



GREENWAY
Transportation Planning

Minnesota Seat Belt Use Survey: June 2012

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**Minnesota Seat Belt
Use Survey: June 2012
Final Report**

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1 Introduction

The study reported here is the first 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 submitted December 30, 2011 and 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 also includes data analyses reporting cell phone use by drivers and front-seat passengers, as well as helmet use by motorcyclists. This report also provides an overview of the study design and quality control procedures; details of which are available in a separate report: *Seat Belt Use Survey Design for Minnesota: Sampling, Data Collection, and Estimation Plan (Greenway, March 2012)*.

Survey Methodology Changes

2012 marks the first use of the new methodology. The following lists the differences between the 2012 methodology and that used in 2011 as documented in the report *Minnesota Safety Belt and Motorcycle Helmet Use (Eby et al., August 2011)*. Note that all of the studies have been conducted in accordance with the NHTSA requirements in force at the time.

1. *Sample Selection.* 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% 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 were smaller (e.g., in 2011, 37 counties were included in the sampling frame). The sampling frame in prior years was selected to exclude those counties in the lowest 15% of state population (i.e., the sampled counties accounted for 85% of the state's population). This change in methodology ensured that more rural counties were included in the sample in 2012 than had been the case in previous years.
2. *Prior knowledge of belt use.* In previous years, the sample was stratified based on belt use and Vehicle Miles Traveled (VMT). Because the 2012 sampling frame included so many counties for which no prior belt use data was available, the stratification methodology was altered to rely on VMT only.

3. *Site Selection.* In the new methodology, NHTSA allowed states to select sites 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. In prior years, sites were selected at random using a graphical method, which divided the sampled counties into grids of x and y coordinates, then using a random number generator to pick values for x, and y to determine which part of the grid to select. The street falling nearest to the randomly selected values for x and y was added to the sample.
4. *Observer positioning.* In 2012, observations were to take place at mid-block locations in order to obtain data from free-flow traffic positions. In previous years, observers were stationed at intersections and were trained to conduct observations of stationary vehicles at traffic controlled devices. This new methodology for observer positioning poses new risks for the observers and increases the chances of missing some planned observations when speeds are too high.
5. *Case Weighting.* While there were no NHTSA-required changes in data analysis for 2012, this year marks a change in how data were gathered for the purpose of weighting individual cases. In the past, observers collected traffic counts for five minutes prior to starting their observation period, and for a second 5-minute period after the observations. These traffic counts were used to develop volume weightings during data analysis. In 2012 the traffic volume data supplied by MnDOT was used in place of brief counts collected in the field. The 2012 methodology has the advantage of making use of published annualized traffic volume data rather than relying on a brief observation period on a single day.
6. *Data Analysis.* As with case weightings, there were no NHTSA-required changes in data analysis for 2012. In order to support comparisons to prior years' data, it was decided to retain and update several data tables from the 2011 report. The 2012 report includes several tables, graphs, and analyses in addition to those presented in prior years. In particular, the 2012 report includes both weighted and unweighted data, in recognition of the fact that case weighting (as also noted in the 2011 report) can sometimes result in summary data that appear to show results that are contrary to well established trends. It is often the case that these surprising results are due to a small number of sites with both high weightings and unexpected results. For this reason, the reader is encouraged to look at both the weighted and unweighted data in order to form a more complete picture of what is happening. The total number of cases (unweighted) is provided in all data tables to help with interpretation of the results. Unexpected results, when based on a small number of actual cases, should be interpreted with caution and not necessarily used to make judgments at a statewide level. This cautionary note appeared in the 2011 report as well.
7. *Standard Error.* A standard error of less than 2.5% on the seat belt use estimate is required in the new methodology, which is significantly lower than the prior year target of 5%. However, since the 2011 sample size of approximately 11,000 observations obtained a standard error of 0.6%, well below both values, gathering a similar sample size for 2012 should meet the accuracy requirement.

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 sample 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%, well below the allowed value of 2.5%.
3. In 2011, the 37 counties included in that year's seat belt usage survey were stratified according to high, medium, and low 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 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	Region DVMT Total
Hennepin County	Hennepin	30,030,003	30,030,003
High VMT	Ramsey	12,367,507	37,193,740
	Dakota	10,512,179	
	Anoka	8,188,710	
	Washington	6,125,344	
Med VMT	St. Louis	5,970,800	35,571,795
	Stearns	4,962,757	
	Wright	4,133,188	
	Olmsted	3,804,351	
	Scott	3,429,249	
	Sherburne	2,504,030	
	Crow Wing	2,269,926	
	Carver	2,251,316	
	Otter Tail	2,236,360	
	Chisago	2,070,261	
	Rice	1,939,557	
Low VMT	Clay	1,898,601	36,596,759
	Goodhue	1,798,349	
	Blue Earth	1,734,871	
	Winona	1,672,928	
	Freeborn	1,555,959	
	Douglas	1,553,009	
	Pine	1,545,028	
	Steele	1,407,290	
	Itasca	1,406,513	
	Morrison	1,358,758	
	Benton	1,309,168	
	Kandiyohi	1,302,302	
	Cass	1,204,992	

Strata	County	County DVMT	Region DVMT Total
	Beltrami	1,168,855	
	Mille Lacs	1,149,914	
	Polk	1,101,274	
	Becker	1,095,733	
	Nicollet	1,064,280	
	Isanti	1,053,958	
	Martin	854,203	
	Nobles	826,623	
	Todd	820,645	
	Le Sueur	784,263	
	Lyon	772,158	
	Hubbard	719,426	
	Aitkin	714,619	
	Meeker	701,873	
	Jackson	690,695	
	Renville	661,906	
	Fillmore	617,252	
	Redwood	595,570	
	Wabasha	582,637	
	Pipestone	310,670	
	Murray	292,901	
	Stevens	269,536	

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, cul-de-sacs, 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 $g = 1, 2, \dots, G$ be the first stage strata, v_{gh} be DVMT for road segment stratum h in stratum g , and $v_g = \sum_{all\ i\ in\ gh} v_{ghi}$ be the total DVMT for all road segments in stratum g and functional class group h . The road segment inclusion probability is $\pi_{i|gh} = n_{gh}v_{i|gh}/v_g$, where n_{gh} 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 as described 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 Table 2.

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

Stratum		Roadway Functional Strata			Total
		Interstate/ Primary	Arterial/ Secondary	Local	
Hennepin County	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
High VMT	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
Medium VMT	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
Low VMT	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 survey design called for a process of replacement for unusable roadway segments. In the event that an original road segment was judged to be permanently unavailable, a reserve road segment was used. 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 Maps® 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 travelling to the assigned locations.

3.2 Staff Selection and Training

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

Observer and QC Monitor training was conducted at the Office of Traffic Safety and in the field for two days during the week prior to the data collection period; on May 31, 2012 and June 1, 2012. The training syllabus is shown as Figure 1.

Figure 1. Training Syllabus

<p>Day 1: Welcome</p> <p>Review and sign contracts</p> <p>Distribute training materials</p> <p>Survey overview</p> <p>Data collection techniques</p> <ul style="list-style-type: none">Definitions of belt/booster seat use, passenger vehicles, cell phone use, and motorcycle helmet useObservation protocolWeekday/weekend/rush hour/non-rush hourWeather conditionsDuration at each site <p>Scheduling and rescheduling</p> <ul style="list-style-type: none">Site Assignment SheetDaylightTemporary impediments such as weatherPermanent impediments at observation sites <p>Site locations</p> <ul style="list-style-type: none">Locating assigned sitesInterstate ramps and surface streetsDirection of travel/number of observed lanesNon-intersection requirementAlternate site selection <p>Data collection instrument</p> <ul style="list-style-type: none">Explanation of featuresBasic descriptionsRecording observationsProcess for recording alternate site informationSupporting software/applications <p>Data uploads</p> <p>Day 2: Day 1 review</p> <p>Quiz</p> <p>Safety and security</p> <p>Timesheet and expense reports</p> <p>Field practice</p> <p>Field Reliability Testing</p>

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% correct on the quiz. Incorrect responses were discussed in a final classroom briefing at the end of the second day of training.

One observation site was designated for training and device familiarization. Two more 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% disagreement on the count of vehicles and overall belt use percentage. The results of the reliability testing are contained in a separate document provided to the Office of Traffic Safety.

A pre-deployment meeting was conducted on June 7, 2012 to distribute final observation site assignments and survey equipment. The seat belt observation survey was scheduled for June 8 – June 21, 2012.

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 belt usage 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/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) lane/s 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 lane/s to be observed at each site. This method, similar to prior years' seat belt observation studies in Minnesota, was designed to provide the expected traffic volume during the 45-minute belt use observation period. 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.

*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 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 s/he could while obtaining data on at least 90% 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, 4 alternate sites were used due to construction and 5 sites were rescheduled due to bad weather. The alternate sites and survey rescheduling were disclosed to the observers by the QC Monitor. All observations, including rescheduled observations, were completed by June 29, 2012.

Quality Control Procedures

The QC Monitor made unannounced visits to 19 of the observation sites. This represented 7.9% of the sites and was greater than the required 5% 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 20 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 Nonresponse 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 nonresponding site nonresponse 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 was one site 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, belt use was estimated as follows:

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

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

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:

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

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 at the field.

4.5 Variance Estimation

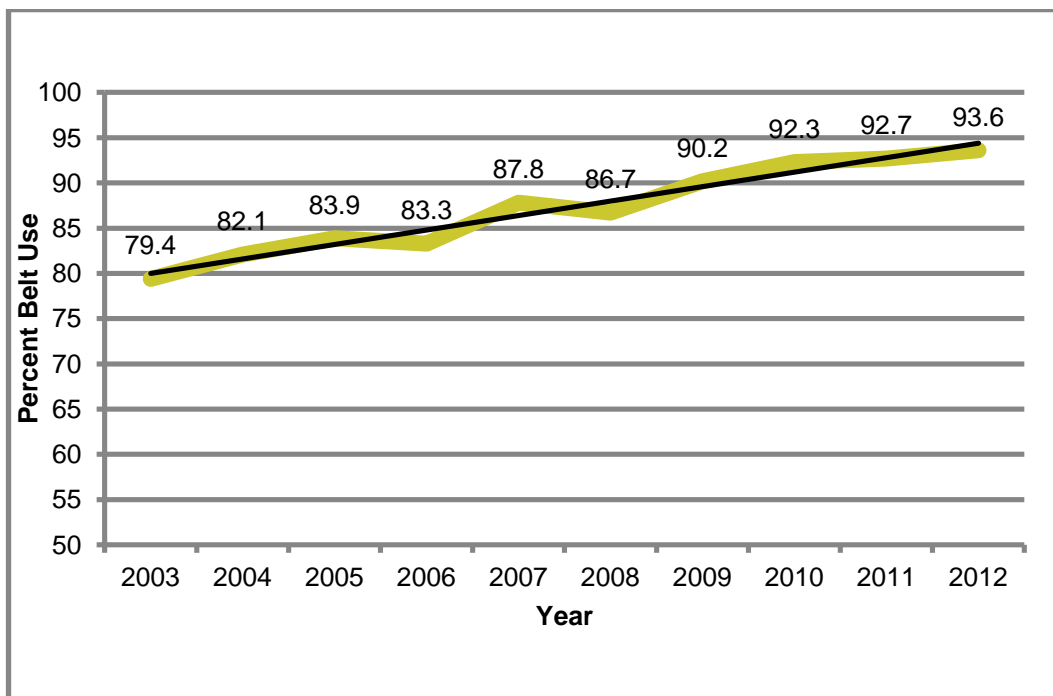
PROC SURVEYFREQ and PROC SURVEYMEANS in SAS were used for the ratio estimator ρ_{VMT} along with the joint PSU selection probabilities to calculate the seat belt use rate and its variance.

5 Data Analysis

5.1 Overall Measures of Seat Belt Use

The 2012 Minnesota seat belt survey included 16,924 front seat occupant observations from 13,339 vehicles. The overall percent belt use by front seat occupants was 93.6% (std error = 1.42%; 95% confidence interval is 90.8% - 96.4%). This weighted value represents a slight increase from the value for 2011 and is the highest value obtained since the first seat belt observation studies were performed in Minnesota in 1986. Figure 2 shows the annual weighted average belt use and a linear trend line over the years 2003-2012.

Figure 2. Belt Use Percentage for 2003-2012



The equation for the trend line is $y = (1.5976 * \text{YEAR}) + 78.413$. The upward trend is significantly different from zero (flat) ($R^2 = 0.9581$). This indicates a baseline value (pre-2003) of 78.413% belt use, and a steady increase of about an additional 1.6% belt usage each year.

Note that an alternative weighting scheme that takes into account the probability of selecting any particular front-seat occupant returned a statistically equivalent value of 92.9% belt use (std. error = 1.49%; 95% confidence limit is 90.0% to 95.9%). This alternative weighting is used in those analyses reported as a function of seating position. From a statistical data analysis perspective, the two weighting methods give nearly identical results. The measure with the smaller standard error is used because it ignores seating position as a factor.

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 belt use rate as a function of time of day for the years 2003 – 2012.

Figure 3. Belt Use Across Hours of the Day: 2003-2012

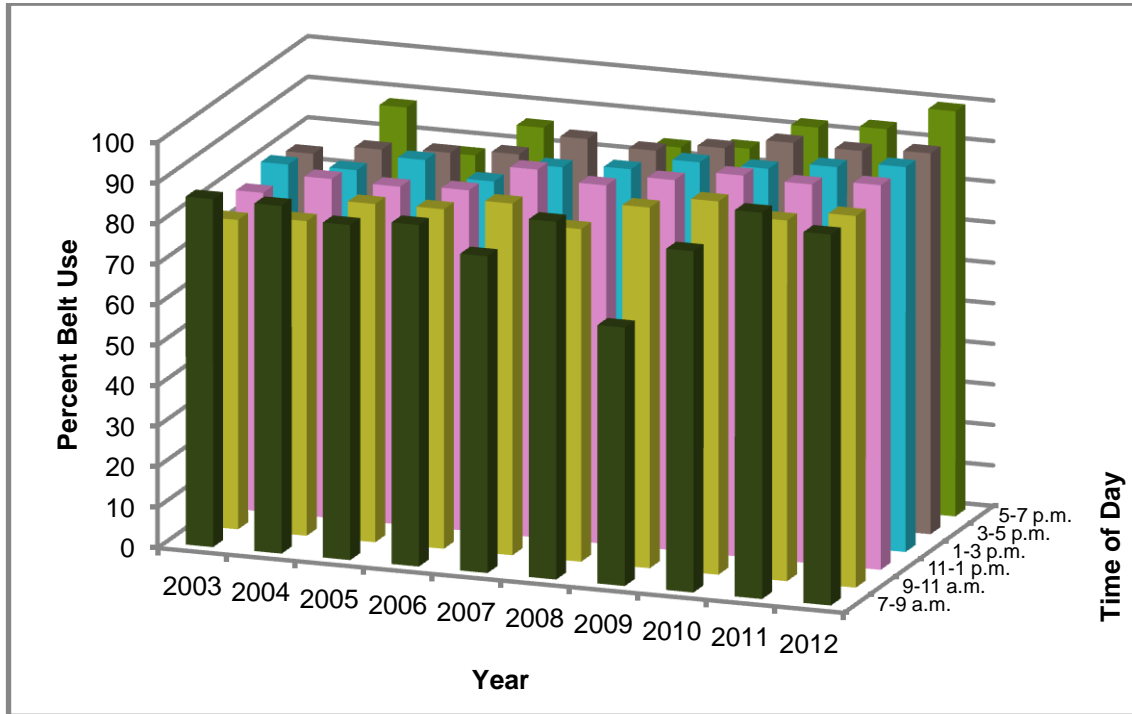


Figure 4 shows the belt use patterns over the days of the week for the years 2003-2012.

Figure 4. Belt Use Across Days of the Week: 2003-2012

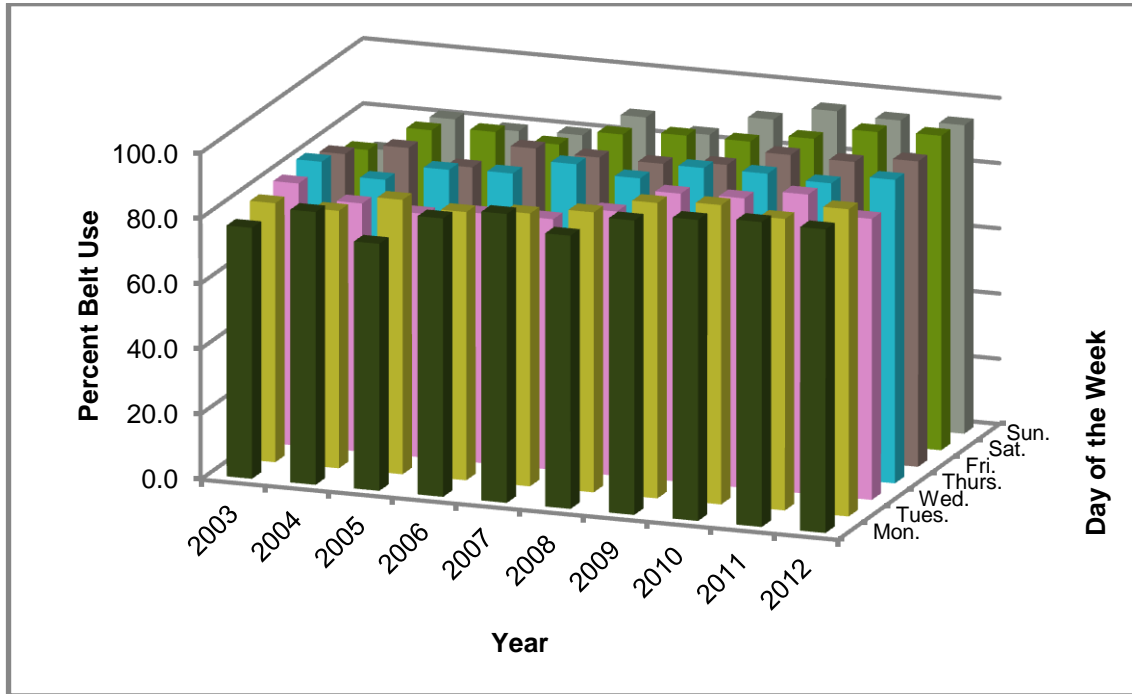


Figure 5 shows the belt use patterns as a function of occupant age for the years 2003 – 2012.

Figure 5. Belt Use Among Age Groups: 2003-2012

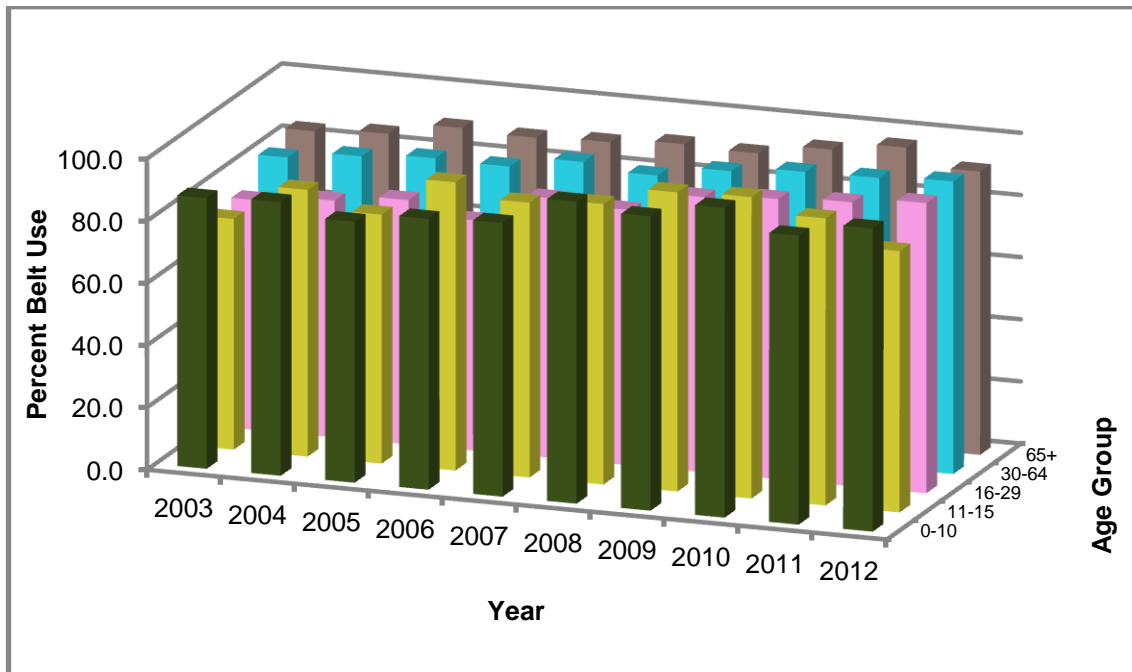


Figure 6 shows belt use for male and female front seat occupants for the years 2003-2012.

Figure 6. Belt Use as a Function of Sex of the Occupant: 2003-2012

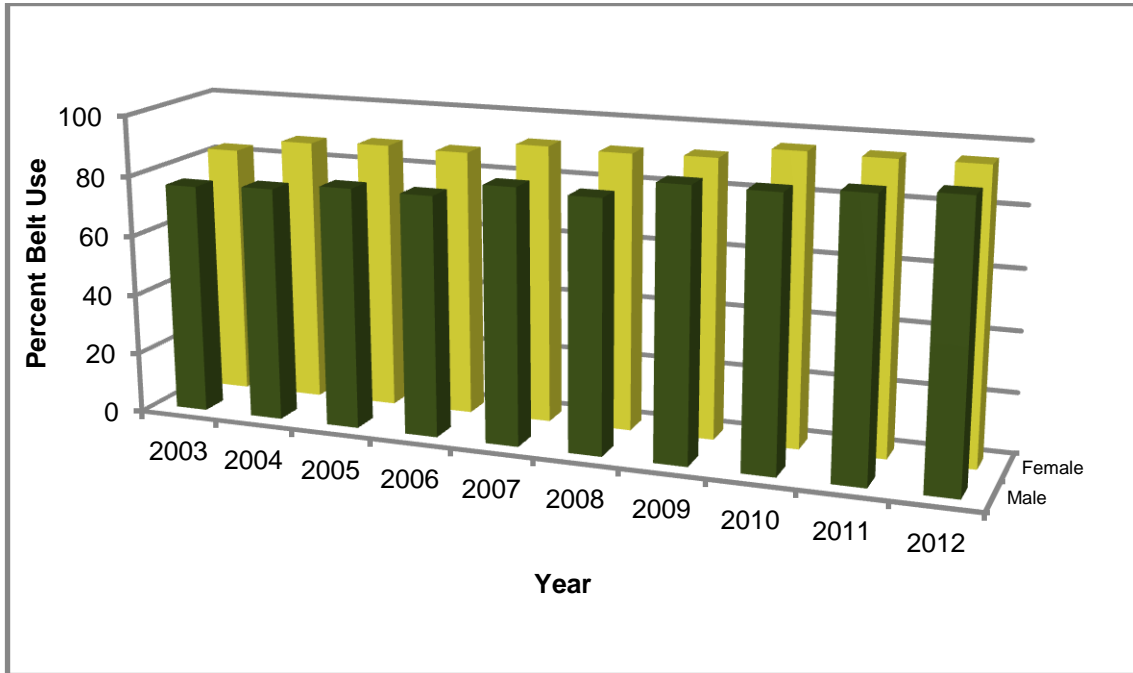
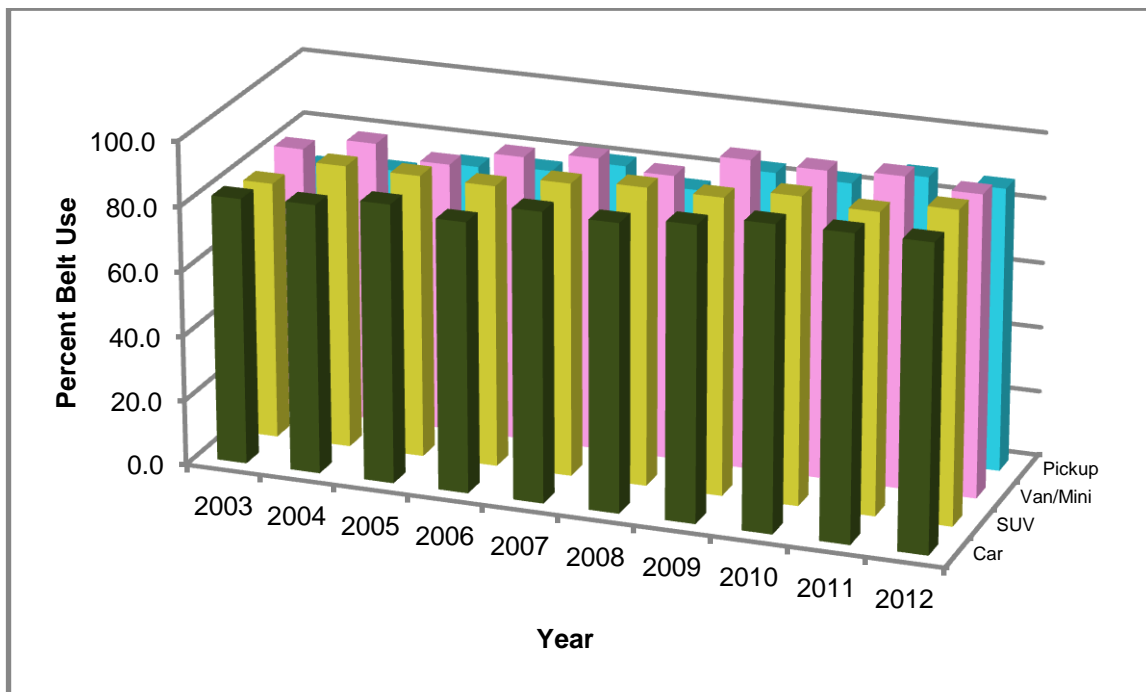


Figure 7 shows belt use for front seat occupants of pickup trucks, vans/min-vans, SUVs, and cars for the years 2003-2012.

Figure 7. Belt Use as a Function of Vehicle Type: 2003-2012



5.2 Updated Versions of Data Tables from the 2011 Report

In order to facilitate comparison of seat belt usage results between this 2012 survey and the data reported for 2011, this section presents data tables that are equivalent to those produced last year.

Table 3 presents the belt use results for each stratum. The 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 usable view 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 3. Unweighted Safety Belt Use Rates and Ns as a function of Stratum, Roadway Type

Stratum	Location/Road Type	Percent Use	N
Hennepin	Primary	95.5	2660
	Secondary	94.9	1808
	Local	93.7	143
Low VMT	Primary	90.6	2089
	Secondary	87.0	1160
	Local	86.0	93
Med VMT	Primary	94.2	2686
	Secondary	91.6	1802
	Local	89.4	180
High VMT	Primary	94.7	2459
	Secondary	93.6	1730
	Local	90.4	114
OVERALL Statewide		93.5	16924

Table 4 presents weighted belt use percentages and unweighted Ns as a function of Site Type, Time of Day, Day of Week, Weather, Sex, Age, and Position in the Vehicle.

Table 4. Weighted Safety Belt Use Rates and Unweighted Ns as a function of Subgroup, Vehicle Type

	All Vehicles		Car		SUV		Van/Minivan		Pickup Truck	
	% Use	N	% Use	N	% Use	N	% Use	N	% Use	N
Overall	93.6	16924	93.9	7904	95.9	4321	93.0	2034	87.2	2498
Site Type										
Intersection	93.1	9449	93.7	4262	95.7	2323	92.0	1179	85.7	1624
Mid-Block	94.9	1937	93.6	914	96.9	513	95.0	241	95.6	259
Ramp	96.4	5211	97.2	2728	96.8	1485	97.3	614	90.2	615
Time of Day										
7-9 am	91.4	2334	91.3	1132	93.5	602	94.7	246	83.3	346
9-11 am	91.6	4517	91.1	2080	95.0	1170	88.7	575	85.8	658
11-1 pm	94.8	4133	94.1	1941	97.3	1063	94.6	537	90.4	576
1-3 pm	94.9	4143	96.6	1842	95.6	1084	94.0	503	87.2	687
3-5 pm	93.9	1612	94.9	843	96.6	374	93.4	163	87.9	220
5-7 pm	99.9	115	99.9	66	100	28	100	10	82.7	11
Day of Week										
Monday	93.0	2456	96.2	1074	93.2	626	86.6	341	88.0	396
Tuesday	94.1	2707	95.9	1285	95.3	645	92.5	358	83.3	410
Weds	86.1	2187	86.6	1001	88.8	573	91.9	280	74.4	326
Thursday	93.0	1681	91.7	826	95.9	354	92.1	206	93.9	269
Friday	93.6	3276	96.9	1517	92.8	865	95.5	404	85.9	475
Saturday	96.4	1976	93.0	825	99.1	533	95.1	175	89.1	413
Sunday	94.6	2571	92.5	1376	95.7	703	99.3	250	94.4	209
Weather										
Sunny	93.4	9614	92.6	4538	96.5	2492	91.8	1156	86.6	1376
Cloudy	93.9	5847	95.7	2705	88.4	1451	94.9	711	88.4	940
Rainy	93.7	1393	94.8	661	83.6	378	93.2	167	83.6	182
Sex										
Male	91.9	9161	92.1	3996	95.6	2059	91.1	1043	85.1	2018
Female	95.6	7653	95.5	3890	94.4	2254	95.0	989	94.4	468
Age										
0-10	97.4	24	99.7	8	86.5	5	100	5	100	6
11-15	84.0	227	84.2	87	89.9	64	77.3	41	80.7	34
16-29	93.3	3706	93.6	2299	97.3	703	90.6	275	87.0	407
30-64	94.1	11557	94.2	404	95.6	2363	93.8	1516	89.9	1905
65+	91.9	1312	93.8	694	99.7	275	97.7	195	55.9	143
Position										
Driver	93.2	13339	93.9	6376	95.1	3374	92.9	1541	86.8	1983
Passenger	94.6	3515	93.7	1528	97.3	947	93.3	493	88.5	515

5.3 Cell Phone Use

Table 5 shows unweighted cell phone use by occupants of passenger vehicles in 2012.

Table 5. Unweighted Cell Phone Use Rate by Vehicle Type

Cell Phone Usage Type		Vehicle Type					Total
		missing	Car	Pickup	SUV	Van/MiniVan	
Hand Held	Count	6	398	130	261	121	916
	% within Vehicle Type	6.2%	5.0%	5.2%	6.0%	5.9%	5.4%
Hands Free	Count	0	18	4	3	1	26
	% within Vehicle Type	.0%	.2%	.2%	.1%	.0%	.2%
None	Count	91	7524	2378	4070	1919	15982
	% within Vehicle Type	93.8%	94.8%	94.7%	93.9%	94.0%	94.4%
TOTAL	Count	97	7940	2512	4334	2041	16924
	% within Vehicle Type	100%	100%	100%	100%	100%	100%

The majority of occupants were not using a cell phone. Roughly one-in-twenty (5.4%) front seat occupants were observed to be using a hand-held 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).

Table 6 shows unweighted counts of and percentages of belt and phone use by occupants of passenger vehicles by vehicle occupant position.

Table 6. Unweighted Cell Phone and Belt Use by Vehicle Occupant Position

Position	Belt Use		Phone Use Type			Total
			Hand Held	Hands Free	None	
Driver	No	Count	55	0	791	846
		% within phone use type	6.6%	.0%	6.3%	6.3%
	Yes	Count	779	26	11688	12493
		% within phone use type	93.2%	100%	93.3%	93.3%
Missing	Count	2	0	42	44	
	% within phone use type	.2%	.0%	.3%	.3%	
TOTAL	Count	836	26	12521	13383	
	% within phone use type	100%	100%	100%	100%	
Passenger	No	Count	2		242	244
		% within phone use type	2.5%		7.0%	6.9%
	Yes	Count	78		3193	3271
		% within phone use type	97.5%		92.3%	92.4%
Missing	Count	0		26	26	
	% within phone use type	.0%		.8%	.7%	
Total	Count	80		3461	3541	
	% within phone use type	100%		100%	100%	

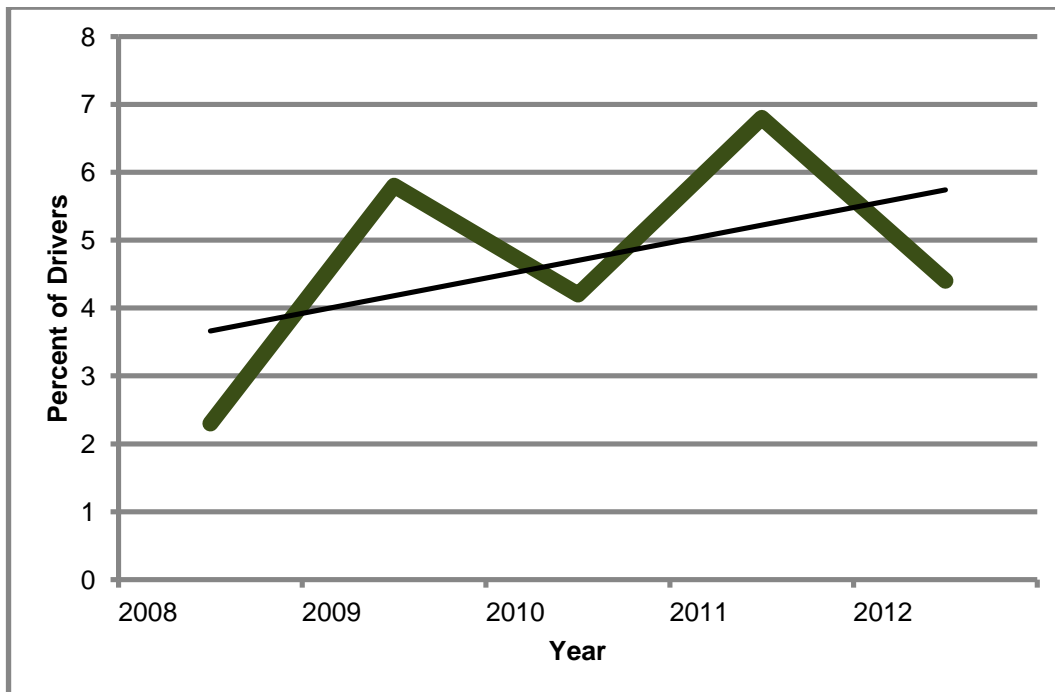
Table 6 appears to indicate that drivers are the only individuals to use hands-free cell phones. This is an artifact of the data collection protocol—it was impossible to determine if a conversation taking place in a vehicle with both a driver and a front seat passenger might have also included use of a hands-free cell phone, so those cells in the table are blank by design. Looking at the column for use of hand-held cell phones, there does not seem to be a strong relationship between belt use and cell phone use. At least among drivers (for whom there is a sufficiently large sample), the percentage of belt use by those using a hand-held cell phone is virtually the same as the overall percentage of belt use (just over 93%).

Figure 8 shows the trend across years 2008-2012 in driver's use of hand-held cell phones from the annual June observations using weighted data. At 4.4% the 2012 drivers' percentage of hand-held cell phone use is slightly below the weighted average of 4.7% 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:

$$\text{Cell phone use percentage} = 0.52(\text{YEAR}) + 3.14 \quad (R^2=0.2307)$$

This indicates that cell phone use is increasing on average about 0.52 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 .

Figure 8. Driver's Hand Held Cell Phone Use (Weighted Data): 2008-2012



5.4 Motorcyclist Analyses

The following data are presented for motorcyclists in 2012. All of the data are unweighted. Motorcycle helmet use of 46.3% in 2012 is down significantly from the 2011 value of 57.1%. Overall usage rates for 2012 are 46.9% for riders and 40.9% for passengers. In 2011 the riders were at 55.6% helmet usage rates and passengers were at 65.2%. Inclusive of riders and passengers considered together, males were only slightly less likely than females to wear a helmet (46.4% for males, 46.9% for females overall), however (as shown in Table 7) 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 7 presents the overall unweighted helmet use by all riders and separated by age, gender and position on the motorcycle.

Table 7. Unweighted Motorcyclist Helmet Use by Age, Sex, Riding Position

		Rider		Passenger	
		% Helmet Use	N	% Helmet Use	N
Age:	16-29	65.2	46	67.7	6
	30-64	40.1	137	26.7	16
	65+	54.6	11	100	1
Sex:	Male	46.4	181	50	2
	Female	58.3	12	40	20
Overall		46.9	194	40.9	22
All Occupants		46.3 %			

6 Discussion

The 2012 Minnesota Seat Belt Use Survey was successful in implementing the new NHTSA 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 data for Minnesota. The 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%-plus level, with some indication that the rate continues to climb slightly each year.

The 2012 study also shows results that are in keeping with the trend in usage rates among specific segments of the population. For the second year in a row, belt use among male front seat occupants was above 90% (90.4% in 2011 and a record high 91.9% in 2012). Female front seat occupants achieved a similar level (92%) in 2007 and have shown a less clear pattern of annual increases over the years since then. The 2012 belt use rate among females is 95.6%—very close to the rates reported in 2010 and 2011. The gap between male and female front seat occupants' belt use levels appears to be narrowing. The average gender gap in belt use for 2003-2005 was just under eight percentage points. The gap has narrowed to 3.7 percentage points in 2012, down from 5 percentage points in 2011. One possible explanation for the narrowing gap is that 95% belt use might represent a practical maximum for the population under observation. Females, having already reached this level, are thus unlikely to increase year-to-year while males are still able to improve slightly to achieve a similar level.

Vehicle choice continues to be related to seat belt usage rates for front seat occupants. As in past years, the 2012 data show that occupants of pickup trucks are less likely to wear a seatbelt than are occupants of any of the other vehicle types in the study (cars, SUVs, and vans/minivans). Belt use among pickup truck occupants dropped slightly from the high of 88.0% in 2011 to 87.2% in 2012. Belt use by occupants of vans also dropped slightly from the 2011 record of 95.7% to a five-year low of 93.0%. SUV and passenger car occupants achieved record levels of belt use in 2012 (95.9% and 93.9% respectively). 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% confidence limits for the data and could simply be an artifact of weighting versus an indication of an important shift in behavior.

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 belt use among front seat occupants. In 2012, passengers aged 0-10 years old were much more likely to be belted (97.4% belt use) than any other age group of front seat occupants). 11-15 year olds had the lowest belt use rates in 2012 (84.0%); this group was at 92.3% in 2011 and 95.9 percent in 2010. 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., the N becomes smaller in each cell of the summary table).

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 2012, the 5-7 PM time interval achieved a near-perfect 99.9% belt use—the highest ever recorded for any time period from 2003 to the present. In prior years this time period has been at or near the middle of the pack. Similarly, in 2012 Saturday was the

day of the week with the highest belt use (96.4%). Saturday belt use was also highest in 2011. Prior to that Saturday would have been ranked 4th in 2010 and 5th in 2009. The most likely explanation for this pattern of differences among time periods across the years is that the sampling and weighting can magnify small changes. This issue was noted in the 2011 report as well.

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 belt use rates than occupants of other vehicle types and females' 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 belt use levels achievable within a given population. Looking at the data for 2012 in comparison to prior years, it is possible that female front seat occupants are at or near that hypothetical maximum achievable value (about 95% in present-day Minnesota). If so, future gains in overall belt use will 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 belt use rates can be expected to be near 95% (an estimate based on the relatively flat trend among female occupants). Some years the value will be higher, some years lower. It is also worth considering that the achievable maximum 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 95% and the statewide value (a combination of usage rates for males and females) will also stabilize at a value lower than 95%. Since the seatbelt usage rate for males has been rising steadily in Minnesota, there is no reason to suspect today that their rate is nearing its maximum.

Hand-held cell phone use by drivers has shown an increase across the years from 2008 to the present. The weighted 2012 value is about average overall for the years 2008-2012 (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 every two years (slope of the line is 0.52). This correlation between years and cell phone use is not particularly strong (the R^2 is 0.23 indicating a weak correlation). The increase over years may just reflect increased use of cell phones in general.

The drop in helmet use between 2011 and 2012 by motorcycle occupants (riders and passengers) from 57.1% to 46.3% is concerning. As in 2011, 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 prior years); however, it is important to recognize that the change in the sampling frame did not apparently affect the belt usage rate. It would be surprising to see such a large difference (roughly 10 percentage points) 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 2012 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 by Stratum

List of Road Segment Samples by Stratum

ID	Roadtype	County	Observation Site	Route Number	Beg. Ref Point	End Ref. Point
Hennepin Stratum						
1	Primary	Hennepin	EB US 55 & CH 101 (Sioux Dr)	94	208.313	214.045
2	Primary	Hennepin	EB MN 62 & Lyndale Ave S off ramp	494	10.956	11.999
3	Primary	Hennepin	EB MN 62 & 28th Ave S off ramp	94	206.008	207.617
4	Primary	Hennepin	SEB I-94 & MN 101 (Main St) off ramp	100	9.785	11.435
5	Primary	Hennepin	SEB I-94 & Maple Grove Pkwy off ramp	394	5.855	7.604
6	Primary	Hennepin	NWB I-94 & Maple Grove Pkwy off ramp	62	113.682	114.512
7	Primary	Hennepin	WB I-94 & CH 61 (Hemlock La) off ramp	62	111.043	112.106
8	Primary	Hennepin	EB I-94 & CH 152 (Brooklyn Blvd) off ramp	694	34.191	35.762
9	Primary	Hennepin	SB I-94 & 53rd Ave off ramp	94	216.99	218.393
10	Primary	Hennepin	WB I-94 & Riverside Ave S off ramp	394	4.606	5.855
11	Primary	Hennepin	SB MN 100 & CH 40 (Glenwood Ave) off ramp	394	0.727	1.511
12	Primary	Hennepin	NB MN 100 & 36th Ave N off ramp	100	7.726	8.902
13	Primary	Hennepin	NB US 169 & CH 1 (Pioneer Tr) off ramp	35W	16.399	16.944
14	Primary	Hennepin	NB US 169 & 7th St S off ramp	494	17.622	19.765
15	Primary	Hennepin	NB US 169 & CH 81 (Lakeland Ave)	494	16.016	17.622
16	Primary	Hennepin	SB US 169 & 117th Ave N	94	234.828	235.565
17	Primary	Hennepin	SWB US 212 & CH 4 (Eden Prairie Rd) off ramp	494	13.657	16.016
18	Primary	Hennepin	EB I-394 & CH 61 (Plymouth Rd) off ramp	94	221.277	223.223
19	Primary	Hennepin	WB I-394 & CH 61 (Plymouth Rd) off ramp	394	0	0.727
20	Primary	Hennepin	WB I-394 & Xenia Ave S off ramp	55	175.534	176.393
21	Primary	Hennepin	EB I-394 & CH 2 (Penn Ave S) off ramp	94	226.35	227.386
22	Primary	Hennepin	EB I-494 & CH 1 (24th Ave) off ramp	169	139.278	142.631
23	Primary	Hennepin	EB I-494 & CH 17 (France Ave S) off ramp	169	122.65	124.797
24	Primary	Hennepin	WB I-494 & Prairie Center Dr off ramp	94	214.045	216.329
25	Primary	Hennepin	SB I-494 & CH 62 (Townline Rd) off ramp	494	20.175	21.473
26	Primary	Hennepin	NB I-494 & CH 5 (Minnetonka Blvd) off ramp	35W	15.339	16.399
27	Primary	Hennepin	SB I-494 & CH 16& CH 5 (Minnetonka Blvd) off ramp	494	19.765	20.175
28	Primary	Hennepin	NB I-494 & Carlson Pkwy on ramp	494	7.045	7.976
29	Primary	Hennepin	SB I-494 & Carlson Pkwy off ramp	169	136.46	137.412
30	Primary	Hennepin	SB I-494 & CH 9 (Rockford Rd) off ramp	169	116.579	118.192
31	Primary	Hennepin	WB I-94 & Shingle Creek Pkwy off ramp	494	23.335	26.027
32	Primary	Hennepin	SB I-35 & W 35 St off ramp Driver's side	35W	18.217	18.748
33	Primary	Hennepin	NB I-35 & E 37 St off ramp	212	155.209	157.166
34	Primary	Hennepin	SB I-35 & Washington Ave S off ramp	494	2.064	2.789
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
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

ID	Roadtype	County	Observation Site	Route Number	Beg. Ref Point	End Ref. Point
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	15650014	0.03	3.57
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	CH 9 (Rockford Rd) & Plymouth Blvd	27000009	0.821	1.047
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 Wooddale 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						
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
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
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

ID	Roadtype	County	Observation Site	Route Number	Beg. Ref Point	End Ref. Point
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 5	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
95	Secondary	Ramsey	NEB S Dodd Rd & W Baker St	34250119	0.015	0.31
96	Secondary	Ramsey	SB MN51 (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	EB MN 5 (34th St N) & Imation Pl	5	79.227	79.906
102	Secondary	Ramsey	SB MN51 (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
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						
121	Primary	Rice	NB I-35 & MN 60 off ramp , Fairbault	35	55.287	55.725
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

ID	Roadtype	County	Observation Site	Route Number	Beg. Ref Point	End Ref. Point
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
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 & US 169 off ramp , 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 & CH 18 , Nisswa	371	32.437	39.133
145	Primary	Sherburne	EB US 10 (Jefferson Blvd) & MN 25 (Lake St S) Big Lake	10	192.425	196.139
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
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) & Todd 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
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	86000034	4.66	7.92

ID	Roadtype	County	Observation Site	Route Number	Beg. Ref Point	End Ref. Point
			Michael			
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
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						
181	Primary	Nobles	EB I-90 & MN 264 off ramp, Round Lake	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 & CR 137, 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
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	EB US 2 & La Prairie Ave 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, Sherburne	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
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

ID	Roadtype	County	Observation Site	Route Number	Beg. Ref Point	End Ref. Point
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
219	Secondary	Isanti	SB Main St & Central Ave, Cambridge	5700113	0.21	1.172
220	Secondary	Lyon	SEB MN 68 & Channel Parkway, Marshall	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
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 Kram Ave & 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 Observation Forms:

Site Description Form

iPad 6:57 AM 79%

Cancel Site Description OK

Site ID 15 Surveyor 2

Date 5/30/12 Start 06:46:14

Road Name CH 55 Day Monday

Cross Street Park St Weather Mostly Cloudy

Alternate Site?

Median Present? Site Type Intersection

Traffic Control Traffic Light Direction NE

Lanes Observed 1 Actual # Lanes 2

5-minute Vehicle Count 112

Step 1: Pre-survey Step 2: Survey Step 3: Post-survey

+ New Previous Delete Tools

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?

SeatBelt **Yes** Driver **Yes** SeatBelt

Yes No Unknown **Yes** No Unknown

Gender **Female** Gender **Male**

Male Female Male Female

Age 1-10 Age 11-15 30-64

11-15 30-64

16-29 65+ 16-29 65+

Cell **None** Cell **None**

None Hand Held Hands Free None Hand Held Hands Free

Record 6/28/12 **Post-Survey**

+ New Delete Tools

Motorcycle Survey Form

iPad 3:31 PM 88%

Cancel **Motorcycle Form** OK

Site ID 15

Motorcycle Record

Passenger? **Driver**

Passenger?		Driver	
Helmet	Yes	Yes	Helmet
Yes	No	Yes	No
Gender	Female	Male	
Male	Female	Male	Female
Age	30-64		Age
1-10	30-64	11-15	16-29
11-15	30-64	30-64	65+
16-29	65+	30-64	65+

Record **Post-Survey**

+ New Delete Tools

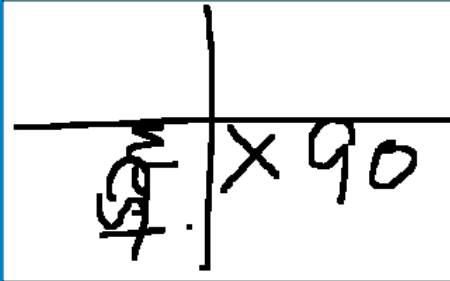
Post-Survey Form

iPad 3:46 PM 60%

Cancel **Site Notes** OK

Date 5/7/12 Site ID: 240

Site Sketch



Notes

Type comments here.

End 03:46:34 pm

Step 1: Pre-survey Step 4: Finish Step 3: Post-Survey

+ New || Previous Delete Tools