Minnesota Seat Belt Use Survey: June 2014

GREENWAY

Minnesota Seat Belt Use Survey: June 2014 Final Report

Submitted to:

Office of Traffic Safety

445 Minnesota Street, Suite 150
St. Paul, MN 55101-5150

By:

Greenway Transportation Planning
Vanasse Hangen Brustlin, Inc.
Lawrence Cook, Ph.D.

Greenway Transportation Planning
1338 Keston St, St Paul MN 55108 USA
Tel +1 651 788 7801
www.greenway-consulting.com

Job number: J1017

Table of Contents

Tables, Figures and Appendices

1 Introduction

The study reported here is the third implementation of a new methodology (the Uniform Criteria) required by the National Highway Traffic Safety Administration (NHTSA). The new methodology (reported in Title 23: Highways, Part 1340 – Uniform Criteria for State Observational Surveys of Seat Belt Use of the Code of Federal Regulations) affected the sample selection, survey design, data collection methodology, data analysis, and reporting. Minnesota's survey design was accepted by NHTSA on March 30, 2012. No changes in methodology were made after the NHTSA acceptance notice was received.

The focus of the report is to present data analyses of seat belt use by front seat occupants (drivers and outermost passengers), both overall and within categories defined by:

- Vehicle type
- Age
- Sex
- Seating Position
- Time of Day
- Day of Week

The report includes data analyses reporting cell phone use by drivers and front-seat passengers, helmet use by motorcyclists, and the quality control procedures.

Survey Methodology Changes

2012 marked the first use of the new survey methodology. Beginning in 2012, NHTSA required states to expand the list of counties included in the sample by making sure that sampled counties were selected from among those accounting for 85 percent of fatal crashes in the state. In Minnesota for 2012, this resulted in 51 of 87 counties being included in the sampling frame. Prior years' sampling frames included 37 counties. More rural counties were also included in the sample than had been the case in previous years. Other changes included:

1. The stratification methodology relied on vehicle-miles-traveled (VMT only)
2. Sites were selected based on a probability of selection related to either road segment length or average daily traffic. Since the Minnesota Department of Transportation (MnDOT) was able to

supply comprehensive traffic data for all public roads, the traffic volume selection method was adopted

3. Observations took place at mid-block locations and approaches to intersections in order to obtain data from free-flow traffic positions, though observer positioning posed new risks for the observers and increased the chances of missing some planned observations when speeds were too high
4. Traffic volume data supplied by MnDOT was used in place of brief counts collected in the field thereby making use of published annualized traffic volume data rather than relying on a brief observation period on a single day, and
5. A standard error of less than 2.5 percent on the seat belt use estimate was required which was significantly lower than the target of 5 percent from the previous survey design.

2 Methods

2.1 Sample Design

Minnesota is composed of 87 counties; 51 of which account for 85.5 percent of the passenger vehicle crash-related fatalities according to Fatality Analysis Reporting System (FARS) data averages for the period 2007-2009. These 51 counties were included in the sample pool for this study.

Using 2010 Road Segment data provided by MnDOT, a listing of county road segments was developed. Each segment was identified by road functional classification (Interstate/Primary, Arterial/Secondary, and Local), by Average Annual Daily Traffic (AADT) and segment length. This descriptive information allowed for stratification of road segments. A systematic probability proportional to size (PPS) sample was adopted to select the road segments to be used as observation sites.

The research design conformed to the requirements of the Uniform Criteria. The selected approach includes a stratified systematic PPS sample of observation sites as is described below.

1. All 87 counties in Minnesota were listed in descending order of the average number of motor vehicle crash-related fatalities for the period of 2007 to 2009. The 51 counties accounting for approximately 85 percent of Minnesota's total passenger vehicle occupant fatalities were selected to compose the sampling frame.
2. *A priori*, it was expected there would be a sample size of approximately 11,000 vehicles overall. This is based on the

2011 Minnesota seat belt use survey which had a standard error of 0.6 percent, well below the allowed value of 2.5 percent.

3. In 2011, the 37 counties included in that year's seat belt use survey were stratified according to high, medium, and low seat belt use (based on prior data or estimated values), with the addition of a separate stratum for Hennepin County (the largest county by population in the state). Because the new sampling frame included more counties than in the past, prior historical seat belt-use data for a number of counties upon which to base decisions on stratum assignments was not available. A different method of stratification based on 2010 vehicle-miles-traveled (VMT) data provided by MnDOT for each county was therefore adopted. Counties were stratified in three levels (high, medium, and low VMT) with the exception of Hennepin County which, as in previous years, was treated as its own stratum. The designation of high, medium, or low traffic volume was determined by first calculating the total VMT for the remaining 50 counties. Counties were then sorted from highest VMT to lowest. Cut points were then determined which created three strata with roughly equal VMT based on an analysis looking for cut points in the data for county VMT (after excluding Hennepin County from the analysis). See Table 1.
4. Road segments were selected randomly and with PPS from all segments in the sampling frame. The road segments were stratified by functional classification (Interstate/Primary, Arterial/Secondary, and Local). This process resulted in the selection of 240 road segments (4 strata x 60 sites per stratum).
5. Additional stages of selection were used to determine the individual site observation period, travel direction, lane, and vehicles to be observed, at random and with known probability, as described in Section 4.1 under the Uniform Criteria.

2.2 County Selection

The 51 counties accounted for 85.5 percent of the total fatalities and represented the first stage of sampling. These counties were stratified into four groups according to their VMT. The strata, counties, their daily vehicle-miles-traveled (DVMT), and stratum total DVMT are shown in Table 1.

Table 1. County and Regional Vehicle Miles Traveled, by Stratum, for County Selection

Strata	County	County DVMT
Hennepin County	**Hennepin**	**30,030,003**
High VMT	Ramsey	12,367,507
High VMT	Dakota	10,512,179
High VMT	Anoka	8,188,710
High VMT	Washington	6,125,344
High VMT	**Total**	**37,193,740**
Med VMT	St. Louis	5,970,800
Med VMT	Stearns	4,962,757
Med VMT	Wright	4,133,188
Med VMT	Olmsted	3,804,351
Med VMT	Scott	3,429,249
Med VMT	Sherburne	2,504,030
Med VMT	Crow Wing	2,269,926
Med VMT	Carver	2,251,316
Med VMT	Otter Tail	2,236,360
Med VMT	Chisago	2,070,261
Med VMT	Rice	1,939,557
Med VMT	**Total**	**35,571,795**
Low VMT	Clay	1,898,601
Low VMT	Goodhue	1,798,349
Low VMT	Blue Earth	1,734,871
Low VMT	Winona	1,672,928
Low VMT	Freeborn	1,555,959
Low VMT	Douglas	1,553,009
Low VMT	Pine	1,545,028
Low VMT	Steele	1,407,290
Low VMT	Itasca	1,406,513
Low VMT	Morrison	1,358,758
Low VMT	Benton	1,309,168
Low VMT	Kandiyohi	1,302,302
Low VMT	Cass	1,204,992
Low VMT	Beltrami	1,168,855
Low VMT	Mille Lacs	1,149,914
Low VMT	Polk	1,101,274
Low VMT	Becker	1,095,733
Low VMT	Nicollet	1,064,280

Strata	County	County DVMT
Low VMT	Isanti	1,053,958
Low VMT	Martin	854,203
Low VMT	Nobles	826,623
Low VMT	Todd	820,645
Low VMT	Le Sueur	784,263
Low VMT	Lyon	772,158
Low VMT	Hubbard	719,426
Low VMT	Aitkin	714,619
Low VMT	Meeker	701,873
Low VMT	Jackson	690,695
Low VMT	Renville	661,906
Low VMT	Fillmore	617,252
Low VMT	Redwood	595,570
Low VMT	Wabasha	582,637
Low VMT	Pipestone	310,670
Low VMT	Murray	292,901
Low VMT	Stevens	269,536
Low VMT	**Total**	**36,596,759**

2.3 Road Segment Selection

Using all 51 counties in the sampling frame, a total of 60 road segments were selected with PPS from within each stratum. The 2010 MnDOT roadway inventory and traffic volume data was used for the selection of road segments. The available exclusion option and removal of non-public roads, unnamed roads, unpaved roads, vehicular trails, access ramps, traffic circles, and service drives from the dataset was exercised.

Road segments within each county were first stratified by functional classification (Interstate/Primary, Arterial/Secondary, and Local). Within each VMT and functional class stratum road segments were selected with PPS with the measure of size (MOS) being DVMT. Let $g = 1,2, \ldots G$ be the first stage strata, v_{gh} be DVMT for road segment stratum *h* in stratum g, and $v_{gh} = \sum_{all\ i\ in\ gh} v_{ghi}$ be the total DVMT for all road segments in stratum *g* and functional class group *h*. The road segment inclusion probability is $\pi_{i|gh} = n_{gh} v_{i|gh} / v_{gh}$, where $n_{hg}$is the sample size for the roadway functional class stratum *h* in VMT stratum g that was allocated. If a roadway segment was selected with certainty (i.e., its MOS was equal to or exceeded v_{gh}/n_{gh}), it was set aside as a certainty selection and the probabilities of selection were recalculated for the remaining road segments in the stratum. This was repeated and the certainty selections were identified successively until no roadway segment's MOS was equal to or exceeded the recalculated v_{gh}/n_{gh}. After all certainty road segments were identified, the R statistical software package sampling function with a selection probability vector was used to obtain a road segment sample with PPS. *(Software package used: R Development Core Team. (2010). R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing)*

The resulting composition of the sample of each functional class within each stratum is shown in Tables 2, 3, 4 and 5.

Table 2. Road Segments Population (N), DVMT, and Number of Segments Selected (n) by Road Functional Strata: Hennepin County Stratum

Data	Interstate/ Primary	Arterial/ Secondary	Local	Total
N	245	2,458	15,606	18,309
DVMT	17,306,755	9,277,288	3,445,962	30,030,005
n	34	19	7	60

Table 3. Road Segments Population (N), DVMT, and Number of Segments Selected (n) by Road Functional Strata: High VMT Stratum

Data	Interstate/ Primary	Arterial/ Secondary	Local	Total
N	339	3,704	24,699	28,742
DVMT	18,261,044	14,340,989	4,591,711	37,193,744
n	29	23	8	60

Table 4. Road Segments Population (N), DVMT, and Number of Segments Selected (n) by Road Functional Strata: Medium VMT Stratum

Data	Interstate/ Primary	Arterial/ Secondary	Local	Total
N	658	5,183	36,256	42,097
DVMT	17,219,124	12,958,057	5,394,615	35,571,796
n	29	22	9	60

Table 5. Road Segments Population (N), DVMT, and Number of Segments Selected (n) by Road Functional Strata: Low VMT Stratum

Data	Interstate/ Primary	Arterial/ Secondary	Local	Total
N	1,143	8,454	57,117	66,714
DVMT	17,388,783	12,871,951	6,336,030	36,596,764
n	29	21	10	60

2.4 Reserve Sample

The reserve road segment sample consisted of two additional road segments per original road segment selected, resulting in a reserve sample of 480 road segments. These reserve segments were identified and selected based on similarity to the primary selected sample segments they would have to replace. Similarity was verified based on functional classification and DVMT. Thus, reserve road segments were selected with PPS using DVMT as MOS by the same approach as described earlier. For the purposes of data weighting, the reserve road segment inherits all probabilities of selection and weighting components up to and including the road segment stage of selection from the original road segment actually selected. Probabilities and weights for any subsequent stages of selection (e.g., the sampling of vehicles) will be determined by the reserve road segment itself. Appendix A presents the surveyed road segments.

3 Data Collection

3.1 Site Selection

Road segments were mapped according to their latitude and longitude. The selected road segments were examined using both Google and Esri mapping tools to identify an intersection or interchange that occurs within the segment. If no intersection or interchange occurred within the segment, then any suitable point within that segment was used for observation. Observation sites were selected to identify a safe and convenient location for the observer to be stationed during the survey period. Observation site selection also included cross-checking survey dates against scheduled construction activities via MnDOT's 511 Traveler Information Service and inspection of state highway GIS base maps for posted speed limits and supporting traffic control installations. Sites including an intersection or interchange were assigned to locations in the segment at or as near as possible to any controlled intersections. For interstate highways and other primary roads with interchanges, observation sites were selected to be on a ramp carrying traffic that is exiting the highway. The observed direction of travel was randomly assigned for each road segment.

For high-volume roadways (those in which an observer could not reasonably be assured of surveying all lanes of travel in the desired direction), observations were taken from the curbside or next-to-curbside lanes. This was because it was found to be impractical (especially in free-flowing traffic at speeds in excess of 40 mph) to observe vehicles more than two lanes distant from the observer's position. The locations of the observation sites were described on Site Assignment Screens provided to aid the observers and Quality Control (QC) Monitor in traveling to the assigned locations.

3.2 Staff Selection and Training

Four experienced observers from prior Minnesota seat belt use surveys were hired and assigned observation sites throughout the state. One staff member was designated as the QC Monitor responsible for monitoring observations conducted at 5 percent of all sites.

Observer and QC Monitor training was conducted at the Office of Traffic Safety and in the field on Friday, May 30, 2014 which was one week prior to the data collection period. The training syllabus is found in Figure 1

Figure 1. Training Syllabus

Friday, May 30, 2014:

Welcome

Review and sign contracts

Distribute training materials

Survey overview

Data collection techniques
- Definitions of seat belt, booster seat use, passenger vehicles, cell phone use, and motorcycle helmet use
- Observation protocol
- Weekday/weekend/rush hour/non-rush hour
- Weather conditions
- Duration at each site

Scheduling and rescheduling
- Site Assignment Sheet
- Daylight
- Temporary impediments such as weather
- Permanent impediments at observation sites

Site locations
- Locating assigned sites
- Interstate ramps and surface streets
- Direction of travel, number of observed lanes
- Non-intersection requirement
- Alternate site selection

Data collection instrument
- Explanation of features
- Basic descriptions
- Recording observations
- Process for recording alternate site information
- Supporting software applications

Data uploads

Safety and security

Timesheet and expense reports

Field practice

Field Reliability Testing

At the conclusion of the classroom portion of the training the observers took a 12–question quiz to ensure that they understood the survey terminology, the data collection protocols, and reporting requirements. The observers scored over 90 percent correct on the quiz.

Field reliability testing was conducted at the end of the training day. Two sites were selected for reliability testing where about 70 vehicles were observed in order to assess agreement among the observers and the QC Monitor. Criterion performance was set at no greater than 5 percent disagreement on the count of vehicles and overall seat belt use percentage. The results of the reliability testing are contained in a separate document provided to the Office of Traffic Safety. A second training day on Monday, June 2, was conducted for further device familiarization and equipment checkout. The seat belt use observation survey was scheduled for June 6–19, 2014.

3.3 Observation Periods and Quality Control

All observations were conducted during weekdays and weekends between 7:00 a.m. and 6:00 p.m. The schedule included rush hour (before 9:30 a.m. and after 3:30 p.m.) and non-rush hour observations. Observation of seat belt use was conducted for 45 minutes per site, at up to five sites per day for each observer. Sites within close proximity were grouped as observation clusters and were randomly assigned a day of the week observation period. Start times were staggered to ensure that a representative number of weekday, weekend, rush hour and non-rush hour sites were included. The first site in each group and its observation time was randomly selected. The order for the observations of the remaining sites for the day was designed to reduce travel time and costs.

Maps showing the location of all observation sites and site assignment sheets were provided to the observers and QC Monitor. These indicated the observed road name, the crossroad included within the road segment (or nearest crossroad), assigned date, assigned time, direction of travel, and (if necessary) lanes assigned.

Data Collection

All passenger vehicles, including commercial vehicles weighing less than 10,000 pounds, were eligible for observation. The data collection input screens are shown in Appendix B. The start-up screen was designed to allow for documentation of descriptive site information, including: date, site location, site number, alternate site data, assigned traffic flow, number of lanes available and observed, start and end times for observations, and weather conditions. This form was completed by the observer at each site.

A five-minute pre-observation period was used to collect eligible vehicle counts for the lanes to be observed at each site. This period of counting was used to determine the sampling rate of vehicles at the site. In keeping with the guidance in the Preamble of the Uniform Criteria, observers were instructed to sample every Nth vehicle at locations, using the following guideline:

1. For 31 or more vehicles per five minute count—observe every 5th vehicle.
2. For 16–30 vehicles per five minute count—observe every 3rd vehicle.
3. For 0–15 vehicles per five minute count—observe every vehicle.

In addition, observers were instructed to collect helmet-use information for every motorcycle and keep a count of those missed in the event of a large rally passing during the observation period.

This technique (as briefly described in the Uniform Criteria) allowed for detailed information to be gathered beyond the collection of seat belt use alone. This is in keeping with the survey designs in past years for Minnesota and gives the state additional useful information tied directly to the vehicle occupants for which seat belt use information was obtained. All relevant information was collected for all qualifying front seat occupants. The data collection screens were designed to record seat belt use, cell phone use by drivers and passengers, as well as motorcycle helmet use by motorcycle riders. The apparent age and gender of all drivers, front seat passengers, and motorcycle riders were collected as well.

For low-to-moderate volume locations, the observer surveyed as many lanes of traffic as possible while obtaining data on at least 90 percent of the vehicles included in the sample. For high-volume sites, the observer was instructed to survey the pre-selected lane of traffic. Only one direction of traffic was observed at any given site.

Observations were made of all drivers and right front seat occupants in eligible vehicles. This included children riding in booster seats. *The only right front seat occupants excluded from this study were child passengers who were traveling in child seats with harness straps*. All entries were made on data entry screens.

Alternate Sites and Rescheduling

When a site could not be observed due to safety concerns, construction or inclement weather and an alternate site was not immediately available, data collection was rescheduled for later in the data collection period, selecting a similar time of day and day of week. In the event that the site was going to be unavailable for the duration of the study, then a preselected alternate site was taken from the reserve sample and used as a permanent replacement.

During the survey, 2 sites were rescheduled due to bad weather and significant traffic variation, resulting in a large number of missed vehicles. The survey rescheduling were disclosed to the observers by the QC Monitor. All observations, including rescheduled observations, were completed by June 22, 2014.

Quality Control Procedures

The QC Monitor made unannounced visits to 15 of the observation sites. This represented 6.2 percent of the sites and was greater than the required 5 percent monitoring rate. During these visits, the QC Monitor evaluated the observer's performance from a distance (if possible) to ensure that the observer was following all survey protocol including: being on time at assigned sites, completing the data collection forms, and making accurate observations of seat belt use. The QC Monitor then worked alongside the observer to obtain comparison data of at least 30 vehicles when possible. The monitoring results are contained in a separate document provided to the Office of Traffic Safety.

4 Imputation, Estimation and Variance Estimation

4.1 Imputation

No imputation was done on missing data.

4.2 Sampling Weights

The following is a summary of the notation used in this section.

g – Subscript for PSU strata

h – Subscript for road segment strata

i – Subscript for road segment

j – Subscript for time segment

k – Subscript for road direction

l – Subscript for lane

m – Subscript for vehicle

n – Subscript for front-seat occupant

Under this stratified multistage sample design, the inclusion probability for each observed vehicle is the product of selection probabilities at all stages: π_{gh} for road segment strata, $\pi_{i|gh}$ for road segment, $\pi_{j|ghi}$ for time segment, $\pi_{k|ghij}$ for direction, $\pi_{l|ghij}$ for lane, and $\pi_{m|ghijl}$ for vehicle. So the overall vehicle inclusion probability is:

$$\pi_{ghijklm} = \pi_{gh}\pi_{i|gh}\pi_{j|ghi}\pi_{k|ghij}\pi_{l|ghij}\pi_{m|ghijl}.$$

The sampling weight (design weight) for vehicle *m* is:

$$w_{ghijklm} = \frac{1}{\pi_{ghijklm}}$$

4.3 Non–response Adjustment

Given the data collection protocol described in this plan, including the provision for the use of alternate observation sites, road segments with non-zero eligible volume and yet zero observations conducted should be a rare event. Nevertheless, if eligible vehicles passed an eligible site or an alternate eligible site during the observation time but no usable data were collected for some reason, then this site will be considered as a “non–responding site.” The weight for a non–responding site will be distributed over other sites in the same road type in the same PSU. Let:

$$\pi_{ghi} = \pi_{gh}\pi_{i|gh}$$

be the road segment selection probability, and

$$w_{ghi} = \frac{1}{\pi_{ghi}}$$

be the road segment weight. The non–responding site non–response adjustment factor:

$$f_{gh} = \frac{\sum_{all\ i} w_{ghi}}{\sum_{responding\ i} w_{ghi}}$$

will be multiplied to all weights of non–missing road segments in the same road type of the same stratum and the missing road segments will be dropped from the analysis file. However, if there were no vehicles passing the site during the selected observation time (45 minutes) then this is simply an empty block at this site and this site will not be considered as a non–responding site, and will not require non–response adjustment.

There were four sites with zero observation and no non–responding sites encountered during the survey

4.4 Seat Belt Use Estimator

Since AADT and DVMT are available at the roadway and segment level, seat belt use was estimated as follows:

Noting that all front-seat occupants were observed, let the driver/passenger seat belt use status be:

$$y_{ghijklmn} = \begin{cases} 1, & if\ belt\ used \\ 0, & otherwise \end{cases}.$$

The seat belt use rate estimator is a ratio estimator:

$$p_{VMT} = \frac{\sum_g \sum_h \sum_i w_{ghi} VMT_{ghi} p_{ghi}}{\sum_{all\ jklmn\ in\ ghi} w_{jklm|ghi}}.$$

Here w_{ghi} is the road segment weight, VMT_{ghi}, is the road segment VMT. The road segment level seat belt use rate p_{ghi} is estimated by:

$$p_{ghi} = \frac{\sum_{all\ jklmn\ in\ ghi} w_{jklm|ghi} y_{ghijklmn}}{\sum_{all\ jklmn\ in\ ghi} w_{jklm|ghi}}.$$

Here weight $w_{jklm|ghi} = (\pi_{j|ghi}\pi_{k|ghij}\pi_{l|ghijk}\pi_{m|ghijkl})^{-1}$ is the subsequent vehicle selection probability after the site is selected.

Further assuming that all vehicles observed at the same road segment *i* have the equal selection probabilities for the subsequent sampling after road segment selection, then all weights $w_{jklm|ghi}$ for the same road segment are equal and can be cancelled in the calculation of p_{ghi}. One example of this situation is treating the observed vehicles at the same site as a simple random sample of all vehicles passing that site. So p_{ghi} can be estimated by the sample mean.

The seat belt use rate estimator is a ratio estimator:

$$Pghi = \frac{1}{n_{ghi}} \sum_{all\ jklmn\ in\ ghi} y_{ghijklmn}$$

Together the road segment level DVMT and the assumption of equal vehicle selection probabilities at the same site not only simplify the road segment level seat belt use rate estimation, but dramatically reduce the amount of information to be collected in the field.

4.5 Variance Estimation

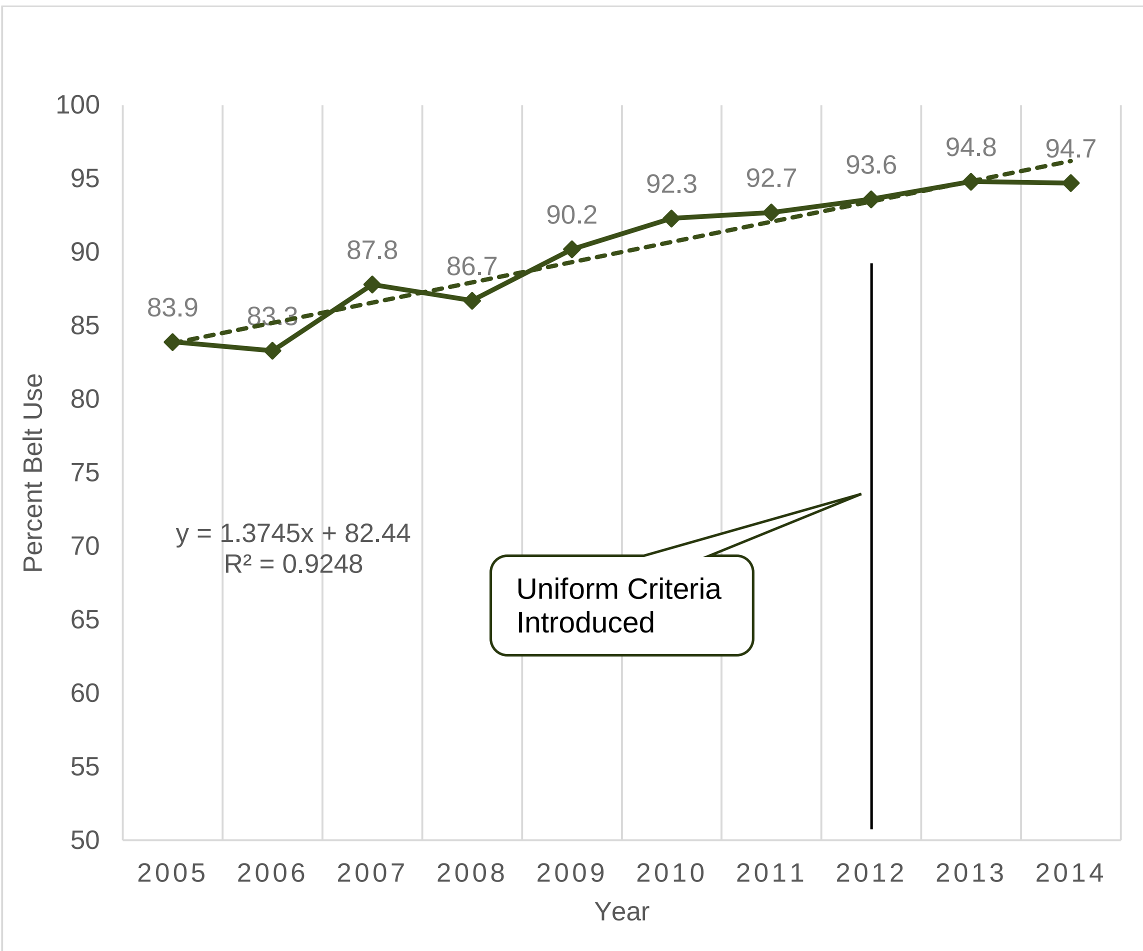
PROC SURVEYFREQ and PROC SURVEYMEANS in SAS were used for the ratio estimator ρ_{VMT} along with the joint PSU selection probabilities to calculate the seat belt use rate and its variance.

5 Data Analysis

5.1 Overall Measures of Seat Belt Use

The 2014 Minnesota seat belt survey included 15,345 front seat occupant observations from 12,014 vehicles. The overall percent seat belt use was 94.7 percent (standard error = 0.011 percent; 95 percent confidence interval is 94.68 to 94.72 percent). This weighted value represents a slight decrease from the value for 2013 (94.8 percent; 95 percent confidence interval of 93.52 to 96.07 percent) but is still one of the highest values obtained since the first seat belt observation studies were performed in Minnesota in 1986. Figure 2 shows the annual weighted average seat belt use and a linear trend line over the years 2005–14.

Figure 2. Seat Belt Use Percentage for 2005–14



The equation for the trend line is y= (1.3745* YEAR) + 82.44. The upward trend is significantly different from zero (flat) (R^2 = 0.9248). This indicates a baseline value (pre–2003 of 78.7 percent seat belt use, and a steady increase of about an additional 1.4 percent seat belt use each year.

The remainder of this section provides high-level summary data in graphic format. Detailed data tables showing both weighted and unweighted data are contained in a separate document provided to the Office of Traffic Safety. In the figures that are presented here, all percentages are based on weighted data.

Figure 3 shows the seat belt use rate as a function of time of day for the years 2005–14.

Figure 3. Seat Belt Use Across Hours of the Day: 2005–14

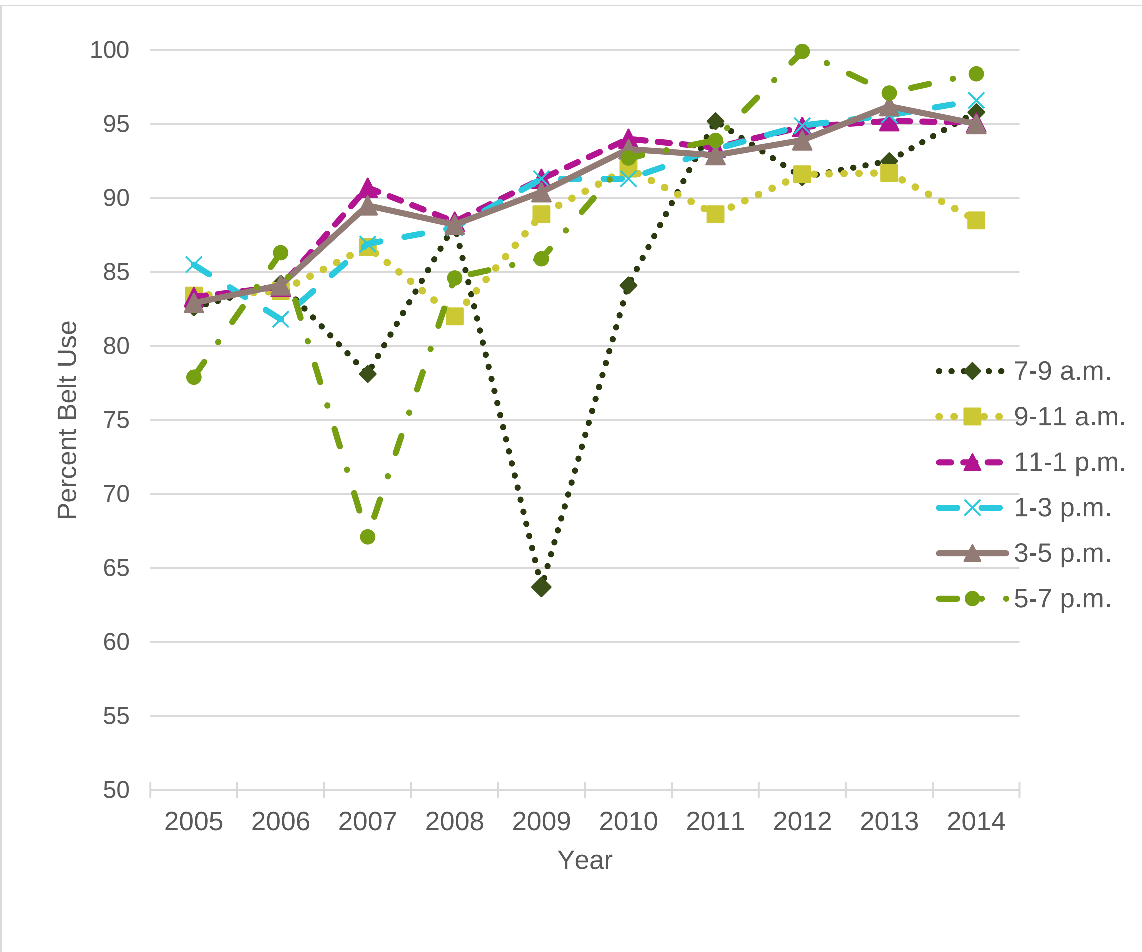


Figure 4 shows the seat belt use patterns over the days of the week for the years 2005–14.

Figure 4. Seat Belt Use Across Days of the Week: 2005–14

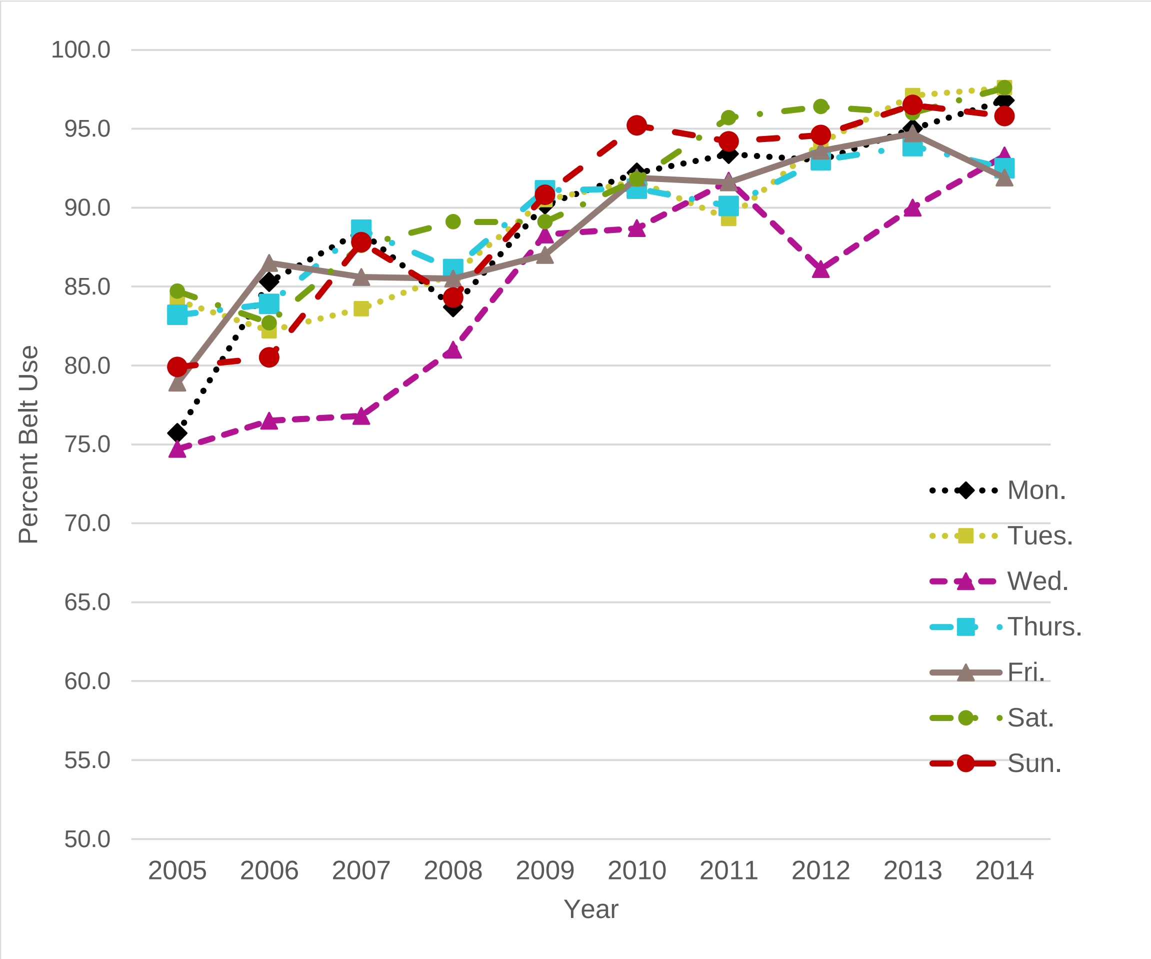


Figure 5 shows the seat belt use patterns as a function of occupant age for the years 2005–14.

Figure 5. Seat Belt Use Among Age Groups: 2005–14

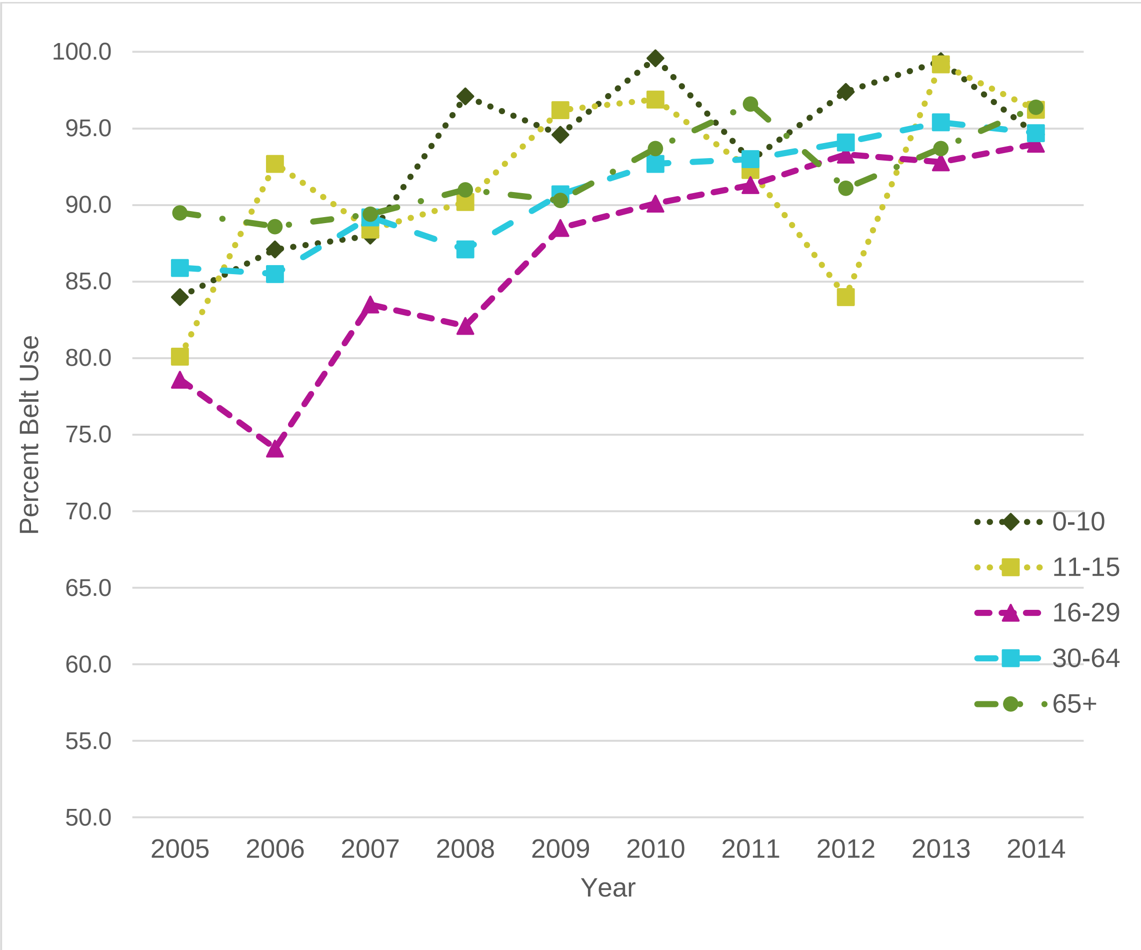


Figure 6 shows seat belt use for male and female front seat occupants for the years 2005–14.

Figure 6. Seat Belt Use as a Function of Gender of the Occupant: 2005–14

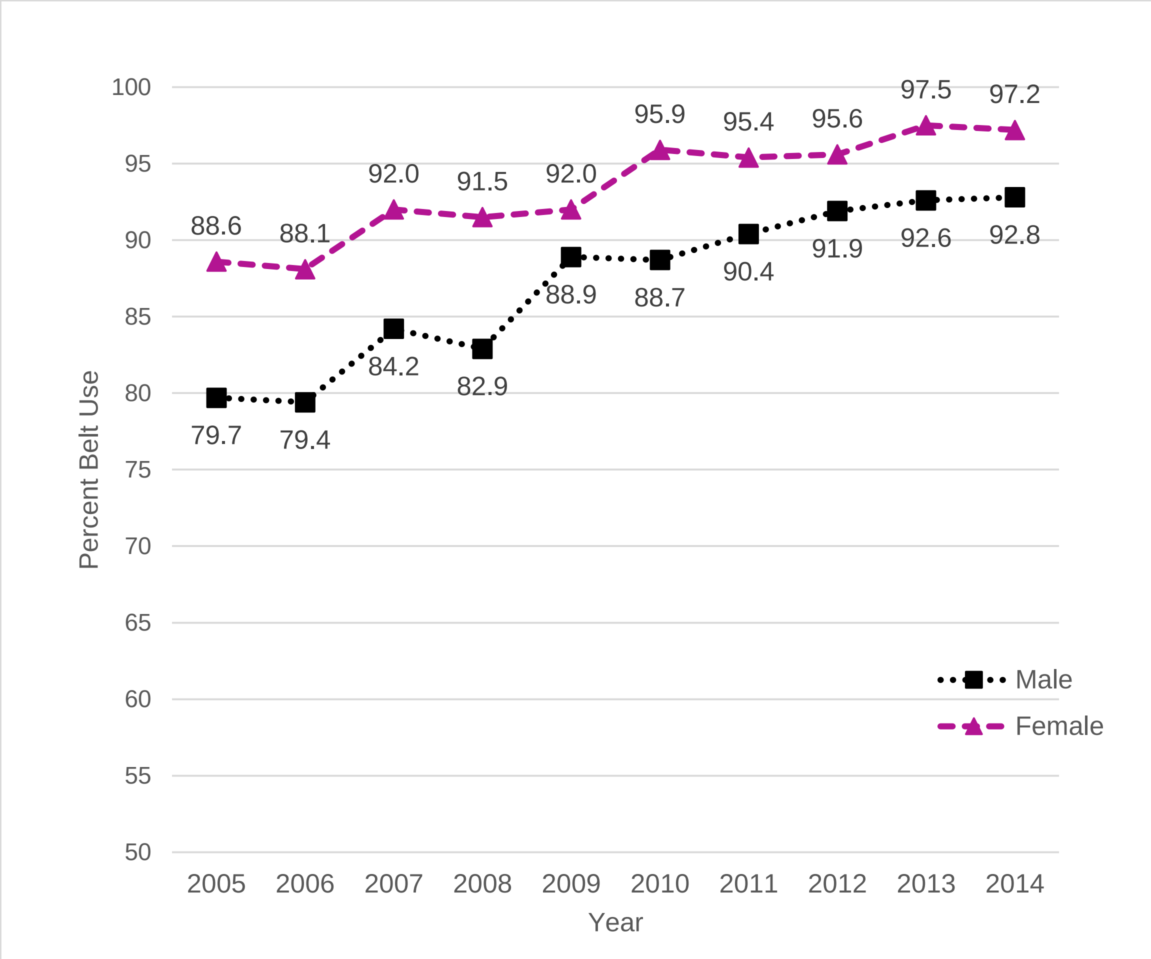
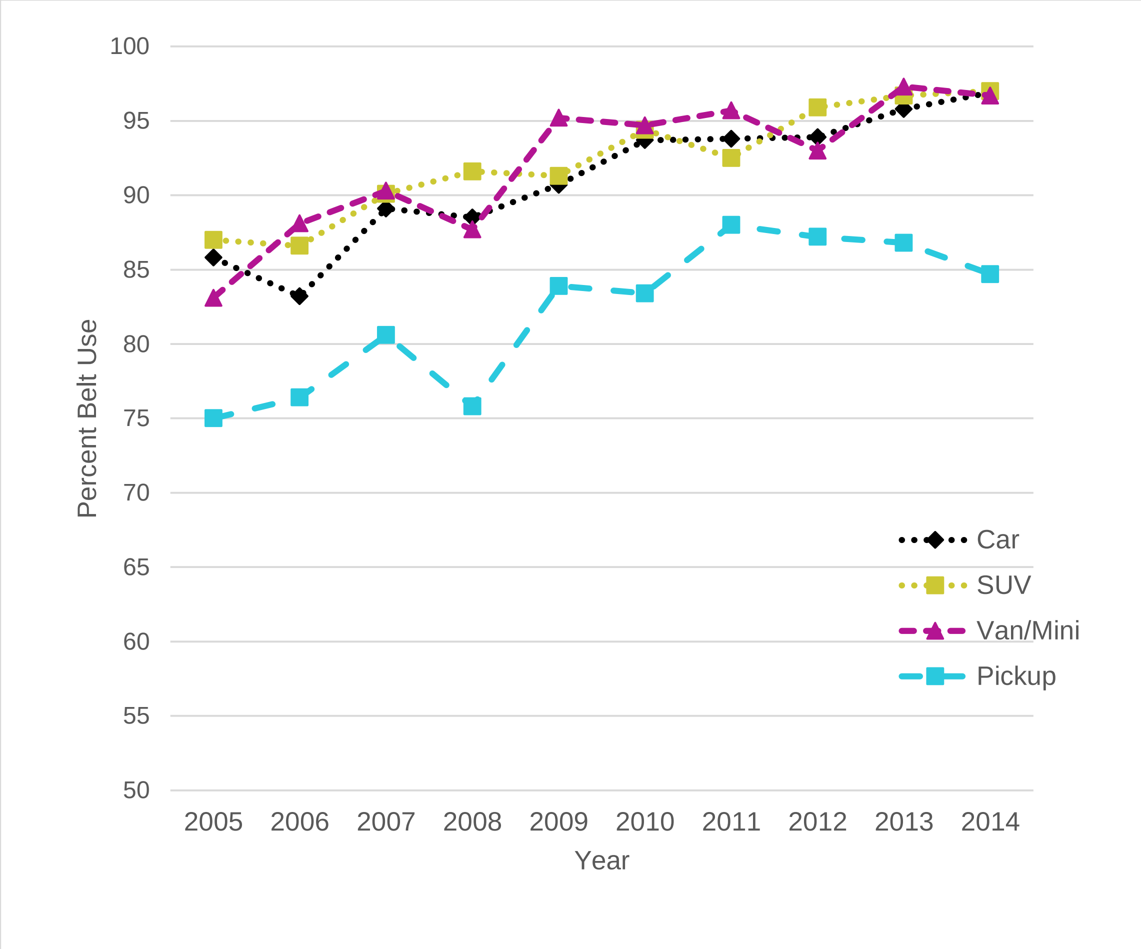


Figure 7 shows seat belt use for front seat occupants of pickup trucks, vans/minivans, SUVs, and cars for the years 2005–14.

Figure 7. Seat Belt Use as a Function of Vehicle Type: 2005–14



5.2 Seat Belt Use Summary Tables

In order to facilitate comparison of seat belt use results between this 2014 survey and prior years, this section presents data tables that are equivalent to those produced last year.

Table 6 presents the seat belt use results for each stratum. The seat belt use values and Ns are the unweighted (actual) number of front seat occupants observed. The presentation in the body of this report of both weighted and unweighted values was determined by a close examination of the results to identify areas of analysis where the unweighted values appear to offer a more accurate representation of the information for policy makers. All of the analyses (both weighted and unweighted) appear in a separate report provided to the Office of Traffic Safety.

Table 6. Unweighted Seat Belt Use Rates and Ns as a Function of Stratum, Roadway Type

Stratum	Location/Road Type	N	Percent
Hennepin	Primary	2,888	96.5
Hennepin	Secondary	1,432	95.7
Hennepin	Local	149	97.3
High VMT	Primary	2,250	96.1
High VMT	Secondary	1,536	95.3
High VMT	Local	164	98.2
Med VMT	Primary	1,865	96.3
Med VMT	Secondary	1,501	94.5
Med VMT	Local	193	93.8
Low VMT	Primary	2,329	93.8
Low VMT	Secondary	993	94.5
Low VMT	Local	46	78.3
Overall	Statewide	15,345	95.4

Table 7 presents the number of observations as a function of Site Type, Time of Day, Day of Week, Weather, Sex, Age, and Position in the Vehicle. Table 8 presents the resulting weighted seat belt use percentages.

Table 7. Number of Observations (N) as a Function of Subgroup, Vehicle Type

Group/ Subgroup	All Vehicles	Car	SUV	Van/ Minivan	Pickup Truck
Overall	15,345	6,908	4,140	1,763	2,659
Site Type					
Intersection	6,827	3,017	1,857	785	1,151
Mid-Block	2,355	934	588	266	545
Ramp	5,996	2,882	1,656	700	745
Time of Day					
7–9 a.m.	1,481	638	426	181	229
9–11 a.m.	3,373	1,458	978	412	519
11 a.m.–1 p.m.	3,956	1,779	1,039	439	687
1–3 p.m.	4,180	1,933	1,088	480	659
3–5 p.m.	1,869	868	475	201	320
5–7 p.m.	486	232	134	50	68
Day of Week					
Monday	2,235	1,024	615	250	336
Tuesday	2,748	1,259	709	340	438
Wednesday	1,828	759	499	250	312
Thursday	1,779	845	421	206	296
Friday	2,540	1,089	698	298	444
Saturday	1,963	809	523	180	443
Sunday	2,252	1,123	675	239	213
Weather					
Sunny	8,266	3,744	2,259	986	1,254
Cloudy	4,823	2,175	1,229	569	828
Rainy	2,256	989	652	208	400
Gender					
Male	8,630	3,565	2,014	986	2,042
Female	6,707	3,336	2,126	776	440
Age					
0-10	45	20	12	4	8
11-15	268	98	86	44	39
16-29	3,339	2,045	655	240	387
30-64	10,513	4,123	3,137	1,348	1,877
65+	1,172	617	248	127	171
Position					
Driver	12,014	5,496	3,198	1,312	1,976
Passenger	3,331	1,412	942	451	506

Table 8. Weighted Seat Belt Use Rates (%) as a Function of Subgroup, Vehicle Type

Group/ Subgroup	All Vehicles	Car	SUV	Van/ Minivan	Pickup Truck
Overall	94.7%	96.9%	97.0%	96.7%	84.7%
Site Type					
Intersection	94.6%	97.0%	97.0%	96.5%	84.4%
Mid-Block	94.6%	96.4%	97.3%	97.8%	84.6%
Ramp	96.4%	96.7%	97.0%	96.1%	93.3%
Time of Day					
7–9 a.m.	95.8%	98.1%	96.3%	99.7%	83.3%
9–11 a.m.	88.5%	96.1%	94.8%	95.8%	63.1%
11 a.m.–1 p.m.	95.1%	95.8%	96.7%	97.7%	88.3%
1–3 p.m.	96.6%	97.1%	98.1%	95.8%	94.8%
3–5 p.m.	95.0%	96.6%	96.3%	93.1%	89.8%
5–7 p.m.	98.4%	98.0%	99.4%	98.3%	96.9%
Day of Week					
Monday	96.8%	97.0%	97.6%	99.0%	90.8%
Tuesday	97.6%	98.0%	98.6%	97.9%	93.4%
Wednesday	93.3%	96.0%	95.5%	92.1%	85.2%
Thursday	92.5%	95.7%	96.7%	93.6%	75.4%
Friday	91.9%	97.6%	96.3%	97.6%	69.1%
Saturday	97.6%	96.3%	98.8%	97.7%	97.5%
Sunday	95.8%	96.5%	95.2%	96.7%	93.7%
Weather					
Sunny	93.9%	97.2%	96.4%	97.3%	77.4%
Cloudy	95.2%	95.8%	97.6%	95.6%	91.3%
Rainy	96.1%	97.8%	97.5%	96.2%	86.7%
Sex					
Male	92.8%	96.0%	95.0%	95.7%	85.3%
Female	97.2%	97.8%	99.1%	97.6%	81.2%
Age					
0-10	94.6%	87.8%	100%	100%	98.1%
11-15	96.2%	100%	100%	80.9%	89.9%
16-29	94.0%	96.8%	97.6%	96.9%	82.7%
30-64	94.7%	96.7%	96.7%	96.8%	85.7%
65+	96.4%	98.0%	99.1%	98.4%	80.9%
Position					
Driver	94.1%	96.7%	96.7%	96.7%	81.5%
Passenger	97.2%	97.5%	98.4%	96.4%	95.6%

5.3 Cell Phone Use

Table 9 shows unweighted cell phone use by occupants of passenger vehicles in 2014.

Table 9. Unweighted Cell Phone Use Rate by Vehicle Type

Vehicle Type	Value	Handheld	Hands-Free	None	Total
Car	Count	412	6	6,490	6,908
Car	%	6.0%	0.1%	93.9%	100%
Pick Up	Count	102	3	2,377	2,482
Pick Up	%	4.1%	0.1%	95.8%	100%
SUV	Count	215	2	3,923	4,140
SUV	%	5.2%	0.1%	94.8%	100%
Van/Minivan	Count	87	4	1,672	1,763
Van/Minivan	%	4.9%	0.2%	94.9%	100%
Missing	Count	1	0	51	52
Missing	%	1.9%	0.0%	98.1%	100%
All vehicles	Count	817	15	14,513	15,345
All vehicles	%	5.3%	0.1%	94.6%	100%

The majority of occupants were not using a cell phone. Roughly one-in-twenty (5.3 percent) front seat occupants were observed to be using a handheld cell phone. Fewer than one-in-one-hundred were judged to be using a hands-free cell phone. This is, naturally, a difficult judgment for the observers to make and is particularly difficult when there are passengers in the vehicle (i.e., one cannot tell if the conversation is between vehicle occupants only or if an occupant is using a hands-free cell phone).

Tables 10 and 11 show unweighted counts of and percentages of seat belt and phone use for drivers and front seat passengers.

Table 10. Driver Unweighted Cell Phone Use by Seat Belt Use

Phone Use	Value	Belted	Unbelted	Total	% Phone Use
Handheld	Count	659	32	691	5.8%
Handheld	%	95.4%	4.6%	100%	
Hands-Free	Count	15	0	15	0.1%
Hands-Free	%	100%	0%	100%	
None	Count	10,760	548	11,308	94.1%
None	%	95.2%	4.8%	100%	
Overall	Count	11,434	580	12,014	100%
Overall	%	95.2%	4.8%	100%	

Table 11. Passenger Unweighted Cell Phone Use by Seat Belt Use

Phone Use	Value	Belted	Unbelted	Total	% Phone Use
Handheld	Count	123	3	126	3.8%
Handheld	%	97.6%	2.4%	100%	
Hands-Free	Count	0	0	0	0%
Hands-Free	%	n/a	n/a	n/a	
None	Count	3,084	121	3,205	96.2%
None	%	96.2%	3.8%	100%	
Overall	Count	3,207	124	3,331	100%
Overall	%	96.3%	3.7%	100%	

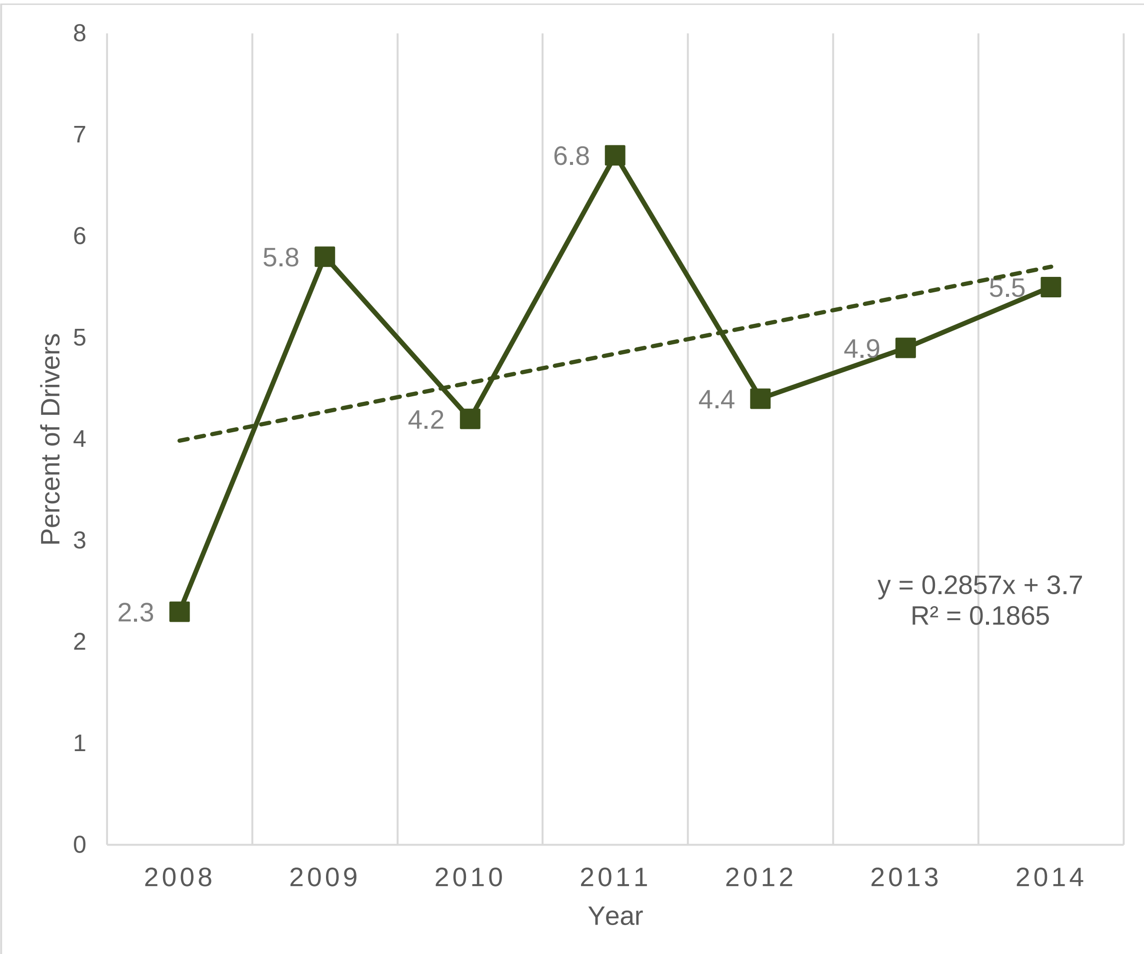
Tables 10 and 11 appear to indicate that drivers are the only individuals to use hands-free cell phones. This is an artifact of the data collection protocol—it was difficult to determine if a conversation taking place in a vehicle with both a driver and a front seat passenger might have also included use of a hands-free cell phone, so those cells in the table are blank by design. Looking at the row for use of handheld cell phones, there does not seem to be a strong relationship between seat belt use and cell phone use. At least among drivers (for whom there is a sufficiently large sample), the percentage of seat belt use by those using a handheld cell phone is virtually the same as the overall percentage of seat belt use (95.4 percent versus 95.2 percent).

Figure 8 shows the trend across years 2008–14 in driver's use of handheld cell phones from the annual June seat belt observation surveys using weighted data. At 5.5 percent the 2014 drivers' percentage of handheld cell phone use is above the weighted average of 4.8 percent for the years in which data are available. Across years, there is a noticeable upward trend, as shown in the linear trend line displayed in the figure. The equation for this trend line is:

Cell phone use percentage = 0.2857(YEAR) + 3.7 (R^2=0.1865)

This indicates that cell phone use is increasing on average about 0.28 percentage points per year. However, the strength of the correlation between years and cell phone use is not high as shown by the low value of R^2. In addition, the increase in the trend may be slowing since the same trend line last year predicted a 0.32 percentage point increase per year. Both 2013 and 2014 are below the value predicted by linear trend.

Figure 8. Driver's Handheld Cell Phone Use (Weighted Data): 2008–14



5.4 Motorcyclist Analyses

The following data are presented for motorcyclists in 2014. All of the data are unweighted. Motorcycle helmet use of 44.8 percent in 2014 increases slightly from the 2013 value of 42.8 percent, but is still under the 2012 value of 46.3 percent and the 2011 value of 57.1 percent. Overall usage rates for 2014 are 45.3 percent for riders and 40 percent for passengers. In 2013 the riders were at 41.4 percent helmet usage rates and passengers were at 53 percent. Inclusive of riders and passengers considered together, males were more likely than females to wear a helmet (45.5 percent for males, 40 percent for females overall), however (as shown in Table 12) the number of female riders and passengers is low and thus the helmet use rate might be less reliable for females as opposed to males.

Table 12 presents the overall unweighted helmet use by all riders and separated by age, gender and position on the motorcycle.

Table 12. Unweighted Motorcyclist Helmet Use by Age, Gender and Riding Position

Characteristic	Value	Rider	Passenger	Total/ Overall
Age 11-15	Count[1]	0	0	0
11-15	% Helmet Use[2]	n/a	n/a	n/a
16–29	Count	43	4	47
16–29	% Helmet Use	55.8%	0%	51.1%
30–64	Count	115	16	131
30–64	% Helmet Use	41.7%	50%	42.7%
65+	Count	3	0	3
65+	% Helmet Use	33.3%	n/a	33.3%
Gender Male	Count	155	1	156
Male	% Helmet Use	45.8%	0%	45.5%
Female	Count	6	19	25
Female	% Helmet Use	33.3%	42.1%	40%
Overall[3]	Count	161	20	181
Overall	% Helmet Use	45.3%	40.0%	44.8%

Note: 1 Count refers to total number of observations per sub-group.
2 Percentage refers to proportion within sub-group.
3 Total counts for Gender and Age differ slightly due to missed entries.

6 Discussion

The 2014 Minnesota Seat Belt Use Survey was successful in continuing use of the 2012 updated methodology and meeting the accuracy requirements put forward by NHTSA. As with any methodological change, there is the danger that results gathered with the new procedures will not be strictly comparable to those from prior years. This appears not to be a concern with the 2012, 2013 and 2014 data for Minnesota. The seat belt use rate estimates and overall measures of variability are in line with the data reported in recent years. In fact, it is safe to say that belt use rates in Minnesota have achieved the 90 percent-plus level, with strong indication that the rate continues to climb each year.

The 2014 study also shows results that are in keeping with the trend in usage rates among specific segments of the population. For the fourth year in a row, seat belt use among male front seat occupants was above 90 percent (90.4 percent in 2011, 91.9 percent in 2012, 92.6 percent in 2013, and a record high 92.8 percent in 2014). Female front seat occupants achieved a similar level (92 percent) in 2007 and have shown a less clear pattern of annual increases over the years since then. The 2012 seat belt use rate among females was 95.6 percent--very close to the rates reported in 2010 and 2011. However, female front seat passengers showed a marked increase in seat belt use rates in 2013, achieving a record 97.5 percent. Female front seat passengers' seat belt use dropped slightly in 2014 to 97.2 percent. Both male and female front seat occupants contributed to maintaining the overall level of seat belt use rate in 2014. The gap between male and female front seat occupants' seat belt use levels decreased slightly in 2014 to 4.4 percentage points, from 4.9 percentage points in 2013 and 5 percentage points in 2011, but still more than the 3.7 percentage points gap in 2012. It is encouraging to see both male and female front seat occupants maintaining high seat belt use rates.

Vehicle choice continues to be related to seat belt use rates for front seat occupants. As in past years, the 2014 data show that occupants of pickup trucks are less likely to wear a seat belt than are occupants of any of the other vehicle types in the observation survey (cars, SUVs, and vans/minivans). Seat belt use among pickup truck occupants dropped from 86.8 percent in 2013 to 84.7 percent in 2014 and continues to lag behind the record of 88 percent achieved in 2011. Seat belt use by occupants of vans/minivans decreased slightly from the 2013 record of 97.3 percent to 96.7 percent in 2014 but still remains higher than the 93 percent value in 2012. SUV (97 percent) and passenger car (96.9 percent) occupants achieved record levels of seat belt use in 2014. Small differences from year to year, and the direction of those changes, should be interpreted with caution. All of the changes noted are well within the 95 percent confidence limits for the data and could simply be an artifact of sample weighting rather than an indication of an important shift in behavior.

Seat belt use varies across age groups, but the pattern is not stable from year to year—that is, there is no reliably best or worst age group for seat belt use among front seat occupants across years. In 2014, passengers aged 65+ years old were much more likely to be belted (96.4 percent seat belt use) than any other age group of front seat occupants). Seat belt use rate for 0-10 year olds went from the highest rate in 2013 (99.4 percent) to second lowest in 2014 (94.6percent); this group was at 97.4 percent in 2012 and 92.9 percent in 2011. There are many non-behavioral reasons why the rates vary so much from year to year, including the fact that weighted summary data tend to vary dramatically when separated into multiple categories (i.e., when the N becomes smaller in each cell of the summary table).

Seat belt use also varies among hours of the day and days of the week. The pattern across years is not stable—there is no reliably high or low day of the week or hour of the day. In 2014, the 5–7 p.m. time interval achieved 98.4 percent seat belt use, up from 97.1 percent in 2014 but still less than the near-perfect 99.9 percent seat belt use in 2012—the highest ever recorded for any time period from 2003 to the present. Tuesday and Saturday were the days of the week with the highest seat belt use in 2014 (97.6 percent). Monday was next with 96.8 percent. In 2011, Tuesday was the worst day of the week for seat belt use percentage (89.3 percent). The most likely explanation for the pattern of differences among time periods across the years is that the sampling and weighting can magnify small changes.

In summary, Minnesota's seat belt use rate has climbed steadily over the years. There are some stable patterns within the data (such as pickup truck occupants consistently showing lower seat belt use rates than occupants of other vehicle types and females' seat belt use being consistently higher than that for males). The reader is cautioned to be aware that there may be a practical upper limit to the seat belt use levels achievable within a given population. Looking at the data for 2014 in comparison to prior years, with the female front seat occupants' 97.2 percent seat belt use rate close to last year's record high, it is possible that female front seat occupants are at or near a hypothetical maximum achievable value (which could be about 97 percent in present-day Minnesota). If so, future gains in overall seat belt use will need to come from males gradually achieving the same potential maximum rate. Against this backdrop of gradual increases, therefore, there may be a point at which Minnesota's rate stabilizes. At that point, it could be expected that the annual rate will fluctuate up and down around that upper-limit value. It is likely that Minnesota will reach that point in the not-too-distant future. At that point, annual seat belt use rates can be expected to be near 95 percent. Some years the value will be higher, some years lower. The slight difference between the 2014 and 2013 seat belt use rates could indicate that this is exactly the situation now. It is also worth considering that the achievable maximum seat belt use rate for males may be lower than that achieved by females. If so, the pattern for male usage rates will stabilize at some value less than whatever value is achieved by females and the statewide value (a combination of usage rates for males and females). Since the seat belt use rate for males has been rising steadily in Minnesota, there is no reason to suspect today that their rate is nearing its maximum. The 97.2 percent level achieved by females in 2014 leads to the hope that the overall statewide usage rate will stabilize at a value above 95 percent. Future years will show if further gains are made or if the (roughly) 95 percent value is maintained.

Handheld cell phone use by drivers has shown an increase across the years from 2008 to the present. The weighted 2014 value is more than average overall for the years 2008–2014 (the years for which June observation study data is available for cell phone use). Based on the trend analysis, Minnesota is experiencing a percentage-point increase in cell phone use about every three years (slope of the line is 0.28)—down from the estimate calculated in 2012, but about the same as the estimate in 2013. This correlation between years and cell phone use is not particularly strong (the R^2 is 0.19 indicating a weak correlation). The increase over years may just reflect increased use of cell phones in general.

Motorcycle helmet use continues to be low. In 2014, helmet use by motorcycle occupants is 44.8 percent, up from 42.8 percent in 2013, but is still under 46.3 percent in 2012 and 57.1 percent in 2011. As in 2011 and 2012, however, these data must be interpreted with caution because the number of observations is low. The drop could be a result of the sampling frame (including more rural counties than in 2011 and prior years); however, it is important to recognize that the change in the sampling frame did not apparently affect the seat belt use rate. It would be surprising to see such a large difference (roughly 13 percentage points from 2011 to present) as that seen for helmet use due merely to the broadening of the sample to include a few more rural areas. The more likely explanation is that the change indicates a downward trend in helmet use. It should be possible to analyze the change in helmet use as it correlates to changes in the frequency and severity of injuries arising from motorcycle crashes. By this hypothesis, it would be expected that 2014 data on crash severity would show evidence of an increase in motorcycle-related injuries and fatalities as well as the costs associated with those crashes.

APPENDIX A

List of Road Segment Samples by Stratum

List of Road Segment Samples by Stratum

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
Hennepin County Stratum						
1	Primary	Hennepin	WB US 55 & CH 161 (Pinto Dr)	55	175.534	176.393
2	Primary	Hennepin	EB MN 62 & Lyndale Ave S off ramp	62	111.043	112.106
3	Primary	Hennepin	EB MN 62 & 28th Ave S off ramp	62	113.682	114.512
4	Primary	Hennepin	SEB I-94 & MN 101 (Main St) off ramp	94	206.008	207.617
5	Primary	Hennepin	SEB I-94 & Maple Grove Pkwy off ramp	94	208.313	214.045
6	Primary	Hennepin	NWB I-94 & Maple Grove Pkwy off ramp	94	214.045	216.329
7	Primary	Hennepin	WB I-94 & CH 61 (Hemlock La) off ramp	94	216.99	218.393
8	Primary	Hennepin	EB I-94 & CH 152 (Brooklyn Blvd) off ramp	94	221.277	223.223
9	Primary	Hennepin	SB I-94 & 53rd Ave off ramp	94	226.35	227.386
10	Primary	Hennepin	WB I-94 & Riverside Ave S off ramp	94	234.828	235.565
11	Primary	Hennepin	SB MN 100 & CH 40 (Glenwood Ave) off ramp	100	7.726	8.902
12	Primary	Hennepin	NB MN 100 & 36th Ave N off ramp	100	9.785	11.435

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
13	Primary	Hennepin	NB US 169 & CH 1 (Pioneer Tr) off ramp	169	116.579	118.192
14	Primary	Hennepin	NB US 169 & 7th St S off ramp	169	122.65	124.797
15	Primary	Hennepin	NB US 169 & CH 81 (Lakeland Ave)	169	136.46	137.412
16	Primary	Hennepin	SB US 169 & 117th Ave N	169	139.278	142.631
17	Primary	Hennepin	SWB US 212 & CH 4 (Eden Prairie Rd) off ramp	212	155.209	157.166
18	Primary	Hennepin	EB I-394 & CH 61 (Plymouth Rd) off ramp	394	0	0.727
19	Primary	Hennepin	WB I-394 & CH 61 (Plymouth Rd) off ramp	394	0.727	1.511
20	Primary	Hennepin	WB I-394 & Xenia Ave S off ramp	394	4.606	5.855
21	Primary	Hennepin	EB I-394 & CH 2 (Penn Ave S) off ramp	394	5.855	7.604
22	Primary	Hennepin	EB I-494 & CH 1 (24th Ave) off ramp	494	2.064	2.789
23	Primary	Hennepin	EB I-494 & CH 17 (France Ave S) off ramp	494	7.045	7.976
24	Primary	Hennepin	WB I-494 & Prairie Center Dr off ramp	494	10.956	11.999
25	Primary	Hennepin	SB I-494 & CH 62 (Townline Rd) off ramp	494	13.657	16.016

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
26	Primary	Hennepin	NB I-494 & CH 5 (Minnetonka Blvd) off ramp	494	16.016	17.622
27	Primary	Hennepin	SB I-494 & CH 16& CH 5 (Minnetonka Blvd) off ramp	494	17.622	19.765
28	Primary	Hennepin	NB I-494 & Carlson Pkwy on ramp	494	19.765	20.175
29	Primary	Hennepin	SB I-494 & Carlson Pkwy off ramp	494	20.175	21.473
30	Primary	Hennepin	SB I-494 & CH 9 (Rockford Rd) off ramp	494	23.335	26.027
31	Primary	Hennepin	WB I-94 & Shingle Creek Pkwy off ramp	694	34.191	35.762
32	Primary	Hennepin	SB I-35 & W 35 St off ramp Driver's side	35W	15.339	16.399
33	Primary	Hennepin	NB I-35 & E 37 St off ramp	35W	13.901	15.222
34	Primary	Hennepin	SB I-35 & Washington Ave S off ramp	35W	18.217	18.748
35	Secondary	Hennepin	NB CH 101 & Covington Rd	27000101	0.146	0.9
36	Secondary	Hennepin	SB 3rd Ave S & 10th St S	25850305	1.03	1.43
37	Secondary	Hennepin	NB Mcginity Rd W (CH 16) & I-494	27000016	0.84	2.71
38	Secondary	Hennepin	WB W77th St & Lyndale Ave	32100108	0.4	0.53
39	Secondary	Hennepin	SB W Broadway Ave & 37th Ave N	32300297	0	0.68

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
40	Secondary	Hennepin	WN MN 5 & CH 4 (Eden Prairie Rd)	5	48.193	49.096
41	Secondary	Hennepin	NB Ch 116 & CH 3 (97th Ave N)	27000116	4.88	5.86
42	Secondary	Hennepin	SB CH 116 (Pinto Dr) & Clydesdale Tr (near MN 55)	27000116	0	1.35
43	Secondary	Hennepin	SB CH 156 (Winnetka Ave N) & Plymouth Ave	27000156	1.45	2.45
44	Secondary	Hennepin	WB CH 1 (Old Shakopee Rd) & Hampshire Ave S	27000001	8.39	9.28
45	Secondary	Hennepin	NWB CH 152 & CH 130 (68th Ave)	27000152	2.751	3.165
46	Secondary	Hennepin	EB CH 19 (Smith Town Rd)& Wood duck Cir	27000019	0.47	2.61
47	Secondary	Hennepin	NB Dogwood St (CH 92) / MN 55, Rockford	27000092	14.035	14.534
48	Secondary	Hennepin	NB CH 48 (26th Ave S) & CH 5 (Franklin Ave)	27000048	2.45	3.2
49	Secondary	Hennepin	SB CH 101 (Central Ave) & US 12	27000101	6.865	8.269
50	Secondary	Hennepin	NB Medicine Ridge Road & 28th Ave	31050158	0.39	0.882
51	Secondary	Hennepin	WB CH 3 (Excelsior Blvd) & Scenic Heights Dr	27000003	0.61	2.11
52	Secondary	Hennepin	SB CH 156 (Winnetka Ave N) & Orkla Dr	27000156	0.95	1.45
53	Secondary	Hennepin	EB CH 9 (Rockford Rd) & Plymouth Blvd)	27000009	0.821	1.047

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
54	Local	Hennepin	SB Menimac La & CH 6	31050248	0	0.46
55	Local	Hennepin	NB Bunker Ct & Howard La	10940950	0	0.075
56	Local	Hennepin	SB Browndale Ave &W 50th St	11050488	0	0.6
57	Local	Hennepin	NB Niagara Lane & 61st Ave N	31051568	0	0.337
58	Local	Hennepin	NB Woodale Ave & W 50th St	11050150	2.235	2.735
59	Local	Hennepin	NB Texas Ave& Utah Ave N	6300082	0	0.32
60	Local	Hennepin	NB W Island Ave & Grove St	25850866	0	0.48
High VMT Stratum						
61	Primary	Dakota	SB US 52 & CH 73 (Thompson Ave) off ramp	52	127.834	128.567
62	Primary	Ramsey	WB I-35E & W Victoria Ave off ramp	35E	104.26	105.716
63	Primary	Dakota	EB CH 42 & CH 23 (Cedar Ave)	19000042	3.704	5.837
64	Primary	Ramsey	NB I-35W & CH 96 off ramp	35W	26.815	27.402
65	Primary	Ramsey	WBD I-94 & US 61 (Mounds Blvd) off ramp	94	244.088	245.235
66	Primary	Washington	EB I-94 & MN 95 (CH 18) off ramp	94	256.357	258.992

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
67	Primary	Ramsey	WBD I-94 & CH 56 (N Marion St) off ramp	94	242.04	242.554
68	Primary	Ramsey	WB US 10 & Airport Rd Off ramp	10	237.551	238.948
69	Primary	Washington	WB I-94 & MN 95 (Manning Ave S) off ramp	94	254.275	256.357
70	Primary	Dakota	NB I-35E & CH 32 (Cliff Rd) off ramp	35E	93.536	94.633
71	Primary	Anoka	SB US 10 & Foley Blvd NW, off-ramp	10	230.787	234.159
72	Primary	Dakota	SB I-35 & CH 70 (210th St W) off ramp	35	82.083	84.5
73	Primary	Washington	WB I-94 & MN 95 (CH 18) off ramp	94	258.992	259.341
74	Primary	Washington	EB I-94 & CH 13 (Radio Dr) off ramp	94	249.751	251.074
75	Primary	Dakota	SB MN 316 & US 61	316	1.999	3.844
76	Primary	Dakota	NB US 52 & Ch 46 (160th St W) off ramp	52	107.158	113.982
77	Primary	Washington	SWB I-494 & Lake Rd off ramp	494	59.636	60.951
78	Primary	Ramsey	SB I-35E & MN 13 off ramp	35E	102.75	103.214
79	Primary	Dakota	NB I-35E & MN 110 off ramp	35E	99.928	101.454
80	Primary	Ramsey	NB MN 280 & Energy Park Drive Off ramp	280	0	0.714

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
81	Primary	Dakota	NB MN 316 (Red Wing Blvd) & Tuttle Dr	316	7.09	8.562
82	Primary	Ramsey	WB I-94 & Vandalla Ave off ramp	94	237.265	238.849
83	Primary	Washington	EB MN 36 & MN 5 (Stillwater Blvd) off ramp	36	16.775	17.743
84	Primary	Ramsey	EB I-694 & US 61 off ramp	694	47.067	48.309
85	Primary	Dakota	EB CH 42 & CH 31 (Pilot Knob Rd)	19000042	6.343	7.849
86	Primary	Washington	NWB I-494 & Lake Rd off ramp	494	60.951	62.651
87	Primary	Washington	SB I-35 & MN 97 Lake Dr off ramp	35	130.034	132.176
88	Primary	Anoka	EB MN 610 & CH 51 (Univ Ave NW) off ramp	610	11.066	12.314
89	Primary	Dakota	EB MN 13& CH 31 Lynn Ave	13	94.384	95.669
90	Secondary	Ramsey	SEB CH 10 & CH 3 (MSAS 237)	62000010	0.089	2.288
91	Secondary	Ramsey	EB CH 3 (MSAS 237) & Jackson St	62000003	0.22	0.98
92	Secondary	Ramsey	WB Phalen Blvd & N Frank St	34250288	1.131	2.215
93	Secondary	Dakota	WB MN 110 & MN 3 (Robert Tr S) off ramp	110	4.475	5.245
94	Secondary	Dakota	SB Cliff Lake Rd & Target Access	10630124	0	0.328

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
95	Secondary	Ramsey	NEB S Dodd Rd & W Baker St	34250119	0.015	0.31
96	Secondary	Ramsey	SB M N51 (Snelling Ave) & Roselawn Ave W	51	6.348	7.674
97	Secondary	Washington	NB MN 95 & Parker St	95	92.199	96.089
98	Secondary	Washington	NB Hadley Ave N & 41st St N	28880121	4.081	4.868
99	Secondary	Anoka	SB CH 9 (Lake George Blvd NW) & CH 22 (Viking Blvd NW)	2000009	8.624	9.62
100	Secondary	Anoka	EB CH 22 (Viking Blvd NW) & CH 66 (Cleary Rd NW)	2000022	4.02	6.569
101	Secondary	Washington	WB MN 5 (34th St N) & Imation Pl	5	79.227	79.906
102	Secondary	Ramsey	SB MN 51 (Snelling Ave) & Lydia Ave	51	9.082	9.586
103	Secondary	Dakota	NB Holyoke Ave & 190th St W	21500105	2.68	2.815
104	Secondary	Dakota	NB Blackhawk Rd & Davenport Ave	10630103	2.807	3.125
105	Secondary	Anoka	SB CH 7 (7th Ave) & Jackson St	2000007	0.75	1.11
106	Secondary	Anoka	SB CH 17 (Lexington Ave NE) & CH 52 (Lovel Rd)	2000017	1.22	2.04
107	Secondary	Ramsey	WB CH 31 (W University Ave) & Hamline Ave	62000034	2.714	3.216
108	Secondary	Ramsey	SB CH 51 (Lexington Ave) & Edmund Ave	62000051	3.03	3.28

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
109	Secondary	Anoka	NB CH 7 (7th Ave) & Grant St	2000007	1.31	1.54
110	Secondary	Anoka	SB CH 1 (E River Rd) & CH 132 (85th Ave NE)	2000001	6.716	7.66
111	Secondary	Anoka	EB 181st Ave NW & CH 58 (Palm St NW)	2000058	5.808	6.804
112	Secondary	Anoka	WB CH 11 (Northdale Blvd NW) & CH 78 (Hanson Blvd NW)	2000011	4.41	4.89
113	Local	Ramsey	WB E Ross Ave & N Waukon Ave	34251285	0	0.16
114	Local	Anoka	WB 143rd Ave NW & CH 56 (Ramsey Blvd NW)	31480319	0	0.696
115	Local	Washington	SB Lincolntown Ave & Old Wildwood Rd	24050100	1.931	2.251
116	Local	Ramsey	SB Marion St & W Cottage Ave	34250378	0	0.174
117	Local	Anoka	NB W Shadow Lake Dr & Sandpiper Dr	22650332	0	1.287
118	Local	Washington	NB Fox Run Cove & Fox Run Rd	41730747	0	0.08
119	Local	Washington	NB Market Dr& W Orleans St	36750124	0.06	0.26
120	Local	Anoka	WB 150th Ave NW &Raven St NW	880713	0	0.46
Medium VMT Stratum						
121	Primary	Rice	NB I-35 & MN 60 off ramp, Fairbault	35	55.287	55.725

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
122	Primary	Stearns	SEB I-94 & MN 23 off ramp, St Cloud	94	160.679	164.514
123	Primary	Wright	WB US 12 (6th St) & CH 6 (10th Ave), Howard Lake	12	123.521	124.806
124	Primary	Olmsted	SB US 14 & 2th St SW, Rochester	14	215.66	216.279
125	Primary	St. Louis	SB US 169 & MN 37, Hibbing	169	335.836	337.784
126	Primary	Olmsted	NB CH 22 (Salem Rd SW) & CH 25 (16th St SW), Rochester	55000022	0.499	0.987
127	Primary	Sherburne	SEB MN 25 & Norwood Dr (West of junction), Big Lake	25	68.915	70.157
128	Primary	Crow Wing	NB MN 371 & CR 77 (Wise Rd), start of lane	371	28.809	32.437
129	Primary	Chisago	SB I-35 &Ch 22 (Viking Blvd) off ramp, Wyoming	35	135.552	138.413
130	Primary	Wright	SB I-94 & MN 25 (Pine St) off ramp, Monticello	94	184.131	192.646
131	Primary	Sherburne	NB US 169 & CH 12 (Main St),Elk River	169	155.776	156.642
132	Primary	Chisago	SB I-35 &MN 95 (St Crix Tr) off ramp, North Branch	35	147.928	151.171
133	Primary	Scott	NB US 169 & MN 282 (2nd St NW), Jordan	169	96.209	97.914
134	Primary	Scott	SB US 169 & MN 19 (280th St W) off ramp, Belle Plaine	169	83.821	88.921
135	Primary	Olmsted	NB US 14 & 6th St SW, Rochester	14	216.279	216.889

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
136	Primary	Stearns	EB CH 75 (Division St) & CH 81 (15th Ave N), Waite Park	73000075	14.688	15.543
137	Primary	Sherburne	NB US 10 & 171st St, Elk River	10	216.029	219.812
138	Primary	Scott	SB US 169 & MN 21 off ramp, Jordan	169	99.038	101.197
139	Primary	Chisago	SB I-35 &CH 19 (Stacy Tr N) off ramp, Stacy	35	139.983	145.163
140	Primary	Otter Tail	NB US 10 & MN 87 off ramp, Frazee	10	55.163	60.02
141	Primary	Sherburne	NB US 169 & CH 4 (Fremont Ave NW), Zimmerman	169	166.228	166.753
142	Primary	Wright	NEB MN 55 (Cherry St) & Ash St, Rockford	55	159.22	165.315
143	Primary	St. Louis	NB US 53 & MN 37, Eveleth Top of off ramp	53	24.259	55.991
144	Primary	Crow Wing	NB MN 371 & CR 13, Nisswa	371	32.437	39.133
145	Primary	Sherburne	EB US 10 (Jefferson Blvd) & MN 25 (Lake St S) Big Lake	10	205.04	205.652
146	Primary	Carver	EB MN 7 & MN 25, Mayer	7	161.941	165.964
147	Primary	St. Louis	EB US 2 & US 53	2	221.018	244.825
148	Primary	Sherburne	NB US 169 & CH 9 (293rd Ave NW) off ramp, Princeton	169	167.499	174.761
149	Primary	Olmsted	NB US 52 & CH 25 (16th St SW) off ramp, Rochester	52	51.936	54.111

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
150	Secondary	St. Louis	SB Lester River Rd & E Superior St, Duluth	69000012	0.31	1.14
151	Secondary	Scott	WB CH 2 (Main St) & Church St, Elko New Market	72	12.17	14.16
152	Secondary	Chisago	EB CH 10 & CH 8 (Cedar Crest Tr), Harris	13000010	0	4.15
153	Secondary	St. Louis	EB CR 115 & Vermilion Dr	69000115	0	1.62
154	Secondary	Otter Tail	WB CH 1 & MN 78, Ottertail	56000001	42.949	45.189
155	Secondary	Stearns	WB CH 30 & MN 237 (Main St), New Munich	73000030	0	6.9
156	Secondary	Chisago	NB CH 20 (Furuby Rd) & CH 9 (Oasis Rd N) Lyndstrom	13000020	0.4	3.5
157	Secondary	St. Louis	EB MN 37 & US 53, Eveleth	37	16.285	20.241
158	Secondary	Otter Tail	SB MN 78 & MN 210, Battle Lake	78	18.403	20.977
159	Secondary	Stearns	SB CH 3 & Norway Rd	73000003	1.71	7.66
160	Secondary	St. Louis	WB MN 169 & MN 1, Ely	169	415.07	416.033
161	Secondary	Crow Wing	EB CR 37 & CR 37, Crosslake	18000036	1.64	5.33
162	Secondary	Crow Wing	NB CR 3 & SW Horseshoe Lake Rd , Merrifield	18000003	14.747	18.887
163	Secondary	Wright	EB CH 39 (Club View Rd) & Elm St, Monticello	86000039	17.686	18.169

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
164	Secondary	Stearns	SB Cooper Ave & 33rd St S, St Cloud	33800141	1.018	2.67
165	Secondary	St. Louis	NEB N 40th W & Grand Ave, Duluth S	10400110	0.07	0.34
166	Secondary	St. Louis	NB CH 4 (Mesaba Ave) & E Skyline Pkway, Duluth	69000004	0.09	0.73
167	Secondary	Stearns	NB Pine Cone Rd & CH 133 (Heritage Rd), Sartell	34700103	0	1.67
168	Secondary	Wright	WB CH 34 (10th St) & CH 120 (Ibarra Ave NE), St Michael	86000034	4.66	7.92
169	Secondary	St. Louis	EB MN 23 (Grand Ave) & S 75th Ave W, Duluth	23	338.401	339.797
170	Secondary	Scott	SEB CH 21 (Eagle Creek Ave SE) & Duluth Ave SE, Prior Lake	70000021	6.228	7.171
171	Secondary	Crow Wing	WB W College Dr & East River Rd, Brainerd	4350126	0.412	0.99
172	Local	Olmsted	NB Kenosha Dr & 35th St, Rochester	32351803	0	0.344
173	Local	Olmsted	EB Sunset La NE & Century Hill Dr NE, Rochester	32351310	0	0.05
174	Local	Sherburne	SB Sanford Ave& Traverse La, Big Lake	3350211	0	0.452
175	Local	St. Louis	SEB Pineview Ave & W 24th St, Duluth	10400491	0	0.11
176	Local	Crow Wing	SB Cross Ave NW & MN 210 (Main St), Crosby	8600036	0	0.55
177	Local	Wright	SB Desoto Ave NW & CH 37, Maple Lake	86000561	0	0.348

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
178	Local	Scott	NB Fleetwood Blvd & 2nd St W, Jordan	19600108	0	0.34
179	Local	Stearns	SB CH 168 & Ch 17, Melrose, S of junction	73000168	4.35	6.79
180	Local	Wright	WB Town Center Dr NE & Edgewood Dr NE, St Michael	34200440	0	0.517
Low VMT Stratum						
181	Primary	Nobles	SB MN 60 & CH 35, Worthington	60	10.606	11.323
182	Primary	Winona	EB I90 & MN 43, Rushford off ramp	90	242.24	249.103
183	Primary	Kandiyohi	WB US 12 (Pacifica Ave) & CH 8 (N 4th St), Kandiyohi	12	79.467	87.2
184	Primary	Mille Lacs	NB US 169 & MN 27, Onamia	169	213.818	218.639
185	Primary	Douglas	NB I-94 & CH 7, Brandon off ramp	94	89.938	97.415
186	Primary	Itasca	WB US 2 & 1st St SE, Deer River	2	160.999	163.791
187	Primary	Martin	WB I-90 & MN 15 (State St) off ramp, Fairmont	90	102.231	103.227
188	Primary	Murray	NB US 59 & Frontage Rd exit Slayton	59	42.135	46.748
189	Primary	Kandiyohi	NB MN 23 & W South St, Spicer	23	147.087	150.999
190	Primary	Clay	WB US 10 & MN 32 N, Hawley top of off ramp	10	24.624	28.629

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
191	Primary	Jackson	SB US 71 (3rd St) & 4th St, Jackson	71	8.835	9.806
192	Primary	Benton	NB US 10 & CH 2 (Rice St), Rice	10	165.685	167.869
193	Primary	Itasca	WB US 2 & 8th Ave, NE Grand Rapids	2	185.127	190.54
194	Primary	Cass	NB MN 371 & CH 42 (Main St), Pine River	371	56.527	65.213
195	Primary	Benton	SB US 10 & CH 79 (75th St NE), Sauk Rapids	10	167.869	171.743
196	Primary	Goodhue	NB US 52 & MN 19 (W Main St) off ramp, Cannon Falls	52	91.642	98.445
197	Primary	Martin	WB I-90 & MN 4 (Main St) off ramp, Sherburn	90	87.309	93.675
198	Primary	Lyon	NB US 59 & 260th Ave, Marshall	59	58.66	70.721
199	Primary	Isanti	NB MN 65 (Candy St SE) & CH 5, Isanti	65	34.274	37.019
200	Primary	Morrison	NB US 10 & N 3rd St, Royalton	10	158.026	158.985
201	Primary	Todd	SB US 71 & 8th Ave S (Long Prairie)	71	172.069	180.939
202	Primary	Mille Lacs	NB US 169 & MN 23, Milaca off ramp	169	182.371	189.108
203	Primary	Kandiyohi	EB MN 23 & 2nd St, Paynesville	23	161.676	165.886
204	Primary	Todd	NEB I-94 & MN 127, Osakis off ramp	94	115.209	119.363

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
205	Primary	Wabasha	WB US 61 & Terrace Rd, Lake City	61	64.135	70.594
206	Primary	Pine	NB I-35 & MN 324 (Hillside Ave), off ramp	35	165.707	169.567
207	Primary	Polk	SB US 2 & W 2nd St, Crookston	2	26.392	26.534
208	Primary	Nobles	SB MN 60 & I-90, Worthington	60	11.86	12.232
209	Primary	Itasca	EB US 169 & Morgan St, Calumet	169	321.233	323.887
210	Secondary	Wabasha	NB US 63 & Cross St, Lake City	63	70.95	72.748
211	Secondary	Douglas	EB MN 27 & CH 45, Alexandria	27	74.742	76.805
212	Secondary	Blue Earth	EB MN 68 & US 169, Mankato	68	126.172	138.983
213	Secondary	Freeborn	NB CH 30 (850th Ave) & CH 46, Albert Lea	24000030	4.09	10.6
214	Secondary	Itasca	SWB Pincherry & CR 323 36695 Pincherry Rd, Cohasset	31000088	1.189	5.48
215	Secondary	Hubbard	NB MN 64 & CH 12, Akeley	64	38.73	48.263
216	Secondary	Clay	SB 34th St S & S 4th St, Moorehead	26450135	1.45	1.917
217	Secondary	Freeborn	SB N Newton Ave & E William St, Albert Lea	450116	0.5	0.56
218	Secondary	Becker	SB CH34 & CR143 Ogema	3000034	8.839	12.86

ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
219	Secondary	Isanti	SB Main St & Central Ave, Cambridge	5700113	0.21	1.172
220	Secondary	Lyon	SEB MN 68 & N Jefferson St, Minneota	68	22.859	26.414
221	Secondary	Kandiyohi	EB MN 21 (60th Ave NE) & US 71, Wilmar	34000025	1.75	3.23
222	Secondary	Le Sueur	NB MN 13 & CH 14 (E Main St), Waterville	13	46.217	56.475
223	Secondary	Morrison	NEB CH 21 (Great River Rd) & 150th Ave, Bowlus	49000021	10.34	14.56
224	Secondary	Beltrami	WB MN 1 (MN 89) & BIA 50,Red Lake	1	110.124	117.026
225	Secondary	Douglas	EB 22nd Ave & Jefferson St, Alexandria	650130	1.07	1.3
226	Secondary	Morrison	NB 4th St NE & CR 76 (1st Ave NE), Little Fall	22850106	2.09	2.875
227	Secondary	Pine	WB CH 110 (570th St) & CH 361 (Forest Blvd), Pine City	58000110	0	0.5
228	Secondary	Polk	EB MN 11 (260th St SW) & 210th Ave SW Crookston	60000011	2.01	7.05
229	Secondary	Nobles	NB MN 91 & CH 72 (1st St), Chandler	91	21.925	28.192
230	Secondary	Wabasha	NB US 63& Main St, Zumbro Falls	63	61.267	70.95
231	Local	Polk	NB 110th Ave SE & 432nd St SE, Fertile	60000022	0.77	1.02
232	Local	Hubbard	WB 5th St W & Main St S, Park Rapids	29950057	0	0.51

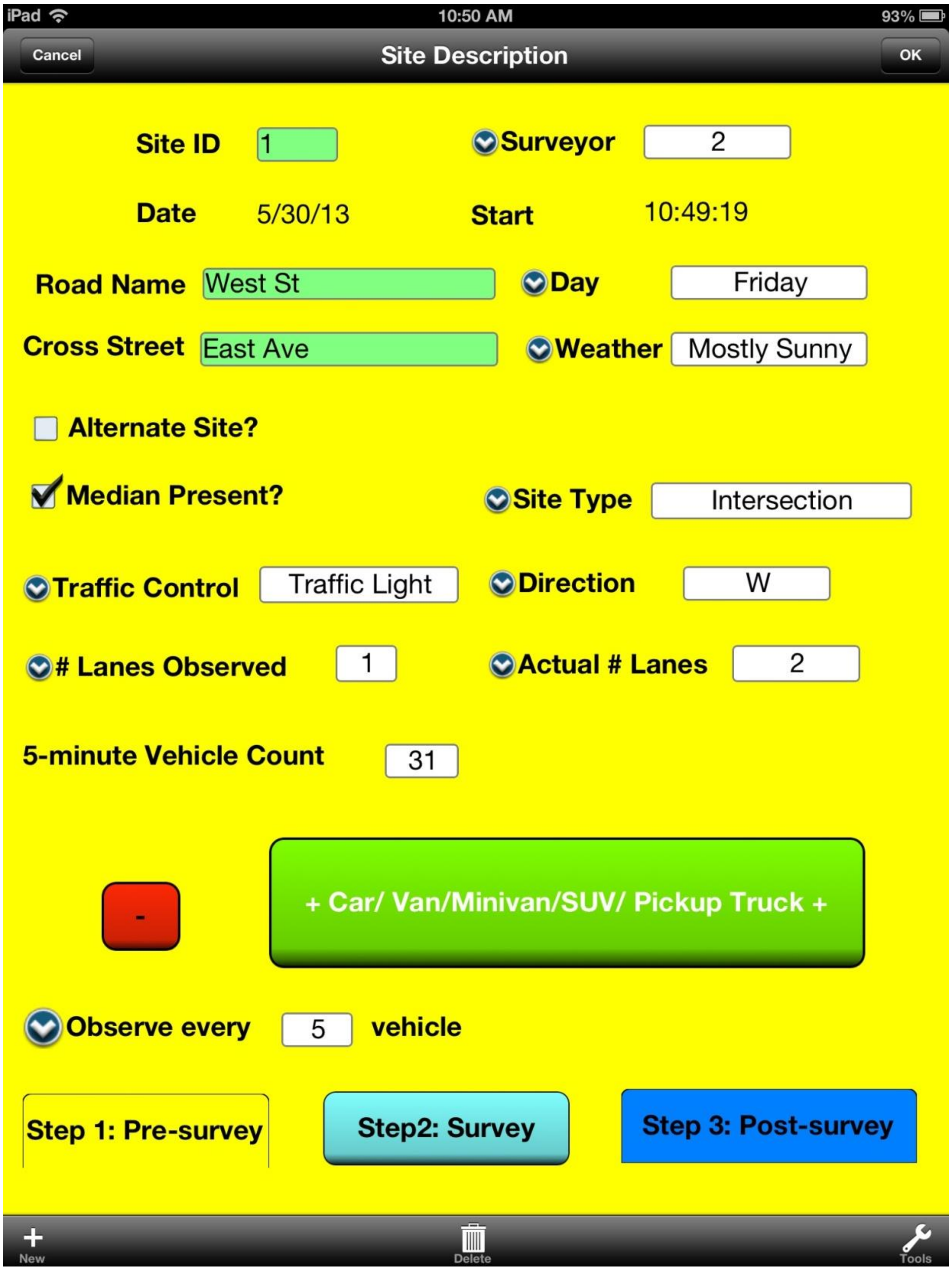
ID	Road type	County	Observation Site	Route No.	Beg. Ref Point	End Ref. Point
233	Local	Goodhue	WB 410th St & 165th Ave, Zumbrota	25000099	3	4.54
234	Local	Goodhue	NB Wakonade Dr & NSP Rd	31750287	0	1.86
235	Local	Martin	NB CR 9 (S Seely St) & Lawrence St, Dunnell	46000009	0.33	0.52
236	Local	Nobles	NB Monroe Ave & 110th St, Fulda	53000151	10.54	11.54
237	Local	Freeborn	SB Ross Dr & Beth La, Albert Lea	450465	0	0.319
238	Local	Steele	NB SW 62nd Ave& SW 8th St, Owatonna	74000038	1.01	2.01
239	Local	Cass	EB Mayo Dr SW & 13th Ave SW, Pequot Lakes	11005146	0	0.32
240	Local	Mille Lacs	WB 125th St & US 169, Milaca	48000188	0	0.54

APPENDIX B

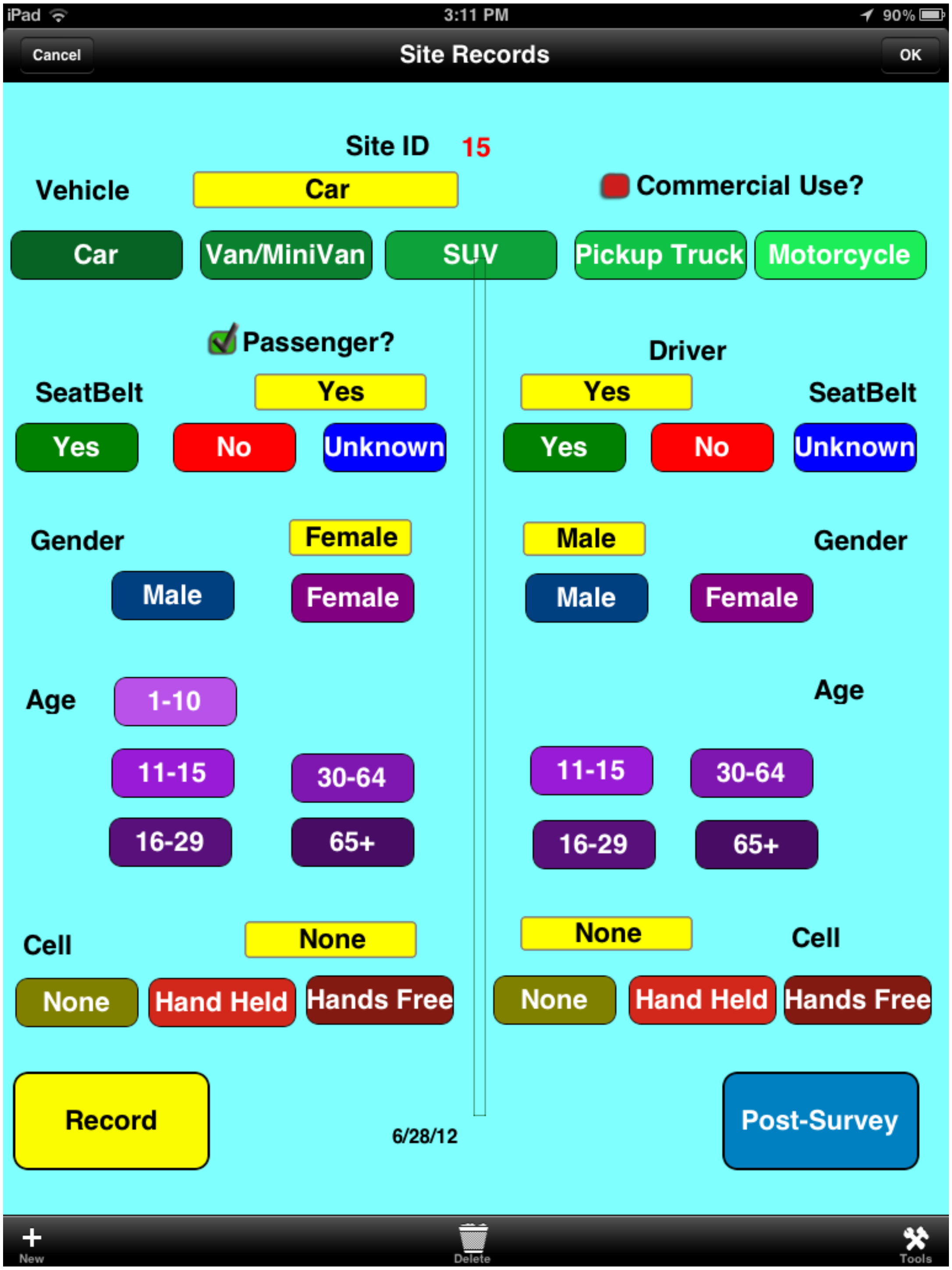
Data Collection Forms

Minnesota Seat Belt Use Observation Forms:

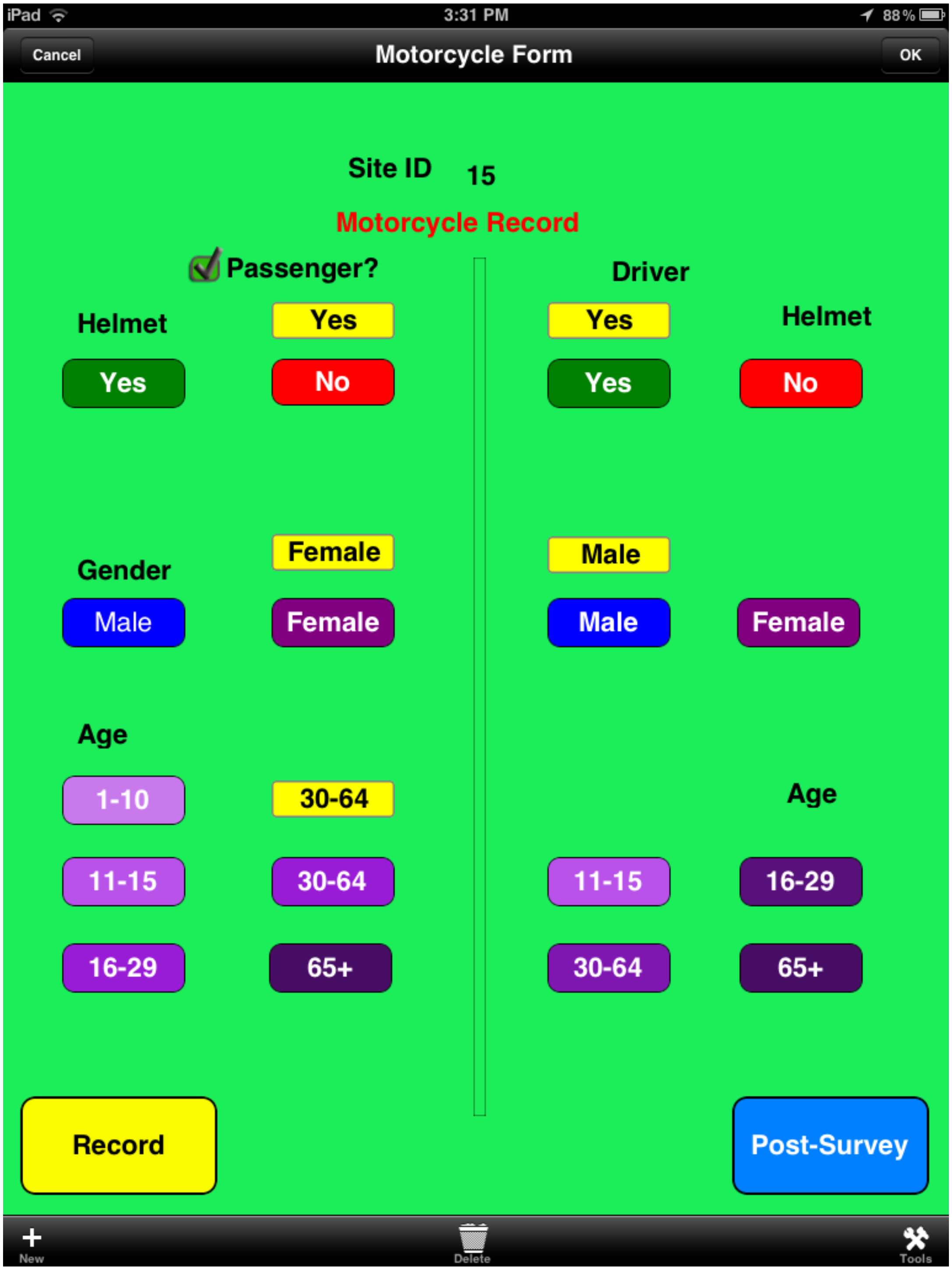
Site Description Form



Survey Form


iPad
3:11 PM
90%
Cancel
Site Records
OK
Site ID 15
Vehicle
Car
Commercial Use?
Car
Van/MiniVan
SUV
Pickup Truck
Motorcycle
Passenger?
Driver
SeatBelt
Yes
Yes
SeatBelt
Yes
No
Unknown
Yes
No
Unknown
Gender
Female
Male
Gender
Male
Female
Male
Female
Age
1-10
Age
11-15
30-64
11-15
30-64
16-29
65+
16-29
65+
Cell
None
None
Cell
None
Hand Held
Hands Free
None
Hand Held
Hands Free
Record
6/28/12
Post-Survey
New
Delete
Tools

Motorcycle Survey Form



Post-Survey Form