Nighttime Safety Belt Use in Minnesota: September, 2010

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INTRODUCTION

According to the National Highway Traffic Safety Administration (NHTSA), safety belt use in the United States (US) has reached an all time high rate of 84% (Chen & Ye, 2010). This rate was calculated from data obtained through the National Occupant Protection Use Survey (NOPUS), a nationwide direct observation survey of belt use during the daytime. Thus, this rate only applies to daytime belt use.

Until recently, gathering valid data on use of belts at night was difficult. The challenge was being able to visually assess belt use because of a lack of proper lighting. Early studies utilized the headlights of a van traveling on the road to illuminate the inside of a vehicle while an observer recorded belt use (e.g., Williams, Lund, Preusser, & Blomberg, 1987; Williams, Wells, & Lund, 1987). Later studies used locations that were well lighted at night such as parking lots (Lange & Voas, 1998; Malenfant & Van Houten, 1988). Recent studies, however, take advantage of newly developed military grade night vision equipment to see inside of vehicle (e.g., Chaudhary, Alonge, & Preusser, 2005; Chaudhary & Preusser, 2006; Vivoda, Eby, St. Louis, & Kostyniuk, 2007a, 2008). The main advantage of night vision equipment is that any roadside location can be observed allowing for the same level of generalizability of survey results as can be obtained during daytime surveys.

Recent studies utilizing night vision equipment comparing daytime and nighttime safety belt use have found interesting results. A study in Reading, Pennsylvania investigated the effectiveness of a nighttime safety belt enforcement campaign (Chaudhary, Alonge, & Preusser, 2005). The study found that even after the campaign, safety belt use was lower at night. A study in Connecticut conducted safety belt observations at 100 sites around the state both during the daytime and nighttime, using night vision equipment for the nighttime sites. The study found that nighttime belt use in this state was 6.4 percentage points lower at night when compared to the daytime rate (Chaudhary & Preusser, 2006). An investigation of nighttime belt use at selected sites in New Mexico found that nighttime belt use was 6.2 percentage points lower than the daytime rate (Solomon, Chaudhary, & Preusser, 2007). Finally, Vivoda et al. (2007b) conducted two waves of a full statewide survey of nighttime belt use in Indiana and compared results to identical surveys conducted during daylight hours. Indiana conducted an intensive daytime “Click-it or Ticket” campaign between the two survey waves. The study found similar rates of belt use for daytime and nighttime prior to the campaign. After the campaign nighttime belt use dropped slightly while daytime belt use increased dramatically, leading to a post campaign difference in belt use between daytime and nighttime of 10.3 percentage points. Thus, data suggest that in several places in the US, belt use at night is lower than belt use during the daytime.

The purpose of the present study was to measure nighttime belt use in Minnesota and compare nighttime belt use rates to rates obtained during daytime. A study of nighttime belt has never been conducted in Minnesota. Two survey waves were conducted using an identical survey design and identical observation sites. The first wave was conducted August 3-19, 2010 during daylight hours (Eby, Vivoda, & Cavanagh, 2010). The second wave was conducted August 5-September 9, 2010 during nighttime hours (9 PM to 5 AM).

METHODS

Sample Design

The same sample design was used for both surveys. 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).[1] 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.

[1] Educational attainment was defined as the proportion of population in the county over 25 years of age with a bachelor degree.

To achieve the NHTSA required precision of less than 5 percent relative error, 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
High Belt Use **Stratum 1: intersections** **Stratum 5: exit ramps**	Carver, Dakota, Olmsted, Ramsey, Wright
Hennepin **Stratum 2: intersections** **Stratum 6: exit ramps**	Hennepin
Medium Belt Use **Stratum 3: intersections** **Stratum 7: exit ramps**	Beltrami, Blue Earth, Clay, Crow Wing, Freeborn, Goodhue, Kandiyohi, Nicollet, Rice, Scott, Sherburne, St. Louis, Steele, Washington
Low Belt Use **Stratum 4: intersections** **Stratum 8: exit ramps**	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.

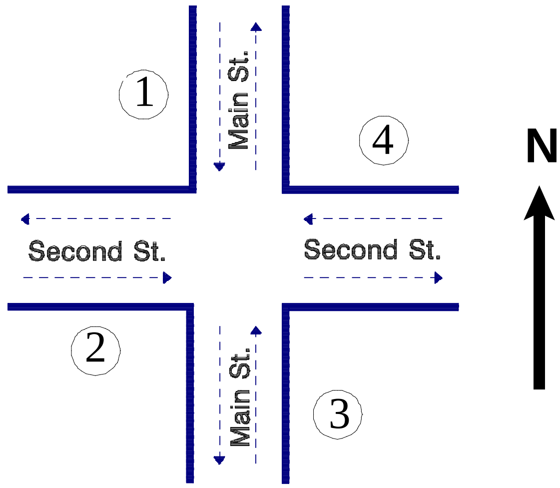

Figure 1. An Example "+" Intersection Showing 4 Possible Observer Locations.

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.[2] 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

[4] 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 for the daytime survey and 9:00 pm – 5:00 am for the nighttime survey) 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.

Although the data collection period was longer for the nighttime wave, all of the nighttime sites were matched to the daytime sites by day of week. Because of differences in likely travel patterns, sites observed on a Friday night were matched to those observed on a Saturday day, and so on. This matching scheme was successful for all b ut one site, which was rescheduled and completed later.

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 August 3-19, 2010 for the daytime survey and August 5-September 9, 2010 for the nighttime survey. 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 either one observer (daytime survey) or a pair of observers (nighttime survey) for a period of one hour. Upon arriving at a site, the observer(s) determined whether observations were possible at the site. If observations were not possible (e.g., due to construction), the observer(s) proceeded to the alternate site. Otherwise, the observer(s) 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. For the nighttime observation, one observer used night-vision goggles and a infrared spotlight to visually assess belt use and other characteristics, calling this information out to the second observer who recorded these data in a PDA. (Note that for some sites, a paper and pencil method was used because not enough PDAs were available for all observers due to the overlapping data collection times for the two survey waves. In these cases, data were entered into an electronic format by the researechers.)

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 and on how to use the night vision equipment and observe at night for the nighttime survey. 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.

Data Processing and Estimation Procedures

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, 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:

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

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 $occs_i$ 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:

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

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

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:

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

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

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:

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

where *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:

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

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

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

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:

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

The 95 percent confidence band was calculated using the formula:

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

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

$$\mathrm{Re}\,lativeError = \frac{SE}{R}$$

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 study reports daytime and nighttime 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. 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/September 2010 was **92.3 ± 1.2** percent for daytime and **90.6 ± 2.8** percent for nighttime. The "±" value following the use rate indicates a 95 percent confidence interval around the percentage. The confidence intervals of the two rates overlap, indicating that there was no statistical difference in Minnesota safety belt use between daytime and nighttime.

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

	Daytime		Nighttime	
	Percent Use	**Unweighted N**	**Percent Use**	**Unweighted N**
Stratum 1 (High, Intersections)	92.9	1,412	97.1	264
Stratum 2 (Hennepin, Intersections)	95.7	2,437	92.3	590
Stratum 3 (Medium, Intersections)	91.7	1,282	90.6	271
Stratum 4 (Low, Intersections)	90.7	1,561	85.9	258
Stratum 5 (High, Exit Ramps)	95.2	614	95.5	418
Stratum 6 (Hennepin, Exit Ramps)	95.3	1,441	91.7	684
Stratum 7 (Medium, Exit Ramps)	88.8	1,551	91.2	283
Stratum 8 (Low, Exit Ramps)	93.8	1,015	93.5	199
Minnesota, Intersections	91.7	6,692	89.5	1,383
Minnesota, Exit Ramps	93.8	4,621	93.1	1,584
STATE OF MINNESOTA	**92.3 ± 1.2%**	**11,313**	**90.6 ± 2.8%**	**2,967**

Safety Belt Use by Subcategory and Daytime/Nighttime

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 or time of day. However, comparing across vehicle types, strata, and daytime/nighttime we find that safety belt use is lower for pickup truck occupants during the day and night. Thus, enforcement and public information and education (PI&E) programs should continue to target pickup truck occupants during both daytime and nighttime.

Table 4a. Daytime and Nighttime Percent Shoulder Belt Use by Stratum (Passenger Cars)

	Daytime		Nighttime	
	Percent Use	**Unweighted N**	**Percent Use**	**Unweighted N**
Stratum 1	94.3	575	98.2	141
Stratum 2	96.0	1,218	94.1	348
Stratum 3	93.3	584	88.4	119
Stratum 4	92.5	628	87.7	131
Stratum 5	95.3	240	95.8	244
Stratum 6	95.7	768	92.0	441
Stratum 7	91.6	673	87.8	117
Stratum 8	95.4	459	93.9	99
MINNESOTA	**93.7 ± 0.8%**	**5,145**	**90.6 ± 3.5%**	**1,640**

Table 4b. Daytime and Nighttime Percent Shoulder Belt Use by Stratum (Sport Utility Vehicles)				
	Daytime		Nighttime	
	Percent Use	Unweighted N	Percent Use	Unweighted N
Stratum 1	93.1	408	94.0	49
Stratum 2	97.0	637	89.9	136
Stratum 3	93.6	326	92.6	50
Stratum 4	94.5	344	89.5	45
Stratum 5	96.5	171	99.1	82
Stratum 6	97.1	384	90.5	150
Stratum 7	91.4	322	98.2	72
Stratum 8	93.2	266	97.6	46
MINNESOTA	**94.4 ± 2.1 %**	**2,858**	**92.6 ± 6.0%**	**630**

Table 4c. Daytime and Nighttime Percent Shoulder Belt Use by Stratum (Vans/Minivans)				
	Daytime		Nighttime	
	Percent Use	Unweighted N	Percent Use	Unweighted N
Stratum 1	96.5	190	98.6	32
Stratum 2	95.0	323	88.9	60
Stratum 3	90.4	179	98.6	46
Stratum 4	96.1	208	88.5	30
Stratum 5	99.0	130	93.3	52
Stratum 6	94.3	166	94.6	50
Stratum 7	94.2	240	94.4	42
Stratum 8	98.7	137	96.0	18
MINNESOTA	**94.7 ± 1.3%**	**1,573**	**93.9 ± 6.5%**	**330**

Table 4d. Daytime and Nighttime Percent Shoulder Belt Use by Stratum (Pickup Trucks)				
	Daytime		**Nighttime**	
	Percent Use	**Unweighted N**	**Percent Use**	**Unweighted N**
Stratum 1	85.3	239	89.6	42
Stratum 2	92.0	259	90.1	46
Stratum 3	82.8	193	89.0	56
Stratum 4	80.7	381	75.3	52
Stratum 5	83.8	73	89.2	40
Stratum 6	89.1	123	87.4	43
Stratum 7	76.9	316	88.8	52
Stratum 8	85.5	153	87.1	36
MINNESOTA	**83.4 ± 3.2%**	**1,737**	**84.7 ± 5.2%**	**367**

Site Type

Estimated safety belt use by type of site, vehicle type, and all vehicles combined is shown in Table 5a-5e. Little difference was found by site type during the daytime but belt use was lower at intersections during the nighttime observations.

Time of Night

Because the two surveys were conducted at different times of the day, Tables 5a-5e only shows belt use by the nighttime hours (see Eby, Vivoda, & Cavanagh, 2010 for daytime rates by time of day. Three time periods were selected for analysis based on potential traffic flow. Belt use was generally highest between 9 PM and midnight. Note also that the vast majority of vehicles observed in the study (about 80%) were traveling between 9 PM and midnight.

Day of Week

Estimated safety belt use by day of week, vehicle type, and all vehicles combined is shown in Tables 5a-5e. Note that the surveys were conducted over 2-week period (for daytime) and a 5-week period (for nighttime). Belt use clearly varied from day to day but no systematic differences were evident.

Sex

Estimated safety belt use by occupant sex, type of vehicle, and all vehicles combined is shown in Tables 5a-5e. The estimated safety belt use was higher for females than for males for all vehicle types combined and for each separate vehicle type in both daytime and nighttime conditions. The difference in belt use between men and women was greatest for occupants of pickup trucks for both day and night.

Age

Estimated safety belt use by age, vehicle type, and all vehicle types combined is shown in Tables 5a-5e. 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. A similar argument can be made for fthe 11-15-year old and 65-up age groups for the nighttime survey. Belt use rates for the 16-29-year old age group were generally lowest, with rates increasing for each of the older age groups. This pattern shows that new drivers and young vehicle occupants (16-29 years of age) should continue to be a focus of safety belt use messages and programs for both daytime and nighttime conditions.

Seating Position

Estimated safety belt use by position in vehicle, vehicle type, and all vehicles combined is shown in Tables 5a-5e. These tables show that there were no systematic differences in belt use by seating position during the daytime but belt use for drivers was higher at night.

Age and Sex

Tables 6a-6b show 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 and the oldest age group have very low numbers in the nighttime survey, so these rates may not be reliable. Belt use data for the other two age groups show that use for females was higher than for males during the day and night.

Table 5a: Daytime and Nighttime Percent Shoulder Belt Use and Unweighted N by Subgroup (All Vehicle Types Combined)				
	Daytime		Nighttime	
	Percent Use	N	Percent Use	N
Overall	92.3	11,313	90.6	2,967
Site Type				
Intersection	91.7	6,692	89.5	1,383
Exit Ramp	93.8	4,621	93.1	1,584
Time of Night				
9pm–11:59pm	na	--	92.2	2,365
12am-2:59am	na	--	87.8	503
3am-4:59am	na	--	89.3	99
Day of Week				
Monday	92.2	1,178	88.4	383
Tuesday	91.7	1,889	89.6	179
Wednesday	88.7	1,000	86.6	261
Thursday	91.2	1,344	83.0	1,194
Friday	91.9	3,423	90.1	356
Saturday	91.8	1,752	93.5	370
Sunday	95.2	727	83.0	224
Sex				
Male	88.7	5,956	87.1	1,722
Female	95.9	5,294	96.5	1,237
Age				
0 - 10	99.6	82	100	10
11 - 15	96.9	227	87.5	41
16 - 29	90.1	2,871	87.8	1,278
30 - 64	92.7	6,564	91.8	1,564
65 - Up	93.7	1,543	99.9	64
Position				
Driver	92.2	8,943	91.3	2,228
Passenger	92.5	2,370	89.5	739

Table 5b: Daytime and Nighttime Percent Shoulder Belt Use and Unweighted N by Subgroup (Passenger Cars)				
	Daytime		**Nighttime**	
	Percent Use	**N**	**Percent Use**	**N**
Overall	93.7	5,145	90.6	1,640
Site Type				
Intersection	93.3	3,005	89.8	739
Exit Ramp	94.8	2,140	92.7	901
Time of Night				
9pm–11:59pm	na	--	93.4	1,314
12am-2:59am	na	--	86.5	291
3am-5:59am	na	--	87.5	35
Day of Week				
Monday	95.5	511	86.0	199
Tuesday	94.6	879	85.6	104
Wednesday	92.6	370	92.5	150
Thursday	93.9	684	86.4	702
Friday	94.5	1,650	96.3	193
Saturday	92.2	793	92.7	176
Sunday	98.5	258	95.3	116
Sex				
Male	91.8	2,426	87.2	922
Female	95.3	2,687	96.4	712
Age				
0 - 10	99.3	29	100	3
11 - 15	95.0	85	55.7	15
16 - 29	91.0	1,660	87.9	844
30 - 64	94.9	2,535	92.5	729
65 - Up	95.8	825	100	45
Position				
Driver	93.3	4,136	90.8	1,241
Passenger	95.1	1,009	90.1	399

Table 5c: Daytime and Nighttime Percent Shoulder Belt Use and Unweighted N by Subgroup (Sport Utility Vehicles)				
	Daytime		Nighttime	
	Percent Use	N	Percent Use	N
Overall	94.4	2,858	92.6	630
Site Type				
Intersection	94.2	1,715	91.3	280
Exit Ramp	95.1	1,143	95.8	350
Time of Night				
9pm–11:59pm	na	--	94.1	506
12am-2:59am	na	--	89.7	99
3am-5:59am	na	--	95.9	25
Day of Week				
Monday	95.2	286	92.7	75
Tuesday	92.8	445	99.4	33
Wednesday	89.3	242	65.4	56
Thursday	93.8	366	95.5	267
Friday	97.7	867	72.7	61
Saturday	96.0	456	96.2	92
Sunday	98.5	196	98.4	46
Sex				
Male	91.8	1,382	91.0	352
Female	96.5	1,460	95.2	276
Age				
0 - 10	100	24	100	3
11 - 15	100	67	58.1	11
16 - 29	92.6	615	86.2	225
30 - 64	94.8	1,873	95.3	380
65 - Up	93.7	272	87.5	8
Position				
Driver	94.9	2,227	93.4	466
Passenger	93.2	631	90.8	164

Table 5d: Daytime and Nighttime Percent Shoulder Belt Use and Unweighted N by Subgroup (Vans/Minivans)				
	Daytime		Nighttime	
	Percent Use	N	Percent Use	N
Overall	94.7	1,573	93.9	330
Site Type				
Intersection	93.9	900	93.7	168
Exit Ramp	96.6	673	94.5	162
Time of Night				
9pm–11:59pm	na	--	97.1	263
12am-2:59am	na	--	89.7	54
3am-5:59am	na	--	100	13
Day of Week				
Monday	98.0	139	91.4	44
Tuesday	97.3	281	85.5	20
Wednesday	97.1	148	100	16
Thursday	94.1	152	94.9	112
Friday	94.1	471	97.8	52
Saturday	95.9	258	97.9	64
Sunday	99.3	124	99.2	22
Sex				
Male	92.0	748	88.9	156
Female	97.0	817	98.8	174
Age				
0 - 10	100	19	100	2
11 - 15	98.3	57	100	12
16 - 29	95.2	271	91.4	83
30 - 64	93.7	1,003	94.5	230
65 - Up	96.9	216	100	1
Position				
Driver	96.3	1,193	95.8	246
Passenger	90.9	380	91.7	84

Table 5e: Daytime and Nighttime Percent Shoulder Belt Use and Unweighted N by Subgroup (Pickup Trucks)				
	Daytime		Nighttime	
	Percent Use	N	Percent Use	N
Overall	83.4	1,737	84.7	367
Site Type				
Intersection	82.9	1,072	83.3	196
Exit Ramp	84.7	665	88.1	171
Time of Night				
9pm–11:59pm	na	--	82.6	282
12am-2:59am	na	--	89.5	59
3am-5:59am	na	--	97.0	26
Day of Week				
Monday	77.0	242	92.0	65
Tuesday	85.9	284	94.0	22
Wednesday	72.0	240	92.2	39
Thursday	81.2	142	67.3	113
Friday	85.9	435	81.1	50
Saturday	78.0	245	77.1	38
Sunday	74.4	149	77.1	40
Sex				
Male	79.4	1,400	81.9	292
Female	95.6	330	95.9	75
Age				
0 - 10	100	10	100	2
11 - 15	72.0	18	100	3
16 - 29	74.5	325	83.1	126
30 - 64	85.7	1,153	84.7	225
65 - Up	88.0	230	100	10
Position				
Driver	83.0	1,387	86.9	275
Passenger	84.3	350	81.0	92

Table 6a. <u>Male</u> Daytime and Nighttime Percent Shoulder Belt Use and Unweighted N by Age and Sex (All Vehicle Types Combined)				
Age Group	Daytime		Nighttime	
	Percent Use	Unweighted N	Percent Use	Unweighted N
0 - 10	100	49	100	7
11 - 15	96.1	96	95.3	22
16 - 29	86.1	1,393	82.7	706
30 - 64	88.6	3,564	89.0	945
65 - up	91.4	849	99.8	38

Table 6b. <u>Female</u> Daytime and Nighttime Percent Shoulder Belt Use and Unweighted N by Age and Sex (All Vehicle Types Combined)				
Age Group	Daytime		Nighttime	
	Percent Use	Unweighted N	Percent Use	Unweighted N
0 - 10	98.8	33	100	3
11 - 15	98.0	131	79.2	19
16 - 29	93.5	1,459	95.9	569
30 - 64	97.0	2,974	97.3	616
65 - up	96.2	691	100	26

DISCUSSION

This report has two main purposes: (1) to present the results of the first statewide nighttime safety belt survey conducted in Minnesota; and (2) to compare the nighttime results to the results of a daytime survey conducted concurrently with the nighttime survey. All data for the study were collected through direct observation, with night-vision equipment being used to collect nighttime belt use data.

The nighttime statewide safety belt use survey showed that Minnesota has a nighttime safety belt use rate of 90.6 ± 2.8 percent. This rate was statistically identical to the rate found in the daytime survey. Thus, Minnesota has done a great job of increasing safety belt use to more than 90 percent both during the daytime and nighttime. This result is contrary to research carried out in other states showing that belt use is lower at night.

Comparison of belt use trends between daytime and nighttime showed that many of the trends found during the daytime are also found at night. For example, belt use rates for pickup truck occupants are the lowest of any vehicle type both during the day and night. Similarly, belt use rate are lower for men than for women regardless of whether it is day or night. There were, however, a few differences. The present study found that belt use at night was lower at local intersections than at freeway exit ramps and that belt use for passengers was lower than for drivers. These results may indicate that different factors influence one's decision to buckle-up at night, or may reflect a difference in people who tend to drive at night compared to daytime drivers.

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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.

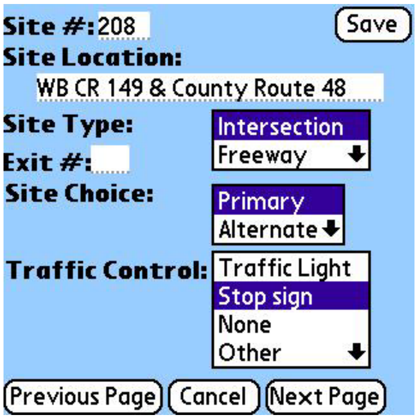

Figure 2. Site Description Form – Screen 1.

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.

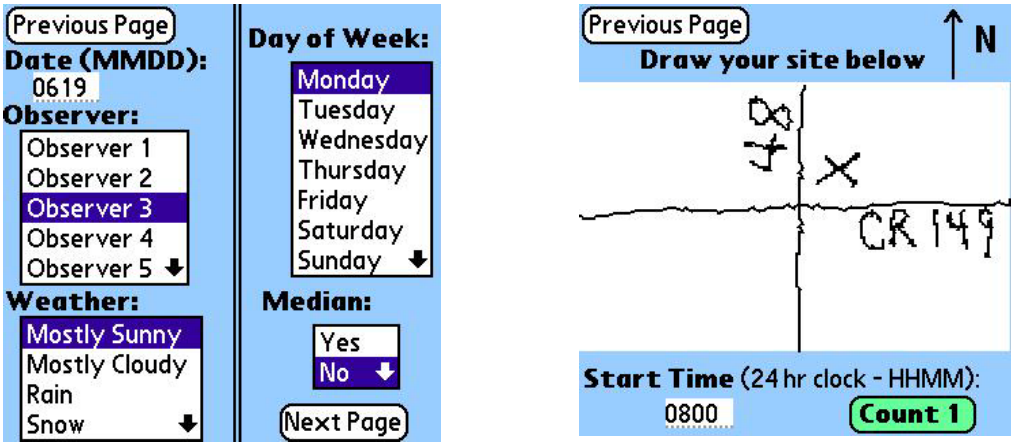

Figure 3. Site Description Form - Screens 2 and 3

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[3]. 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.

[3]The PDA traffic counting method was compared with a mechanical counter during the pilot testing and no difference was found between the two methods.

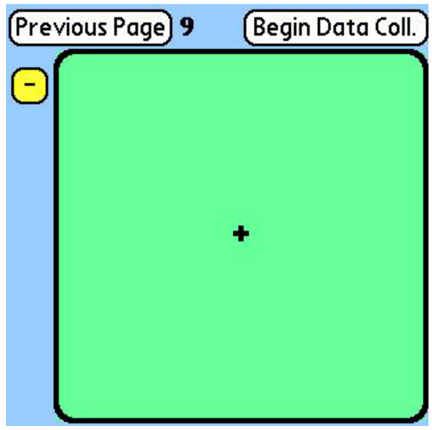

Figure 4. Site Description Form – Screen 4

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.

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, is 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.

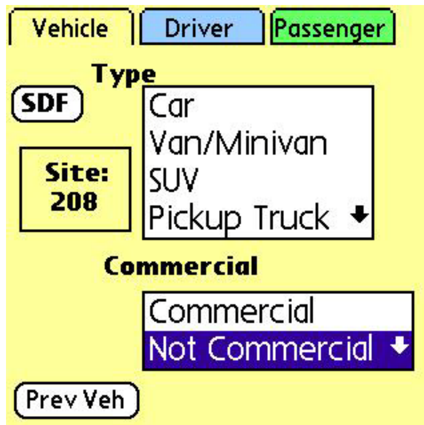

Figure 6. Observation Form - Vehicle Screen

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.

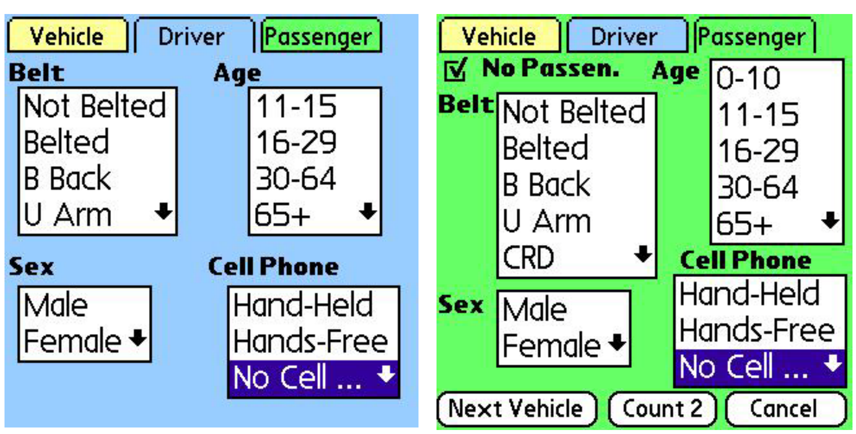

Figure 7. Observation Form - Passenger and Vehicle Screens

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/Guam 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 & Coutny 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	EBP 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 Rotue 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 Belchtold 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 & Pagenkoph Rd
*101	Hennepin	EB Duck Lake Tr & Eden Prarie Rd/County Route 4
102	Hennepin	NB Eden Prarie 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.