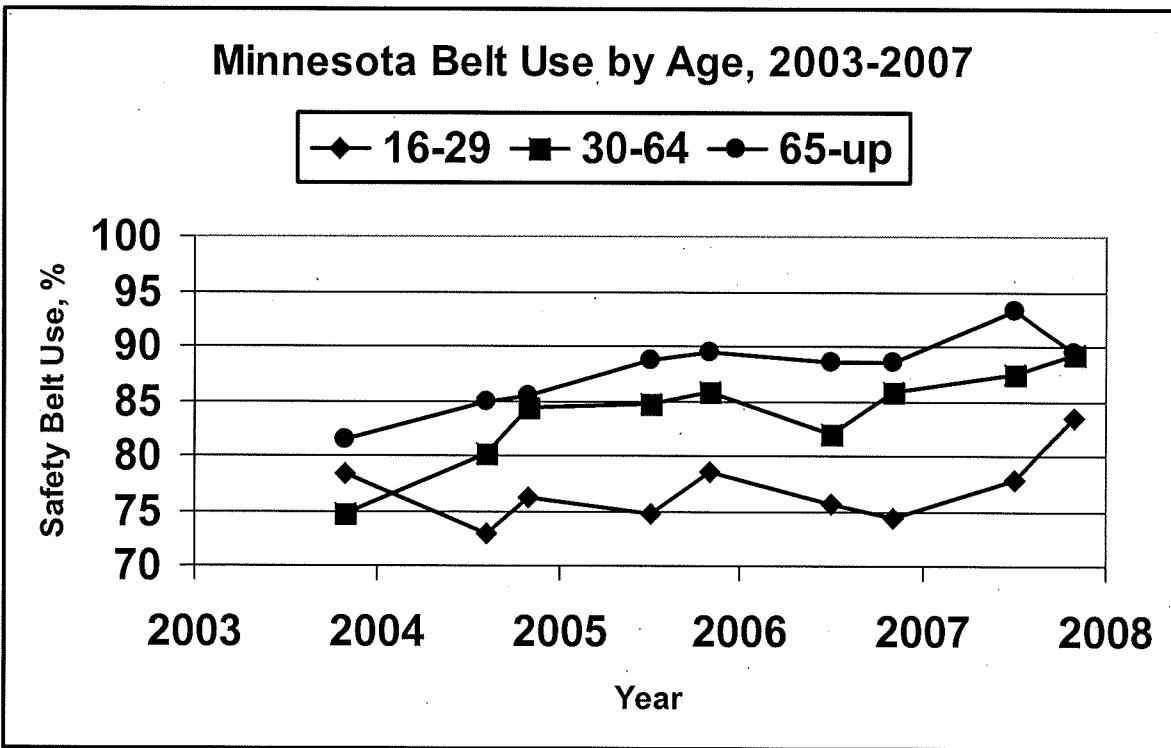
**Figure 3: Minnesota safety belt by type of site, 2003-2007.**

Sex: Figure 4 shows the estimated statewide safety belt use rate by sex for Minnesota since 2003. As can be seen in this figure, safety belt use for females has been consistently higher than use for males, a common finding in the occupant protection device use literature. Belt use for both sexes appears to have increased at the same rate since 2003.



**Figure 4: Minnesota safety belt by sex, 2003-2007.**

*Age:* Figure 5 shows the estimated statewide safety belt use rate by age for Minnesota since 2003. As can be seen in this figure, safety belt use for the 16-29-year olds is consistently the lowest of any age group but is showing an upward trend. Belt use for the two youngest age groups has been excluded from this graph, due to the low number of vehicle occupants in these age groups. Disregarding the two youngest age groups, belt use across survey waves was directly related to age.



**Figure 5: Minnesota safety belt by age, 2003-2007.**

*Seating Position:* Figure 6 shows the estimated statewide safety belt use rate by seating position for Minnesota since 2003. Safety belt use for drivers has been slightly, but consistently, greater than or equal to the safety belt use of front-outboard passengers in all survey waves, except for the current wave where belt use was found to be higher for passengers.

### Minnesota Belt Use by Seating Position, 2003-2007

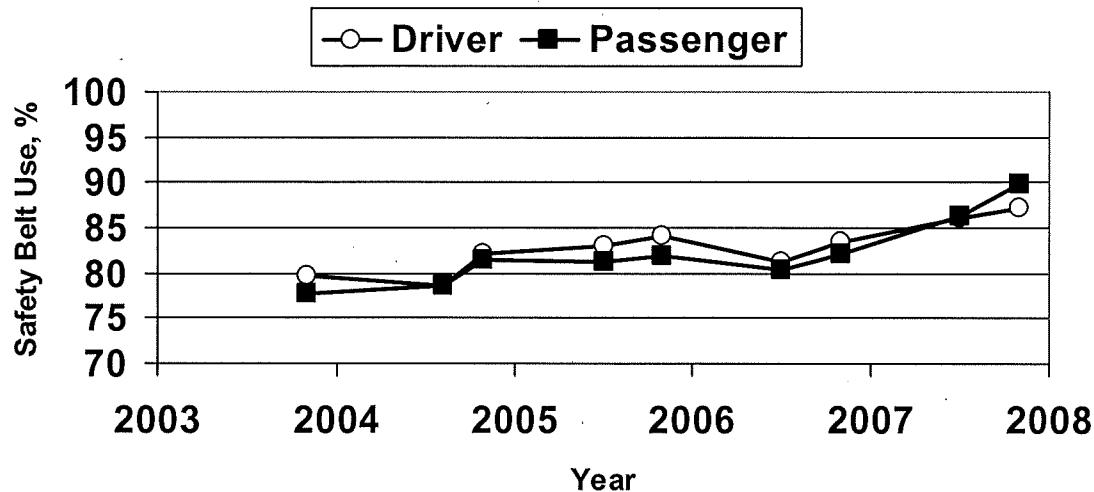


Figure 6: Minnesota safety belt use by Seating Position, 2003-2007.

*Vehicle Type:* Figure 7 shows the estimated statewide safety belt use rate by type of vehicle for Minnesota since 2003. As can be seen in this figure, belt use for cars, SUVs, and van/minivans were roughly the same during each survey wave. Safety belt use in pickup trucks, however, has been consistently lower than for other vehicle types. One positive note is that safety belt use for pickup truck occupants has been increasing at a faster rate than for the other three vehicle types.

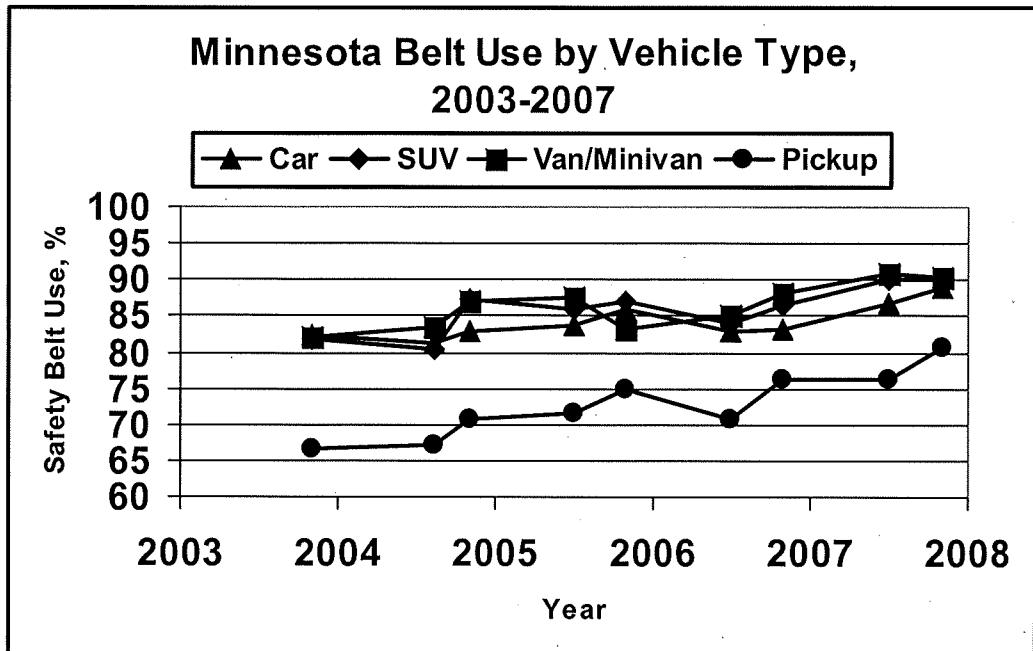


Figure 7: Minnesota safety belt use by vehicle type, 2003-2007.

## **Motorcycle Helmet Use**

The current survey recorded helmet use of motorcycle riders that happen to be observed during the safety belt data collection. Because the safety belt survey design was based on travel patterns of passenger vehicles in Minnesota instead of motorcycle patterns and the low number of motorcycle riders seen in the survey (124 motorcycle riders observed), no weighting of these data were performed. Instead, we present the unweighted helmet use rates so that a picture of the helmet use patterns in Minnesota can be realized. The results are summarized in Table 7.

**Table 7: Motorcycle Helmet Use in Minnesota by Demographic Variables**

|                    | <b>Percent Use</b> | <b>N</b> |
|--------------------|--------------------|----------|
| <u>Overall</u>     | 59.7               | 124      |
| <u>Time of Day</u> |                    |          |
| 7 - 9 a.m.         | 72.7               | 11       |
| 9 - 11 a.m.        | 27.8               | 18       |
| 11 - 1 p.m.        | 59.6               | 47       |
| 1 - 3 p.m.         | 57.7               | 26       |
| 3 - 5 p.m.         | 86.7               | 15       |
| 5 - 7 p.m.         | 71.4               | 7        |
| <u>Day of Week</u> |                    |          |
| Monday             | 69.2               | 13       |
| Tuesday            | 63.2               | 19       |
| Wednesday          | 70.0               | 10       |
| Thursday           | 53.3               | 15       |
| Friday             | 63.6               | 44       |
| Saturday           | 33.3               | 9        |
| Sunday             | 50.0               | 14       |
| <u>Weather</u>     |                    |          |
| Sunny              | 59.3               | 81       |
| Cloudy             | 58.5               | 41       |
| Rainy              | 100.0              | 2        |
| <u>Sex*</u>        |                    |          |
| Male               | 58.3               | 103      |
| Female             | 65.0               | 20       |
| <u>Age†</u>        |                    |          |
| 0 - 10             | ---                | 0        |
| 11 - 15            | 100.0              | 1        |
| 16 - 29            | 82.1               | 28       |
| 30 - 64            | 52.8               | 91       |
| 65 - Up            | 66.7               | 3        |
| <u>Position</u>    |                    |          |
| Driver             | 58.7               | 109      |
| Passenger          | 66.7               | 15       |

\* There was 1 motorcyclist where sex was not identified.

† There was 1 motorcyclist where age was not identified.

## DISCUSSION

This report has three purposes: (1) to present the results of a full statewide survey of safety belt use, conducted in August 2007; (2) to report and interpret safety belt use trends in Minnesota since August 2003; and (3) to report rates of motorcycle helmet use in Minnesota. All data for the study were collected through direct observation.

The statewide safety belt use survey showed that Minnesota belt use has continued to increase since the last survey conducted three months ago. In fact, the current rate of 87.8 percent is the highest rate ever achieved in Minnesota and is above the national average (Glassbrenner, 2005a). Still, this rate is below the national goal of 90 percent set by NHTSA.

It should be noted that the outcomes observed in the current survey may have been influenced by the catastrophic collapse of the I-35W bridge in Minneapolis during the evening rush hour of August 1, 2007. The collapse, which involved about 100 vehicles, killed 13 people and injured more than 100. The event received worldwide news coverage with all major US news organizations sending reporters to Minneapolis for live coverage. Some of this coverage included interviews of experts, including an ABC news feature that highlighted the value of safety belt use in helping vehicle occupants survive the bridge collapse. That feature was titled "Seat belts key to survival in bridge collapse." There were also several news stories that interviewed people who survived the collapse. Many of these people attributed their use of belts as a factor in their surviving the collapse. Here are a few quotes from various news sources:

- "We all had our seat belts on. We had five people in the car. We feel so lucky because you didn't feel like you were going to live through it." Jamie Winegar, *Minnesota Public Radio*, August 2, 2007
- "My seat belt probably saved my life." Alicia Babatz, *Star Tribune*, *Minneapolis-St. Paul*, August 3, 2007.
- "Thank God I was wearing my seat belt. I can't believe I'm alive." Gary Babineau, *New York Daily News*, August 2, 2007.

On the other hand, there were also experts quoted that suggested belt use may have hindered survival:

- "You've got to think methodically. Otherwise, what happens first is you'll hit the water and then you'll try to get out and you'll forget you didn't unbuckle your seat belt." Lt. Joseph Conway of the Dive Team at the Madison, Wis., Fire Department. *ABC News*, August 6, 2007
- "It's not surprising that the missing haven't been found yet...they could be trapped in tangles of rebar or pinned in vehicles by seat belts and air bags, or by debris." John L. Sanders, director of the Ohio-based National Underwater Rescue Recovery Institute, *Associated Press*, August 6, 2007.

Because of the unfortunate fact that many of the victim's bodies were trapped under debris, bodies were being recovered until the evening of August 20, 2007. This prolonged recovery effort meant that the bridge collapse was the top news story in Minnesota and elsewhere for about three weeks, the entire duration of the direct observation survey.

It is unknown how this event influenced Minnesota belt use during this survey wave. Evidence from the current survey suggests that the collapse may have increased belt use. It is safe to assume that all Minnesota motorists were exposed to the media covering this event. If one assumes also that the event had no influence on full time belt users (who already perceive the benefits of belt use) or hard-core nonusers (who already make the conscious choice not to use a belt), then the bridge collapse would have only impacted the part-time users. According to the most recent Motor Vehicle Occupant Protection Use Survey (Boyle and Vanderwolf, 2003), the groups most likely to report part-time use are males, young people (16-24), and occupants of pickup trucks. An examination of Figures 4 (sex), 5 (age), and 7 (vehicle type) show that there were increases in belt use when compared to the survey conducted three months prior to the present survey for males, young people, and pickup truck occupants. No similar increase was found for older age groups or other vehicle types, but female belt use also increased. Although far from conclusive, these results suggest that the tragic bridge collapse may have had the positive effect of raising belt use among Minnesota's high risk driver groups.

Analysis of safety belt use by the various subgroups showed that there are several areas on which Minnesota should continue to focus efforts to increase safety

belt use. One of the lowest use group discovered was young people. While this group has historically been found to have lower safety belt use than other groups, it is also the group in which the biggest gains in traffic-crash-related-injury reduction can be found. On a per population basis, young drivers in the US had the highest rate of involvement in fatal crashes of any age group in 2001 and their fatality rate based on vehicle miles traveled was four times greater than the comparable rate for drivers age 26 to 65 (NHTSA, 2002). Teenage drivers have by far the highest fatal crash involvement rate of any age group based on number of licensed drivers. Motor vehicle injury rates also show that teenagers continue to have vastly higher rates than the population in general.

We discovered large differences in safety belt use between males and females, although this difference has been shrinking. Understanding why there is a difference in belt use between males and females is very important. In the current survey there is a belt use difference of nearly 8 percentage points between the sexes. According to the Motor Vehicle Occupant Safety Survey, when safety belt non-users and part-time users were asked why they did not wear belts, males and females give different reasons (Block, 2000). Females state "I forgot to put it on" as the most important reason for non-use, while males list "I'm only driving a short distance" as the reason most important to them. An analysis of the types of answers given for non-use by sex revealed that males tend to report reasons that are related to a lower perception of risk (e.g. low probability of a crash or receiving a citation), while more of the answers given by female non-users and part-time users are related to discomfort and forgetting. Traffic safety professionals in Minnesota could use this information for the development of programs aimed at increasing belt use among males.

Occupants of pickup trucks also define a unique population that historically exhibits low safety belt use in Minnesota, and may therefore 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). Focus group work by the Center for Applied Research (NHTSA, 2004b) with rural pickup truck drivers explored why these occupants wear, or do not wear, safety belts. The following reasons were given

for nonuse of safety belts: vehicle size protects them from serious injury; safety belt not needed for short or work trips; fear of being trapped in vehicle after a crash; inconsistency between belt law and motorcycle helmet law; and opposition to government mandate. Reasons given for use were: presence of family or friends; travel on interstate highways, travel during inclement weather; and when not traveling in their pickup truck. This information provides a starting point for the development of programs designed to influence pickup truck occupant safety belt use, as efforts to encourage belt use by occupants of pickup trucks are warranted. The Center for Applied Research (NHTSA, 2004b) study also suggests passage of mandatory motorcycle helmet use law might also increase belt use among pickup truck drivers.

The good news about pickup truck occupants is that belt use for the first time is over 80 percent. Whether this increase is due to the bridge collapse or the direct results of Minnesota's efforts to raise belt use in this vehicle type remains to be seen.

Our analyses of helmet use showed that only about 60 percent of motorcycle occupants were using helmets—a rate that was quite higher than the rate of 44 percent observed last year. The current use rate is about the same as the national helmet use rate of 58 percent and well above the use rate of 48 percent for states with no mandatory helmet use law (Glassbrenner, 2005b). It is unknown why helmet use increased by more than 15 percentage points from last year, but it is possible that the bridge collapse may have influenced helmet use, as motorcycle riders are a high risk group.

While helmet use is still far from 100 percent in Minnesota, the safety implications of this use rate may be magnified even more. Based on national data (Glassbrenner, 2005b), it is likely that about 6-16 percent of those recorded as wearing helmets, are using helmets that do not meet Federal Motor Vehicle Safety Standard 218. This standard sets minimum requirements for the construction and crashworthiness of helmets. The two main issues are the helmet thickness and the durability of the chin strap. Many riders purchase helmets that do not meet these requirements which are sold as "novelty" helmets. Novelty helmets do not provide proper protection in a crash. Future surveys of helmet use in Minnesota should attempt

to distinguish between legal and novelty helmets during data collection to further explore this issue.

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**APPENDIX A:**  
**PDA Data Collection Details**

In the current study all data collection was conducted using Personal Digital Assistants (PDAs). The transition from paper to PDA data collection was made primarily to decrease the time necessary to move from the end of the data collection phase of a survey to data analysis. With paper data, there is automatically two to three weeks of additional time built-in while the paper data are being entered into an electronic format. Before making this transition, a pilot study was conducted to compare data collection by PDA to paper. Several key factors were tested during the pilot study including accuracy, volume (speed), ease of use, mechanical issues (i.e. battery life), and environmental issues (i.e. weather, daylight). The pilot study found PDA use to be equal to, or better than paper data collection on every factor tested. Before making the change to PDA data collection, electronic versions of the *Site Description Form* and *Observation Form* were developed (these have since been combined into a single electronic form). The following pages show examples of the electronic form and discuss other factors related to using PDAs for safety belt data collection.

The goal of adapting the existing paper forms to an electronic format was to create electronic forms that were very similar to the paper forms, while taking advantage of the advanced, built-in capabilities of the PDA. As such, the electronic data collection form incorporated a built-in traffic counter and included high resolution color on the screens. The site description form (SDF) portion of the data collection form is divided into five screens. The first screen of the SDF (Figure 2) allows users to type in the site location (street names and standing location). Observers use the PDA stylus to tap on the appropriate choices of site type, site choice, and traffic control. If a mistake is made, the observer can change the data they have input, simply by tapping on the correct choice. All selected choices appear highlighted on the screen.

Site #:208 Save

**Site Location:** WB CR 149 & County Route 48

**Site Type:** Intersection  
Freeway

**Exit #:** .....

**Site Choice:** Primary  
Alternate

**Traffic Control:** Traffic Light  
Stop sign  
None  
Other

Previous Page Next Page

Figure 2. Site Description Form – Screen 1.

Screens 2 and 3 are shown in Figure 3. As seen in this figure, observers enter their observer number, the weather, day of week, and median information, simply by tapping the appropriate choice on the display list. Screen 3 allows users to sketch in the intersection and show where they are standing, and to record the start time for the site.

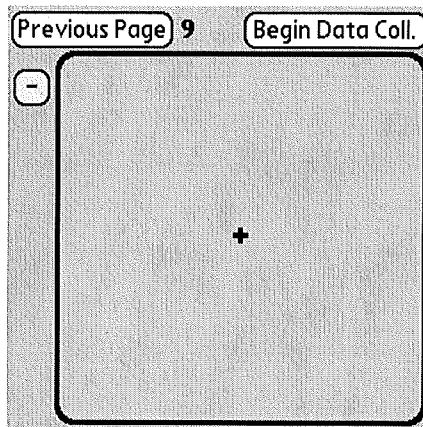
|   |                             |   |                             |                  |
|---|-----------------------------|---|-----------------------------|------------------|
| <b>Previous Page</b>  | <b>Date (MMDD):</b><br>0619 | <b>Day of Week:</b><br>Monday<br>Tuesday<br>Wednesday<br>Thursday<br>Friday<br>Saturday<br>Sunday | <b>Median:</b><br>Yes<br>No | <b>Next Page</b> |
| <b>Draw your site below</b>   |                             |   |                             |                  |
| <b>Start Time</b> (24 hr clock - HHMM):<br><input type="text" value="0800"/> <b>Count:</b> <input type="text" value="1"/> |                             |   |                             |                  |

**Figure 3. Site Description Form - Screens 2 and 3**

In the past, observers had to put away their paper form, get out a mechanical traffic counter, and begin a traffic count after entering the start time. Using a PDA, it is possible to incorporate a traffic counter directly into the site description portion of the data collection form<sup>4</sup>. Figure 4 shows an example of the electronic traffic counter (Screen 4). To count each vehicle that passes, observers tap on the large "+" button. The size of this button allows the observer to tap the screen while keeping their eyes on the roadway. Each tap increases the count that is displayed at the top of the screen. If a mistake is made, the observer can decrease the count by tapping on the small "-" button on the left of the screen.

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<sup>4</sup>The PDA traffic counting method was compared with a mechanical counter during the pilot testing and no difference was found between the two methods.



**Figure 4. Site Description Form – Screen 4**

The last screen of the electronic *Site Description Form*, shown in Figure 5, allows the user to enter the end time of the site observation and interruption (if any). Finally, observers can type in any comments regarding the site or traffic flow that may be important.

A screenshot of the "Site Description Form - Screen 5". At the top is a "Previous Page" button. The main content area contains three fields: "End Time (24 hr clock - HHMM):" with the value "0900", "Interruption (min):" with the value "00", and "Comments:" followed by a dotted text input field. At the bottom is an "End Site" button.

**Figure 5. Site Description Form - Screen 5**

To allow for easier data entry, the observation portion of the electronic data collection form was divided into three screens, one for vehicle information, one for driver information, and one for front-right passenger information. As shown in Figure 6, each screen is accessible by tapping on the appropriate tab along the top of the screen. The screens have also been designed with different colors, with the vehicle screen yellow, driver screen blue, and passenger screen green. As shown below, the first screen that

appears in the form is the vehicle screen. Each category of data, along with the choices for each category, are displayed on the screen. As in the Site Description Form, users simply tap on the choices that correspond to the motorist that is being observed. These data then appear highlighted on the screen. Since most vehicles are not used for commercial purposes, "Not Commercial" is already highlighted as a default. If the vehicle is commercial, that choice can be selected from the list.

|   |   |  |
|---|---|--|
| <input type="button" value="Vehicle"/>  | <input type="button" value="Driver"/>   | <input type="button" value="Passenger"/> |
| <b>Type</b>   |   |  |
| <input type="button" value="SDF"/>  | <input type="button" value="Car"/><br><input type="button" value="Van/Minivan"/><br><input type="button" value="SUV"/><br><input type="button" value="Pickup Truck"/> |  |
| <b>Site:</b><br><b>208</b>  |   |  |
| <b>Commercial</b>   |   |  |
| <input type="button" value="Commercial"/><br><input checked="" type="button" value="Not Commercial"/> |   |  |
| <input type="button" value="Prev Veh"/>   |   |  |

**Figure 6. Observation Form - Vehicle Screen**

Figure 7 shows the driver and passenger screens. Since most motorists are not actively talking on a cellular phone while driving, and most vehicles do not include a passenger, "No Cell Phone" is already highlighted and the "No Passen." box is already checked as defaults. If the motorist is using a cell phone or if a passenger is present, users select the appropriate choices. Once data are complete for one vehicle, observers tap the "Next Vehicle" button to continue collecting data.

|   |  |   |
|---|--|---|
| <input type="button" value="Vehicle"/>  | <input type="button" value="Driver"/>  | <input type="button" value="Passenger"/>  |
| <b>Belt</b>   | <b>Age</b>   | <b>Passenger</b>  |
| <input type="button" value="Not Belted"/><br><input type="button" value="Belted"/><br><input type="button" value="B Back"/><br><input type="button" value="U Arm"/> | <input type="button" value="11-15"/><br><input type="button" value="16-29"/><br><input type="button" value="30-64"/><br><input type="button" value="65+"/> | <input checked="" type="checkbox" value="No Passen."/>  |
| <b>Sex</b>  | <b>Cell Phone</b>  | <b>Age</b>  |
| <input type="button" value="Male"/><br><input checked="" type="button" value="Female"/>   | <input type="button" value="Hand-Held"/><br><input type="button" value="Hands-Free"/><br><input checked="" type="button" value="No Cell ..."/>             | <input type="button" value="0-10"/><br><input type="button" value="11-15"/><br><input type="button" value="16-29"/><br><input type="button" value="30-64"/><br><input type="button" value="65+"/> |
| <b>Cell Phone</b>   | <b>Passenger</b>   | <b>Next Vehicle</b>   |
| <input type="button" value="Hand-Held"/>  | <input type="button" value="Hands-Free"/>  | <input type="button" value="No Cell ..."/>  |
| <input type="button" value="Male"/>   | <input type="button" value="Female"/>  | <input type="button" value="Count 2"/>  |
| <input type="button" value="Female"/>   | <input type="button" value="Male"/>  | <input type="button" value="Cancel"/>   |

**Figure 7. Observation Form - Passenger and Vehicle Screens**

Each PDA also had a built-in cellular phone as well as wireless e-mail capability. At regular intervals, observers e-mailed completed data directly from the PDA to the project supervisor. Data collection forms from completed sites were "zipped," using a compression program, and then transmitted directly to a pre-determined e-mail account. The e-mailing of data allowed the field supervisor to immediately check data for errors, and begin to compile a data analysis file as the project progressed.

**APPENDIX B:**  
**Site Listing**

### Survey Sites By Number

| No.  | County   | Site Location   |
|------|----------|---|
| 001  | Dakota   | EB 135th St/Co. Rd. 38 & Blaine Ave/County Rout 71/Rich Valley Blvd                 |
| 002  | Olmsted  | EB CR 112/County Route 12 & CR 112  |
| 003  | Carver   | EB 150th St/County Route 50 & County Route 41                                       |
| 004  | Carver   | EB 70th St/County Route 30 & State Route 25/Ash                                     |
| 005  | Carver   | NB Yancy Ave & State Route 7  |
| 006  | Carver   | SB Little Ave & 102nd St  |
| 007  | Dakota   | EB W 136th St & Nicollet Ave  |
| 008  | Wright   | WB CR 123 & County Route 7/CR 106   |
| 009  | Olmsted  | EB CR 120 & County Route 20   |
| 010  | Wright   | EB CR 118/CR18/50th St. & County Route 35/Main St.                                  |
| *011 | Dakota   | NB CR 21/Guan Ave & 307th St/CR 90  |
| 012  | Wright   | EB 14th St/CR 112 & State Route 25  |
| 013  | Dakota   | EB 240th St West & Cedar Ave/County Route 23  |
| *014 | Dakota   | NB Johnny Cake Ridge Rd & County Route 32/Cliff Rd                                  |
| 015  | Olmsted  | SB County Route 3 & County Route 4  |
| *016 | Olmsted  | EB CR 137 & CR 136  |
| 017  | Dakota   | EB 80th St & Concord Blvd/County Route 56   |
| 018  | Dakota   | EB 220th St East & Nicolai/County Route 91  |
| 019  | Dakota   | SB Fairgreen Ave & 280th St West/County Route 86                                    |
| 020  | Wright   | NB County Route 12 & County Route 37  |
| 021  | Olmsted  | WB County Route 9 & County Route 10   |
| *022 | Dakota   | EB Wescott Rd & Lexington Ave   |
| 023  | Dakota   | NB Hogan Ave/County Route 85 & 220th St East  |
| *024 | Wright   | SB US 12/County Route 16 & Babcock Blvd/County Route 30                             |
| 025  | Wright   | EB County Route 38/Harrison St. (Near Oak St/CR 24) & State Route 55/State Route 24 |
| 026  | Dakota   | NB Blaine Ave/CR 79 & 245th St East/County Route 80                                 |
| *027 | Olmsted  | SB CR 119 & County Route 9  |
| *028 | Dakota   | EB County Route 88/290th Street East & Northfield Blvd/County Route 47              |
| *029 | Ramsey   | NB Hodgson Rd/County Route 49 & Turtle/County Route 3/CR 1                          |
| 030  | Carver   | SB Yale Ave/Yancy Ave & County Route 30   |
| 031  | Olmsted  | NB CR 125/Maywood Rd. SW & County Route 25/Salem Rd. SW                             |
| 032  | Olmsted  | EB CR 154/85th St. NW & US 52   |
| *033 | Wright   | SB County Route 12 & State Route 55   |
| *034 | Carver   | WB 62nd St & County Route 33  |
| *035 | Ramsey   | EB Minnehaha Ave/State Route 5 & White Bear Ave/County Route 65                     |
| *036 | Olmsted  | SB CR 128 & State Route 247/County Route 12   |
| 037  | Dakota   | SB CR 51/County Route 80/Biscayne Ave & 280th St West/County Route 86               |
| *038 | Olmsted  | NB CR 132/County Route 32 & County Route 9  |
| 039  | Dakota   | SB Inga Ave & State Route 50/240th St East  |
| *040 | Dakota   | EB County Route 14/Grand Ave. & Concord St/State Route 156                          |
| 041  | Dakota   | NB Goodwin Ave & State Route 55   |
| 042  | Ramsey   | NB Rice St & Maryland Ave   |
| 043  | Dakota   | SB Emery Ave & 190th St East/County Route 62  |
| 044  | Ramsey   | NBP I-35 W & Old Hwy 8/Anoka Cutoff (Exit 26)                                       |
| *045 | Ramsey   | NBD I-35 E & County Route 23 (Exit 112)   |
| 046  | Olmsted  | WBP I-90 & County Route 10 (Exit 229)   |
| *047 | Dakota   | SBD I-35 & County Route 50/County Route 5(Exit 85)                                  |
| 048  | Ramsey   | WBP State Route 36 & Hamline Ave  |
| *049 | Dakota   | SBD US-52 & Thompson Ave  |
| *050 | Ramsey   | SBD I-35 E & St. Clair  |
| *051 | Dakota   | WBD I-494 & Robert St (Exit 67)   |
| 052  | Dakota   | NBD I-35 E & State Route 110/Mendota Rd (Exit 101)                                  |
| *053 | Olmsted  | EBD I-90 & State Route 42 (Exit 224)  |
| 054  | Ramsey   | SBD I-35 E & Randolph Ave   |
| 055  | Ramsey   | EBD State Route 36 & Lexington Ave/County Route 51                                  |
| 056  | Ramsey   | EBD US-12/US-52/I-94 & S. Cretin Ave  |
| 057  | Ramsey   | NBP County Route 280 & Energy Park Dr   |
| 058  | Dakota   | SBD US-52/Lafayette Frwy & Butler Ave   |
| 059  | Ramsey   | EWP I-694 & US-61/Maplewood Dr (Exit 48)  |
| 060  | Ramsey   | EBD US-12/US-52/I-94 & Lexington Parkway/County Route 51                            |
| 061  | Hennepin | SB Pineview Ave & 129th Ave   |

|      |            |   |
|------|------------|---|
| 062  | Hennepin   | WB Olson Memorial Hwy/State Route 55 & County Route 102/Douglas Drive     |
| *063 | Hennepin   | NB Mohawk Dr & Horseshoe Tr   |
| 064  | Hennepin   | SB County Route 60/Mitchell Rd & State Route 5                            |
| 065  | Hennepin   | WB Gleason Lake Rd/County Route 15 & Vicksburg Lane                       |
| 066  | Hennepin   | NEB State Route 7 & Chanhassen Rd/State Route 101                         |
| 067  | Hennepin   | NB Brown Rd/County Route 146 & Watertown Rd                               |
| *068 | Hennepin   | NB Commerce Blvd & West Branch Rd/County Route 151                        |
| 069  | Hennepin   | NB Chanhassen Rd/State Route 101 & Minnetonka Blvd/County Route 5         |
| 070  | Hennepin   | SB County Route 44 & Bartlett Blvd/County Route 110                       |
| 071  | Hennepin   | SB Tucker Rd & County Route 116/CR 159/Territorial Rd.                    |
| *072 | Hennepin   | NEB Old Shakopee Rd/County Route 1 & Penn Ave.                            |
| 073  | Hennepin   | NWB County Route 81 & 77th Ave North/County Route 152/Brooklyn Blvd.      |
| *074 | Hennepin   | NB Belchfold Rd & 109th Ave North/County Route 117                        |
| 075  | Hennepin   | NB County Route 34/Normandale Blvd & Old Shakopee Rd/County Route 1       |
| *076 | Hennepin   | NB Penn Ave/County Route 2 & Olson Memorial Highway/State Route 55        |
| 077  | Hennepin   | WB Elm Creek Rd & Fernbrooke Ave/County Route 121                         |
| 078  | Hennepin   | NB Pioneer Tr/County Route 113 & Woodland Tr/County Route 10              |
| 079  | Hennepin   | WB Rockford Rd/County Route 9 & Medicine Lake Dr/Larch Lane               |
| *080 | Hennepin   | SB Lyndale Ave & West 50th St/County Route 21                             |
| 081  | Hennepin   | NB Willow Dr & County Route 24  |
| *082 | Hennepin   | WB 125th Ave North & Zanzibar Lane  |
| 083  | Hennepin   | SB Lyndale Ave & West 82nd St   |
| 084  | Hennepin   | NB Broadway Ave/CR 103/County Route 130 & 85th Ave North/County Route 109 |
| *085 | Hennepin   | NB Mendelssohn Ave & 63rd Ave   |
| *086 | Hennepin   | WB N 121st Ave & Fernbrooke/County Route 121                              |
| *087 | Hennepin   | WB Cedar Lake Rd/County Route 16 & Plymouth Rd/County Route 61            |
| 088  | Hennepin   | EB Nike Rd & Main Street/Country Route 92                                 |
| 089  | Hennepin   | NWB N Nobel Ave & 109th Ave   |
| *090 | Hennepin   | SB Mohawk Dr & State Route 55   |
| *091 | Hennepin   | NB County Route 32 & West 82nd Street                                     |
| 092  | Hennepin   | WB County Route 109/85th Ave N & Country Route 158/Rice Lake Rd.          |
| 093  | Hennepin   | SB Country Route 101 & County Route 42/Wayzata Blvd.                      |
| 094  | Hennepin   | NB University Ave & County Route 23                                       |
| *095 | Hennepin   | SB Country Route 116/Fletcher Lane & County Route 30/97th Ave N           |
| 096  | Hennepin   | EB County Route 53/66th St. & State Route 77                              |
| 097  | Hennepin   | NB Winnetka Ave/County Route 156 & Medicine Lake Rd                       |
| 098  | Hennepin   | SB Goose Lake Rd & Elm Creek Rd   |
| *099 | Hennepin   | WB Medicine Lake Rd/26th St. & Medicine Lake Blvd                         |
| 100  | Hennepin   | NB Budd Ave & Pagenkopf Rd  |
| *101 | Hennepin   | EB Duck Lake Tr & Eden Prairie Rd/County Route 4                          |
| 102  | Hennepin   | NB Eden Prairie Rd/County Route 4 & Excelsior Blvd/County Route 3         |
| 103  | Hennepin   | SEB County Route 152/Osseo Rd. & N. Penn/44th Ave.                        |
| 104  | Hennepin   | SBD State Route 77 & County Route 1/Old Shakopee Rd                       |
| *105 | Hennepin   | NBD I-35 W & W 82nd St (Exit 8)   |
| 106  | Hennepin   | WBP State Route 62/Crosstown Hwy & Gleason                                |
| *107 | Hennepin   | SBD I-494 & County Route 10/Bass Lake Rd (Exit 26)                        |
| *108 | Hennepin   | WBP I-94/US-12/US-52 & S 25th Ave.  |
| *109 | Hennepin   | NBP I-35 W & W 35th St/E 35th St  |
| 110  | Hennepin   | WBP I-94/US-52 & County Route 30/Dunkirk Lane (Exit 213)                  |
| 111  | Hennepin   | SBD I-35 W & W 66th St/E 66th St  |
| 112  | Hennepin   | NBP US-169 & 36th Ave N   |
| *113 | Hennepin   | EBP I-494 & Townline Rd/US-169  |
| 114  | Hennepin   | N/WBD I-494 & State Route 55/Olson Memorial Hwy                           |
| 115  | Hennepin   | WBP State Route 62/Crosstown Hwy & Tracy Ave                              |
| 116  | Hennepin   | SBP State Route 100 & Minnetonka Blvd/County Route 5/Vernon               |
| 117  | Hennepin   | SBP State Route 100 & W 50th St/County Route 21/County Route 158          |
| *118 | Hennepin   | EBD State Route 62 & Portland Ave South                                   |
| 119  | Hennepin   | NBP US-169 & Valley View Rd   |
| 120  | Hennepin   | NBD US-169 & Plymouth Ave/13th Ave N                                      |
| 121  | Sherburne  | NB County Route 73/127th St./County Route 48 & CR 73/185th Ave.           |
| 122  | St. Louis  | WB State Route 135/County Route 102 & US 53/State Route 169               |
| 123  | St. Louis  | WB CR 791 & County Route 25   |
| 124  | Rice       | SB Culver Ave & 150th Street W/County Route 9                             |
| 125  | Beltrami   | SB State Route 72/County Route 36 & County Route 41                       |
| *126 | Washington | NB Manning & 70th St. S   |
| 127  | Clay       | EB State Route 34 & County Route 25                                       |

|      |            |   |
|------|------------|---|
| 128  | Kandiyohi  | WB 255th Ave Northeast & County Route 9   |
| 129  | St. Louis  | EB County Route 16/CR 957 & US 53   |
| 130  | Kandiyohi  | EB CR 107/240th Ave. & 40th Street NE   |
| 131  | Kandiyohi  | WB 105 Ave SE & CR 136/165th St SE  |
| 132  | Blue Earth | WB County Route 29/State Route 30 & State Route 22/State Route 30                     |
| 133  | Freeborn   | NB US-69 & County Route 46  |
| 134  | Clay       | EB CR 105 & County Route 13/County Route 73/90th St. N                                |
| *135 | St. Louis  | WB State Route 194/Central Entrance & County Route 90/Arlington                       |
| 136  | Steele     | SB County Route 3 & State Route 30  |
| 137  | Blue Earth | WB County Route 13/County Route 38 & US-169   |
| *138 | Sherburne  | SB US 169 & County Route 4  |
| *139 | Sherburne  | EB CR 54/77th St. SE & State Route 25/125th Ave. SE                                   |
| 140  | Freeborn   | EB CR 115/County Route 23 & County Route 26   |
| *141 | Blue Earth | WB CR 167 & County Route 39   |
| 142  | Sherburne  | NWB US 10 & County Route 15   |
| *143 | St. Louis  | EB State Route 194 & US 53  |
| 144  | Freeborn   | NB County Route 24/County Route 45/Independence Ave & County Route 31/CR 116/Main St. |
| *145 | Goodhue    | SB County Route 1 & State Route 60  |
| *146 | Freeborn   | EB County Route 9/CR 78 & US 69   |
| 147  | Blue Earth | NB County Route 30/CR 107 & County Route 22/CR 108                                    |
| 148  | St. Louis  | EB County Route 28/Sax Road & County Route 7  |
| 149  | Nicollet   | EB County Route 15/382nd St. & State Route 15   |
| 150  | Blue Earth | EB Madison Ave/State Route 22 & State Route 22  |
| *151 | Steele     | SB 7th Ave NE & County Route 8/Mineral Springs Rd.                                    |
| 152  | Blue Earth | EB County Route 25/CR 138 & County Route 20   |
| *153 | Blue Earth | NB County Route 14/CR 173 & State Route 83  |
| 154  | St. Louis  | EB County Route 12/Roberg Rd & Lakewood Rd/CR 692                                     |
| *155 | Crow Wing  | NB County Route 25/CR 144 & State Route 18  |
| *156 | Kandiyohi  | WB 60th Ave SW & County Route 7/135th St.   |
| *157 | Scott      | EB County Route 2/CR 54 & State Route 13/Langford Ave                                 |
| *158 | Blue Earth | SB State Route 60 & US 14/State Route 60  |
| 159  | Goodhue    | SB County Route 4 & County Route 10   |
| 160  | Kandiyohi  | SB CR 127/60th St. NE & County Route 26/60th Ave.                                     |
| *161 | Clay       | EB 90th Ave./County Route 10 & 70th St./County Route 11/State Route 336               |
| 162  | Nicollet   | NB County Route 7/585TH St. & County Route 1/350th St.                                |
| 163  | Scott      | EB CR 64/230th St W & State Route 21/Helena Blvd                                      |
| 164  | Steele     | SBD I-35 & County Route 4 (Exit 32)   |
| 165  | St. Louis  | SBP I-35 & US-53/Piedmont Ave   |
| 166  | Freeborn   | SBP I-35 & County Route 35 (Exit 22)  |
| 167  | Clay       | EBP I-94 & County Route 10 (Exit 15)  |
| 168  | Washington | N/WBP I-694 & 10th St/County Route 10 (Exit 57)                                       |
| *169 | Clay       | WBP I-94 & County Route 52 (Exit 2)   |
| 170  | Rice       | SBP I-35 & State Route 60 (Exit 56)   |
| 171  | Steele     | NBD I-35 & County Route 12 (Exit 48)  |
| *172 | Beltrami   | EBP US-2/US-71 & US-71  |
| 173  | Freeborn   | EBD I-90 & State Route 13 (Exit 154)  |
| 174  | Freeborn   | SBD I-35 & State Route 251 (Exit 18)  |
| *175 | St. Louis  | SBP I-35 & S 27th Ave. W (Exit 254)   |
| *176 | Washington | SBP I-35 & Central Ave. (Exit 252)  |
| 177  | St. Louis  | N/EBD I-35 & 46th Ave   |
| 178  | Freeborn   | NBD I-35 & County Route 46 ? (Exit 11)  |
| *179 | Washington | NBP US-10/US-61 & 80th St/Grange Blvd   |
| *180 | St. Louis  | N/EBD I-35 & Skyline Pkwy/Boundary Dr. (Exit 249)                                     |
| *181 | Morrison   | SB CR 264/205th Ave. & County Route 46/183rd St.                                      |
| 182  | Douglas    | SB County Route 6 & County Route 22   |
| *183 | McLeod     | WB County Route 26/100th St. & State Route 15   |
| 184  | Morrison   | SB County Route 37 & County Route 26/Nature Rd.                                       |
| 185  | Polk       | NB County Route 63 & US-2   |
| *186 | Cass       | WB County Route 29/CR 107/76th St. & County Route 1                                   |
| *187 | Becker     | SB Little Toad Lake Rd/County Route 31 & State Route 87                               |
| 188  | Otter Tail | EB County Route 10 & US 59  |
| 189  | Otter Tail | EB County Route 60/State Route 228 & US 10  |
| 190  | Cass       | WB County Route 34 & State Route 64   |
| 191  | Brown      | EB County Route 22/CR 102 & County Route 13   |
| 192  | Morrison   | SB County Route 6/90th Ave. & County Route 1/State Route 238                          |

|      |            |   |
|------|------------|---|
| 193  | Mower      | WB 115th St. & County Route 14/770th Ave.   |
| 194  | Stearns    | WB CR 146 & State Route 15  |
| 195  | Cass       | EB County Route 43/Twp 4/12th St. & State Route 84/County Route 44                              |
| *196 | Polk       | NB County Route 54 & County Route 11  |
| 197  | Polk       | EB CR 213 & CR 213/County Route 48  |
| 198  | Winona     | NEB County Route 44/Huff St. & US 14/US 61  |
| *199 | Morrison   | EB CR 203/County Route 1 & County Route 2   |
| 200  | Stearns    | SB US 71 & State Route 55   |
| *201 | Douglas    | EB State Route 27 & State Route 29  |
| *202 | Winona     | WB County Route 22 extension (unmarked gravel road North of County Route 115) & County Route 37 |
| *203 | Anoka      | SB CR 67 & County Route 22  |
| 204  | Cass       | EB County Route 66/122nd St. & State Route 371  |
| *205 | Benton     | WB County Route 12/Pine Rd. & State Route 25  |
| 206  | Becker     | SB County Route 49/CR 119 & State Route 87  |
| *207 | Polk       | NB County Route 65 & US-75  |
| 208  | Stearns    | WB CR 149 & County Route 48   |
| 209  | Isanti     | SB State Route 47 & County Route 8  |
| 210  | Otter Tail | EB County Route 6 & County Route 59   |
| *211 | Stearns    | WB Division St/County Route 75 & State Route 15   |
| 212  | Itasca     | EB US 2/4th St. & State Route 38/3rd Ave.   |
| 213  | McLeod     | SB County Route 25/CR 52/5th Ave. S. & US 212   |
| 214  | Mower      | EB County Route 1 & US 218  |
| 215  | Benton     | SB County Route 6 & County Route 4  |
| 216  | Brown      | WB 150th St./CR100 & County Route 2   |
| *217 | Anoka      | SB County Route 5/CR 56 & Northern Blvd/County Route 5  |
| 218  | Douglas    | NB County Route 40 & County Route 82  |
| 219  | Douglas    | WB County Route 10 & County Route 3   |
| *220 | Winona     | NEB County Route 7 & US 14/US 61  |
| 221  | Stearns    | SEB County Route 152 & County Route 10  |
| 222  | Stearns    | WB County Route 75 & County Route 2   |
| 223  | Isanti     | NB County Route 7/CR 57 & State Route 95  |
| 224  | Carlton    | SWBP I-35 & State Route 45 (Exit 239)   |
| *225 | Anoka      | SBP I-35 W & County Route 23/Lake Dr (Exit 36)  |
| 226  | Stearns    | WBD I-94/US-52 & CR 159 (Exit 156)  |
| 227  | Winona     | EBD I-90 & State Route 43 (Exit 249)  |
| 228  | Stearns    | EBP I-94 & State Route 23 (Exit 164)  |
| *229 | Anoka      | EBP US-10 & State Route 65  |
| *230 | Chisago    | SBD I-35 & County Route 10 ( Exit152)   |
| 231  | Mower      | WBP I-90 & State Route 56 (Exit 183)  |
| 232  | Stearns    | EBP I-94 & County Route 7 (Exit 171)  |
| *233 | Winona     | WBP I-90 & State Route 76 (Exit 257)  |
| *234 | Otter Tail | W/NBP I-94 & US-59/County Route 52/County Route 88 (Exit 50)                                    |
| 235  | Anoka      | WBP US-10/State Route 610 & State Route 47  |
| 236  | Douglas    | EBD I-94 & State Route 79 (Exit 82)   |
| 237  | Stearns    | WBP I-94 & County Route 9 (Exit 153)  |
| 238  | Stearns    | WBD I-94 & County Route 11 (Exit 137)   |
| 239  | Carlton    | EBD I-35 & State Route 61 (Exit 245)  |
| *240 | Douglas    | EBP I-94 & State Route 29 (Exit 103)  |

\* indicates a site used in the mini survey.