Connecting South Dakota and the Nation

South Dakota
Department of Transportation
Office of Research

U.S. Department
of Transportation

Federal Highway
Administration

SD2003-15-F

Factors Contributing to South Dakota Crash and Fatality Rates

Study SD2003-15
Final Report

Prepared by
The Center for the Advancement of Transportation Safety
Purdue University School of Civil Engineering
1291 Cumberland Avenue, Suite F
West Lafayette, Indiana 47906

November 2005

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the South Dakota Department of Transportation, the State Transportation Commission, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

ACKNOWLEDGEMENTS

his work was performed under the supervision of the SD2003-15 Technical Panel:

John Adler................................Operations Support
Larry Dean........................... Planning & Programs
Larry Engbrecht................................Pierre Region
Mark Gilmore .... Federal Motor Carrier Safety
Heath Hoftiezer........................... Roadway Design
Dave Huft .... Research
Dennis Johnson....................................... Research
Sharon Johnson.. FHWA
Michael Kreutzfeldt .... McCook Co. Highway
Terry Lohr............................... City of Watertown
Roy Meyer ....SD Dept. of Public Safety
Creighton Miller............SD Dept. of Public Safety
Cliff Reuer ....Local Gov't Assistance
Todd Seaman .... Rapid City Region
Sgt. Dana Svendsen................. SD Highway Patrol

The work was performed in cooperation with the United States Department of Transportation Federal Highway Administration.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
SD2003-15-DF		

4. Title and Subtitle	5. Report Date
Factors Contributing to South Dakota Crash and Fatality Rates	October 2005
	6. Performing Organization Code
7. Author(s) Maria L. Drake, Erin A. Sparks, Jose E. Thomaz	8. Performing Organization Report No.
9. Performing Organization Name and Address Center for the Advancement of Transportation Safety 1291 Cumberland Avenue, Suite F West Lafayette, IN 47906	10. Work Unit No. 11. Contract or Grant No. 310870
12. Sponsoring Agency Name and Address South Dakota Department of Transportation Office of Research 700 East Broadway Avenue Pierre, SD 57501-2586	13. Type of Report and Period Covered Final; March 2004 to November 2005 14. Sponsoring Agency Code

15. Supplementary Notes

Two supplementary Appendices are published as SD2003-15-DF2 and SD2003-15-DF3.

16. Abstract

Traffic crash and fatality rates reported in South Dakota appear to be higher than those reported by surrounding states. South Dakota's actions to reduce crash and fatality rates within the state should be based upon a careful review of the crash and fatality rates in South Dakota over the past several years, followed by a thorough investigation of primary contributory factors. The entire process would require a comparison with other states to determine where South Dakota stands relative to promoting a safe driving environment. The degree to which the research objectives and tasks were accomplished must be considered in light of project setbacks that were encountered over the course of the research efforts, not only with South Dakota's data acquisition, but also with the comparison states of: Montana, New Mexico, Nevada, North Dakota, Utah, and Wyoming. Since the Native American reservations are sovereign and thus not subject to local, state, and federal mandates concerning crash reporting, members of the Technical Panel did not believe that the state received all the non-fatal crashes from these areas. The information obviously presented the project with a substantial limitation in terms of analyzing South Dakota's crash and fatality rates. This meant that differences in crash characteristics and crash rates throughout the state could be due to differences in reporting procedures. In response to these questions and concerns, CATS produced a statistical underreporting model to estimate the degree of underreporting in counties with high Native American populations in order to provide the South Dakota DOT with justification to engage in further investigations of crash reporting methods in these areas and to provide them with a ballpark idea of how many crashes they could potentially be missing. Additionally, after multiple attempts to obtain complete crash datasets and other pertinent information from the comparison states yielded only partial success, the research team and the SDDOT determined that the best course of action was to proceed using the FARS database to conduct the comparative analysis. Surveys sent to FARS analysts pertaining to perceived completeness of FARS data were not completed, compromising the validation process of this project in that the research group cannot determine with definitive certainty the root cause for South Dakota's higher rate of crashes and fatalities compared to other states.

However, significant information was gleaned from the data available. Based upon the analyses conducted on the available crash data, the researchers determined that the primary focus areas for the state consist of the following six areas: Underreporting, Rollover Crashes, Restraint Use, Alcohol, Speeding, and Young Drivers. A number of tools and recommendations have been formulated to assist the state with reducing their fatality and crash rates, but without a systemic approach to capturing and analyzing all of their crash reports, particularly those occurring on Reservation lands, not just those in which there is a fatality, there is no statewide mechanism in place to monitor progress. A supplemental grant recently announced by the South Dakota Department of Transportation is positioned to become the catalyst necessary to help the state reduce the loss of life on its roadways.

17. Keywords	18. Distribution Statement
	No restrictions. This document is available to the public from the sponsoring agency.

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	127	

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: EXECUTIVE SUMMARY

As stated in the original request for research proposal, "traffic crash and fatality rates reported in South Dakota appear to be higher than those reported by surrounding states… South Dakota needs to formulate actions that could potentially reduce crash and fatality rates within the state. These actions should be based upon a careful review of the crash and fatality rates in South Dakota over the past several years, followed by a thorough investigation of primary contributory factors. The entire process would require a comparison with other states to determine where South Dakota stands relative to promoting a safe driving environment. Once the factors that contribute to higher crash rates are identified, the state will have the means to better allocate resources to promote better traffic safety." However, throughout the course of the research, major hindrances to accomplishing the research goals were identified. As a result, the project scope, research objectives, and research tasks underwent a formal revision in November 2004, and the researchers were given the charge of documenting additional barriers to completing research tasks.

Six comparison states were selected by the South Dakota Technical Panel: Montana, New Mexico, Nevada, North Dakota, Utah, and Wyoming. Key findings in the process of data and information collection from these six comparison states revealed that project scope, research objectives, and research tasks had to be modified. Many of the desired data elements, such as statewide demographically-based elements, were successfully obtained via the Internet through publicly available resources for all six comparison states and South Dakota for the years 1998-2003. However, state crash databases, much of the demographic data by county, and information on traffic crash reporting procedures could not be obtained through publicly available resources for all six states. These data elements were specifically pursued by working with representatives from each state, and success rates varied.

The technical data was pursued individually from each state with disappointing success rates. For the non-technical information, several questionnaires were created that addressed such items as the data handlers' perceived views of the data available from each state and how inquiries pertaining to states' crash reporting procedures are handled. One survey was sent to those listed as part of the Traffic Records Team on the National Center for Statistic and Analysis (NCSA) website and specifically asked for information regarding motor vehicle crash data collection for crashes on Indian Reservations, including the perceived completeness of the data collected. A second survey was created to be sent to individual tribal communities in order to determine reporting practices on Indian Reservations, as well as seek out tribes who might be willing to share their internal crash databases with CATS. However, SDDOT deemed such a survey to be outside the scope of the project and did not want to risk the alienation of state-tribal relations at that time, and thus the survey was never administered. A third and final survey was prepared for the Fatality Analysis Reporting System (FARS) desk representatives of South Dakota and all six comparison states. This brief questionnaire asked the state FARS desk personnel for an assessment of their data collection procedures and how they interpret the variables collected. However, a national FARS representative from the National Highway Traffic Safety Administration (NHTSA) advised Purdue CATS that FARS is a federally funded program and clearance must be obtained through the NHTSA headquarters office to administer such a survey before the State FARS analysts could participate; additionally, CATS was advised that such a survey would not be granted clearance because FARS analysts are not paid to spend their time offering perceptions or opinions.

Four key project setbacks were identified as a result of this information and data collection process:

1. The considerable amount of time that was unsuccessfully spent in pursuit of the various datasets limited time for analysis.
2. The inability to obtain data that properly reflected what CATS sought or covered the same span of years as the South Dakota data considerably hampered the degree of analysis that could be conducted. The research team and the SDDOT determined that the best course of action was to proceed using the FARS database to conduct the desired comparative analysis, in addition to other statistics obtained from national publications at the statewide level. An impact of having the state-to-state comparative analyses exclusively restricted to fatality data is that the sample sizes are considerably smaller than if all crashes were used, which introduces the potential for inaccurate summary conclusions that don't necessarily apply to the general population of motor vehicle crashes in a given state.
3. Information that was received about substantial holes in South Dakota's crash database due to underreporting of Native American crashes limited internal South Dakota analysis.
4. Comparisons to other states were severely compromised as well. Even if CATS had been able to obtain complete databases from all six states, state-to-state comparisons would be suspect at best due to unknowns surrounding Native American reporting procedures, according to those states that responded to the survey. Direct comparisons to other states would also be limited due to other issues such as differences in reporting thresholds. Even FARS state-to-state comparisons are suspect due to unknowns surrounding completeness because the FARS analyst survey was terminated.

With these project setbacks in mind, researchers presented key findings and conclusions in the form of six traffic safety focus areas. The six main focus areas are areas that the researchers have either identified as critical contributing factors to South Dakota's crash and fatality rates, or as traffic records areas that need to be addressed in order to accurately assess and monitor factors contributing to South Dakota's crash and fatality rates, as compared to peer states.

Focus area one was identified as the underreporting of Native American crashes. The scope of the project shifted due to the recognition of the fact that South Dakota is missing a substantial number of its traffic crashes. The original goal of assessing contributing factors to crash and fatality rates in South Dakota as compared to peer states was severely compromised due to the fact that fully quantifying and assessing to what degree each state and South Dakota might be missing its crashes was well outside the scope of the project. Additionally, the researchers discovered that nowhere in South Dakota's Highway Safety Plan or South Dakota's Motor Vehicle Traffic Crash Summary publications is it acknowledged that South Dakota does not have a complete picture of its traffic crashes statewide. The need to investigate, document, and quantify the degree to which this hole is a substantial traffic records concern for the state became readily apparent. Without accurate and complete traffic records, factors contributing to crash and fatality rates can never be fully studied or monitored for future progress, and there is apparently no formal acknowledgement of this fact at the statewide level or in the South Dakota Highway Safety Plan. Additionally, the underreporting of Native American Crashes in particular is of substantial noteworthiness due to the fact that the Native American population has a fatality rate that is higher than that of the rest of the state. An investigation into the potential impact of missing crashes in the top 12 Native American counties by population was undertaken, including the construction of an underreporting model which modeled the relationship between county traffic flow descriptors and total crash counts in order to predict total crashes in the Native American counties.

Focus area two was identified as rollover crashes. South Dakota has the highest percentage of all vehicle miles traveled that are rural when compared to the six selected peer states. As expected, the percentage of all South Dakota fatal crashes with a vehicle rollover coded as the first harmful event was nearly three times the national rate in 2003. Additionally, South Dakota's fatal rollover rate per 100 million vehicle miles traveled (MVMT) has also been on the rise since 1998. When total crashes (not just fatal crashes) are examined, there is again an upward trend seen in the percentage of all crashes that have a rollover as the first harmful event. In fact, while the overall non-property damage only (pdo) crash rate per 100 MVMT decreased from 65.0 to 58.1 between 1998 and 2003, the non-pdo crash rate for rollover crashes increased from 8.4 to 9.2 crashes per 100 MVMT over the same period.

When rollovers are investigated by road class, rural interstate and rural local roads have the largest percentage of all fatal crashes that are rollover, and rural local roads have the highest rollover fatal crash rate per 100 MVMT. There are also specific driver factors that contribute to rollover crashes, such as alcohol and speeding. Typically, sport utility vehicles (SUV) have the largest rollover problem and this is evidenced in South Dakota as well. In terms of roadway characteristics, between 1998 and 2003, when compared to non-rollover crashes, a larger percentage of crashes with a rollover coded as the first harmful event occurred on a stretch of roadway categorized as a hillcrest or on a grade, and a larger percentage occurred on a curve. Finally, safety belt usage is particularly important in shaping the outcome and severity of rollover crashes because an unrestrained occupant is more likely to be ejected and severely injured.

Focus area three was identified as restraint usage. During September 2004 and February 2005, NHTSA and the Bureau of Indian Affairs (BIA) sponsored the first ever occupant protection observational survey targeted toward Native Americans. Modeled after the National Occupant Protection Usage Survey (NOPUS), nine of the reservations were in states that had a primary seat belt law[1], and they also posted the highest belt usage rates of the survey. Among the other seven reservations in states with a secondary seat belt law, the observed usage rates accounted for the lowest usage rates of the study. Among South Dakota and the six comparison states, only New Mexico has a primary seat belt law. It was the first state among the seven states to enact such legislation, and New Mexico had the highest observed restraint use rate among the same states. North Dakota and South Dakota have the lowest restraint use rates of the seven states, and also the weakest laws and penalties of the seven states.

A December 2004 study conducted by the Insurance Institute for Highway Safety documented the benefits of a primary law as measured by the number of lives saved since the change from a secondary to a primary law (Farmer and Williams, 2004). At the present time, South Dakota continues as a secondary law state for seat belt use for all occupants age 18 or older (the law is primary for occupants 0-17 years of age). However, in 1998, the percentage of motor vehicle occupant fatalities that were restrained was only 24.3 percent. By 2003, this rate had plummeted to 18.0 percent. The research group can find no evidence that a concentrated, intensive enforcement effort has continued beyond the isolated “Buckle Up Badlands” or “Seat Belts Saves Lives.” Based upon the NHTSA Lives Saved Model, potential lives saved are the number of lives that might have been saved if seat belt use were 100 percent.

Focus area four was defined as alcohol-related crashes. An examination of fatal crash data reveals that while South Dakota fatality rates have been on the rise, so has the percentage of all fatalities that are alcohol-related. South Dakota’s alcohol-involvement rate is much higher than the nationwide average.

---

[1] “Primary enforcement means that law enforcement officers may issue a citation any time they observe an unbelted driver or passenger. Secondary enforcement means that officers may issue a safety belt citation if and only if the officer has stopped the vehicle for some other reason.” (NHTSA *Traffic Tech*, Number 93, May 1995)

This focus area raises a particularly large concern due to the fact that reservation crashes have high alcohol-involvement rates, and complete crash data from these areas is not available. When all alcohol-related crashes (both fatal and nonfatal) are examined and categorized by county, it is apparent that within the Native American counties, the percentage of all reported crashes categorized as alcohol-related has increased since 1998. A potentially increasing rate of alcohol-involvement in these counties raises cause for concern. Due to the incomplete records of all crashes in these counties, the statewide rate of alcohol-involvement for all crashes could also potentially be on the rise more than is reflected in the current database.

The Rating the States 2002 report made available by Mothers Against Drunk Driving (MADD) provides a good comparison of South Dakota's efforts to reduce alcohol-related fatalities to the peer states. South Dakota is one of only three states in the country to receive an "F" for Administrative Measures and Criminal Sanctions. They are joined by comparison state Montana. For state law enforcement programs, South Dakota received a "C." A 2002 study from the Centers for Disease Control and Prevention analyzed data from the 1997 Behavioral Risk Factor Surveillance System national telephone survey and the MADD Rating the States 2000 survey, and it was discovered that drivers from states that received a MADD grade of "D" who participated in the national telephone survey self-reported that they were 60 percent more likely to drive while impaired, compared to those drivers of states that received an "A" in the MADD 2000 survey (Shults, Sleet, Elder, Ryan, & Sehgal, 2002).[2]

Focus area five was identified as speeding. Similarly to rollover crashes, speed-related crashes, whether due to driving too fast for conditions or simply driving in excess of the speed limit has increased in recent years such that the National Highway Traffic Safety Administration has determined it to be a principal focus. Speed-related crashes are a factor in rollover crashes, aggressive driving crashes, driver inexperience, restraint use, and fatal alcohol-related crashes. Efforts to reduce speed-related crashes and fatalities can include traffic calming interventions, increased enforcement efforts, and the implementation of driver education and awareness campaigns. South Dakota is one of a number of states that fall within the extreme for speed-related fatalities per 100 MVMT. Additionally, during the years 1995 and 1996, 24 states increased their speed limits, resulting in an increase in motor vehicle fatalities noted during the 1996-1997 years (IIHS, 1999). Based upon fatality rates per vehicle mile traveled, the researchers at the Insurance Institute estimated that motor vehicle fatalities increased

[2] "States implement a wide variety of activities, programs, and legislation designed to improve highway safety, reduce alcohol-related deaths and injuries on our nation's highways, provide victim assistance, and prevent underage drinking. Rating the States makes a systematic review of state laws and programs, and it provides commentary on how individual states can take action to save lives." madd.org/stats

15 percent among the 24 states whose speed limits were raised, compared to seven states whose speed limits were not raised and experienced no increases at all.

Focus area six was identified as young drivers. Motor vehicle crashes are the leading cause of death for individuals 15 to 20 years of age. Although South Dakota does have a Graduated Driver's License law in effect, in its present form it does not prohibit newly licensed teenage drivers from transporting a carload of their peers beginning on day one. The purpose of the "no young passengers" component of the law is to allow a novice driver the time and opportunity to become more familiar and confident in being behind the wheel of a motor vehicle. Teen drivers are well-documented as being one of the highest-risk drivers on the road, especially for young male drivers. A total of 218 young South Dakota drivers (age 14-20) were involved in a fatal crash between 1998 and 2003, with 58.3 percent having at least one passenger with them at the time. As crash severity diminishes, so does the percentage of young drivers with passengers. Additionally, crash-involvement per 100 licensed drivers diminishes as driver age increases, with a higher rate of decline from the 14-20 year old age group to the 25-34 year old age group. From age 35 and on, the rate of decrease is much flatter.

CATS developed ten recommendations rooted in the analysis of the six focus areas with respect driver behavior, driver safety education, traffic law governance, roadway characteristics, and traffic records.

FOCUS AREA 1: UNDERREPORTING OF NATIVE AMERICAN CRASHES

Recommendation 1. The primary recommendation is that the South Dakota Department of Transportation designates funding for an additional research project that will potentially incorporate members of the South Dakota Office of Highway Safety, Nine South Dakota Indian Tribes, Bureau of Indian Affairs, and Indian Health Service. The primary goal of this project should be to assess the traffic records practices of the Nine South Dakota tribes and improve the completeness and accuracy of reports of traffic crashes by these tribes to the South Dakota Department of Public Safety.

Recommendation 2. To further enhance the crash data evaluation system, the South Dakota Department of Transportation should seek to fully support the reinstating of the Crash Outcome Data Evaluation System (CODES) in South Dakota.

Recommendation 3. For the next update of the South Dakota crash form, it is also recommended that a designator be added that indicates whether a crash occurred under the geographic jurisdiction of the tribal police. This will provide another opportunity to properly code and identify personal injury and property damage crashes on tribal lands.

FOCUS AREA 2: ROLLOVER CRASHES

Recommendation 4. The recommendations pertaining to increased and high visibility enforcement for the focus areas of alcohol, speeding and occupant protection should be implemented locally in light of an evaluation of roadway characteristics and demonstrated crash particulars. Because speeding and alcohol use directly contribute to rollover crashes and a lack of restraint is particularly deadly in these crashes, an integrated approach should be adopted in an effort to maximize lives saved. Additionally, roadway characteristics of areas of high incidence of rollover crashes should be reviewed in an effort to improve conditions or more thoroughly alert the driving population to potential rollover risks. For example, rollover crashes, especially at curves are most often due to excessive speed, and a repeated media/public awareness campaign that reminds motorists of the dangers of rollover crashes will aid in reducing the frequency of these types of crashes.

FOCUS AREA 3: RESTRAINT USE

Recommendation 5. At the present time, South Dakota continues as a secondary law state for seat belt use for all occupants age 18 or older (the law is primary for occupants 0-17 years of age). However, in 1998, the percentage of motor vehicle occupant fatalities that were restrained was only 24.3 percent. By 2003, this rate had plummeted to 18.0 percent. Strong support for a primary law needs to be championed by the South Dakota Department of Transportation, and year-round dedication to the education regarding the need for the law must continue.

Recommendation 6. Implement highly organized and visible safety belt enforcement efforts using a model based upon the Special Traffic Enforcement Program (STEP). The sTEP campaign model has been developed and used with success in Canada and several states across the country. The sTEP model combines periodic waves of stepped-up enforcement of seat belt and child passenger safety laws with aggressive publicity highlighting the enforcement.

FOCUS AREA 4: ALCOHOL

Recommendation 7. It is recommended that the South Dakota Department of Transportation continually lobby for an Administrative License Revocation/Suspension or a Mandatory License Revocation/Suspension for BAC test refusals and failures.

Recommendation 8. South Dakota should continue to increase highly visible impaired driving enforcement efforts as described in the South Dakota Highway Safety Plan.

FOCUS AREA 5: SPEEDING

Recommendation 9. Promote engineering, education, and enforcement activities that specifically and effectively address the issue of speeding. Research data is necessary to evaluate the net impact on lives lost by increasing or decreasing the posted speed limits on South Dakota's roadways. Additionally, enforcement efforts need to be geared at establishing recognized speed limit thresholds for which the motoring public readily complies. Initiate an all encompassing effort that enlists the assistance and support of all aspects of the traffic safety arena (state and local law enforcement, prosecutorial, judicial, and tribal) to implement a reduced incidence of speeding-related crashes within the state is recommended.

FOCUS AREA 6: YOUNG DRIVERS

Recommendation 10. South Dakota's current Graduated Driver's License law does not prohibit or restrict the transport of passengers younger than the age of 18. In an effort to reduce the loss of life on South Dakota's roadways, the primary recommendation is to implement this restriction for no less than 90 days, with strong enforcement and zero tolerance components to support the state's commitment to the efforts.

Clearly, the specific benefits of a full implementation of all recommendations are difficult to quantify fiscally due to all of the unknowns surrounding South Dakota's complete crash numbers. However, the research has revealed that South Dakota should take an aggressive approach to addressing key traffic safety concerns that contribute to high crash and fatality rates, in conjunction with an effort to improve accident records.

CHAPTER 2: PROBLEM DESCRIPTION

2.1 Project Scope, as Described in Original Request for Research Proposal

As stated in the original request for research proposal, "traffic crash and fatality rates reported in South Dakota appear to be higher than those reported by surrounding states. However, unique circumstances in each state may affect crash and fatality reporting and lessen the significance of direct comparisons. The way the crash data itself is collected and categorized may vary on a state-by-state basis. Regardless of the questions surrounding comparative statistics, the state of South Dakota is clearly aware that its crash and fatality rates have fluctuated over time. During the energy crisis of the 1970s when speed limits were lowered, crash rates appear to have decreased relative to prior years, when speed limits were higher. Conversely, when the legal drinking age was lower than it is now and enforcement of alcohol-related driving offenses wasn't as focused, crashes and fatalities in certain categories reflected appreciably higher rates. A wide range of common factors contributes to traffic safety in all states. The treatments used to reduce crash and fatality rates can often vary greatly by each state, however. Prevailing attitudes related to traffic safety in South Dakota have recently drawn specific interest, particularly when crash and fatality statistics are compared to other states. Recent traffic safety concerns have led to several questions about how similar states are attempting to lower crashes when compared to South Dakota's efforts, including:

- Would stronger educational programs promoting traffic safety and awareness help lower crash rates?
- Are safety programs effectively promoted and instilled around the state?
- Do prevailing laws governing speed limits, driving ages, alcohol use, seat belt use, other vehicle safety features, etc, appropriately promote traffic safety?
- Are law enforcement personnel and resources at sufficient levels for the traffic safety needs of the general public?
- Do crash rates among demographic groups vary enough to suggest reallocation of traffic safety resources to groups exhibiting higher risk levels?
- Does the geography of the state contribute to higher crash fatality rates (*e.g.*, long distances between medical facilities)?
- Do the composition of drivers' manuals and drivers' tests promote safe driving habits among the public?
- Do certain roadway conditions in the state contribute to higher crash rates?

- Do roads under local government jurisdiction have a different set of matters concerning traffic safety?

South Dakota needs to formulate actions that could potentially reduce crash and fatality rates within the state. These actions should be based upon a careful review of the crash and fatality rates in South Dakota over the past several years, followed by a thorough investigation of primary contributory factors. The entire process would require a comparison with other states to determine where South Dakota stands relative to promoting a safe driving environment. Once the factors that contribute to higher crash rates are identified, the state will have the means to better allocate resources to promote better traffic safety."

2.2 Problem Description Background, as Described in Original Research Proposal

Over the past eight years, South Dakota has experienced a 17 percent increase in the number of motor vehicle-related fatalities, compared to the national increase of 5.2 percent. Of particular concern is that while the national fatality rate per 100 MVMT fell by 11.8 percent from 1994 to 2002, South Dakota's fatality rate per 100 MVMT actually increased by 5.0 percent. This represents the 3rd greatest increase in the fatality rate behind Montana (22.7 percent) and Rhode Island (22.2 percent).

Of the 180 people killed in 2002, 119 were drivers of a motor vehicle and 48 were passengers, for a combined percentage of 92.8 percent of all traffic-related deaths in South Dakota, compared to the national combined rate of 86.7 percent. By age group, South Dakota is only slightly higher than the national rate in the number of motor vehicle fatalities age 0-20 at 23.9 percent, and 20.6 percent, respectively. Not only is South Dakota highest (51 percent) in the percentage of persons killed in alcohol-related crashes among its peer (contiguous) states, it is ten percentage points higher than the national rate (41 percent). Moreover, 44 percent of South Dakota's fatalities were in crashes in which at least one driver or non-occupant involved had a blood alcohol concentration (BAC) of at least 0.08 g/dl (the legal *per se* limit for South Dakota). The fatality rate for alcohol-involved crashes in 2002 was 1.08 per 100 MVMT, an increase of 29 percent from 1998.

A total of 68 percent of all passenger car and light truck occupants killed in South Dakota were unrestrained at the time of the fatal crash. Of the 11 occupants who were between the ages of 21 and 24, nine (91 percent) were completely unrestrained. This is only slightly better than the 24 occupants 25-34 years of age in which 80 percent were unrestrained. Vehicle type is likewise associated with injury severity. In 2002, 58 percent of all killed passenger car occupants were unrestrained, compared to 78 percent of all killed light truck occupants. Two out of three light truck occupants were ejected, compared to approximately one-half of passenger car occupants. Since 1998, South Dakota's safety belt use rate has increased from 43.5 percent to 69.9 percent in 2003. As is true for all six states within the National Highway Traffic Safety Administration's (NHTSA) Region 8 (Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming), South Dakota continues to support a secondary law for the enforcement of safety belts for occupants over the age of 17.[3] As such, a law enforcement officer must stop an individual for another traffic violation before the officer can issue a citation for violating the seat belt provision.

During South Dakota's 2003 seat belt observational survey, researchers recorded whether the observed vehicle displayed an in-state license plate or an out-of-state license plate. Of the 1,436 out-of-state vehicles observed, restraint use was recorded at 73.5 percent. In comparison, of the 10,224 in-state vehicles observed, restraint use was measured at 61.5 percent.

Intervention activities include the Buckle Up Badlands seat belt initiative, a program based upon a selective Traffic Enforcement Program (sTEP). The sTEP model is a three-tiered occupant protection campaign that utilizes public information and education, awareness, and enforcement. The stated goal of the program was to increase seat belt use rates as well as decrease motor vehicle injuries and fatalities. According to the published results, observed seat belt use rates increased from 38.6 percent to 84 percent during the course of the campaign (NHTSA, 2003). Although more than 500,000 Badlands Park visitors received the program message, there are no indications that the campaign achieved its ultimate goal of reducing the fatality rate based upon the available data.

Based upon the 2001 South Dakota Motor Vehicle Traffic Accident Summary report, the total number of Driving While Intoxicated (DWI) arrests decreased by two percent compared to the previous three-year average. What is not clear from this statistic is the underlying reason or reasons for the decrease. Specifically, was there a decrease in the enforcement/arrest efforts, or was there an increase in public awareness and perceived sanctions? In comparison, alcohol-related fatal crashes have increased steadily since 1993 from 47 to 65 in 2001.

With regard to restraint use of fatally injured motor vehicle occupants, South Dakota has seen minimal reductions in the number of unrestrained killed drivers over the past several years. Conceptually, it is understood that the ultimate goal is for 100 percent of killed motor vehicle occupants to be restrained, with the understanding that not every crash is survivable despite the use of safety equipment.

Similar to national trends, South Dakota's crash rates by gender are a 60/40 male to female ratio, whereas the ratio of male to female licensed drivers is closer to a 50/50 split. However, based upon observational data, when males and females travel together, the greater percentage of drivers are male. To accurately measure the impact of this potential over-representation of male driver crashes, detailed

---

[3] As of July 1, 2001, South Dakota enacted a primary enforcement law for motor vehicle occupants less than 18 years of age.., which means drivers can be stopped for transporting unrestrained occupants 0-17 years of age in their vehicle even without another violation.

multivariate analyses of crash reports comparing single occupant and multiple occupant vehicles should be conducted, combined with a review of observational data for occupant protection.

When reviewing for population mix, South Dakota's population by five-year age groups is very similar to that of the national level—no age group is substantially over or under-represented compared to the U.S. as a whole. When population data was reviewed for race/ethnicity, Native Americans only account for one percent of the U.S. population, whereas in South Dakota, the percentage is much greater at 8.3 percent. In contrast, African-Americans account for 12.7 percent of the U.S. population, but only 0.8 percent of South Dakota's.

A detailed review of South Dakota's traffic safety-related publications revealed that they are lacking in the degree of interpretative analysis. Specifically, within the *Motor Vehicle Traffic Accident Summary* reports, although a wealth of data is presented, it is limited to the confines of a general presentation with minimal explanation provided. An in-depth analysis of historic trends or the implications for the future is lacking, and an underlying cohesion between the various reports and data elements is not noted.

CHAPTER 3: OBJECTIVES

3.1 ORIGINAL RESEARCH OBJECTIVES

In the original request for research proposal, the research objectives were defined as follows:

1. Identify critical factors involving driver behavior, traffic safety education, traffic law governance, and roadway characteristics that could contribute to higher crash and fatality rates in South Dakota compared to similar states.
2. Develop performance measures that can be used to compare South Dakota's crash and fatality rates to similar states, and also used to gauge the effectiveness of South Dakota's progressive efforts to improve roadway safety.
3. Formulate a plan that responds to the critical factors and defined performance measures, along with recommendations for a prioritized set of alternatives that includes estimates of costs and benefits for each alternative, aimed at reducing crash and fatality rates in South Dakota.

3.2 PROJECT SETBACKS AFFECTING RESEARCH OBJECTIVES

The degree to which the research objectives were accomplished must be considered in light of project setbacks that were encountered over the course of the research efforts. Originally, it was decided that the researchers and the Technical Panel would choose six comparison states to complete these objectives and formulate key project conclusions. These states were: Montana, New Mexico, Nevada, North Dakota, Utah, and Wyoming. A wide variety of data and information was sought from each state for analysis in this project. Specifically, CATS began to compile the following information for each identified comparison state for 1998 to 2003: complete state crash databases; fatal crash databases (FARS); licensed drivers by driver age and county; vehicle registrations by vehicle type and county; vehicle miles traveled by road class and county; land area profiles; population data by age, county, race/ethnicity, and gender; state laws pertaining to traffic safety; casino locations; other statewide factors that might affect the traffic environment, such as state codes and statutes, weather, participation in traffic safety countermeasure programs, crash costs based on NHTSA's economic loss model, and information on crash reporting procedures (particularly with regards to crashes taking place on Native American lands, and FARS reporting procedures). While the information and data sought was straightforward, there were many unforeseen difficulties in obtaining large portions of it with no single state being capable of producing every type of dataset, and often not to the degree of detail specified.

Some of the demographically-based elements were successfully obtained via the Internet through publicly available resources for all six comparison states and South Dakota for the years 1998-2003, though slight discrepancies did exist between various sources for these data elements. Fatal crash data was easily downloaded from the Fatality Analysis Reporting System made available online by NHTSA. In addition, net land area and population (percent Rural and Urban), and annual vehicle miles of travel (Rural and Urban) was obtained at the statewide level from the recent online updates available to Federal Highway Administration's (FHWA) Highway Statistics Series publications, Tables PS-1 (Selected Measures for Identifying Peer States). Additional population data by county and by race, age and gender was downloaded from the National Center for Health Statistics (NCHS). NCHS worked in collaboration with the U.S. Census Bureau to produce bridged-race post-censal estimates through the Population Estimates Program. Since the Census Bureau changed the way it collected race information (in the past, only one race box could be checked, and now, many can be checked), they worked with the NCHS to develop a method of estimating how the new results would distribute themselves into the original race categories of the past, so comparisons could be made through the years. CATS downloaded full race data sets from NCHS and manipulated the databases to summarize pertinent information both by state and county for the states of interest; particularly, the percentage of the population Native American. Additional statewide VMT data, broken down by functional road class, was also obtained from the FHWA's Highway Statistics Series, Table VM-1 (vehicle miles of travel and related data, by highway category and vehicle type). Statewide licensed driver data by state, gender, and age group was obtained from the Highway Statistics Series Table DL-22. Statewide vehicle registrations were obtained from table MV-1 from the same publications.

For all six states, summaries of state traffic laws, casino locations, other unique state qualities, such as climate, and participation in traffic safety countermeasure programs was successfully obtained through extensive literature reviews and pursuit of other resources, while again there are variations depending upon which source is utilized. However, state crash databases, licensed drivers by age and county, vehicle registrations by county, vehicle miles traveled by county, and information on traffic crash reporting procedures could not be obtained through publicly available resources for all six states. These data elements were specifically pursued by working with representatives from each state, and success rates varied. The technical data (crash databases, licensed drivers by county counts, vehicle registrations by county, and VMTs by county) was pursued individually from each state with disappointing success rates. For the non-technical information, several questionnaires were created that addressed such items as the data handlers' perceived views of the data available from each state and how inquiries pertaining to states' crash reporting procedures are handled. One survey was sent to those listed as part of the Traffic Records Team on the National Center for Statistic and Analysis (NCSA) website. This survey, which is attached as Appendix A, specifically asked for information regarding motor vehicle crash data collection for crashes on Indian Reservations, including the perceived completeness of the data collected.

A second survey was created (Appendix B) to be sent to individual tribal communities in order to determine reporting practices on Indian Reservations, as well as seek out tribes who might be willing to share their internal crash databases with CATS. However, SDDOT deemed such a survey to be outside the scope of the project and did not want to risk the alienation of state-tribal relations at that time, and thus the survey was never administered.

A third and final survey (Appendix C) was submitted to the FARS desk representatives of South Dakota and all six comparison states. This brief questionnaire requested that the state FARS desk personnel complete an assessment of their data collection procedures and how the representatives interpret the variables collected; more specifically, with regard to Native Americans and the "special jurisdiction" variable when coded as an Indian Reservation. However, a representative for the national FARS Team with NHTSA advised Purdue CATS that FARS is a federally funded program and clearance must be obtained through the NHTSA headquarters office to administer such a survey before the state FARS analysts could participate. The representative informed CATS that completion of such a survey would not be granted clearance because FARS analysts are not paid to spend their time offering perceptions or opinions.

The following sections further detail the state by state results of CATS' attempts to acquire the remaining data elements from each state, as well as the enormous amounts of time and effort expended to acquire the needed datasets–some to no appreciable end:

Montana

Attempts to obtain data were the least successful in the state of Montana. Nearly all contacts provided by NSCA and the South Dakota Department of Transportation failed to respond to data requests sent via phone, email, and post. Despite receiving an affirmative email response from a contractor working to validate Montana's traffic data, the requested data was never provided as promised.

Nevada

Two contacts within the Nevada Department of Transportation provided the Nevada crash database and codebook requested by CATS. They were also able to provide CATS with the VMT for Nevada from 1999 to 2003, although the 1998 data was not available. Upon his suggestion, CATS contacted a representative from the Office of Traffic Safety (Department of Public Safety) in order to obtain licensed driver data. While the individual did attempt to obtain the data for CATS, the last email indicated that the data was currently unavailable. One reason for this was due to a labor intensive project being undertaking by the department to create a repository of traffic records for the state. Such a comment suggested that in future years the data might be made readily available for research purposes—the indication was certainly that such requests could be honored. The Nevada Department of Motor Vehicles provided the registered motor vehicle data requested by CATS, and all of the data requested (1998 to 2003) was provided.

New Mexico

All data received from New Mexico was received in spring 2005 from a contractor for the New Mexico Traffic Safety Bureau. Vehicle miles traveled was received in April 2005, and while the data was available for all five requested years, it was less exact than the data received from other comparison states as it was rounded by the millions rather than having more precise numbers. Licensed driver data for all requested years was also received in April 2005, but the registered motor vehicle data for New Mexico was not available. Although there was some basic data available in their crash book, the contractor employee advised that there were concerns about the validity of such data when used in a single-year format as New Mexico moved to a two-year registration system in 1998.

North Dakota

As communicated by the Technical Panel, data from North Dakota was the most desired of all comparison states; however, it also proved to be the most difficult to obtain. Multiple attempts at obtaining the North Dakota crash database and codebook were unsuccessful despite numerous emails and phone messages left for the NSCA site of Traffic Records Team members, various personnel with the North Dakota Department of Transportation, and other Office of Traffic Safety staff. A member of the Traffic Records Team did respond to the questionnaire regarding Native American reporting practices, but the insufficiency of the received responses failed to provide a clear picture of Native American crash data in the state. The Interim FARS Analyst at the Office of Traffic Safety was able to provide a modest amount of the data requested by CATS. Licensed driver data was only available for 2001 to 2003, registered motor vehicle data was not available for either 1998 nor 2002 (although the remaining years requested were available), and the VMT data was not available by road function class, although it was available by rural versus urban classifications for all years requested.

South Dakota

The technical data (crash databases, licensed drivers by county counts, vehicle registrations by county, and VMTs by county) was provided by the South Dakota DOT (either in hard copy reports that had to be manually keyed into databases or electronic databases). The South Dakota DOT also engaged in an ongoing dialogue with Purdue CATS throughout the project regarding traffic crash reporting in which it was communicated that it was their perception that the state is doing a rather good job of pursuing fatal crashes. However, since the Native American reservations are sovereign and thus not subject to local, state, and federal mandates concerning crash reporting, members of the Technical Panel did not believe that the state had received all the non-fatal crashes from these areas. As the state of primary analysis, CATS responded to this information by submitting additional inquiry regarding the "special jurisdiction" variable coding to the South Dakota FARS analyst, along with pursuing at length any and all available resources and contacts that would help CATS gain an understanding of reservation jurisdictions within South Dakota so that CATS might better understand the determination and frequency of reservation crashes.

Utah

The crash database for Utah was received during the first quarter of 2005, having been provided by the Utah Department of Transportation. In order to obtain registered vehicle data, CATS was guided to the state of Utah's tax website (http://tax.utah.gov/esu/motor/index.html#reg). This data was available for 1998 to 2003; however, there was no notation for motorcycles in the data. Licensed driver data was received in May 2005. Historical data before 2001 was not available; thus, CATS only received three of the five years of requested data. The VMT data was located on the Utah Department of Transportation's website, although it was limited to data from 1998 to 2002 at the time of inquiry. The Native American crash data questionnaire was sent to one of the Traffic Records Team members, who forwarded the request to yet another individual at the University of Utah's Intermountain Injury Control Research Center. This individual spoke with CATS at length to discuss the questions, but unfortunately was unable to provide the information requested.

Wyoming

Crash data for the state of Wyoming was the very first received from the comparison states. A data request was emailed to the Wyoming Department of Transportation during the first quarter of 2005, and the data was received on CDs in the mail several days later. VMT data for 1998 to 2003 was received April 12, 2005. The person suggested contacting yet an additional person for the remaining licensed driver and registered vehicle data; however, the individual indicated such data was not available for the state. Stephanie Lucero, Senior Highway Safety Technician at the Wyoming Highway Safety Program was contacted for the Native American crash data questionnaire. Her responses were received via email on October 14, 2004.

As evidenced above, there were many attempts to collect the necessary data from any and all six states. First and foremost was the difficulty in reaching the correct contacts. Many emails, voicemails, and letters never even received a response. Continued online searches usually led to a response, but not in all cases. Once a contact was reached, he or she often indicated that the data was not available and forwarded CATS personnel on to other contacts who would often try to forward the CATS team members back to the previous contact.

In many cases, the data was presented in different formats from the comparison states, or only a limited amount of data was available. For example, the VMT data received from Utah did not include motorcycle data. The New Mexico VMT data was heavily rounded, was not available by specific road function classes (only rural versus urban), and thus was not nearly as precise as the data received from other comparison states. In other cases, only some of the data was available. The Utah VMT data was only available through 2002, and licensed driver data was only available for 2001 to 2003. Nevada's VMT data was by and large complete, but the 1998 data was not available. To further burden the data acquisition task, some of the requested datasets were provided hardcopy and required manual data entry to make them useable. There was not a single comparison state where all of the data was available in the complete format and years requested.

Another issue that was seen in several cases is that many states are currently trying to validate their crashes, or create their own statewide repositories of traffic data. Montana is currently going through a labor intensive project to validate all of their crash data, and thus CATS was unable to receive any data from them. A staff member from the Utah Department of Motor Vehicles indicated that Utah was currently in the process of building a statewide repository of traffic records, and because it was not yet complete, the individual was unable to obtain certain data requested.

The amount of time spent simply collecting the data was very extensive and ultimately revealed that the information was inconsistent and incomplete across the six comparison states. Consequently, the resultant amount of time available for analysis was substantially reduced. Additionally, responses to questions about reporting procedures raised many uncertainties and concerns as to the validity of direct state-to-state comparisons, even if complete data had been disclosed. Four key project setbacks were identified as a result of this information and data collection process.

Project Setback 1: Time Constraints

As stated above, a considerable amount of time was unsuccessfully spent in pursuit of the various datasets and reaching conclusions that the initial proposed methods of analysis would deem unsatisfactory due to missing data and a limited amount of time that was supposed to be devoted to analysis alone.

Project Setback 2: Lack of Full Disclosure of Data

The inability to obtain data that properly reflected what CATS sought or that covered the same span of years as the South Dakota data considerably hampered the degree of analysis that could be conducted such that it required a reshaping of the county-by-county statistics as outlined in the original project objectives. After multiple attempts to obtain complete crash datasets and other pertinent information yielded only partial success, the research team and the SDDOT determined that the best course of action was to proceed using the FARS database to conduct the desired comparative analysis, in addition to other statistics obtained from national publications at the statewide level. An impact of having the state-to-state comparative analyses exclusively restricted to fatality data is that the sample sizes are considerably smaller than if all crashes were used, and an incomplete picture is thus created, which introduces the potential for inaccurate summary conclusions that don't necessarily apply to the general population of motor vehicle crashes in a given state.

Project Setback 3: Internal South Dakota Analysis Limited by Missing Crashes

Information that was received about crash reporting procedures and substantial holes in crash databases due to underreporting of Native American crashes also raised doubts as to the validity of direct state-to-state comparisons, even if all the data were made available. Without the desired information from the other states, the information from the South Dakota DOT regarding reporting practices on Native American reservations obviously presented the project with a substantial limitation in terms of analyzing South Dakota's crash and fatality data if the state does not have complete records of all traffic crashes. This meant that any and all differences in crash characteristics and crash rates throughout the state could be due to differences in reporting procedures. As the nine reservation areas in South Dakota are not required to report non-fatal traffic crashes to the state, CATS pursued further information about the reservations to gain a greater knowledge and understanding of how the Native American jurisdictions worked in terms of traffic crash reporting. A number of maps made available by the BIA and other federal resources revealed the tribal boundaries; however, CATS discovered discrepancies from map to map in how expansive the tribal land was displayed. This led to uncertainty with regard to which areas were subject to state or federal crash reporting requirements and which were not (only those within closed federal reservation boundaries or those on any land owned by the tribe). Additionally, there is no variable in the South Dakota crash database to indicate whether the crash took place within a "Native American Jurisdiction" or not. However, "on reservation" is an indicator in the FARS database, so CATS asked the SD FARS analyst how this variable was determined. It was communicated that a crash was coded as "on reservation" if it met one of the following three criteria:

1. Based on the crash location information provided on the crash form, the crash appeared to take place within only those reservation boundaries appearing on the basic hard copy of the Official SD State Highway map, as far as the FARS analyst can tell. (This is the basic Highway map provided for free from the Department of Tourism, on which the Pine Ridge Reservation, Rosebud Reservation, Crow Creek Reservation, Lower Brule Reservation, Standing Rock Reservation, Cheyenne River Reservation, and Flandreau Reservation are the only reservations with boundaries on the map.)

2. Based on the crash roadway information provided on the crash form, the crash appeared to take place on a BIA road. (BIA roads are determined based on various maps used by the FARS analyst.)

3. The crash report was filed by the BIA or Tribal Police. (These crashes are always coded as taking place on reservation land, whether or not either of the first two criteria is met.)

In addition, the FARS analyst communicated that the investigating officer has no good way of telling whether he/she is within federal reservation boundaries or not, so these categorizations, which are made after the fact, must be made to the best of the FARS analyst's ability using the three criteria.

As suggested by the SDDOT, CATS then contacted Pete Red Tomahawk, Transportation Planner for the Standing Rock Sioux Tribe, to provide a better understanding of the tribal jurisdiction boundaries. Questions posed to him included why the official South Dakota State Highway map from 2003 did not include the Yankton Reservation in Charles Mix, or the Sisseton-Wahpeton Reservation in the northeast portion of the state. He directed CATS to additional contacts at the Great Plains Regional Bureau of Indian Affairs (BIA) Branch of Roads, who never responded to a voice message, and the Indian Health Service (IHS) and the Great Plains Region IHS, Aberdeen, SD, Environmental Health Injury Specialist, Mr. John Weaver.

In a telephone conversation with Mr. Weaver, he indicated that every reservation has a different method for handling the crash reports that they file. Some reservations have electronic systems while others literally have boxes full of paper reports. To actually compare the tribal records to the state records, in his opinion, would be a very laborious and time intensive task. He conveyed that North Dakota is in the process of doing such a task, and preliminary findings suggest about a 60 percent discrepancy between tribal crash reports and state crash reports. It was his perception that within South Dakota, Rosebud and Pine Ridge have the best internal crash systems. He also communicated that maps might differ from each other because some might reflect initially closed federal reservation boundaries, but many of the lands were sold off to other communities, thereby reducing the boundaries (some disappeared altogether). However, even without technical federal reservation boundaries, there are still areas extending beyond federal reservation boundaries that tribes serve. Tribal service areas are a nebulous concept and refer to whether the majority of the population residing in those areas is serviced by certain hospitals. As one example, the present day reservation boundaries of Rosebud are the same as Todd County boundaries; but this tribe serves a population all the way out to Gregory County. When asked who would have jurisdiction in the service areas, Mr. Weaver said it probably varied. He also reported that, in general, a lot of the issues were complicated political struggles. For example, he knew from his experience that people from Rosebud and Pine Ridge frequently would not let state troopers investigate crashes on state roads going through their official reservation boundaries. In addition, depending on the reservation, it might be mixed as to what degree tribal police would dispute state troopers on crashes that occur on state roads that cross through their official boundaries. Mr. Weaver reported that the Sisseton-Wahpeton reservation and Yankton reservation no longer had official boundaries and the tribe had scattered "checkerboard" jurisdictions. He suspected the state and county might handle the majority of the crashes in these areas, but he did not know for certain.

John Weaver gave CATS the contact information for Charles Red Crow, Rosebud chief of police. He reported that they have a very organized internal electronic crash system and they publish a crash book (CATS obtained a copy for 2004). He said that if there is a crash in their jurisdiction, a patrol officer is assigned to a preliminary investigation, and if the officer needs help, the Highway Safety Division will be called in. Chief Red Crow also informed CATS that Rosebud boundaries were not just limited to Todd County, but rather extended into Mellette, Tripp, Gregory, Todd, and Lyman, but were arranged in checkerboard jurisdictions throughout these counties. When questioned as to how crashes were investigated in these jurisdictions, Chief Red Crow reported that there were official agreements with the respective sheriff's departments about jurisdictions. They have a wall-sized map that designates every roadway as to whether they have jurisdiction or not. Additionally, he stated that even if a crash happens on a road that they do have jurisdiction over, they still do not investigate the crash if it is a non-Indian victim. They have to have jurisdiction over both the roadway and the victim. If both criteria are met, the crash is handled within their system; if not, the Todd County Sheriff's Department might be called in. Specifically, Chief Red Crow confirmed that they do have jurisdiction over US Highways 18 and 83. In the Rosebud Sioux 2004 Traffic Crash Information publication, it is confirmed that information on fatal vehicle crashes occurring on the Rosebud Reservation is shared with the state of South Dakota, and in *some cases,* crashes involving property damage over $1,000 are shared with the state.

A member of the Charles Mix County Sheriff's Department was also phoned, and he reported that CATS would be better talking to someone who was more aware of the situation. He hypothesized there was probably an official map that outlined jurisdictions, and it was his perception that tribal police had to have jurisdiction both over the person and roadway. He also reported that it was his opinion that the process seemed a bit undefined, citing an example of a traffic crash the prior week in which both units showed up and his officers were informed that it was tribal land and they left. He suggested that CATS call the local BIA office to ask if they had such maps, but no one ever responded to the messages that were left.

Email correspondence with a member of the Roberts County Sheriff's Department confirmed that the Sisseton Wahpeton reservation is considered a former reservation and no longer exists. The original boundaries were disbanded several years ago. However, there are checkerboard jurisdictions because the tribe still owns land within the county even though the reservation is not closed. This means that tribal police have jurisdiction only on tribal land, and if it involves a tribal member. Most of the time when a fatal crash occurs within the state's jurisdiction the Highway Patrol takes the lead on the investigation. If the crash occurs on tribal land, the BIA Investigator heads it up, but the Roberts County employee did not know if tribal authorities reported their crashes to the state.

The correspondence with sheriff's department personnel and people who work with members of the tribes clearly reveal a complicated situation in terms of estimating and defining for the entire state of South Dakota precisely where all the "holes" are within the database, as tribal jurisdictions are frequently checkerboard throughout the counties of South Dakota. Furthermore, if boundaries can be mapped out throughout the entire state, it seems there might be additional political struggles that might not even guarantee with any certainty what happens in practice. The results of CATS' information gathering in this area clearly reveals that South Dakota's problem identification is severely compromised; additionally, there is no definitive way to know for certain where the crashes might be missing and to what degree; pursuing this effort alone would be an entire research project.

Project Setback 4: Direct State-to-State Comparisons Limited Due to Reporting Unknowns

Comparisons to other states are severely compromised as well. Even if CATS had been able to obtain complete databases from all six states, state-to-state comparisons would be suspect at best due to the unknowns surrounding Native American reporting procedures, according to those states that responded to the survey. As one example, a state employee from North Dakota responded to the survey on Native American crash investigation and reported that all crashes over $1,000 damage and/or involving bodily harm must be reported within ten days of the crash. However, crashes investigated by the BIA do not fall under the authority of the North Dakota Century Code, so they are received voluntarily. The information is not very complete, and at times the North Dakota staff has difficulty accessing the fatal crash report information. The numbers reported to NHTSA and FHWA include what they receive in their office. The respondent did say he was "fairly confident" in the information in FARS, but not very confident in the completeness of the non-fatal crash information from tribal lands.

A state employee from Wyoming reported that they request that the BIA law enforcement agencies submit a Police Accident Report for any crash that meets the State requirements of $1,000, injury, or death. However, the BIA agencies do not always submit the PARs to their office and if so it is generally months if not a year after the crash. The Wyoming respondent said the state is currently working with the BIA to get reports on a timely basis, and in exchange, provide them with useful crash statistics. The numbers that Wyoming reports to NHTSA and FHWA include crashes that occurred on Native American lands if the state receives a copy of the report.

Montana's Traffic Safety Problem Identification for 2006, notes that: "Most law enforcement agencies submit crash reports. The exception is that few crash reports are received from reservation law enforcement." In a report titled, "Traffic Accident Reporting on Indian Reservations in Montana

(TARS)," prepared by Cordell Ringel in 2003, it is stated that "….traffic accident reports investigated by Tribal and BIA Police seldom get forwarded to the Montana Highway Patrol for inclusion in the statewide statistics and traffic analysis."

Obviously, there is absolutely no way to quantify to what extent states are missing this information. In addition, even if every state received the exact same percentage of crash reports investigated by tribal authorities and the BIA, comparisons would be severely hampered due to the fact that some states would simply have differing percentages of their crashes falling under these jurisdictions due to their tribal populations.

Additionally, direct comparisons to other states would be limited due to reasons other than the suspected underreporting of records of Native American crashes. Differences in reporting thresholds, and drill-down analyses at the level of the county could not even be made confidently as hoped. Even when county registration, VMT, licensed driver data, etc. were obtained, they were in different formats. Some states didn't include motorcycles in their registration data while others did, and there were so many unknowns surrounding the validity and consistency of all these databases, state-to-state comparisons at the level of the county must be made with caution if this information is utilized. Finally, even FARS state-to-state comparisons are additionally disadvantaged due to unknowns surrounding completeness because the FARS analyst survey was terminated. Most states do seem to declare more confidence in the completeness of their fatal data, at least slightly justifying FARS comparisons over other crashes in terms of the Native American crash reporting sufficiency. However, there are still unknowns as far as coding consistency. As an example, an April 2004 NHTSA technical report makes the following notation regarding the "on reservation" crashes coded in the "special jurisdiction" variable: "…this designation is made at the state level and could in some cases conflict with Indian Reservations that are recognized by the Federal government. Cases could conceivably be classified as having occurred on a federal reservation when in fact, it occurred on a reservation that is recognized only on the state level." (Poindexter, 2004, p. 4)

An attempt was made to obtain the reporting threshold and degree of comprehensiveness of fatal crash data, particularly those occurring on reservation lands and/or involving Native Americans. While CATS was successful in obtaining readily available state and federal reports and documents, actual FARS data collection validations from South Dakota or comparison states (Montana, Nevada, New Mexico, North Dakota, Utah, and Wyoming) were not available for inclusion in this project. Specifically, CATS obtained the full FARS dataset for South Dakota and the comparison states for 1994-2003, but could not gain access to the methodology these states observe in compiling or subsequently coding the data, nor an understanding of researcher confidence in the degree of completeness of same. In other words, the fatal crash records as reported by FARS must be considered "complete" and similarly meaningful from state to state (presumed to be interpreted exactly the same despite levity within each state on the meaning or intent of variables), with no consideration given to accounting for or estimating those crashes that occurred on sovereign Indian land and thereby are considered exempt. Clearly this wielded a tremendous blow to the validation process of this project in that the research group could not determine with certainty the root cause for South Dakota's higher rate of crashes and fatalities compared to other states (*i.e.*, does South Dakota actually experience a higher number of crashes compared to other states, or does South Dakota do a better job of obtaining and reporting their motor vehicle crash incidence?).

In summary, both South Dakota's analysis and state-to-state comparisons were severely compromised. CATS made plans to proceed with the project by providing state-to-state comparisons based on FARS data alone, unfortunately, and without insight or claims made as to data consistency, validity, or completeness. Areas in which South Dakota was revealed to have particular problems comparatively were pursued within their complete state crash database, unfortunately with no assumptions made regarding the completeness of this database. Originally, CATS had planned to provide performance measures on which South Dakota and the counties within the state could be scored and viewed in the form of Excel tables and a software visualization tool in order to aid the state in measuring and identifying problems locally. However, the project setbacks led CATS to instead plan to provide the county rankings using a county-by-county three-tiered stratification methodology based upon urban, rural, and Native American county groupings. The purpose of the groupings was to attempt to identify those counties with particularly high Native American populations and note them as particularly untrustworthy in their rankings, obviously compromising the intended purpose of the rankings. Additionally, CATS made plans to produce a statistical underreporting model of the degree of underreporting in these counties, in order to provide the South Dakota DOT with justification to engage in further investigations of crash reporting methods in these areas and to provide them with a ballpark idea of how many crashes they could potentially be missing. However, significant information was gleaned from the data available, even if all of the original research questions could not be answered with full confidence.

3.3 Completion of Revised Research Objectives

As discussed above, throughout the course of the research, major hindrances to accomplishing the project objectives were identified. As a result, the project scope, research objectives, and research tasks underwent a minor formal revision in November 2004, and the researchers were given the charge of documenting additional barriers to completing research objectives and tasks. The revised research objectives and a summary of the degree to which each could or could not be completed are presented immediately following.

1. *Identify differences in driver behavior, driver safety education, traffic law governance, and roadway characteristics at similar states that could contribute to higher accident and fatality rates in South Dakota.*

Analysis was limited to fatal data, which led to sample sizes considerably smaller than if all crashes were used. An incomplete picture was thus created, and it was also identified that several of the peer states did not report fatality rates that were any lower than South Dakota's. However, with the information available, CATS did identify six apparent South Dakota traffic safety problem areas that were discussed in light of pertinent information pertaining to driver behavior, driver safety education, traffic law governance, roadway characteristics, and traffic records.

2. *Develop baseline measures, supported through analysis of other states' efforts to successfully lower accident and fatality rates that can ultimately be used to gauge the effectiveness of South Dakota's impending efforts to improve roadway safety.*

Once again, the development of baseline measures was hindered due to the incompleteness of data and potentials problems with direct state to state comparisons. If South Dakota strives to improve the completeness of their traffic records, baseline measures would reflect changes in crash records, not necessarily improvements in roadway safety. However, performance measures and benchmarking tools such as Stratified County Rankings tables were developed to assist in this evaluation and better enable program managers to develop specific counter-measure programs to fit the needs of the locales. Indices pertaining to each of the traffic safety focus areas are included in the County Rankings tables and County Rankings Visualization Tool, and those counties suspected to have the largest degree of missing data have been placed in separate strata. A detailed explanation of the various indices contained with the ranking is included as Appendix D. Along with a score for each index, a rate of change in the score has also been computed for each so that improvement versus deterioration in the score can be measured. Each table divides the 66 counties in South Dakota into three categories– Urban, Rural, and Native American. Rather than using results from a single year, the results have been calculated using data from the most recent three years available (2001-2003), data from 2000-2002, and data from 1999-2001 (resulting in three data points that represent three different three-year moving averages).

Another tool that was utilized is the Yearly Municipality Crash Data Reports. This report was modified to meet South Dakota's specific demographics to provide a comprehensive view of county-by-county crash data. The final product reports the results based upon each county's largest municipalities, with the remaining crashes grouped into a rural category. Costs were calculated based upon total crashes and alcohol-related crashes, with the corresponding economic losses associated with each type of crash severity (the number of fatalities X $916,019.00, the number of personal injuries X $18,634.30, and the number of vehicles involved in property damage crashes X $1,951.61), along with the percent of the total represented by each municipality. Historically, economic losses have been calculated based upon the NHTSA model of estimated crash costs and are adjusted each year for economic inflation.

3. Formulate a plan that utilizes the baseline measures to develop a prioritized set of alternatives, including estimates of costs and benefits for each alternative that is aimed at reducing accident and fatality rates in South Dakota.

CATS formulated a series of recommendations pertaining to each of the identified focus areas. However, specifics of costs and benefits were obviously more difficult to assess due to the unknowns surrounding the actual completeness of data.

CHAPTER 4: RESEARCH TASKS

4.1 ORIGINAL RESEARCH TASKS

In the original request for research proposal, the research tasks were defined as follows:

1. Meet with the project's Technical Panel to review the project scope and work plan.
2. Review all material furnished by the project's Technical Panel related to South Dakota traffic crashes and fatalities, with an emphasis on identifying factors that can be correlated to high crash and fatality rates.
3. Review crash and fatality statistics from a minimum of six comparable states with an emphasis on identifying factors that may contribute to crash and fatality rates significantly different from South Dakota's.
4. Compare the crash and fatality reporting practices of South Dakota to the other states reviewed (particularly within FARS reporting), note any discrepancies, and determine the ultimate significance of those discrepancies on the reported crash and fatality rates.
5. Analyze the factors identified in the previous tasks and propose, for review and approval of the Technical Panel, corresponding performance measures that can be used for benchmark comparison with the comparable states, and also used to track South Dakota's future progress and effectiveness in addressing crash and fatality rates.
6. Upon approval of the Technical Panel, compare South Dakota's measures to those from other states, and also identify and prioritize those factors that significantly affect reported crash and fatality rates.
7. Based on feedback and approval of the prioritized listing by the Technical Panel, develop a plan that recommends focus areas with anticipated resource allocations and allocation estimates, and also includes implementation costs, benefits, and ongoing support requirements for reducing crash and fatality rates in South Dakota.
8. Upon review and approval of the plan to reduce crash and fatality rates in South Dakota, prepare a final report and executive summary of the research methodology, findings, conclusions, and recommendations.
9. Make an executive presentation to the SDDOT Research Review Board at the conclusion of the project.

4.2 Completion of Revised Research Tasks

As discussed in chapter 3, throughout the course of the research, major hindrances to accomplishing the project tasks were identified. As a result, the project scope, research objectives, and research tasks underwent a minor formal revision in November 2004, and the researchers were given the charge of documenting additional barriers to completing research objectives and tasks. The revised research tasks and a summary of the degree to which each could or could not be completed is presented immediately following.

1. *Meet with the project's Technical Panel to review the project scope and work plan.*

Two members of the research team traveled to South Dakota March 7-10, 2004, and finalized the research approach and determined a plan of action to acquire the missing data elements needed for project completion.

2. *Review all relevant material furnished by the project's Technical Panel related to South Dakota traffic accidents and traffic fatalities, with an emphasis on pinpointing and analyzing any factors that are deemed to adversely affect the corresponding accident and fatality rates.*

During the initial meeting with the technical panel, it was discovered that South Dakota does not receive complete crash reporting from the nine reservations. Moreover, only fatal crash reports are required to be submitted by the reservations, but the degree of accuracy and compliance with FARS desk and state protocols is questionable. Lastly, tentative arrangements to supply CATS with the SD crash database from 1998-2003 were discussed, but this had to remain on hold until the state legal department provided authorization/approval for CATS to receive the database. The submission of the actual database followed approximately six weeks afterward.

3. *Review accident and fatality statistics from a minimum of six other states that have similar traffic safety concerns to South Dakota with an emphasis on pinpointing and analyzing any factors that appear to be contributing to significantly higher, or lower accident and fatality rates than South Dakota's.*

This task was partially completed within the boundaries of the comparison states' FARS data (limited to fatal crashes only). The six comparison states were chosen during the kick-off meeting with the Technical Panel and consisted of: Montana, Nevada, New Mexico, North Dakota, Utah, and Wyoming. These states were selected for their higher population percentages among Native Americans, their similarities in topography, their advances in highway safety, and for some, the proximity to South Dakota. Multiple attempts to obtain complete crash datasets from the comparison states yielded no to only partial success. Specifically, complete crash data was not available from Montana and North Dakota. Other data sources requested and/or acquired include licensed drivers by age and county, motor vehicle registrations by county, vehicle miles traveled by county and road class, and population. Again, some of these resources were unavailable to the degree of specificity desired for unlimited analysis purposes, but it became too late in the grant process to select alternative states in hopes of obtaining crash reports and supplemental data resources from the alternative states.

4. *Review traffic accident data collection and reporting practices across representative Indian Reservation jurisdictions, describe the extent of reporting omissions, assess the overall impact of having to omit these areas, and prepare recommendations for an approach to help alleviate this situation in future years. The impacts of these omissions will also need to be considered, quantified, and noted throughout all work efforts of this particular study.*

This task could not be completed within the confines specified in this study Exhaustive attempts to acquire the necessary information yielded little to no results. In order to aid in the completion of this task, a questionnaire that covered all of these issues was created early in the research phase for submission to each Indian tribe, but the SDDOT deemed it to be outside the scope of the original project and did not want to risk alienating tribal governments at the time. Thus, these specifics will never be known unless an entire project focused on state-tribal relations and an investigation of each tribe's specific reporting practices is undertaken. However, CATS did pursue the development of an underreporting tool that provides a rough estimate at a county level of the extent of missing data in counties with large Native American populations. Complete Indian Reservation crash data was unavailable for this study, thereby rendering this task well beyond the scope of accessibility at the present time. Appropriate discussion and conclusions detailing the efforts expended and results obtained are included in this report.

5. *Compare the accident and fatality reporting practices of South Dakota to the other states reviewed (particularly within FARS reporting), note any discrepancies in the comparative data collection or reports, and determine the ultimate significance of those discrepancies in the reporting schemes.*

An attempt to contact each of the comparison states' FARS desk representatives to obtain specifics on FARS data collection process was intercepted by the national coordinator. Specifically, CATS submitted a brief questionnaire to the FARS desks requesting an assessment of their data collection procedures and how they interpret the variables collected, particularly with regard to Native Americans and the coding of Special Jurisdiction as (3), Indian Reservation. CATS was advised that the FARS desk personnel are not available to provide analysis or respond to opinion questions, and cannot respond to data requests without receiving prior approval from the national office. As a result of this, CATS could only provide analysis of the data based upon its intended merit, without any additional insight into how each state views its reliability, validity, or degree of comprehensiveness.

For non-fatal data collection in each state, the true extent of underreporting (particularly for reservation areas) also cannot be quantified and is simply unknown. However, CATS was able to provide some subjective qualitative anecdotes from state employees that provide evidence for the fact that there is reason to suspect underreporting in some of the comparison states along with sufficient differences in reporting practices to make direct comparisons potentially unreliable.

6. *Using the factors that emerge from the previous tasks as seeming to contribute to accident and fatality rates in South Dakota that are considerably removed from the norm, compile baseline measures that can be used to gauge each factor's contributory significance relative to higher accident and fatality rates.*

This task was completed within the limitations of the available data, with significant limitations regarding Native American crashes and fatalities. Specifically, the key factors that were identified based upon the 1998-2003 crash data that was made available consisted of:

- Underreporting
- Rollover Crashes
- Restraint Use
- Alcohol
- Speeding
- Young Drivers

The issue of underreporting is not actually a contributing factor to South Dakota's fatal crashes and fatalities, but it does interfere with the analyses and conclusions drawn due to the unknown quantity of missing data and the impact that is experienced in managing the state's highway safety plan. While the five remaining indices are prominent within the crash data that was provided, with an unknown number of personal injury and property damage crashes yet to be factored into the calculations, the possibility exists that the degree of severity of some or all of these indices could change.

The Stratified County Rankings were designed to clearly pinpoint the principle areas of concern within a state. However, with the 12 top Native American counties by population moderately to severely lacking in reported personal injury and property damage crashes, the remaining fatal crashes/fatalities are not large enough in number from county to county to produce meaningful rates and projections. To accommodate for the small numbers present in crash and fatality rates, an Underreporting Prediction Tool was created to estimate the relationship between the number of traffic crashes and representative predictor variables for the local traffic flow in each county via an appropriate model which describes how the relationship will be built.

7. *Propose and present the baseline measures, along with documentation that clearly positions each factor deemed to contribute to higher accident and fatality rates in South Dakota, for review and approval of the Technical Panel.*

This task was completed within the limitations of the available data, with significant limitations regarding Native American crashes and fatalities. The baseline measures for factors two through five are heavily dependent upon the successful resolution of factor one—Underreporting. Without a much more in-depth and comprehensive county-by-county crash record database that accurately reflects the nature of motor vehicle crashes within the state of South Dakota, meaningful, reliable baseline measures cannot be completed. The crash record deficiencies are primarily located within those counties that have a larger percentage of Native Americans by population.

8. *Upon final approval of the baseline measures by the Technical Panel, develop a prioritized list of factors that advances from the measures according to each factor's contribution to higher accident and fatality rates in South Dakota.*

This task was completed within the limitations of the available data, with significant limitations regarding Native American crashes and fatalities.

9. *Based on feedback and concurrence of the Technical Panel on the prioritized listing, develop a plan for reducing accident and fatality rates in South Dakota that includes recommended focus areas, resource allocations, levels of commitment, and on-going support requirements.*

This task was completed for each focus area to the *degree* of confidence that was available due to the limitation of the missing data.

10. *Upon review and approval of the plan to reduce accident and fatality rates in South Dakota, develop estimates for plan implementation costs, benefits, and any impacts to involved state government agencies.*

This task likewise was significantly hampered with regard to the estimations to implement a traffic safety plan that includes sharing and disclosure of crashes and fatalities involving Native Americans.

11. *Prepare a final report and executive summary of the reviews of South Dakota accident & fatality rates, other state accident & fatality rates, research methodology, findings, conclusions, and recommendations.*

The draft final report and executive summary were submitted on October 24, 2005. Clearly, the conclusions and recommendations generated from this research included a specific focus on creating and improving the crash reporting structure.

12. *Make an executive presentation to the SDDOT Research Review Board at the conclusion of the project.*

This took place on September 21-22, 2005.

CHAPTER 5: KEY FINDINGS AND CONCLUSIONS

5.1 PEER STATE FATALITY RATES

Immediately following is a general introduction to traffic fatality rates in South Dakota versus the six selected comparison states and the nation. The following tables and figures represent fatality rates over the past ten years.

Table 1. Fatality Rate per 100 Thousand Population

Year	Montana	Nevada	New Mexico	North Dakota	South Dakota	Utah	Wyoming	USA
1994	23.63	20.19	27.04	13.76	21.30	17.77	30.32	15.64
1995	24.75	20.51	28.83	11.53	21.70	16.44	35.53	15.91
1996	22.81	21.80	28.43	13.22	23.95	15.87	29.79	15.86
1997	30.16	20.71	28.09	16.38	20.25	17.72	28.54	15.69
1998	26.95	20.70	24.46	14.42	22.58	16.66	32.08	15.36
1999	24.92	19.35	26.44	18.78	20.46	16.90	39.41	15.30
2000	26.23	16.00	23.71	13.41	22.89	16.63	30.76	14.86
2001	25.40	14.97	25.34	16.50	22.55	12.77	37.67	14.80
2002	29.55	17.58	24.24	15.30	23.67	14.15	35.28	14.93
2003	28.54	16.41	23.37	16.58	26.54	13.14	32.86	14.66

Figure 1. Fatality Rate per 100 Thousand Population

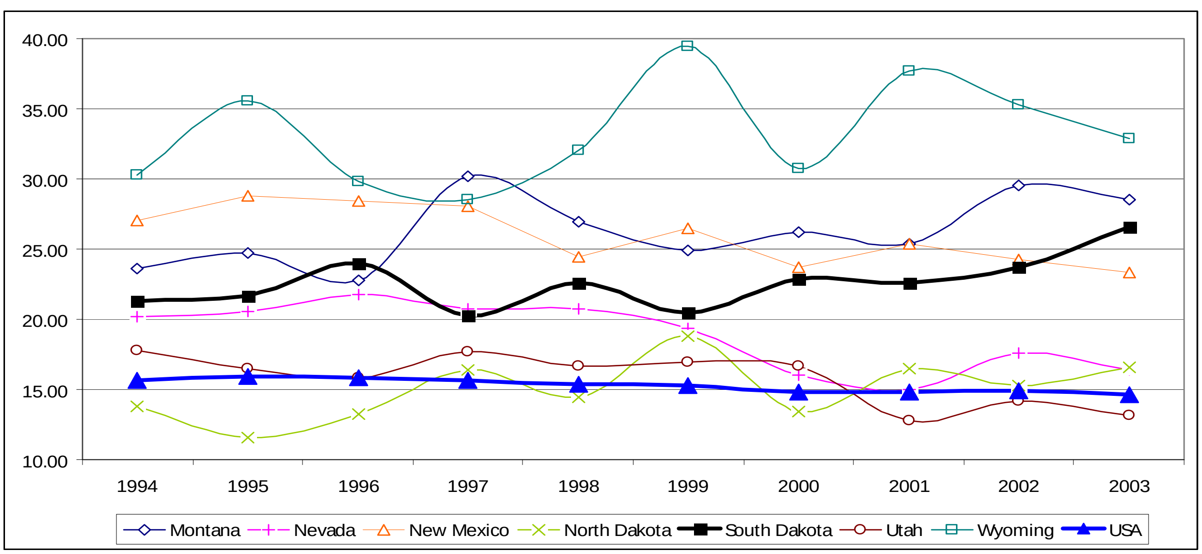
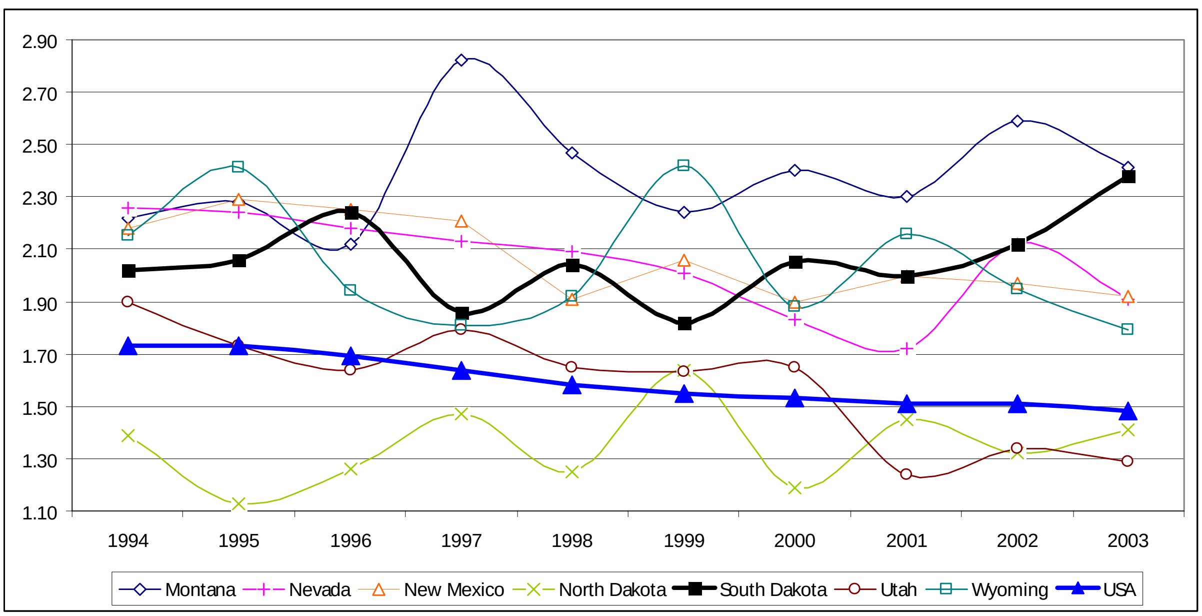


Table 2. Fatality Rate per 100 Million VMT

Year	Montana	Nevada	New Mexico	North Dakota	South Dakota	Utah	Wyoming	USA
1994	2.22	2.26	2.18	1.39	2.02	1.90	2.15	1.73
1995	2.28	2.24	2.29	1.13	2.06	1.73	2.41	1.73
1996	2.12	2.18	2.25	1.26	2.24	1.64	1.94	1.69
1997	2.82	2.13	2.21	1.47	1.86	1.79	1.81	1.64
1998	2.47	2.09	1.91	1.25	2.04	1.65	1.92	1.58
1999	2.24	2.01	2.06	1.64	1.82	1.63	2.42	1.55
2000	2.40	1.83	1.90	1.19	2.05	1.65	1.88	1.53
2001	2.30	1.72	2.00	1.45	2.00	1.24	2.16	1.51
2002	2.59	2.12	1.97	1.32	2.12	1.34	1.95	1.51
2003	2.41	1.91	1.92	1.41	2.38	1.29	1.79	1.48

Figure 2. Fatality Rate per 100 Million VMT



When considered per 100 million vehicle miles traveled, over the past ten years North Dakota and Utah are the only selected peer states to drop below the national fatality rate, and Montana consistently has the highest fatality rate. When considered per 100 thousand population, North Dakota and Utah are again the only selected peer states to drop below the national fatality rate, and Wyoming consistently has the highest fatality rate (Wyoming averages more vehicle miles traveled per capita than any of the selected comparison states). Of particular concern is that while the United States has demonstrated a downward trend, South Dakota has demonstrated an upward trend in recent years and was second only to Montana in 2003 in terms of fatalities per vehicle mile traveled. Assuming that data from the Fatality Analysis Reporting system is viewed as complete and reliable, Utah and North Dakota necessarily emerge as model peer states while Wyoming and Montana emerge as states with particularly high fatality rates.

Fatality rates also need to be considered in light of key differences in rural versus urban profiles of the selected states. In 2003, 74.9 percent of the United States population was classified as urban. In South Dakota, only 45.8 percent of the population was classified as urban, the lowest for any of the selected peer states. Montana followed as the second lowest with 47.3 percent. Utah was at a level of 82.8 percent, so one can expect the traffic climate and challenges facing Utah (and Nevada) to be distinctly different from the other selected peer states. Similarly, when vehicle miles of travel are examined, in 2003 South Dakota had the highest percentage of all VMTs classified as rural (77.2 percent) while Utah and Nevada were much closer to the national average of 37.5 percent (36.3 percent and 31.0 percent, respectively). Again, Montana was second to South Dakota with 76.4 percent of all VMTs classified as rural.

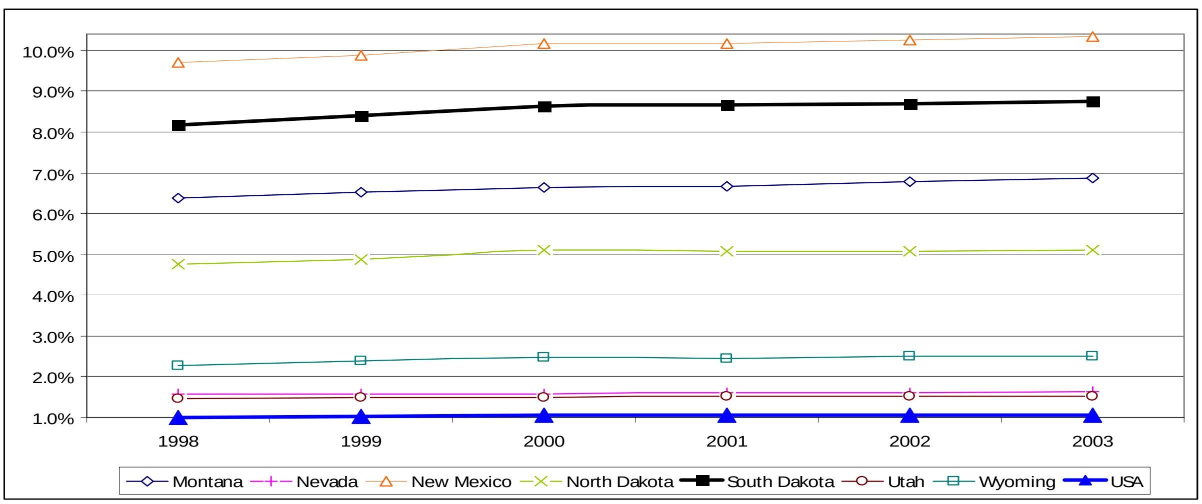
Immediately following is a summary of the six key findings and conclusions that resulted from the assessment and investigation of factors contributing to South Dakota and peer state fatality rates. The six main focus areas are areas that the researchers have either identified as critical contributing factors to South Dakota's crash and fatality rates, or as traffic records areas that need to be addressed in order to accurately assess and monitor factors contributing to South Dakota's crash and fatality rates, as compared to the chosen peer states.

5.2 South Dakota Focus Area 1: Underreporting of Native American Crashes

As described in chapter 3, the scope of the project was drastically shifted due to the recognition of the fact that South Dakota is missing a substantial number of its traffic crashes. The original goal of assessing contributing factors to crash and fatality rates in South Dakota as compared to peer states were severely compromised due to the fact that fully quantifying and assessing to what degree each state and South Dakota might be missing its crashes was well outside the scope and time frame of the current project. Additionally, the researchers discovered that nowhere in South Dakota's Highway Safety Plan or South Dakota's Motor Vehicle Traffic Crash Summary publications is it acknowledged that South Dakota does not have a complete picture of its traffic crashes statewide. The need to investigate, document, and quantify the degree to which this hole is a substantial traffic records concern for the state became readily apparent. As a result, it was determined that the project focus and scope should be shifted and the underreporting of Native American Crashes, while not a factor contributing to fatality rates in and of itself, should be identified and highlighted as a separate key project finding and focus area. Without accurate and complete traffic records, factors contributing to crash and fatality rates can never be fully studied or monitored for future progress, and there is apparently no formal acknowledgement of this fact at the statewide level or in the South Dakota Highway Safety Plan. Additionally, the underreporting of Native American Crashes in particular is of substantial noteworthiness due to the fact that the Native American population has a fatality rate that is higher than that of the rest of the state.

As discussed in chapter 3, responses to surveys by other states indicate that this problem is not unique to South Dakota. However, the underreporting of Native American Crashes is of particular concern to South Dakota when the Native American population in each state is considered. All comparison states have a Native American population that is above the national average, but South Dakota is second only to New Mexico. As a result, when compared to most of the selected peer states, South Dakota would be expected to have a higher proportion of its traffic crashes unreported due to the size of its Native American population.

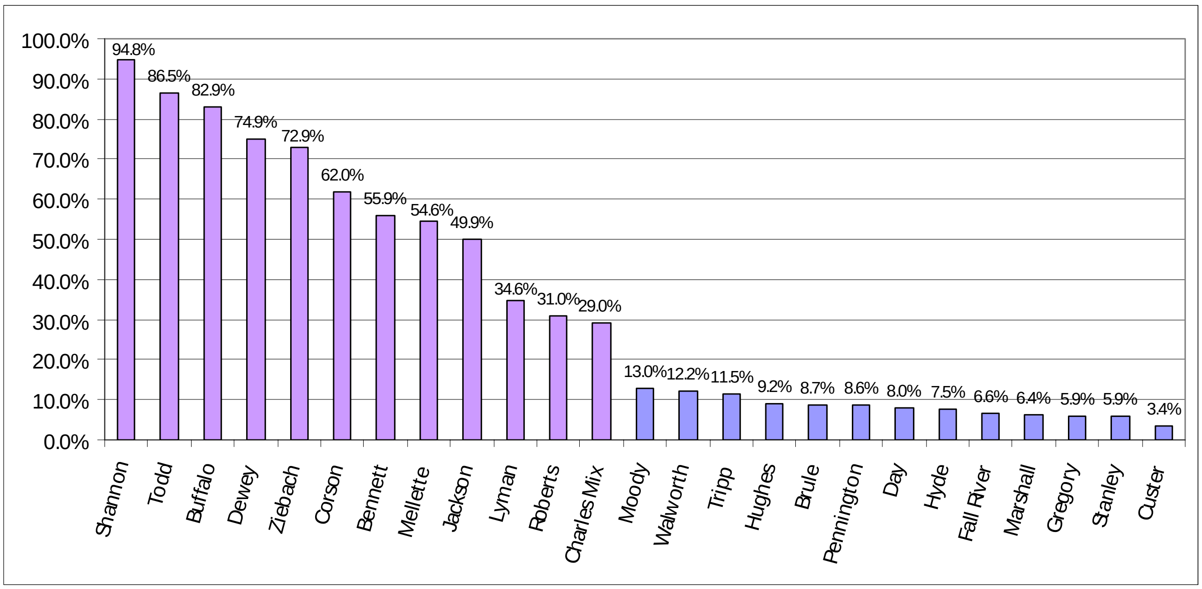
Figure 3. Percentage of Population Native American/Alaska Native



Given that South Dakota is expected to have a particular problem with regards to missing crashes, an investigation into the potential impact of this omission was undertaken. First, in an effort to approach the nine holes in the state at a statewide level, there needed to be a straightforward way to classify the approximately 18,000 crashes each year into one of two categories: those taking place on a roadway segment that was suspected to have total crashes underreported due to being under Native American jurisdiction, and those taking place on a roadway segment suspected to have the majority of its crashes reported. Tribal law enforcement has to have jurisdiction both over the roadway and the individual to investigate the crash. As a result, one would expect there to be records of crashes involving non-native individuals in the state crash system from areas under Native American jurisdiction. With approximately 18,000 crashes appearing in the state database annually, these crashes could only be easily located and categorized by jurisdiction if there was a variable in the database that indicated the reporting jurisdiction of the crash location. In the face of not having such a variable available, the problem was inspected at a more broad level–that of the county.

In an effort to attempt to locate South Dakota's crashes with respect to the potential crash reporting holes in the state, South Dakota's 66 counties were ranked according to the overall percentage of the population that was American Indian or Alaskan Native between 1998 and 2003. The results for the top 25 counties appear in Figure 4 below.

Figure 4. Top 25 SD Counties by Native American/Alaska Native Population, 1998-2003



Between 1998-2003, there was a natural breaking point in the makeup of the population for each county. There were only 12 counties that had an estimated population that was 29.0 percent or higher American Indian or Alaska Native: Bennett, Buffalo, Charles Mix, Corson, Dewey, Jackson, Lyman, Mellette, Roberts, Shannon, Todd, and Ziebach. (Shannon County has the largest Native American population at 94.8 percent, and Charles Mix has the lowest, at 29.0 percent.) After Charles Mix, the next lowest county in South Dakota is Moody (only 13.0 percent Native American). The state average is 8.6 percent. These 12 counties can be identified as those that would be suspected to suffer from the *largest* degree of underreporting. Figure 5 depicts original official closed reservation boundaries in South Dakota as compiled by the Bureau of Indian Affairs. The researchers have slightly modified this map by inserting reservation names along with the county names of those 12 counties that have been classified as "Native American." Figure 6 presents the present day reduced reservation boundaries made available online by the South Dakota Department of Transportation. As these reduced boundary maps are examined, one should note, however, that as described in chapter 3 tribes have checkerboard jurisdiction on lands that are still owned and served by the tribe in areas that extend beyond the present day reduced closed reservation boundaries.

Figure 5. Original South Dakota Reservation Boundaries and 12 Counties with the Largest Native American Population (Boundaries Compiled by the BIA from Unknown Sources)

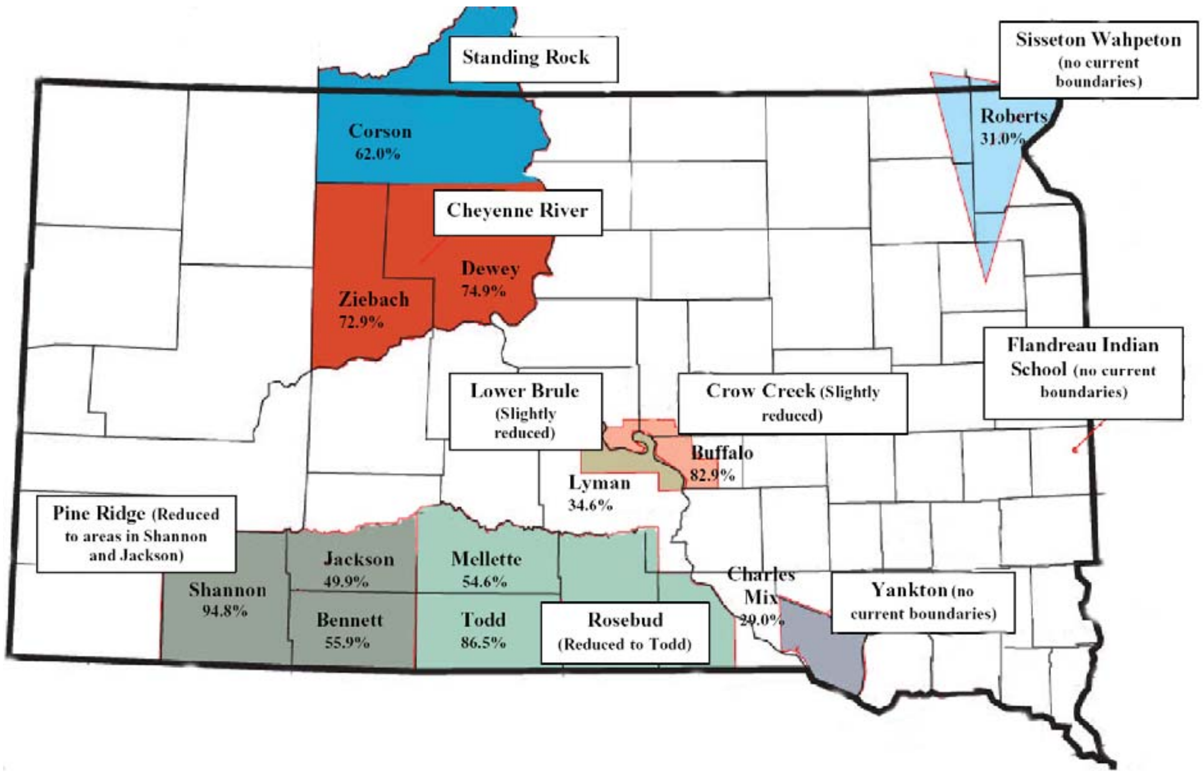
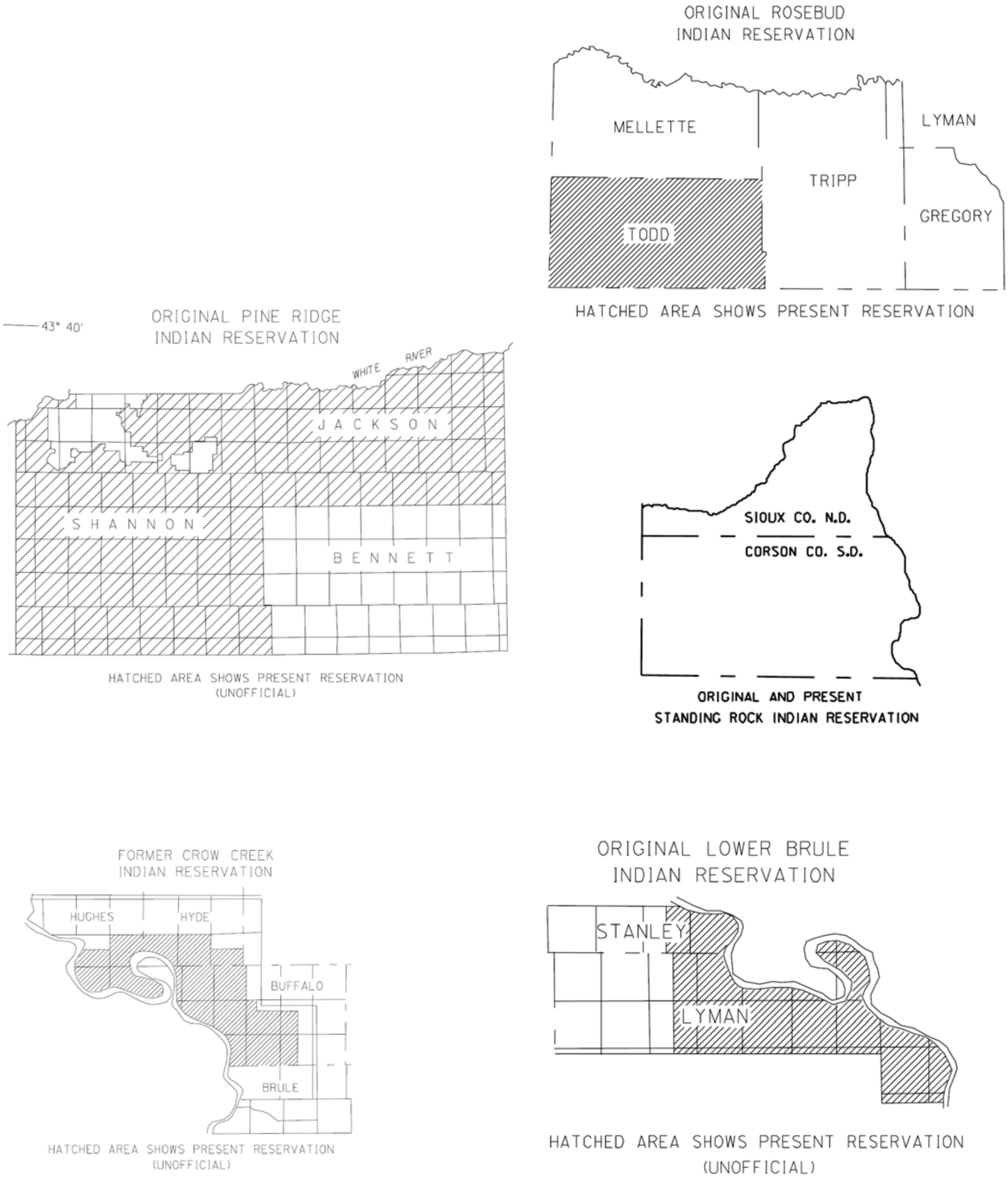


Figure 6. Present Day Reduced Closed Reservation Boundaries (South Dakota-DOT)



In order to use the South Dakota Crash Database to estimate the degree of the underreporting problem, crashes were investigated at the level of the county, keeping in mind that the 12 identified "Native American" counties are suspected to suffer from the largest degree of underreporting. It is believed that South Dakota has fairly complete fatal crash data from Native American jurisdictions, yet fairly incomplete injury and property damage data. When all 66 South Dakota counties are ranked according to the percentage of all reported crashes between 1998 and 2003 classified as fatal, all twelve Native American counties appear in the top 20 counties.

Table 3. 1998-2003 South Dakota Percentage of all Reported Crashes Fatal, Top 20 Counties

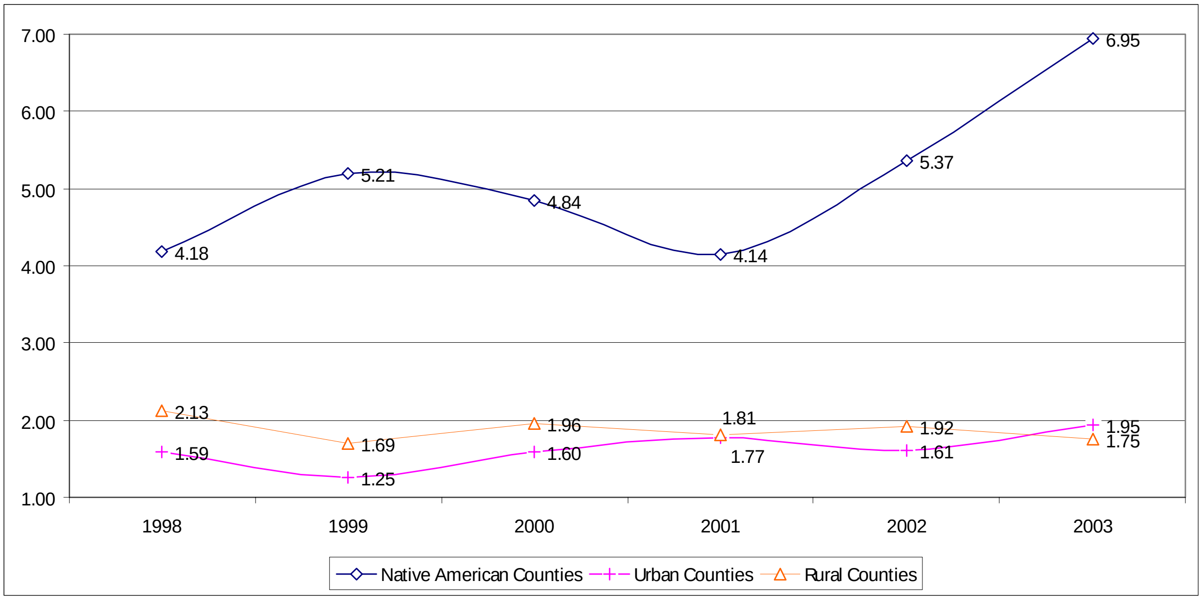
County	Total	Fatal	% Fatal
TODD	80	40	50.0%
SHANNON	363	51	14.0%
BENNETT	92	11	12.0%
MELLETTE	149	16	10.7%
BUFFALO	130	9	6.9%
CORSON	388	18	4.6%
MCPHERSON	103	4	3.9%
ZIEBACH	162	5	3.1%
HARDING	238	7	2.9%
ROBERTS	991	29	2.9%
GREGORY	360	10	2.8%
DEWEY	340	9	2.6%
DOUGLAS	227	6	2.6%
HUTCHINSON	606	14	2.3%
JACKSON	698	16	2.3%
CHARLES MIX	737	16	2.2%
SULLY	284	6	2.1%
LYMAN	984	18	1.8%
DAY	626	11	1.8%
FALL RIVER	864	15	1.7%
STATEWIDE TOTAL	112,281	921	0.8%

In fact, between 1998 and 2003 in Todd County, there were 80 total reported crashes and 50.0 percent of them were fatal. The statewide rate was a mere 0.8 percent. Clearly, this does not appear to be an accurate picture of the crash environment in Todd County and there appear to be a substantial number of nonfatal crashes missing from the crash database. Of larger concern is the fact that these 12 counties represent 25.8 percent of the state's total reported fatal crashes, but only 4.4 percent of the state's total reported nonfatal crashes. Additionally, for all fatal crashes filed within these 12 counties, 37.0 percent were filed by the BIA or the Tribal Police. However, for all nonfatal crashes filed within these 12 counties, only 9.5 percent were filed by the BIA or the Tribal Police. Clearly, there is reason to suspect that the state is missing nonfatal crashes falling under tribal jurisdiction in these counties. These counties contribute approximately one-fourth of all of South Dakota's fatal crashes and clearly play a large role in the fluctuation of the fatality rates released by the National Highway Traffic Safety Administration every year. However, the state cannot engage in further problem identification and study of all crashes occurring in these areas due to the fact that so many are obviously missing.

Similarly, total crash counts should be inspected based on what the traffic environment in these counties might predict counties with similar traffic environments. In an effort to complete this task, CATS constructed a prediction model for the total crashes occurring in these 12 counties based on descriptors of the traffic flow. Appendix E fully reports the results of this modeling procedure. Results reveal that for these 12 Native American counties, reported crash counts systematically fall below the prediction interval for actual crash counts. In the original project proposal, CATS planned to deliver county rankings to the state of South Dakota to provide the state with benchmarks and indices on which to track key traffic problems locally. However, small crash counts in certain counties and the apparently complete unreliability of data redirected this task. The County Rankings, an explanation of which appears in Appendix D, have still been produced, but they place counties into categories that take into account the Native American population so the user can keep in mind those counties for which comparisons on certain indices may be particularly skewed. If one plots all counties in this visualization tool, Native American counties appear to fare much worse on key indices than they probably actually do, due to the fact that their total crash counts are small leading to high variability, and they will always have characteristics typical of fatal crashes over-represented in their numbers. Again, the incompleteness of data severely compromises the usefulness of tools such as this for the Native American counties.

Finally, the apparently large degree of underreporting from these areas needs to be noted in particular because these areas suffer from particularly high and increasing fatality rates. If the state had a record of all nonfatal crashes from these areas, it is suspected that these reported crash rates would be particularly high and potentially increasing as well. South Dakota's overall crash rate does not appear to be increasing, but because such a large number of nonfatal crashes are most likely missing, proper problem identification and monitoring of progress cannot be completed.

Figure 7. 1998-2003 Fatalities per 100 MVMT by County Type

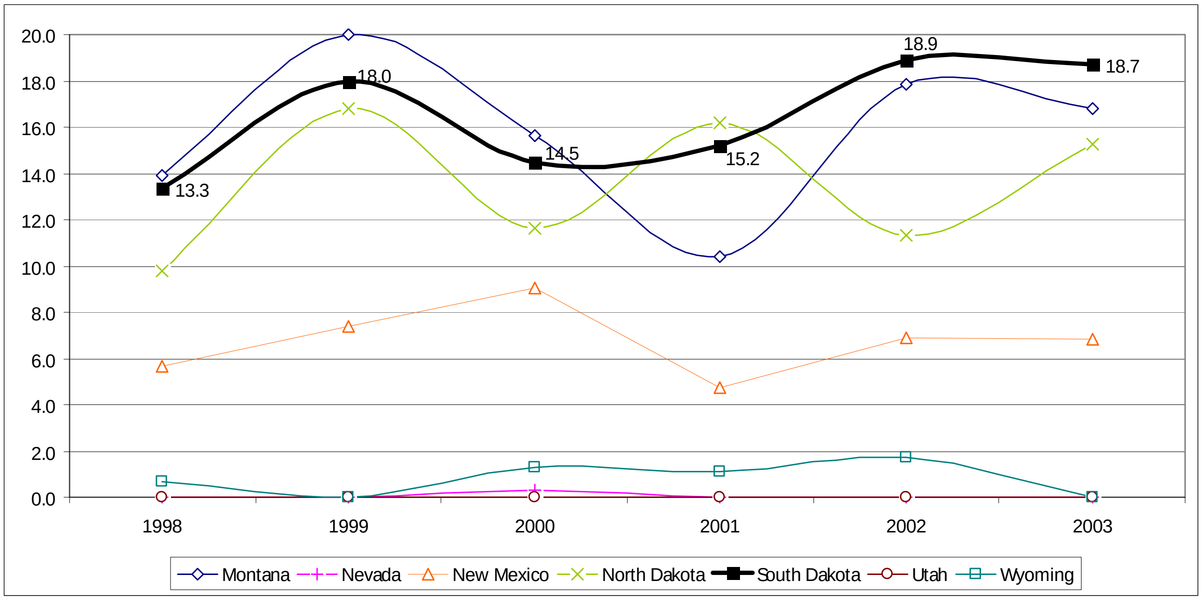


When crashes are grouped by their county location, it is evident that fatality rates are substantially higher in the predominantly Native American counties (over three times as high in 2003). Additionally, when fatalities are considered in terms of whether or not the FARS analyst coded them as "On Reservation" versus not, South Dakota displays the highest percentage of all fatalities coded as "On Reservation" when compared to the peer states in recent years. (Recall that crashes appearing within one of the present day closed reservation boundaries, on a BIA road, or submitted by the tribal police or BIA are coded as "On Reservation" in South Dakota, but how this is interpreted and coded within comparison states is unverified).

Additionally, when compared to the selected peer states, South Dakota has a particularly large and increasing percentage of its fatalities that are categorized as "On Reservation" according to the FARS special jurisdiction variable.

Those areas with predominantly Native American populations are very large contributors to South Dakota's increasing fatality rates. These are the areas that the state has the least information about, preventing a further investigation of the qualities and characteristics of nonfatal crashes in these areas. Within the confines of this research project it was deemed impossible acquire the crash data necessary to conduct the full data analysis. Nonetheless, this project was very instrumental in identifying that an amenable solution is needed so that the state can conduct more complete crash data analyses and problem identification without infringing upon the tribes' sovereignty. Please see Chapter 7 for a full discussion of the primary recommendations for this focus area.

Figure 8. Percentage of all Fatalities Occurring "On Reservation" (FARS Special Jurisdiction Variable), 1998-2003

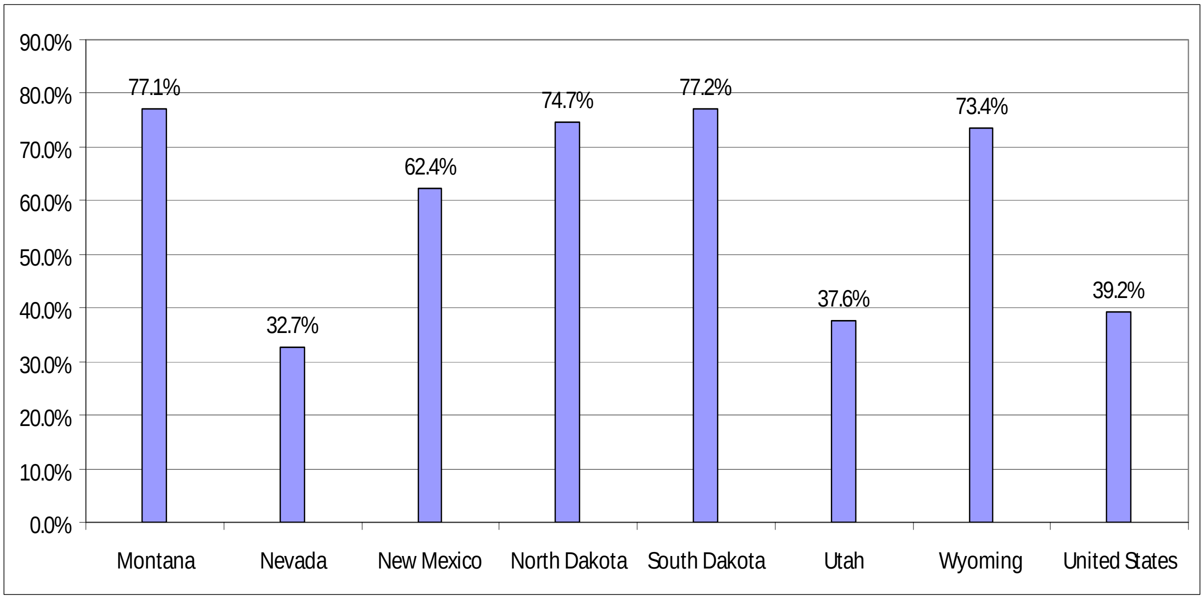


It has been established that those areas with predominantly Native American populations are very large contributors to South Dakota's increasing fatality rates. Additionally, these are the areas that the state has the least information about, preventing a further investigation of the qualities and characteristics of nonfatal crashes in these areas. Within the confines of this research project it was deemed impossible to achieve the necessary acquisition of crash data to conduct the full data analysis. Nonetheless, this project was very instrumental in identifying that an amenable solution is needed so that the state can conduct more complete crash data analyses and problem identification without infringing upon the tribes' sovereignty. Please see chapter 7 for a full discussion of the primary recommendations for this focus area.

5.3 Focus Area 2: Rollover Crashes

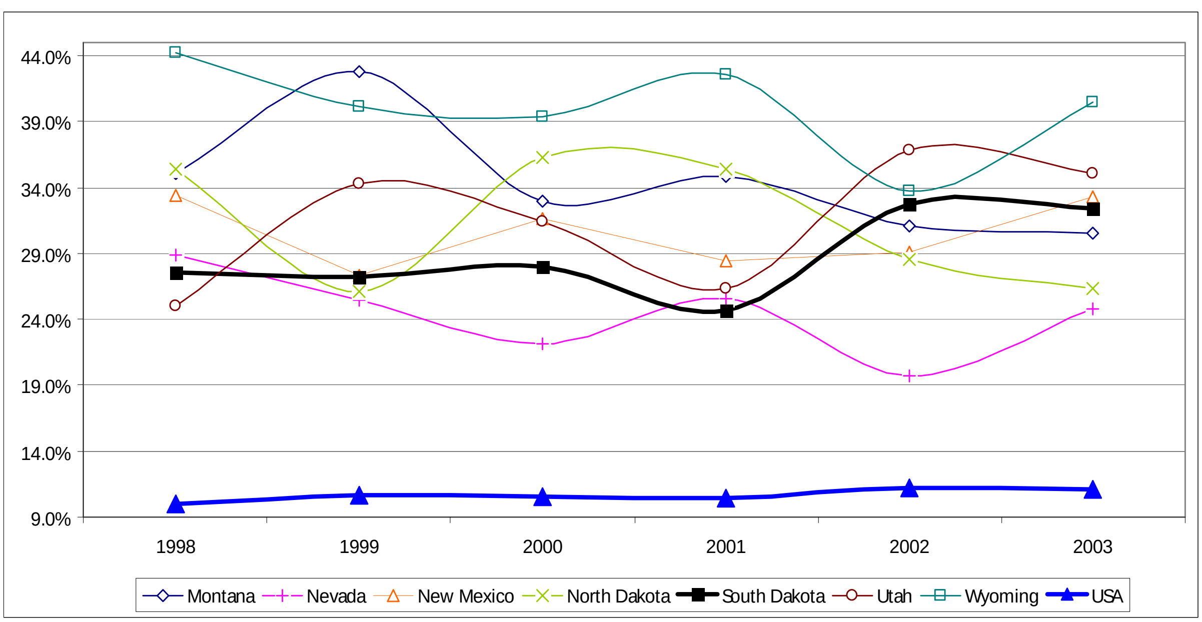
Rollover crashes have been identified as one of NHTSA's agency priorities. In 2003 in the United States, 12.8 percent of all vehicle occupant fatalities (motorcycles excluded) were in a vehicle that rolled as the first event in the crash. Twenty percent were in a vehicle that rolled as a subsequent event. Eleven percent of the nation's total traffic fatalities (occupants and non-occupants) were in a fatal crash in which the first harmful event of the crash was a vehicle rolling over. Rollover crashes are also predominantly a rural problem. Overall between 1998 and 2003, 14.7 percent of all crashes on roadways classified as rural experienced a rollover as the first harmful event, compared to 4.8 percent of all fatal crashes on roadways classified as urban. South Dakota has the highest percentage of all rural vehicle miles traveled when compared to the six selected peer states. As a result, one could expect that rollover crashes should be a particular area of concern for the state of South Dakota.

Figure 9. 1998-2003 Percentage of Total VMTs Rural



As expected, the percentage of all South Dakota fatal crashes with a vehicle rollover coded as the first harmful event was nearly three times the national rate in 2003.

Figure 10. 1998-2003 Percentage of Fatal Crashes with Vehicle Rollover Coded as First Harmful Event



Additionally, South Dakota's fatal rollover rate per 100 MVMT has also been on the rise since 1998. In 2002 and 2003, South Dakota was second only to Montana.

Figure 11. 1998-2003 Fatal Crashes with Vehicle Rollover Coded as First Harmful Event, per 100 MVMT

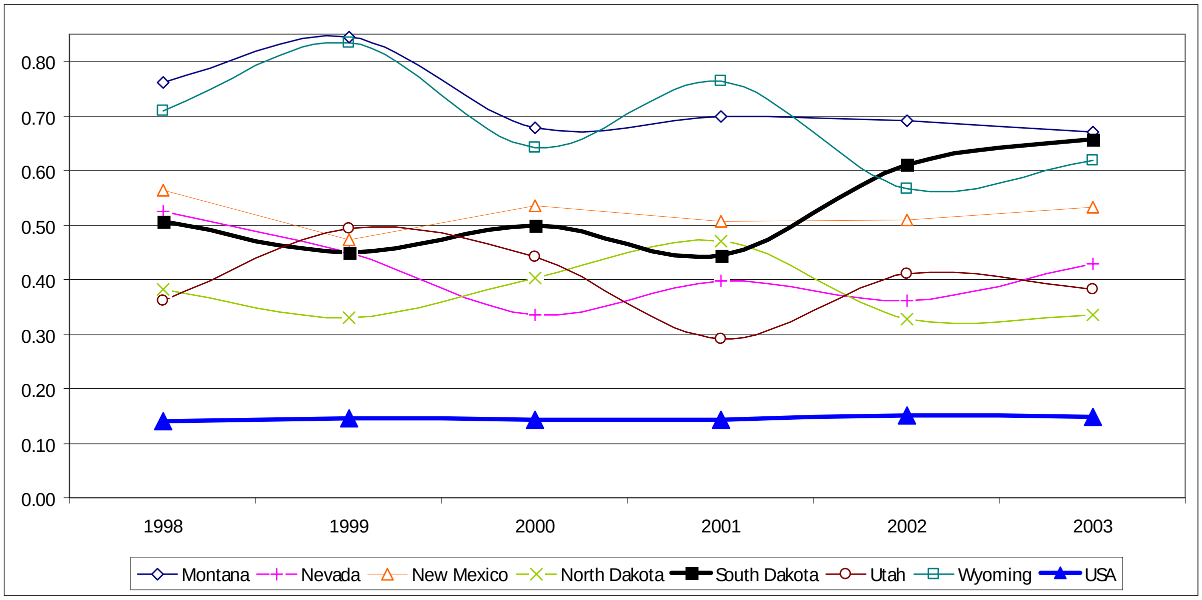
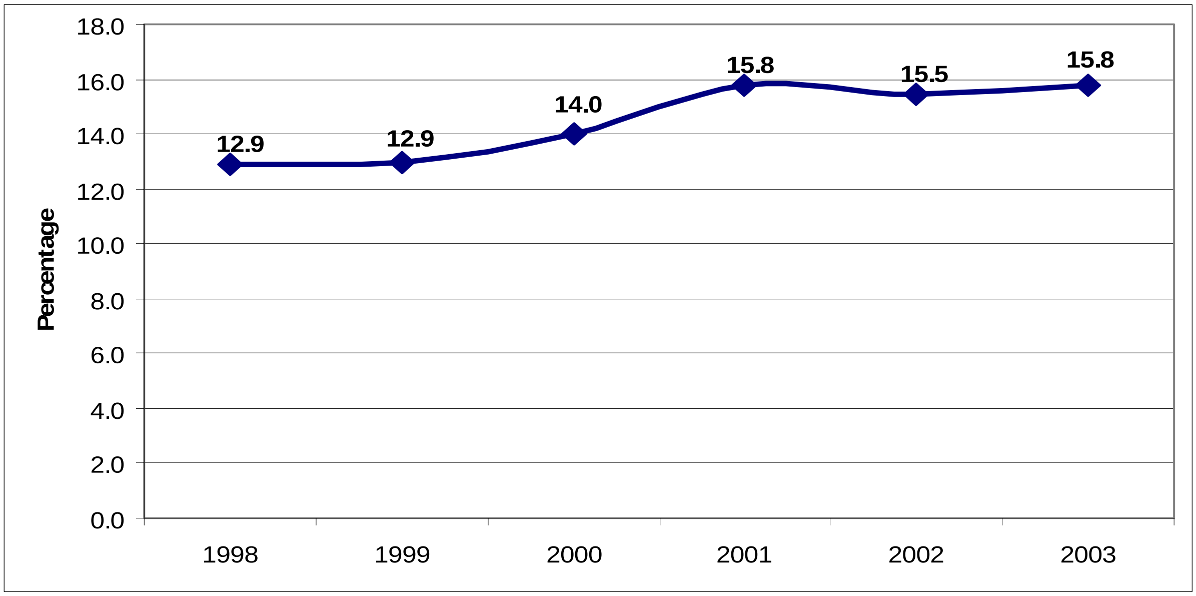


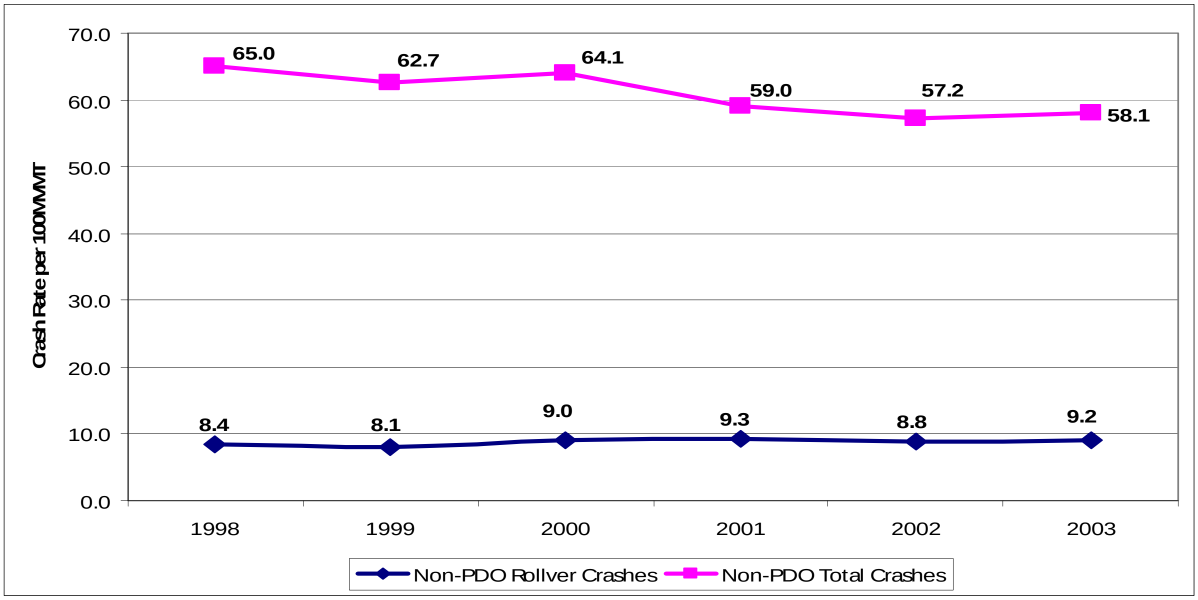
Figure 12. South Dakota 1998-2003 Percentage of all Non-PDO Crashes with First Harmful Event Rollover



An examination of the complete South Dakota database confirms these findings. Firstly, when total crashes (not just fatal crashes) are examined, there is again an upward trend seen in the percentage of all crashes that have a rollover as the first harmful event. Unfortunately, because the threshold for what qualified as a reportable property damage only crash changed in 2001, PDO crashes are excluded from this analysis due to the fact that shifts in crash profiles could simply be due to the systematic exclusion of crashes of lower property damage values from the database in later years. When all non-PDO crashes are examined, between 1998 and 2003, the percentage of all crashes that were rollover increased from 12.9 to 15.8 percent.

In fact, while the overall non-PDO crash rate per 100 million VMT decreased from 65.0 to 58.1 between 1998 and 2003, the non-PDO crash rate for rollover crashes increased from 8.4 to 9.2 crashes per 100 million VMTs over the same period. Rollovers are over-represented in fatal crash rates, and it is the South Dakota fatal crash rate that is not declining.

Figure 13. South Dakota Non-PDO Crash Rate per 100 MVMT and Non-PDO Rollover Crash Rate per 100 MVMT



In order to investigate these rollover crashes by road class, for all rural road classes, rollover rates on each specific road class type can be conceptualized both in terms of the percentage of all fatal crashes on that roadway that are rollover crashes and in terms of fatal rollover crashes per 100 MVMT. The first approach identifies those roadways for which rollovers are proportionally the largest problem as compared to other types of crashes, and the second approach identifies those roadways that generate the most fatal rollover crashes per 100 MVMT traveled. An investigation reveals that rural interstate and rural local roads have the largest percentage of all fatal crashes rollover, and rural local roads have the highest rollover fatal crash crate per 100 MVMT.

Figure 14. United States and South Dakota Percentage of all Fatal Crashes Rollover by Road Class, 1998-2003

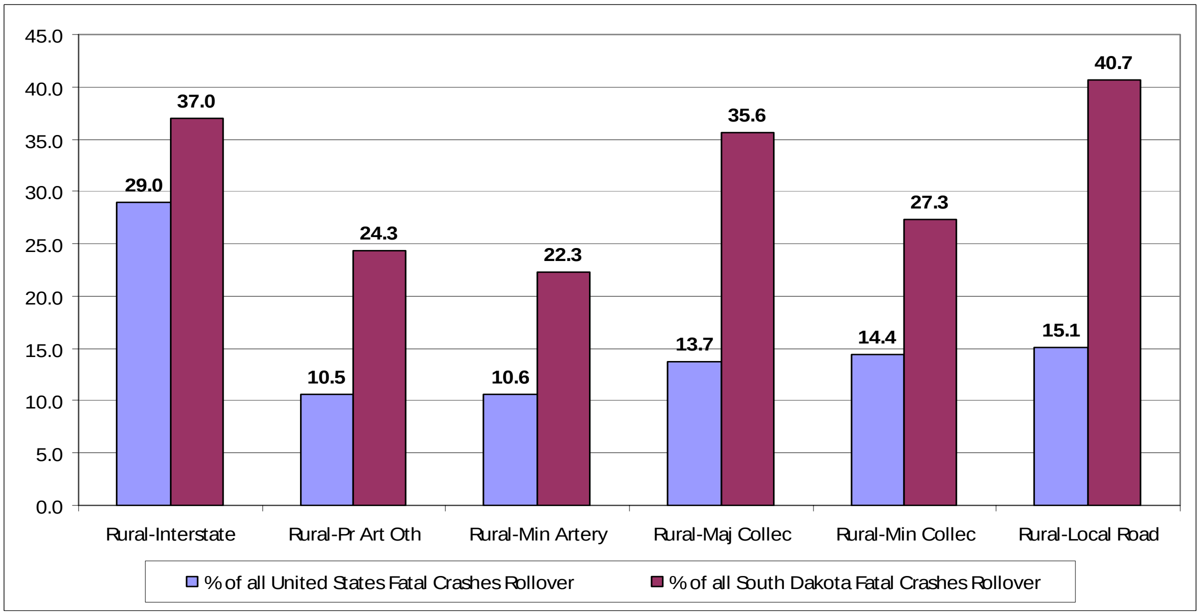
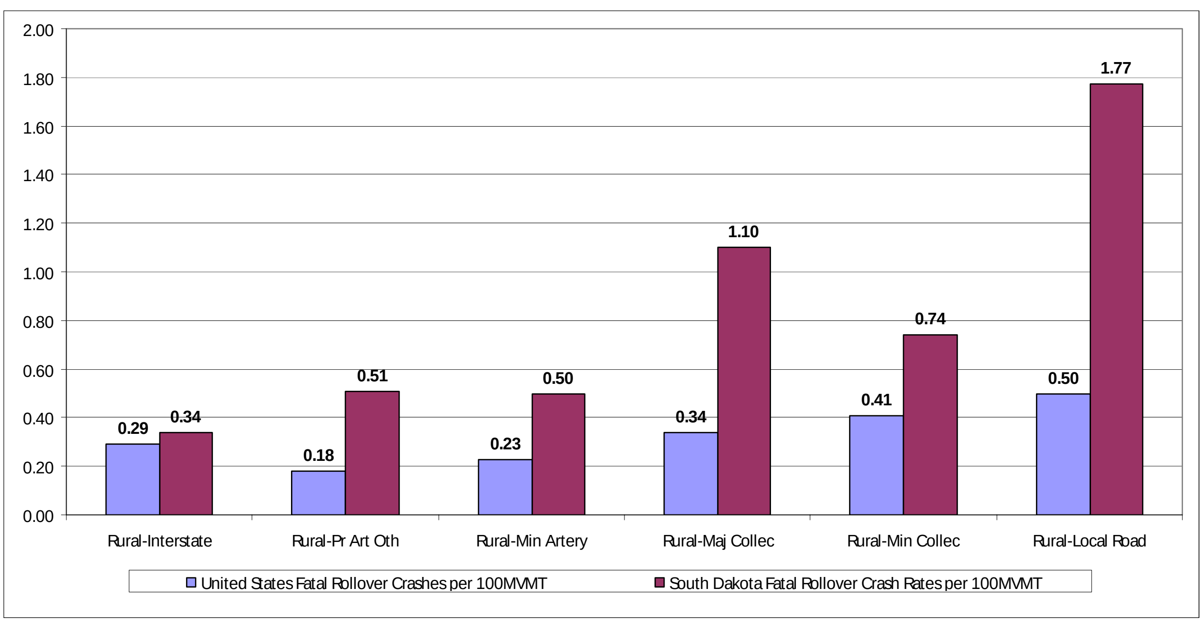


Figure 15. United States and South Dakota Fatal Rollover Crashes per 100 MVMT by Road Class, 1998-2003



When all fatal crashes over the past six years are further broken down just by route signage, 36.4 percent of fatal crashes in South Dakota on interstates experienced a rollover as the first harmful event, and 39.8 percent of those on county roads did (the highest two rates).

Table 4. South Dakota Fatal Rollover Crashes by Route Signage, 1998-2003

Route Sign	Total Fatal Crashes	Total Rollover Fatal Crashes	Percent of Fatal Crashes on this Roadway that were a Rollover
Interstate	118	43	36.4
US Highway	210	46	21.9
State Highway	206	44	21.4
County Road	299	119	39.8
Township	36	10	27.8
Municipality	52	4	7.7

When the fatal rollover crashes are plotted by trafficway ID, the roads with the largest sheer raw number of rollover fatal crashes between 1998-2003 were I-90 (30), US18 (15), and I-29 (12). These roadways also had the largest total number of fatal crashes. However, for those 7 roadways with more than 20 total fatal crashes, I-90 and I-29 also had the highest percentages that were rollovers (37.5 percent each). When the complete South Dakota crash database is examined, the Highway Number variable is used to examine some of these roadways further. Table 5 lists roadways in South Dakota that have experienced over 1,000 total reported crashes between 1998-2003. Just as was revealed in the fatal crash data, highways I-29 and I-90 fare the worst (13.3 and 12.9 percent, respectively), followed by US18 (11.2 percent). In short, I-29 and I-90 stretching across the state of South Dakota both experience the highest raw number of crashes and the highest percentage of all crashes that experience a rollover as the first harmful event. A focused effort to examine crashes along these highways with the goal of reducing rollover crashes would result in a large reduction of South Dakota's total fatal and non-fatal crashes. However, it should be noted that US18 is partially under the jurisdiction of the Rosebud reservation, so once again, problem identification is limited due to the incompleteness of traffic records.

Table 5. South Dakota Roadways with Over 1,000 Reported Crashes 1998-2003, Percent Rollover

Highway	Total Crashes	Total Rollover Crashes	Percent of Crashes on this Roadway that are Rollover
Not on State Highway System	56,407	4,364	7.7
90	8,560	1,102	12.9
29	5,473	730	13.3
14	3,810	184	4.8
12	3,126	139	4.4
42	2,996	41	1.4
16	2,852	75	2.6
44	2,361	77	3.3
34	2,244	118	5.3
212	2,166	161	7.4
115	2,022	15	0.7
81	1,651	48	2.9
37	1,590	72	4.5
18	1,443	162	11.2
281	1,340	76	5.7
50	1,338	100	7.5
229	1,198	26	2.2

Specific driver factors contribute to rollover crashes. For all crashes experiencing a rollover as the first harmful event in South Dakota, 43.4 percent had a speeding driver listed as a crash contributing circumstance. Additionally, 15.2 percent were alcohol-related.

Figure 16. Percentage of South Dakota Rollover Crashes with a Speeding Driver

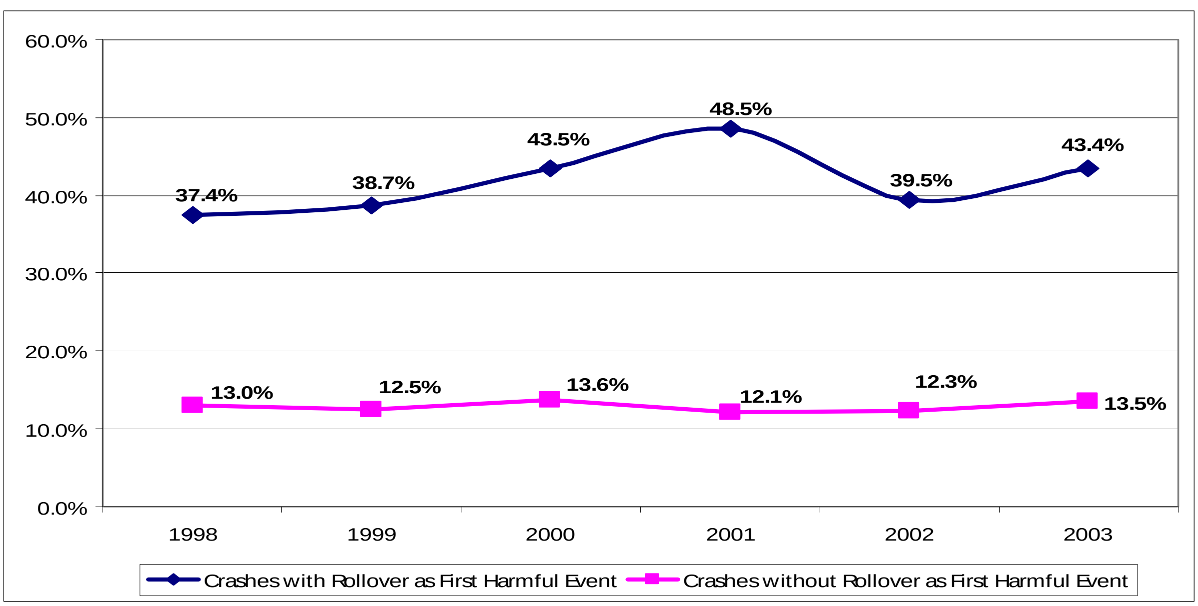
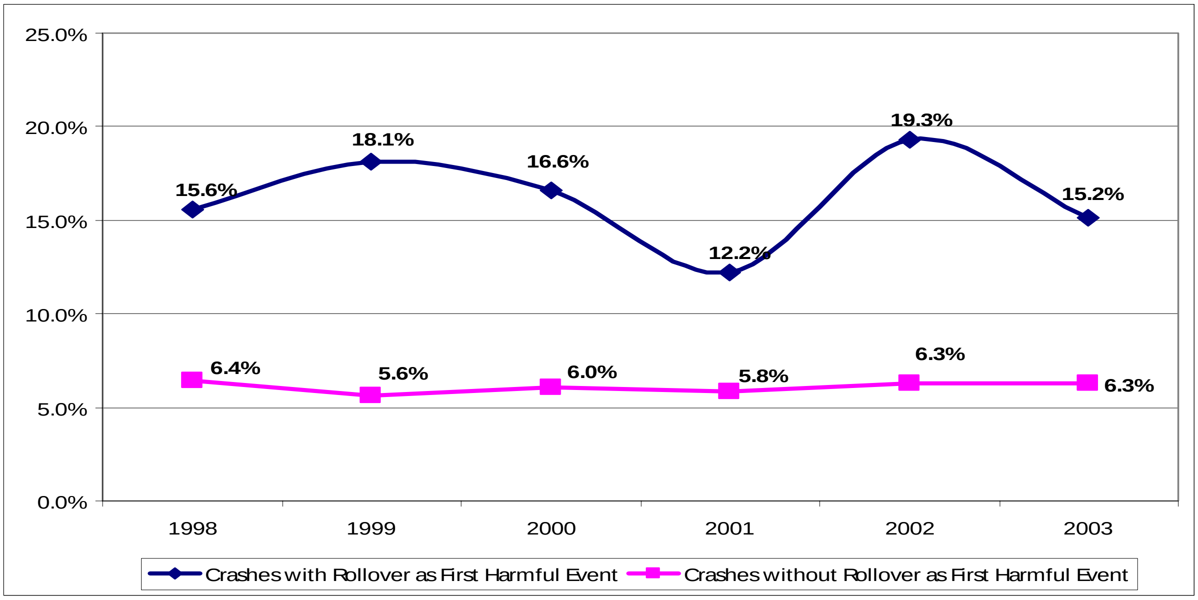


Figure 17. Percentage of South Dakota Rollover Crashes Alcohol-Related

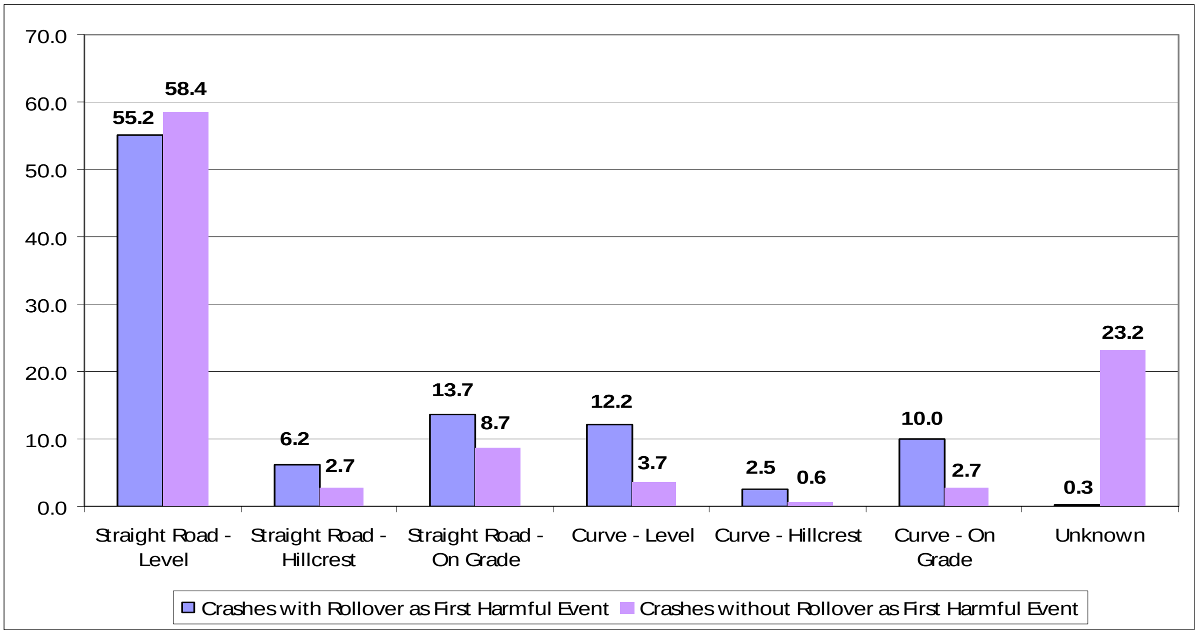


Typically Sport Utility Vehicles (SUVs) have the largest rollover problem and this is evidenced in South Dakota as well. Between 1998 and 2003, of the 129 SUVs involved in South Dakota fatal crashes, 64.3 percent rolled over at some point in the crash (compared to 32.4 percent of the 537 passenger cars, 42.0 percent of the 293 pickups, and 40.7 percent of the 86 vans).

In terms of roadway characteristics, between 1998 and 2003, a larger percentages of crashes without a rollover coded as the first event occurred on a stretch of roadway categorized as a hillcrest or on a grade. A total of 24.7 percent occurred on a curve (either level, a hillcrest, or on a grade). Results are displayed below in Figure 18. It should also be noted that in nearly one fourth of all non-rollover crashes, the roadway character was unknown or not stated. Most likely, the majority of these crashes occurred on straight level roadway, but this omission does limit a complete picture of the problem.

Finally, safety belt use is particularly important in shaping the outcome and severity of rollover crashes because an unrestrained occupant is more likely to be ejected and severely injured. In South Dakota between 1998 and 2003, only 0.5 percent of all unrestrained crash-involved drivers in a vehicle that did not roll over as the most harmful event were totally ejected from the vehicle. (Drivers of motorcycles, snowmobiles, and mopeds are excluded from this figure). However, 20.4 percent of all unrestrained crash-involved drivers in vehicles that rolled over as the most harmful event were totally ejected. Additionally, for all drivers killed in a vehicle that rolled over as the most harmful event, 83.0 percent were unrestrained, and 70.0 percent of these unrestrained driver fatalities were totally ejected from the vehicle.

Figure 18. 1998-2003 South Dakota Crashes by Roadway Character



Clearly, rollover crashes represent a need to carefully consider the interaction of multiple factors in order to best discern how to most effectively prevent resulting fatalities. Recommendations are discussed in chapter 7, and indices pertaining to rollover crashes are available as benchmarks in the County Rankings tool.

5.4 Focus Area 3: Restraint Use

Ideally, 100 percent of fatalities would be restrained, because that would mean complete compliance with the seat belt laws. However, this index is often not understood and can be easily misinterpreted to mean that wearing a seat belt is pointless because this person or that person was killed anyway. This can additionally be reinforced by media and law enforcement who unwittingly make statements to the effect that “wearing a seat belt wouldn’t have made a difference to the person’s survival or quality of life,” or “it was fortunate that the driver was not wearing a seat belt and was ejected,” since the vehicle caught fire as a result of the crash. It is obvious and sensible to persons in the field of traffic safety that not every crash is survivable, but to a large segment of the population, such a concept can be more of a challenge to comprehend. Similarly, fire occurred in only 0.1 percent of vehicles that were involved in a motor vehicle crash during 2003, but the public believes that it is a much more likely occurrence and uses this unfounded fear as a rationale for not wearing a safety restraint.

Table 6. Percentage of Occupant Fatalities that were Restrained, by State and Year

State	1998	1999	2000	2001	2002	2003
Montana	28.5%	20.3%	30.1%	26.5%	22.4%	27.2%
Nevada	12.8%	7.4%	8.1%	7.1%	12.8%	14.0%
New Mexico	**30.0%**	26.8%	27.4%	**28.2%**	27.6%	24.3%
North Dakota	17.6%	**28.7%**	12.3%	24.0%	23.4%	15.6%
South Dakota	24.3%	17.3%	13.9%	22.3%	22.1%	18.0%
Utah	23.7%	26.3%	27.9%	29.1%	**33.0%**	**34.3%**
Wyoming	23.2%	18.7%	**36.1%**	24.9%	28.0%	30.3%

During September 2004 and February 2005, NHTSA and the BIA sponsored the first ever occupant protection observational survey targeted toward Native Americans, conducted at 120 sites and 16 tribal reservations (NHTSA, 2005). Modeled after the National Occupant Protection Usage Survey (NOPUS), the project excluded one reservation as well as the entire Navajo reservation due to their refusal to allow observers onto their territories. The Navajo reservation accounts for 22 percent of the total Native American population, so their non-participation represents a substantial segment for which no data is available. Nonetheless, nine of the reservations were in states that had a primary seat belt law, and they also posted the highest belt use rates of the survey, averaging 72.8 percent restraint use. Among the other seven reservations in states with a secondary seat belt law, the observed use rate averaged only 33.3 percent, and accounted for the lowest use rates of the study.

Table 7. Seat Belt Use Laws in South Dakota and the Comparison States

State	Enacted Legislation Effective Date	2004 Use Rate	Primary Enforcement	Additional Information
Montana	10/1/1987	80.9		$20 fine; all seats
New Mexico	1/1/1986	89.7	X	$25 fine; all seats
North Dakota	7/14/1994	67.4		damage mitigation; $20 fine; front seat only
South Dakota	1/1/1995	69.4		$20 fine; front seat only
Utah	4/28/1986	85.7		$45 fine; all seats
Wyoming	6/8/1989	70.1		$10-$25 fine; all seats

Among South Dakota and the six comparison states, only New Mexico has a primary seat belt law. It was the first state among the seven states to enact such legislation, and New Mexico had the highest observed restraint use rate among the same states. At 67.4 percent and 69.4 percent, respectively, North Dakota and South Dakota have the lowest restraint use rates of the seven states, and also the weakest laws and penalties of the seven states.

Over the past ten years, a number of states have upgraded their secondary enforcement laws to primary enforcement. A December 2004 study conducted by the Insurance Institute for Highway Safety documented the benefits of a primary law as measured by the number of lives saved since the change from a secondary to a primary law (Farmer and Williams, 2004). The researchers noted that the change in the law was followed by decreased fatality rates in nine states and the District of Columbia, and estimated the number of lives saved since the upgrade to the primary law. Furthermore, the model (which accounted for possible economic impact and time trend influences) showed a statistically significant negative relationship between the fatality rate within these states and the changing of their law to primary enforcement. Table 8 displays the state, the year their law changed, the estimated number of highway deaths since the law changed, and the number of lives saved as a result of the change. Also, based on the 5,594 driver deaths in these states in 2003, an estimated 421 lives will be saved each year in the near future.

Table 8. Estimated Lives Saved Due to Primary Safety Belt Enforcement

States	Year of Change	Deaths After Change	Lives Saved
California	1993	18,469	1,388
Louisiana	1995	3,917	295
Georgia	1996	6,067	456
District of Columbia, Maryland, Oklahoma	1997	4,430	333
Indiana	1998	2,511	189
Michigan, New Jersey	2000	4,072	306
Washington	2002	307	23
Total		39,773	2,990
*Assuming a 7.0 percent reduction in each state			

According to data published by the National Highway Traffic Safety Administration (1999), states that have a primary enforcement law typically have higher seat belt use rates at an average of 17 percentage points higher than states with just secondary enforcement. Additional data published by the National Safety Council (2003) revealed that:

Nationwide Crash Data

- Driver restraint use is the strongest predictor of child restraint use.
- A restrained driver is three times more likely to restrain a child.

Nationwide Observational Research

- When a driver is ***buckled***, restraint use for children (birth to 15) is **87 percent.**
- When a driver is unbuckled, restraint use for children (birth to 15) is **24 percent.**

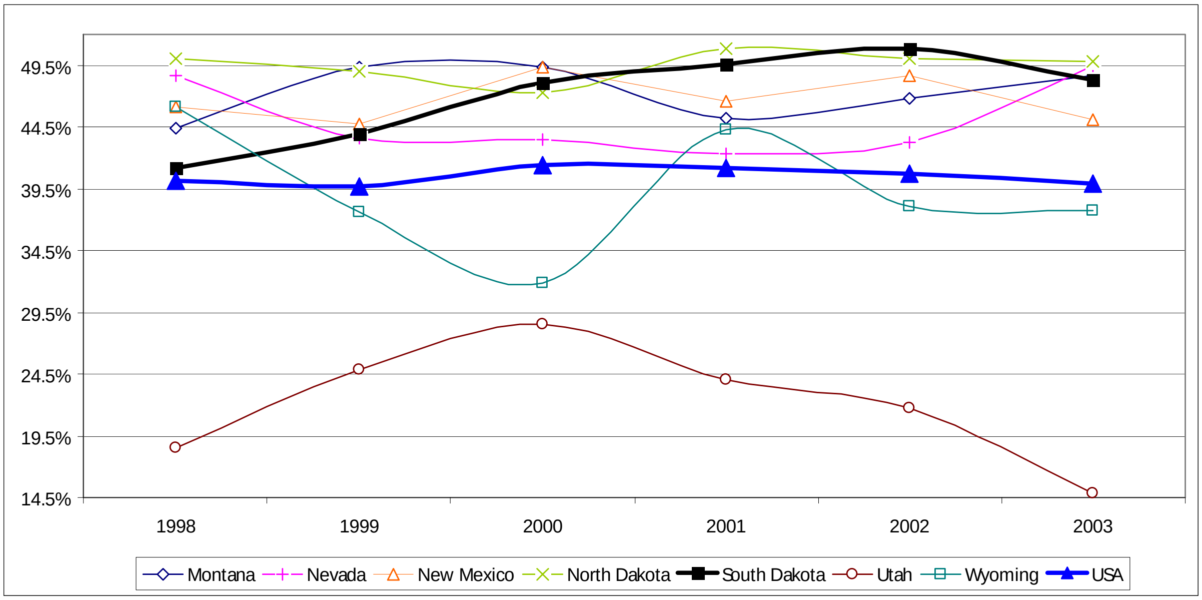
Primary Belt Law: Primary belt laws allow law enforcement to stop and ticket a driver for non-use of a safety belt without requiring the driver to be cited for or having commited another offense. Based upon data compiled by the National Highway Traffic Safety Administration, unbelted drivers account for 75 percent of impaired driving fatalities. A primary belt law can reduce alcohol-related fatalities in South Dakota by 10 percent. The law would save $100 per licensed driver. If enforced with frequent belt-use checkpoints, the value of temporary discomfort experienced by some new belt wearers and travel delay costs at checkpoints would be the large majority of the law’s $3.00 cost per licensed driver (NHTSA, 2004).

At the present time, South Dakota continues as a secondary law state for seat belt use for all occupants age 18 or older (the law is primary for occupants 0-17 years of age). However, in 1998, the percentage of motor vehicle occupant fatalities that were restrained was only 24.3 percent. By 2003, this rate had plummeted to 18.0 percent. The significance of this decrease is that as the number of people who travel unrestrained increases, their likelihood of fatal injury increases. Thus, the ideal scenario is to have 100 percent of all motor vehicle occupants belted such that the only fatalities are due to the fact that the crash was not survivable, rather than losing lives due to a failure to wear the safety restraint. The research group can find no evidence that a concentrated, intensive enforcement effort has continued beyond the isolated “Buckle Up Badlands” or “Seat Belts Saves Lives.” Based upon the NHTSA Lives Saved Model, potential lives saved are the number of lives that might have been saved if seat belt use were 100 percent. The potential number of lives saved is calculated by assuming that use of seat belts reduces fatalities by 45 percent (NCSA. 2001). Thus, of the 133 passenger vehicle unrestrained occupants that were killed in 2003, another 60 lives could have been saved. In light of all these issues, please see chapter 7 for a specific formulation of recommendations for this focus area.

5.5 Focus Area 4: Alcohol

An examination of fatal crash data reveals that while South Dakota fatality rates have been on the rise, so has the percentage of all fatalities that are alcohol-related.

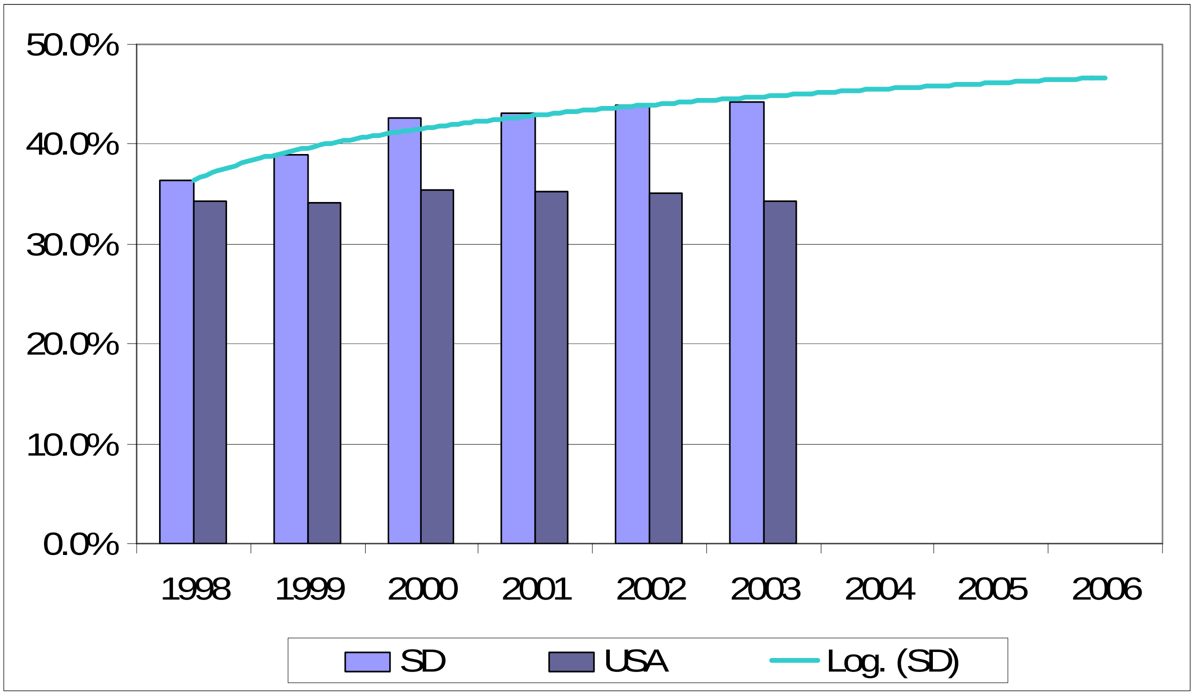
Figure 19. Percentage of all Fatalities Alcohol-Related, 1998-2003



Note: Rates are based on the FARS imputation model used to estimate blood alcohol values when they are missing.

In 2003, 48 percent of all South Dakota's fatalities occurred in crashes were at least one driver or non-occupant was known or estimated to have a positive blood alcohol content. South Dakota has diverged from the national rate and in 2003 was well over the national average of 40 percent. Additionally, 44 percent of all fatalities in 2003 were in a crash in which at least one driver or non-occupant was intoxicated (BAC≥0.08). Figure 20 projects this rate through the year 2006.

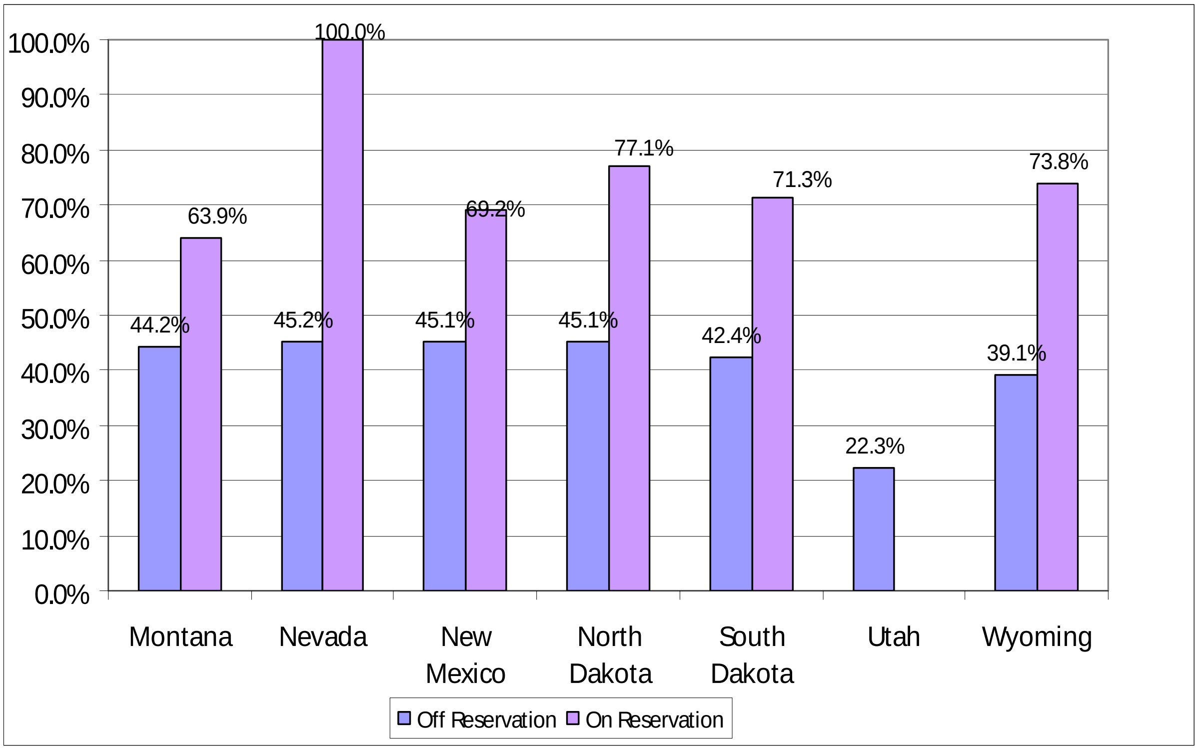
Figure 20. Percentage of all Fatalities with an Intoxicated Driver or non-occupant, 1998-2003



Note: Rates are based on the FARS imputation model used to estimate blood alcohol values when they are missing.

This focus area raises a particularly large concern due to the fact that reservation crashes have high alcohol-involvement rates, and complete crash data from these areas were not available. One should note that these fatalities are classified according to the special jurisdiction variable in FARS, which is unverified for consistency in its application.

Figure 21. 1998-2003 Percentage of All Fatalities Alcohol-Related, On Reservation vs. Off Reservation Lands

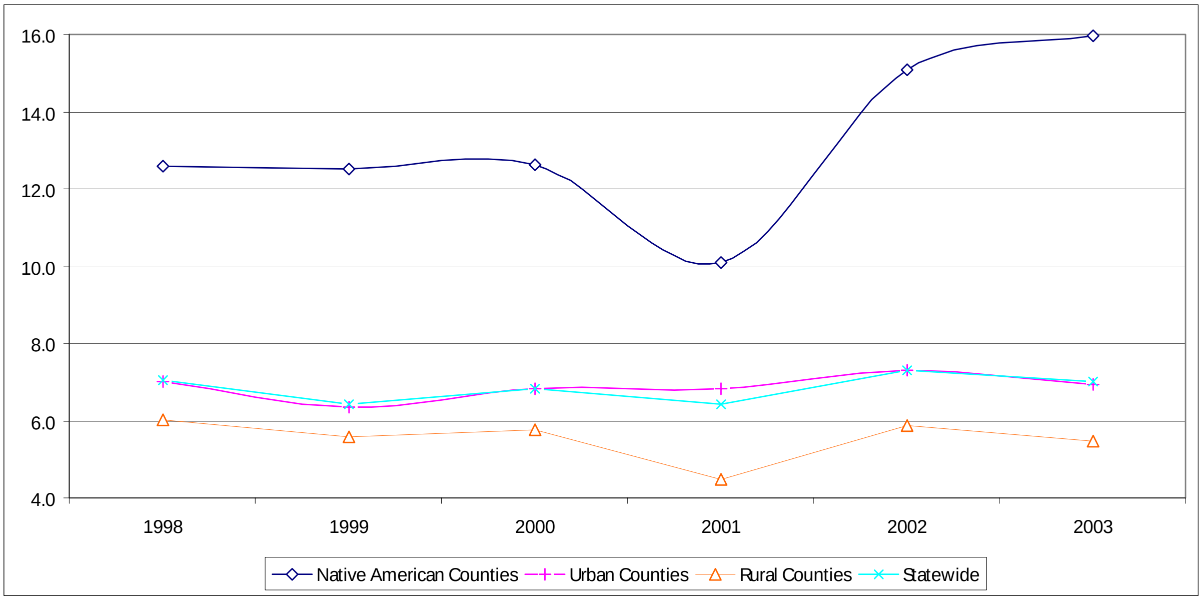


Please note that Utah did not have any on reservation fatalities, and the on reservation rate of 100% for Nevada refers to only fatality.

Note: Rates are based on the FARS imputation model used to estimate blood alcohol values when they are missing.

When all alcohol-related crashes (both fatal and nonfatal) are examined without the benefit of the imputation model within the complete South Dakota crash database and categorized by county, it is apparent that within the Native American counties, the percentage of all reported crashes categorized as alcohol-related (based on known results as reported by law enforcement officers) has increased since 1998. A potentially increasing rate of alcohol-involvement in these counties raises cause for concern. Due to the incomplete records of all crashes in these counties, the statewide rate of alcohol-involvement for all crashes could also potentially be on the rise more than is reflected in the current database.

Figure 22. Percentage of All South Dakota Reported Cashes Alcohol-Related, 1998-2003



One should note that fatal crashes (which have a higher degree of alcohol-involvement) are severely over-represented in the Native American counties, so in actuality the difference between the Native American alcohol-involvement rate and the other strata may not as great as it appears. However, once again, full evaluation of this problem is hampered due to data incompleteness. To further aid the state in the identification of localized areas of concern with respect to alcohol-related problems, numerous benchmarks are made available in the alcohol indices in the County Rankings tool. This tool also allows the user to rank counties based on driver age for the four age groups with the highest rate of alcohol-involvement (21-24, 25-34, 35-44, and 14-20). Once again, please take note that the County Rankings are most useful for the urban counties with the highest crash counts, and Native American counties will score poorly due to an over-representation of fatal crashes.

The "Rating the States 2002" report made available by Mothers Against Drunk Driving provides a good comparison of South Dakota's efforts to reduce alcohol-related fatalities to the peer states. South Dakota is one of only three states in the country to receive a failing grade for Administrative Measures and Criminal Sanctions, and was joined by comparison state Montana. Utah received a C+, New Mexico and North Dakota received a B-, and Nevada and Wyoming received a B+. One should also note that Utah clearly stood out in the selected comparison states as having a very low alcohol-involvement rate in fatal crashes, but Wyoming, receiving a high grade for Administrative Measures and Criminal Sanctions, was also the only other peer state to drop below the national average.

For state law enforcement programs, North Dakota received a D, Montana received a D+, South Dakota and Utah both received a C, Nevada received a B-, Wyoming received a B, and New Mexico received an A-.

Table 9. Selected Scores from "Rating the States 2002"

State	BAC Testing, Data and Records	State Law Enforcement Programs	Administrative Measures and Criminal Sanctions	Underage Drinking and Drinking and Driving Control
Montana	C-	D+	F	F
Nevada	C	B-	B+	C
New Mexico	B	A-	B-	B
North Dakota	B-	D	B-	F
South Dakota	C+	C	F	D
Utah	B	C	C+	B
Wyoming	B-	B	B+	C-

New Mexico and Wyoming received the most noteworthy combined scores for state law enforcement programs and administrative measure and criminal sanctions combined. Additionally, aside from Utah, which had an extremely low rate of alcohol-involvement most likely due to its significant Mormon population, Wyoming appeared to have one of the lowest alcohol-related fatality rates. New Mexico had the largest Native American population of all the states, and since alcohol-related fatalities were over-represented in reservation crashes, the fact that New Mexico's rate was not higher is an achievement. A 2002 study from the Centers for Disease Control and Prevention analyzed data from the 1997 Behavioral Risk Factor Surveillance System national telephone survey and the MADD Rating the States 2000 survey, and it was discovered that respondents in states receiving an overall MADD grade of D were 60 percent more likely to report alcohol-impaired driving than residents of states receiving an A (Shults, Sleet, Elder, Ryan, & Sehgal, 2002). Given the validity of these MADD ratings, the fact that South Dakota scores poorly on Administrative Measures and Criminal Sanctions and only average on State Law Enforcement Programs, necessitates that these two areas be emphasized in formulating recommendations for this focus area. Appearing below is a breakdown of alcohol laws for the comparison states.

Table 10. State Laws Curbing Drunk Driving

State	BAC (1)	Admin License Rev/Susp (2)	Mandatory 90-day License Rev/Sups (3)	Open Container Law (4)	Preliminary Breath Test Permitted by Law	DWI Plea Bargaining Prohibited
Montana	0.08			X (6)	X	
Nevada	0.08	X	X	X	X	X
New Mexico	0.08	X	X	X		X (6)
North Dakota	0.08	X	X	X	X	
South Dakota	0.08			X	X	
Utah	0.08	X	X	X		
Wyoming	0.08	X	X	X (5)		X
the current 0.08 impaired driving law does not include an Administrative License						

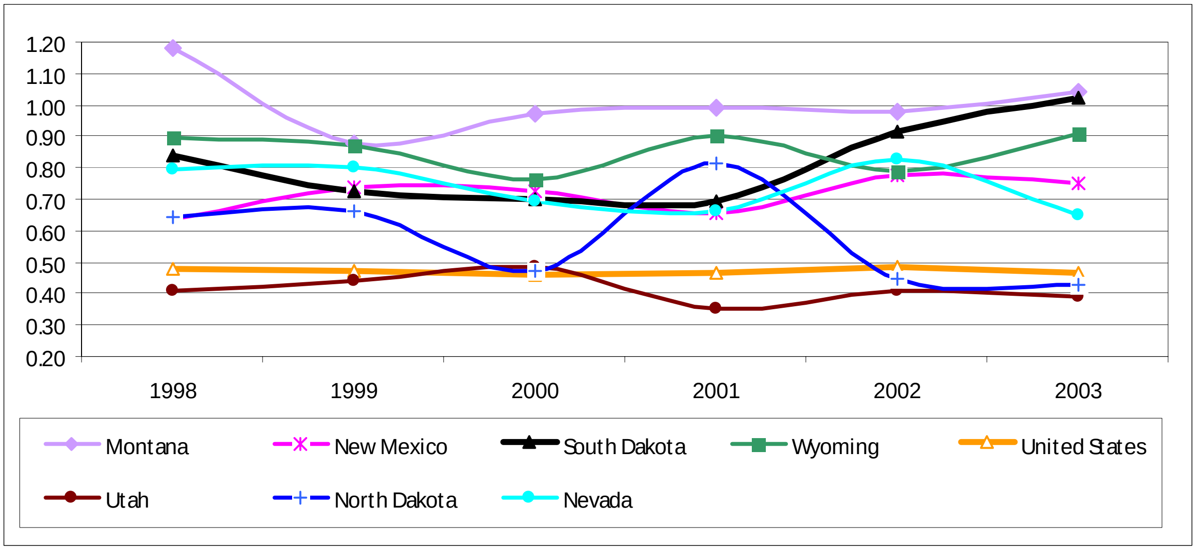
(1) Blood alcohol content (BAC) defining "driving while intoxicated."
(2) On-the-spot driver's license suspension or revocation if BAC is over the level in column 1 or the driver refuses to take a BAC test.
(3) Mandatory penalty for violation of the implied consent law, which means that drivers who refuse to take a breath alcohol test when stopped or arrested for drunk driving will have their license revoked or suspended.
(4) Prohibits unsealed alcohol containers in motor vehicle passenger compartments for all occupants. Arresting officer not required to witness consumption.
(5) Applies only to the driver.
(6) With limitations or conditions.

Source: Insurance Information Institute.

5.6 Focus Area 5: Speeding

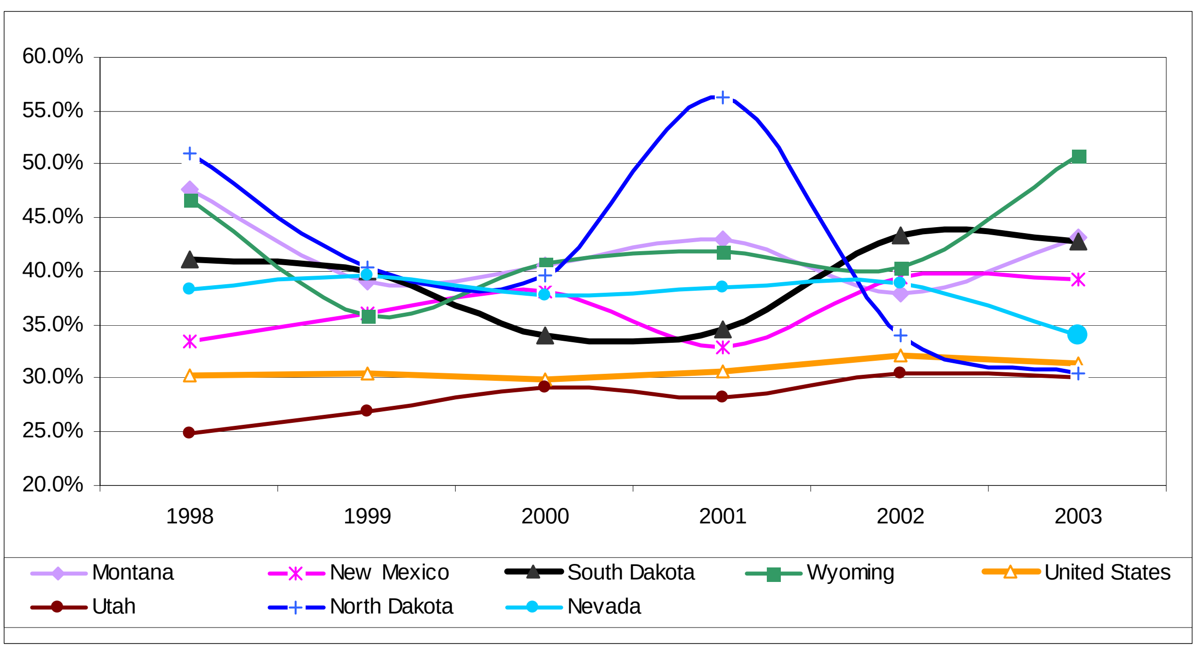
Similarly to rollover crashes, speed-related crashes, whether due to driving too fast for conditions or simply driving in excess of the speed limit, have increased in recent years such that the National Highway Traffic Safety Administration has determined them to be a principal focus. Speed-related crashes are a factor in rollover crashes, aggressive driving crashes, driver inexperience, restraint use, and fatal alcohol-related crashes. Efforts to reduce speed-related crashes and fatalities can include traffic calming interventions, increased enforcement efforts, and the implementation of driver education and awareness campaigns.

Figure 23. Speed-Related Fatalities per 100 MVMT, 1998-2003



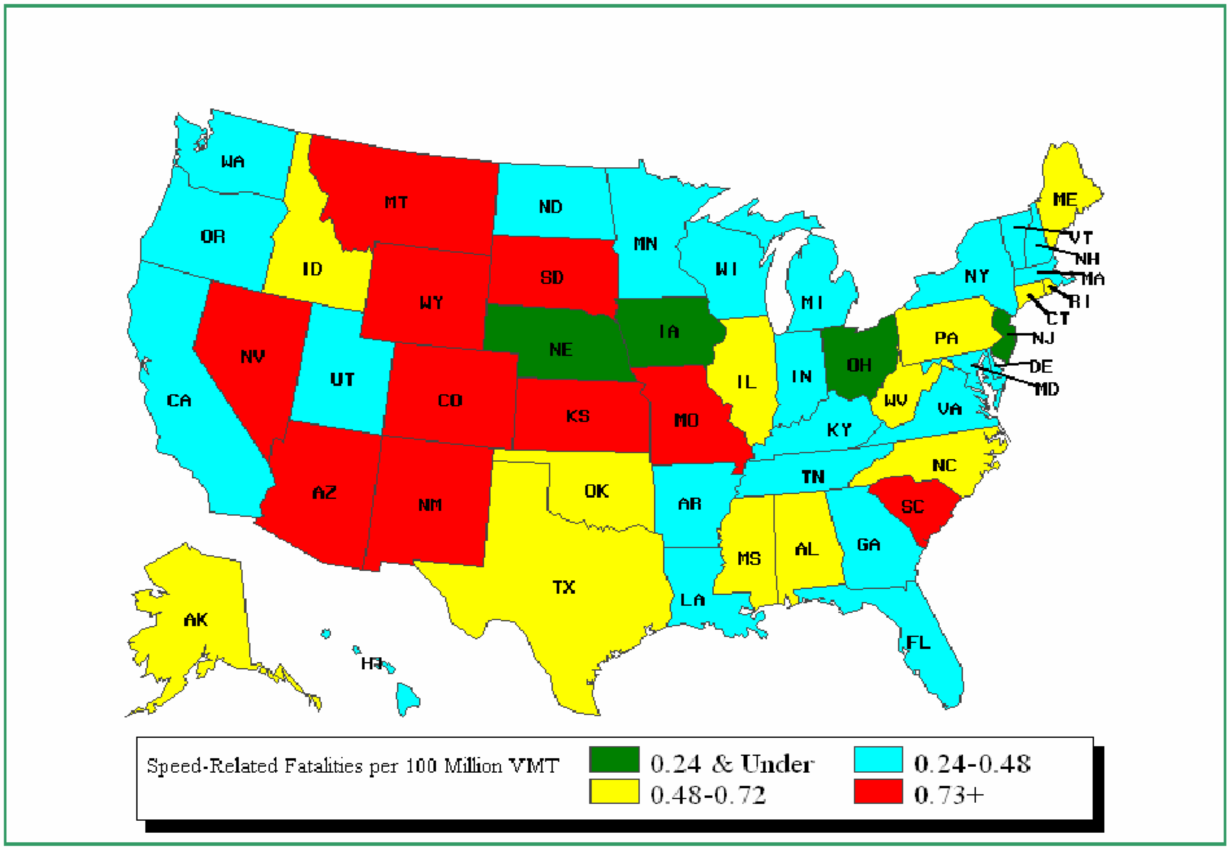
Speed-related crashes are a factor in rollover crashes, aggressive driving crashes, driver inexperience, restraint use, and fatal alcohol-related crashes. Efforts to reduce speed-related crashes and fatalities can include increased enforcement efforts, and the implementation of driver education and awareness campaigns.

Figure 24. Percentage of all Fatalities, Speed-Related, 1998-2003



As illustrated in the map below, South Dakota is one of a number of states that fall within the extreme for speed-related fatalities per 100 MVMT.

Figure 25. Speeding-Related Fatalities



During the years 1995 and 1996, 24 states (including South Dakota April 1, 1996) raised their speed limits, resulting in an increase in motor vehicle fatalities noted during the 1996-1997 years (IIHS, 1999). Based upon fatality rates per vehicle mile traveled, the researchers at the Insurance Institute estimated that motor vehicle fatalities increased 15 percent among the 24 states whose speed limits were raised, compared to seven states whose speed limits were not raised and experienced no increases at all.

An analysis of the dynamics of speed-related crashes illustrates that increased speeds decrease the amount of time drivers have to initiate crash avoidance maneuvers, thus increasing the likelihood of being involved in a crash, and additionally increasing the crash severity. According to Brian O'Neill at the Institute, the increase in speed limits translates into greater crash costs not only in dollars, but in loss of life as well. O'Neill estimates that hundreds more lives are lost on the country's roadways as a direct result of the increases in speed limits.

5.7 FOCUS AREA 6: YOUNG DRIVERS

Motor vehicle crashes are the leading cause of death for individuals 15 to 20 years of age. Although South Dakota does have a Graduated Driver's License law in effect, in its present form it does not prohibit newly licensed teenage drivers from transporting a carload of their peers beginning on day one. The purpose of the "no young passengers" component of the law is to allow a novice driver the time and opportunity to become more familiar and confident in being behind the wheel of a motor vehicle. Teen drivers are well-documented as being one of the highest-risk drivers on the road, especially for young male drivers. As shown in Table 11 below, a total of 218 young South Dakota drivers (age 14-20) were involved in a fatal crash, with 58.3 percent having at least one passenger with them at the time. As crash severity diminishes, so does the percentage of young drivers with passengers. For example, of the 26,626 teen drivers in crashes, a total of 64.6 percent were in a property damage only crash in which they were the only occupant in the vehicle.

Table 11. 1998-2003 Drivers Age 14-20 in Crashes by Severity and Number of Occupants

Crash Severity	Only 1 Occupant (the Driver)	2 or More Occupants (Driver Plus at Least One Passenger)	Total Number of Drivers
Fatal Crash	91	127	218
	41.7%	58.3%	
Incapacitating Injury Crash	1,138	1,093	2,231
	51.0%	49.0%	
Non-Incapacitating Evident Injury Crash	2,668	2,229	4,897
	54.5%	45.5%	
Possible Injury Crash	3,055	2,466	5,521
	55.3%	44.7%	
Property Damage Only Crash (Non-Injury)	17,202	9,424	26,626
	64.6%	35.4%	
Total Number of Drivers	24,154	15,339	39,493

Figure 26 displays the percentage of drivers involved in fatal crashes where the driver is between the ages of 14 and 20. The data are represented for South Dakota and all six of the comparison states for years 1998-2003. It is clear that South Dakota is not doing substantially better or worse than the peer states. In fact, this scenario depicts exactly the concern developed by the research group with regard to using a static number of comparison states for every index identified within the Problem Identification process. For example, in order to evaluate South Dakota against the top states that are leaders in Graduated Driver's Licensing and/or in reducing teen driver fatal crash rates, it would be optimal to first identify the lead states, and then make the comparisons to South Dakota. The critical factor is that no single state or small subset of states are going to be a top performer in every index that South Dakota has identified as its primary problems, as demonstrated below. Of the six states included in the figure, only Nevada is consistently lower than South Dakota across all years. Among the other states, there is much fluctuation in their percentages from year to year, with the second-least being displayed by New Mexico.

Figure 26. Percentage of Drivers in Fatal Crashes, Age 14-20, by State and Year

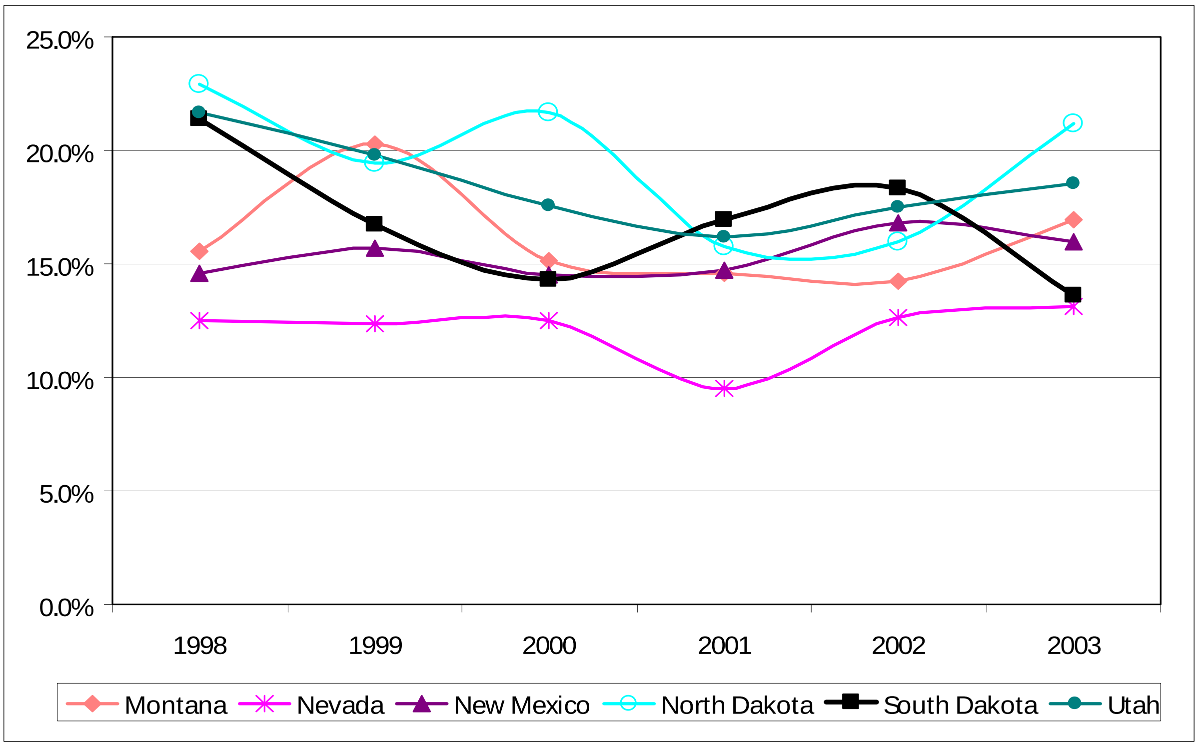
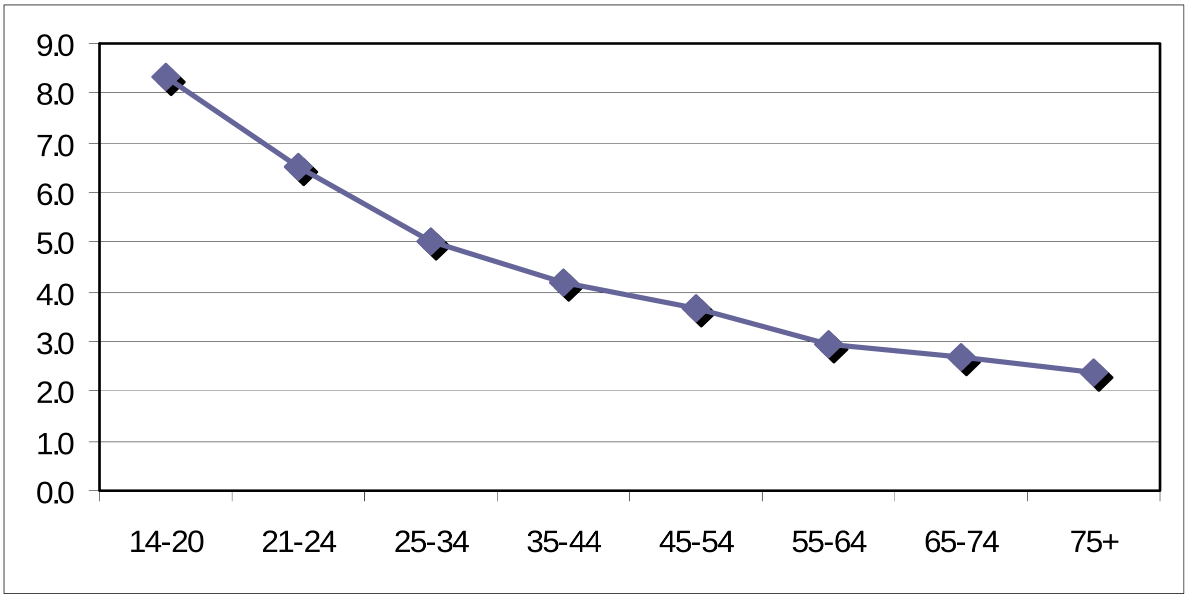


Figure 27 illustrates how crash-involvement per 100 licensed drivers diminishes as driver age increases, with a higher rate of decline from the 14-20 year old age group to the 25-34 year old age group. From age 35 and on, the rate of decrease is much flatter.

Figure 27. Crash Involvement Rate per 100 Licensed Drivers, by Age, 2003



CHAPTER 6: IMPLEMENTATION RECOMMENDATIONS

6.1 Focus Area 1: Underreporting of Native American Crashes

Recommendation 1. The primary recommendation is that the South Dakota Department of Transportation make funding available for an additional research project that will potentially incorporate members of the South Dakota legislature, South Dakota Office of Highway Safety, Nine South Dakota Indian Tribes, Bureau of Indian Affairs, and Indian Health Service. The primary goal of this project should be to assess the traffic records practices of the Nine South Dakota tribes and improve the completeness and accuracy of reports of traffic crashes by these tribes to the South Dakota Department of Public Safety.

Focus area one was clearly at the forefront of the data collection issues experienced while trying to fulfill the research requirements specified in the “Factors Contributing to South Dakota Crash and Fatality Rates” project number SD2003-15. It is readily acknowledged that while some tribes have very sophisticated crash reporting mechanisms in place, complete reporting of their motor vehicle crashes is not taking place. Further, other tribes do not have an established protocol to collect or disseminate their crash records (they do not have the proper state crash report forms or have not received the necessary training needed to complete a crash report).

The most logical way that a state can obtain a complete picture of its crash and fatality rates is by full data disclosure from every one of its law enforcement and crash investigation agencies. However, at the present time, South Dakota has no statewide mechanism in place that provides for this disclosure from sovereign tribal nations. Further, upon contacting numerous individuals throughout South Dakota as well as the comparison states, the lack of crash reporting for non-fatal crashes on Reservation lands is not unique to South Dakota—it is a problem that has been identified nationwide.

Within the confines of this research project, it was deemed impossible to acquire the crash data necessary to conduct the full data analysis. Nonetheless, this project was very instrumental in identifying that an amenable solution is needed so that the state can conduct complete crash data analyses and problem identification without infringing upon the tribes’ sovereignty.

As a result of the unsuccessful attempts to gather non-fatal crash data collected by Tribal or BIA police, the South Dakota Department of Transportation, Bureau of Indian Affairs, and the Indian Health Service have deemed it appropriate to pursue an additional research project to address this important issue. This project is currently in the planning stages and has the long-term potential of becoming the standard for a nationally-adopted model to be implemented in all states where sovereignty, cultural, or logistical issues are of concern.

South Dakota is primed to move forward in pursuit of these goals. The 2005 Annual Report of the Mountain-Plains Consortium Universities reported that transportation experts from Colorado, Minnesota, Montana, North Dakota, Washington, and Wyoming had a video conference during National Transportation Week to share ideas for improving transportation on reservation lands. An employee with the FHWA in Montana noted that it is a challenge to get tribes to submit crash reports to the state because it raises issues of sovereignty, and the state did not want to accept the crash reports without personal identifiers. The employee also noted that the Rosebud Reservation in South Dakota could serve as a model for other tribes in crash data collection procedures. South Dakota certainly has a good starting point in that it contains a reservation already publicly recognized by those who have worked on this problem for its crash data collection system (Mountain-Plains Consortium 2005 Annual Report). Charles Red Crow, Rosebud Chief of Police, confirmed that Rosebud has an excellent electronic crash records system in place and publishes a crash book every year.

The research objectives of such a project should be to evaluate the crash reporting practices on all nine Indian reservation lands in South Dakota, identify barriers to accurate reporting on reservations, recommend methods for improvement, and ultimately improve the completeness of an identified calendar year of crash data reported to the South Dakota Department Office of Highway Safety. A research project of this magnitude would need to involve liaisons from all nine tribes in South Dakota. These nine liaisons would need to work closely with the principal researchers, the South Dakota Office of Highway Safety, the Indian Health Service, and the BIA. The efforts to evaluate the crash reporting practices on all nine Indian reservations and assess the completeness of the data as reported to the state should come with a systematic and careful documentation of findings. If possible, every effort should be made to work with tribes to complete a preliminary assessment of how many crashes the state might be missing, both in terms of fatal and nonfatal crashes. The degree to which this undertaking can be completed will largely vary depending on the traffic records situation within each tribe. If at all possible, these nine liaisons should work closely with the South Dakota FARS analyst to assess discrepancies between records of fatal crashes that the state received as compared to what the tribe has on record. If the project goal of improving crash reporting from reservation areas is ultimately achieved, there is a possibility it will be discovered that fatal crash reporting also has room for improvement and South Dakota could experience an artificial increase in fatality rates. Documenting any records discrepancies for a calendar year of data prior to the implementation of any plans that will enhance the completeness of the Office of Highway Safety’s data will be critical in order to establish the true cause of the apparent increase in fatality rates. Establishing this groundwork will lay the foundation to most effectively bring any project successes and results to national attention in terms of their implications for other states and the potential accuracy of reported fatality rates.

There were numerous potential barriers encountered trying to acquire accurate and complete crash data reporting from these reservation areas, and it is suggested that this become a primary goal of the project will be to discern these barriers and meet with the tribal representatives to ascertain if they can be overcome. Most likely, the situation will be unique for each South Dakota tribe, and such a project will need to involve a large coordinated effort spanning many areas of expertise, and a great deal of time and care. A July 2003 report entitled, "Traffic Accident Reporting on Indian Reservations in Montana," by Cordell Ringel documents efforts to determine the primary cause for the historically low reporting of motor vehicle crashes to the Montana Highway Patrol from BIA and Tribal Law Enforcement. Individual meetings were held with Montana tribes to determine if tribes objected to establishing a system to report traffic crashes to the state. The project revealed that about one half of the tribes in Montana supported reporting traffic data to the state and recognized the benefits, while the other half did not, for varying reasons such as "confidentially of data, jurisdictional issues, sovereignty of Tribes, concern about racial stereotyping, a general mistrust of state, past experiences of dealing with the state, etc." Some tribes reported that they would be willing to share data if the state was willing to remove certain fields such as personal identifiers and Social Security Numbers. The findings in studies such as these should be carefully reviewed by the researchers who undertake this task in order to be as familiar as possible with potential roadblocks that might be encountered in these discussions and formulate potential planned responses and alternatives. Ultimately, in these endeavors, working to get more accurate and complete crash data should be the priority, without infringing upon the sovereignty of the tribes (Ringel, C., 2003).

Clearly, entering into conversations with the nine tribes, assessing the state of their traffic records and discrepancies between tribal records and those of the state, and implementing a system to improve reporting to the state is a daunting and multi-stage task that should be given careful consideration and time to complete.

Recommendation 2. To further enhance the crash data evaluation system, the South Dakota Department of Transportation should seek to fully support the reinstating of the Crash Outcome Data Evaluation System (CODES) in South Dakota.

To further enhance the crash data evaluation system, or in the event this additional research project does not come to fruition or is unsuccessful, there are other alternatives for trying to build a comprehensive crash location and identification database. One such opportunity is using the Crash Outcome Data Evaluation System (CODES). CODES evolved from a congressional mandate to report on the benefits of safety belts and motorcycle helmets. NHTSA has funded Alaska, Arizona, Connecticut, Delaware, Georgia, Hawaii, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, Nevada, New Hampshire, New Mexico, New York, North Dakota, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, and Wisconsin to link statewide crash and injury data. Probabilistic linkage techniques make it possible for the states to link large state data files in a short time at relatively low cost. Crash data are collected at the crash scene and then linked to injury outcome data also collected at the scene, en route to the emergency department, at the hospital or trauma center, and after discharge. The type of injuries, their severity, and the costs incurred by persons injured in motor vehicle crashes are described and computerized. The linked crash outcome data are also linked to other traffic records such as vehicle registration, driver licensing, citation and roadway inventory data in order to generate more comprehensive information to evaluate highway safety. Linked data identify the types of injuries and the costs that result from specific driver, vehicle, and crash characteristics.

One challenge to the state's trying to establish quality data linkages among the various agencies could potentially exist with Tribal and BIA trauma centers and hospitals. Without a collaborative agreement, disclosure of EMS and treatment data may not be available, thereby prohibiting the necessary data linkages.

Randy Stuefen at the University of South Dakota has confirmed that CODES is already being re-established in South Dakota and that reports will be issued again with a year. This program currently needs to receive ongoing support and recognition from users.

Recommendation 3. For the next update of the South Dakota crash form, it is also recommended that a designator be added that indicates whether a crash occurred under the geographic jurisdiction of the tribal police. This will provide another opportunity to properly code and identify personal injury and property damage crashes on tribal lands.

6.2 Focus Area 2: Rollover Crashes

Recommendation 4. The recommendations pertaining to increased and high visibility enforcement for the focus areas of alcohol, speeding and occupant protection should be implemented locally in light of an evaluation of roadway characteristics and demonstrated crash particulars. Because speeding and alcohol use directly contribute to rollover crashes and a lack of restraint is particularly deadly in these crashes, an integrated approach should be adopted in an effort to maximize lives saved. Additionally, roadway characteristics of areas of high incidence of rollover crashes should be reviewed in an effort to improve conditions or more thoroughly alert the driving population to potential rollover risks. For example, rollover crashes, especially at curves are most often due to excessive speed, and a repeated media/public awareness campaign that reminds motorists of the dangers of rollover crashes will aid in reducing the frequency of these types of crashes.

6.3 Focus Area 3: Restraint Use

Recommendation 5. Strong support for a primary law needs to be championed by the South Dakota Department of Transportation, and year-round dedication to the education regarding the need for the law must continue. At the present time, South Dakota continues as a secondary law state for seat belt use for all occupants age 18 or older (the law is primary for occupants 0-17 years of age). However, in 1998, the percentage of motor vehicle occupant fatalities that were restrained was only 24.3 percent. By 2003, this rate had plummeted to 18.0 percent.

Recommendation 6. Implement highly organized and visible safety belt enforcement efforts (sTEP campaign).

The key to the success of this program is that it is persistent in message, enforcement, and media, and it needs to be a recurring event no less than 2-3 times a year, every year. Previous attempts at occupant protection efforts in South Dakota have been isolated, singular events that were not sustained, and thus were more or less ineffectual. The extent to any restraint use gains achieved needs to be evaluated and compared to previous levels so that benchmarks, goals, and progress can be established and monitored.

6.4 Focus Area 4: Alcohol

Recommendation 7. It is recommended that the South Dakota Department of Transportation continually lobby for an Administrative License Revocation/Suspension or a Mandatory License Revocation/Suspension for BAC test refusals and failures.

In the Impaired Driving State Cost Fact Sheets developed by the Pacific Institute for Research and Evaluation in 2002, it is documented that "Laws that allow police or driver licensing authorities to revoke a driver's license swiftly and automatically for refusing or failing a BAC test have reduced alcohol-related fatalities by 6.5 percent on average and saved an estimated $49,800 per driver sanctioned. The value of the driver's lost mobility is the large majority of the estimated $2,500 cost per driver sanctioned. Reinstatement fees assessed to offenders typically cover start-up and operating costs."

Additionally, according to Mothers Against Drunk Driving, an administrative license revocation (ALR) is the removal of a DUI/DWI offender's driver's license *at the time of an arrest* upon the failure or refusal of a chemical test. This distinction is important–administrative revocations are immediate in nature and, because of this factor, ALR is one of the most effective ways to deter people from driving under the influence of alcohol and thus prevents crashes and loss of lives.

ALR laws are effective in saving lives. When states pass ALR laws, their fatal late-night crashes decrease by an average of nine percent. Because of decreases in crashes, costs to the state are decreased. A study of ALR laws in Illinois, Mississippi, and Nevada found that the startup and operating costs of administrative license revocation are covered by reinstatement fees and that the savings in costs associated with nighttime crashes ranged from $37 million to $104 million in those three states alone. Studies have shown that license revocations do not lead to losses of job or income; also, fears like these give ALR its deterrent effect. Additionally, the Supreme Court found in *Mackey v. Montrym* (1979) that ALR does not violate due process rights.

Mother's Against Drunk Driving have made a rather strong case that administrative license revocation is effective and it makes sense. Furthermore, driving is a privilege that is granted via compliance with the rules of the road, not a right, and those who abuse the privilege should have it removed. This should be a primary area for concern for South Dakota.

Recommendation 8. South Dakota should continue to increase highly visible impaired driving enforcement efforts as described in the South Dakota Highway Safety Plan.

The effectiveness of highly visible and sustained impaired driving enforcement campaigns has been well documented. In the Guide to Community Preventive Services, December 2002, a systematic review of published studies on behalf of the Task Force on Community Preventive Services discerned strong and compelling evidence for the effectiveness of sobriety checkpoints in reducing alcohol-related crashes and deaths. Twenty-three different studies were reviewed and crashes involving alcohol dropped a median of 20 percent subsequent to an implementation of sobriety checkpoints, while fatal crashes involving alcohol dropped a median of 23 percent.

The Impaired Driving State Cost Fact Sheets developed by the Pacific Institute for Research and Evaluation in 2002, it's estimated estimate that highly intensive sobriety checkpoint program would reduce alcohol-related fatalities in South Dakota by 15 percent and ultimately save approximately $57,600 per checkpoint. South Dakota receives a C from MADD for current efforts of law enforcement to conduct highly visible checkpoints. However, it does not receive a higher score due to the fact that participation is only periodic and there is no comprehensive year-round statewide DUI enforcement program. South Dakota needs to follow through on those plans noted in the 2006 Highway Safety Plan to continue to work to develop and implement a statewide sustained highly visible enforcement plan.

6.5 Focus Area 5: Speeding

Recommendation 9. Promote engineering, education, and enforcement activities that specifically and effectively address the issue of speeding.

Research data is necessary to evaluate the net impact on lives lost by increasing or decreasing the posted speed limits on South Dakota's roadways. Additionally, enforcement efforts need to be geared at establishing recognized speed limit thresholds for which the motoring public readily complies. An all-encompassing effort enlisting the assistance and support of all stakeholders within the traffic safety arena (state and local law enforcement, engineering, public education, prosecutorial, judicial, and tribal) to implement a reduction in the incidence of speeding-related crashes within the state is also recommended. The key to this recommendation is the adoption and maintenance of an ongoing, unified approach that encompasses all aspects of enforcement, education, engineering, and evaluation.

6.6 FOCUS AREA 6: YOUNG DRIVERS

Recommendation 10. South Dakota's current Graduated Driver's License law does not prohibit or restrict the transport of passengers younger than the age of 18. In an effort to reduce the loss of life on South Dakota's roadways, the primary recommendation is to adopt this restriction for no less than 90 days, with strong enforcement and zero tolerance components to support the state's commitment to the efforts.

A critical principle of the Graduated Driver's License law is that the teen drivers and their parents need to be educated on the importance and rationale of the law, despite the temporary restrictions it places on the teen driver's ability to transport young siblings, neighbors, or friends. Ensuring that a young, novice driver has every opportunity to become better equipped to handle the challenges of driving a motor vehicle is a burden that must be shared not only by the Bureau of Motor Vehicles as the licensing agency, not only by law enforcement as upholders of the law, not only by driver's education curriculums as educators and role models, not only by the parents as the setters of the example teens are expected to follow, but also by the teen drivers themselves taking a proactive, potentially life-saving stance through law-abiding compliance.

Research conducted by the Insurance Institute for Highway Safety found that the passenger restrictions are:

> "…essential components of graduated licensing. Crash risk for teenage drivers increases incrementally with one, two, or three or more passengers. With three or more, fatal crash risk is about three times higher than when a beginner is driving alone."
>
> "Passenger presence is a major contributor to the teenage death toll. In 2003 almost half of the crash deaths that involved 16-year-old drivers occurred when the beginners were driving with teen passengers. Studies indicate that passenger restrictions can reduce this problem."
>
> "States with graduated licensing report that the benefits far outweigh any costs. For example, in Oregon the administrative costs were estimated at $150,000 while the benefits were

estimated at nearly $11 million. This amounts to a benefit-to-cost ratio of better than 74 to 1. Maryland and California also report lifesaving and injury-reducing benefits well in excess of administrative costs," (IIHS, 2005).

CHAPTER 8: ANALYSIS OF RESEARCH BENEFITS

Clearly, the specific benefits of a full implementation of all recommendations are difficult to quantify fiscally due to all of the unknowns surrounding South Dakota's complete crash numbers. However, the research has revealed that South Dakota could benefit from taking an aggressive approach to addressing key traffic safety concerns that contribute to high crash and fatality rates, in conjunction with an effort to improve crash records. As a result of this research endeavor, the Department of Transportation currently recognizes the importance of making every effort to obtain accurate and complete crash records in order to properly monitor traffic safety performance. In addition, there is a clearer picture of how the omissions from the crash database fully impact the understanding of the South Dakota's key traffic safety concerns and factors contributing to crash and fatality rates. Working fully to combat the identified traffic safety problems in conjunction with striving to increase understanding of these traffic safety concerns by improving records will ultimately leave South Dakota better equipped to save lives and monitor progress from year to year.

WORK CITED

Agran, Phyllis F., *et al.* "Factors Associated with Restraint Use of Children in Fatal Crashes," *Pediatrics*. Sept. 1998. (http://www.pediatrics.org/cgi/content/full/102/3/e39).

Boyle, J.M. and Vanderwall, P. 2003. 2003 Motor vehicle occupant safety survey, volume 2: safety belt report. Report no. DOT-HS-807-789. Washington, DC: U.S. Department of Transportation.

Farmer, C.M., and Williams, A.F. 2004. Effect on fatality risk of changing from secondary to primary seat belt enforcement. Insurance Institute for Highway Safety, December 2004.

Insurance Institute for Highway Safety, 1999. Motor vehicle deaths 15 percent higher on roads in 24 states that raised speed limits: http://www.highwaysafety.org/news/1999/iihs_news_011499.pdf, January 14, 1999.

Insurance Institute for Highway Safety, 2005, Q&A: TEENAGERS—GRADUATED DRIVER LICENSING. http://www.highwaysafety.org/research/qanda/gdl.html#11, as of July 2005.

Mother's Against Drunk Driving, http://www.madd.org/activism/0,1056,7586,00.html#VTF.

Mountain-Plains Consortium 2005 Annual Report. http://www.mountain-plains.org/about/annrpt/2005AnnRpt.pdf.

National Safety Council, 2003. "The Evidence Is In: Adults Who Don't Buckle Up Have a Dangerous Impact on Children's Safety," http://www.nsc.org/public/airbag/Driver_Child_Facts_revised.doc, September 2003.

"National Occupant Protection Use Survey: Controlled Intersection Study," National Center for Statistics Analysis (U.S. Department of Transportation National Highway Traffic Safety Administration, Washington, DC), Aug. 1997.

NHTSA, 2003. South Dakota Buckle up Badlands, Traffic Safety Digest, Summer 2003.

NHTSA. 2004. Safety Belt Use Estimate for Native American "Tribal Reservations" Subject to Tribal Law and Tribal Traffic Enforcement, Traffic Safety Facts, September 2005, Number 304.

Poindexter, K. 2004. Fatal Motor Vehicle Crashes on Indian Reservations 1975-2002. National Highway Traffic Safety Administration, April 2004.

Preusser, D.F.; Solomon, M.G.; and Cosgrove, L.A. 2004. Minorities and primary versus secondary belt use enforcement. *Transportation Research Circular*, *TR Circular E-C072,* January 2005, 23-29.

Public Services Research Institute, http://www.nhtsa.dot.gov/people/injury/alcohol/SD.htm Cooperative Agreement No. DTNH22-97-H-55072.

Rating the States 2002. MADD. http://www3.madd.org/laws/grades.cfm.

Shults RA, Sleet DA, Elder RW, Ryan GW, Sehgal M. Association between state-level drinking and driving countermeasures and self-reported alcohol-impaired driving. *Inj Prev* 2002;8:106–10.

Taylor, D., Miller, T. and Cox, K. The Impaired Driving State Cost Fact Sheets. The Pacific Institute for Research and Evaluation (PIRE), 2002.

The Guide to Community Preventive Services, 2002. Effectiveness of Sobriety Checkpoints for Preventing Alcohol-Involved Crashes. http://www.thecommunityguide.org/mvoi/mvoi-alc-sobr-chckpts.pdf, December 27, 2002.

Traffic Accident Reporting on Indian Reservations in Montana (TARS) Final Report. Cordell Ringel. Prepared for the Western Transportation Institute. College of Engineering, Montana State University–Bozeman. July 7, 2003.

U.S. Department of Transportation, 2005. Speed Management Strategic Initiative, June 2005.

APPENDIX A: SURVEY REGARDING NATIVE AMERICAN REPORTING FOR NSCA TRAFFIC RECORDS TEAM MEMBERS

Hello _________________,

My transportation safety research group is working on a project that includes a sample of states' reporting practices for motor vehicle crashes involving Native Americans and/or on Native American lands. We are trying to assess the varying levels of crash reporting among states with a large Native American population with respect to how under-reporting or a lack of reporting influences the data analysis. The states we are interested in are Montana, Nevada, New Mexico, North Dakota, South Dakota, Utah, and Wyoming.

We would appreciate it if you could tell us:

1. if there is a reporting process in place to track the number and/or severity of motor vehicle crashes occurring on Native American tribal lands within your state;
2. how are those reports collected and received (collected by state, county, local law enforcement, tribal authorities, or self-reported);
3. do the numbers you report to NHTSA, FHWA, etc., include crashes that occurred on Native lands;
4. finally, is crash reporting on tribal lands limited only to fatal crashes, or does it include all property damage and personal injury crashes as well?

Anything else that you think might be relevant would also be most appreciated. Please do not hesitate to call or email if you have any questions regarding this request.

Thank you in advance for your assistance,

Ruth A. Light

APPENDIX B: QUESTIONNAIRE TO BE SENT TO NATIVE AMERICAN TRIBAL REPRESENTATIVES REGARDING AVAILABLE CRASH DATA AND REPORTING PRACTICES

Please answer the following questions:

1. Does your tribe/band/pueblo currently report property damage and personal injury motor vehicle crashes to the state? (Circle one) Yes No

   Because some of the tribal lands in this study cross multiple states, could you please indicate to which state(s) reports are sent: ____

   If you would like to make any other comments regarding the reporting of property damage and personal injury crashes, please do so here:
   ____
   ____
   ____

2. Does your tribe/band/pueblo currently report fatal injury motor vehicle crashes to the state? (Circle one) Yes No

   Because some of the tribal lands in this study cross multiple states, could you please indicate to which state(s) reports are sent: ____

   If you would like to make any other comments regarding the reporting of property damage and personal injury crashes, please do so here:
   ____
   ____
   ____

3. If your tribe/band/pueblo does not report motor vehicle crashes to the state, do they keep records of these crashes? (Circle one) Yes No

   If yes, would your tribe/band/pueblo be willing to share these records with the Center for the Advancement of Transportation Safety for this study? (Circle one) Yes No

   If your tribe/band/pueblo is willing to share crash records, please fill in the following information, and the Center for the Advancement of Transportation will contact you regarding this matter.

   Contact's Name: ____
   Contact's Position/Title: ____
   Telephone Number: ____

4. Does your tribe/band/pueblo routinely request aid from non-reservation police forces in order to investigate property damage and personal injury crashes? (Circle one) Yes No

5. Does your tribe/band/pueblo routinely request aid from non-reservation polices forces in order to investigate fatal injury crashes? (Circle one) Yes No

6. Does your tribe/band/pueblo have any traffic safety programs/initiatives regarding drinking and driving? (Circle one) Yes No

If yes, please list the programs/initiatives, as well as who sponsors/runs them:

____

7. Does your tribe/band/pueblo have any traffic safety programs/initiatives regarding child passenger safety? (Circle one) Yes No

If yes, please list the programs/initiatives, as well as who sponsors/runs them:

8. Does your tribe/band/pueblo have any traffic safety programs/initiatives regarding teen drivers? (Circle one) Yes No

If yes, please list the programs/initiatives, as well as who sponsors/runs them:

9. Does your tribe/band/pueblo have any traffic safety programs/initiatives regarding seat belt usage? (Circle one) Yes No

If yes, please list the programs/initiatives, as well as who sponsors/runs them:

10. Does your tribe/band/pueblo have any traffic safety programs/initiatives regarding speeding? (Circle one) Yes No

If yes, please list the programs/initiatives, as well as who sponsors/runs them:

11. Does your tribe/band/pueblo any other traffic safety programs/initiatives? (Circle one) Yes No

If yes, please list the programs/initiatives, as well as who sponsors/runs them:

12. Does your tribe/band/pueblo have emergency response available in your area? (Circle one) Yes No

13. If emergency response is available, how is it organized?

14. Do the members of you tribe/band/pueblo have access to health facilities **on** the reservation/ tribal lands where your tribe/band/pueblo is located? (Circle one) Yes No

If there are not health facilities available on the reservation, are there health facilities located **near** the reservation? (Circle one) Yes No

If there are neither health facilities on or near the reservation, approximately how far (in miles) must a member of the tribe/band/pueblo travel in order to receive medical treatment?

____
____
____

If you have any other comments regarding the availability of emergency response and health facilities, please write them here:

____
____
____

Thank you for taking the time to complete this survey. If you have indicated that you may be willing to share crash reports with CATS, we will contact you shortly after receiving this information.

APPENDIX C: BRIEF QUESTIONNAIRE SENT TO FARS DESK REPRESENTATIVES

FARS ANALYST SURVEY

Please enter the name of your state:_______________________________

1. Overall, what percentage of all fatal crashes occurring in your state would you feel **confident** the FARS desk obtains a record of and includes in the fatality numbers released by NHTSA? (Please provide your best estimate)

__0-24% __25-49% __50-74% __75-89% __90-99% __100%

2. Please consider only those fatal crashes in your state that fall under the jurisdiction of the BIA or tribal police. What percentage of fatal crashes investigated by these agencies would you feel **confident** the FARS desk obtains a record of and includes in the fatality numbers released by NHTSA? (Please provide your best estimate)

__0-24% __25-49% __50-74% __75-89% __90-99% __100%

3. Describe what considerations led you to the final estimations you provided in questions one and two, such as critical elements of FARS reporting practices that justify high estimations or crashes that could potentially be unreported. For your response to question two, we are particularly interested in details pertaining to the process of collecting fatal crash reports from the BIA/tribal police, successes or challenges, formal investigations that have been made into crash reporting from Indian Reservations in your state, particular tribes that do/don't submit fatal crashes, etc.

____
____
____

4. For all fatal crashes entered into the FARS database, do you use any other sources to research the crash (aside from the crash report)? If so, what are they and how do you obtain them?

____
____
____

5. Specifically, do you send out any follow-up supplemental forms to the investigating law enforcement agencies? What is the procedure for doing so and what information is collected? If you are willing to share these forms with Purdue CATS, please send the forms either as an attachment or via fax.

____
____
____

6. For those reports from the BIA/tribal police that you *do* receive, are there any unique problems with obtaining/interpreting the crash reports, data quality, or follow-up research?

____
____
____

7. For <u>all</u> fatal crashes that you receive, are there particular key crash elements that are frequently incomplete, hard to obtain, or suspected to be inaccurate?

____
____
____

8. The special jurisdiction variable in the FARS database requires that a crash be coded as on "Indian Reservation" if it takes place on Federal Indian Reservation land. However, NHTSA has noted in a technical report that the designations made at the state level could be done differently, and in some cases might conflict with Indian Reservations recognized by the Federal government. We would like you to describe how your FARS Analyst interprets and codes this variable. It would be helpful if you could be as specific as possible (discuss precisely what conditions must be met for a crash to be coded as on reservation, what resources are used, what reservations are recognized, what specific maps and boundaries are used for these reservations, etc.)

____
____
____

APPENDIX D: SOUTH DAKOTA STRATIFIED COUNTY RANKINGS-PROBLEM IDENTIFICATION

Explanation of Supporting Material

Introduction:

As a way of further evaluating highway traffic safety performance in South Dakota, a series of tables have been developed to assist in this evaluation and better enable program managers to develop specific counter–measure programs to fit the needs of the individual counties. Indices have been developed for which to assign a score to each county in South Dakota. Along with a score for each index, a rate of change in the score has also been computed for each county so that improvement or deterioration in the score can be measured. Rather than using results from a single year, the results have been calculated using data from the most recent three years available (2001–2003), data from 2000–2002, and data from 1999–2001 (resulting in three data points that represent three different three–year moving averages).

Summary of Information Contained in the Three Stratified County Ranking Tables:

Urban, Rural, Native American Categorization Scheme

Each table divides the 66 counties in South Dakota into three categories–urban, rural, and Native American. Following is an explanation of the rationale behind this categorization system.

There are nine Sioux tribes in the state of South Dakota, and it is suspected among highway safety and SDDOT personnel that crashes taking place on reservation lands or areas falling under tribal jurisdiction are under–reported to the state of South Dakota. For this reason, results from counties predominantly covered by areas under tribal jurisdiction should be viewed as incomplete and suspect for the purposes of these county rankings. It is likewise virtually impossible to divide the 66 South Dakota counties cleanly into “trustworthy” versus “not trustworthy” categories, as tribal jurisdiction areas spill over into many of the 66 counties and do not follow county lines. Just as one example, the official Rosebud reservation boundaries, (as presented in maps made available by the South Dakota Department of Transportation), appear to line up with Todd County boundaries. However, Charles Red Crow, the Rosebud Chief of Police, reports that in practice their jurisdiction spans five South Dakota counties and is completely checkerboard throughout–meaning that not all areas under tribal jurisdiction are contiguous. As a second example, the Roberts county sheriff reports a similar situation in his area. However, the Sisseton Wahpeton reservation is actually a former reservation whose boundaries were disbanded several years ago and no longer appears on the South Dakota Highway map. While official reservation boundaries no longer exist, the sheriff reports that the tribe still does own land within the county, so there are "checkerboard" jurisdictions for the purposes of crash reporting. Again, the state or county authorities have jurisdiction over the crash only if it occurs off tribal land, or if it involves a non–tribal member.

Ideally, for the purposes of crash data analysis, there would be a systematic way to isolate all geographic areas within the state that were suspected to have incomplete crash data and treat them separately from those areas that were believed to be complete. However, there is no place on the crash form to indicate the area of jurisdiction, and this is not always even easy for an officer to determine. The checkerboard jurisdictions scattered throughout the state within each county, along with the added consideration of the tribal membership of the individual, makes this a complicated and daunting task at the statewide level. In addition, there are also so few crashes in South Dakota each year, working with smaller geographic areas would be both more difficult and less meaningful in terms of analysis.

In order to take a more broad approach for the purposes of producing county rankings, race data from the Census Bureau data was examined. Fortunately, this data is available broken down by county and allows one to compare the specific estimated degree of tribal presence in each county in terms of an actual population number. Between 1998–2003, there was a convenient break point in the makeup of the population for each county. Only 12 counties had an estimated population that was 29.0 percent or higher American Indian or Alaska Native. (Shannon is the highest of these 12, at 94.8 percent, and Charles Mix is the lowest, at 29.0 percent.) The next lowest county in South Dakota after these 12 is Moody (at a level of 13.0 percent). The state total is 8.6 percent. These 12 counties do appear to include a majority of the counties that would be expected to be covered by the largest portion of tribal jurisdiction area, based on state maps showing official reservation boundaries. While one must keep in mind that many of the other counties contain at least *some* portion of land and population that would be under tribal jurisdiction for the purposes of crash reporting, these 12 counties have the highest Native American population. They would be expected to potentially suffer from the *largest* degree of underreporting.

Additionally, there are only 15 out of 66 counties in the state of South Dakota who have any annual vehicle miles of travel within the county classified as "urban," based on the South Dakota Vehicles Miles of Travel Reports by County prepared by the South Dakota Department of Transportation for 1998 through 2003. None of these 15 counties would fall under the "Native American" classification as described above (the closest is Hughes, which is partially covered by Crow Creek land and has a population that is 9.2 percent American Indian or Alaska Native.) Between 1998 and 2003, these 15 counties alone accounted for an estimated 55.9 percent of the entire state's vehicle miles traveled, 67.1 percent of all South Dakota registered vehicles, 70.2 percent of all licensed drivers, 67.5 percent of the state's total population, 71.3 percent of the state's reported crashes, and 45.3 percent of the state's reported fatal crashes. Thus, county scores are presented in three categories–urban counties, rural counties (those remaining 39 counties that have no urban VMTs and do not fall into the Native American classification), and Native American counties (those 12 counties that are rural but fall into the Native American category as discussed above). The categorizations are intended to aid the interpreter in easily estimating which counties might be expected to be at the most extreme end of the underreporting scale (the most untrustworthy results), and which contain urban jurisdictions (since there are so few that do, these jurisdictions would provide unique driving environments).

Specific county results are primarily intended to be used just for the 15 urban counties. Firstly, these areas do not fall into the Native American category and are believed to have more complete and trustworthy results, (while scores for the Native American counties would certainly be less meaningful.) Secondly, there are so few crashes in many of the other rural South Dakota counties, for particular indices analysis is simply much less meaningful (as there is large fluctuation in results from year to year). In some instances, a value for a particular index cannot even be computed for the county, as there are no crashes or drivers of the type needed to compute a score. In these instances, a value of N/A (not applicable) appears. However, while the tables are primarily intended to be used for specific comparisons between the 15 urban counties, results for all 66 counties have been included simply for reference, with the understanding that the non–urban county results should be used and interpreted with caution. The inclusion of all three categories also allows the interpreter to compare the three total scores for all crashes within counties of each of the three categories. These category totals obviously refer to a larger number of crashes and present an interesting way in which to break down some of South Dakota's traffic safety problems.

Ability to Sort Data

For the counties within each category in all 3 tables, results can be sorted by any data column(s), or alphabetically by county. In their default state, the counties are sorted alphabetically within each category, but the user can easily rank the counties within a category on any index by simply sorting by the selected data column(s).

Table I–State of South Dakota Problem Identification, Traffic Safety: 1999–2001, 2000–2002, and 2001–2003

Table I provides information on the percentage of all drivers in crashes that were aggressive (either speeding or engaging in other aggressive behaviors), restraint use, age–related crashes, and rollover crashes for each county. These results are intended to aid the state in identifying particular counties of concern for each of the prior crash problem areas.

Table II–State of South Dakota Outcome Severity: 1999–2001, 2000–2002, and 2001–2003

Table II provides information on the raw number of total crashes, total fatal crashes, total injury crashes, total PDO crashes, total fatalities, and total injuries in each county. All of the prior figures are also expressed as rates per 100 million VMT. These indices are intended to provide summary information to aid the state in identifying which counties have the most severe outcomes (both in terms of the raw number of crashes, fatalities, and injuries, and the rates per VMT). In addition, an index corresponding to the percentage of all reported crashes that are fatal is included in Table II as well.

Table III–State of South Dakota Alcohol–Related Problems: 1999–2001, 2000–2002, and 2001–2003

A separate table that focuses on only alcohol–related problems has been included in order to aid the state in identifying particular counties of concern for alcohol–related problems. Table III provides information on the percentage of all crashes, injury crashes, fatal crashes, and PDO crashes that were alcohol–related, in addition to the total number of alcohol–related crashes, injury crashes, fatal crashes, and PDO crashes per 100 million vehicle miles traveled. Table III also includes the percentage of 21–24 year olds drivers, 25–34 year old drivers, 35–44 year old drivers, and 14–20 year old drivers involved in crashes that were alcohol–involved. Finally, it includes an index that represents the percentage of drivers involved in crashes who were offered a BAC test (tested or refused a test).

Items Common to Each Table:

Actual Score for Each Index

For each table, different indices are presented, and each county is assigned a score on each index. The title of the index should be examined to determine what the scores for a given index represent. For example, in Table 1, the first index is titled “Percentage of Crash–Involved Drivers Aggressive.” As the title suggests, the scores appearing for each county represent the percentage of all crash–involved drivers in each county that were engaging in an aggressive behavior. If the urban counties were sorted by this column, the county with the highest score would be the “worst” in terms of the extent of the aggressive driving problem as a factor in its crashes. As a second example, in Table II there is an index titled “Total Crashes per 100 MVMT.” The score for this index represents the number of total crashes per 100 million vehicle miles traveled for each county.

Note that for each of the tables, there are 3 different tabs–the first tab represents the most recent scores (2001–2003), the second tab represents results for 2000–2002, and the third represents results for 1999–2001. These three tabs represent three–year moving averages. For example, the scores in the 2001–2003 version of each table represent the yearly average for the most recent three-years of data available (2001, 2002, and 2003). In addition, the data is always weighted with the most recent data weighted higher in order to emphasize recent performance. The most recent year is weighted at 1.0, the prior year weighted at 0.9, and the earliest year weighted at 0.8. For example, for the 2001–2003 version of each table, scores for 2003 are weighted at 1.0, scores for 2002 are weighted at 0.9, and scores for 2001 are weighted at 0.8, and the presented values represent the three-year weighted average.

Yearly Rate of Change

In all three tables, note that every index includes both the score for that index, and the yearly rate of change in the score for that index. Yearly rate of change is an indicator of how fast the results for that index are changing on average per year for the presented three-year period, and in which direction the change is. A negative (–) sign indicates that in that particular category, the annual rate of change is negative (the score is decreasing). A positive rate of change indicates that the score is increasing. However, only by looking at the particular indicator can you determine whether performance is deteriorating or improving. As an example, a negative rate of change for a seat belt use score would indicate deteriorating performance, while a negative rate of change for the total number of crashes would indicate a reduction in the number of crashes—or an improving performance. The magnitude of the rate of change indicates the extent of improvement or deterioration.

For example, for the index in Table 1 entitled "Percentage of Crash–Involved Drivers Aggressive," for 2001–2003 (the most recent data point), Davison county has the highest (and thus worst) score for all the urban counties, 39.73. Davison's yearly rate of change for this score is 0.77. This is computed by taking the rate of change in the score for each year in the 2001–2003 period, and computing the weighted average. In other words, in order to compute the rate of change from the prior year for 2001, the raw change in the score from 2000 to 2001 is computed, this raw change is divided by the baseline 2000 score, and the resulting figure is multiplied by 100 to get the rate of change in the score from 2000 to 2001. Similarly, in order to compute the rate of change from the prior year for 2002, the raw change in score from 2001 to 2002 is computed, this raw change is divided by the baseline 2001 score, and the resulting figure is multiplied by 100 to get the rate of change in the score from 2001 to 2002. Finally, in order to compute the rate of change from the prior year for 2003, the raw change in the score from 2002 to 2003 is computed, this raw change is divided by the baseline 2002 score, and the resulting figure is multiplied by 100 to get the rate of change in the score from 2002 to 2003.

$$\text{Rate of change from prior year for 2003} = 100^* \frac{(\text{Score for 2003–Score for 2002})}{\text{Score for 2002}}$$

$$\text{Rate of change from prior year for 2002} = 100^* \frac{(\text{Score for 2002–Score for 2001})}{\text{Score for 2001}}$$

$$\text{Rate of change from prior year for 2001} = 100^* \frac{(\text{Score for 2001–Score for 2000})}{\text{Score for 2000}}$$

Just like the overall score for the index, these three yearly rates of change are averaged, with the most recent year weighted the highest. As in the example of the 2001–2003 version of Table 1 presented above, the yearly rate of change presented for the "Percentage of Crash–Involved Drivers Aggressive" score represents the average of the rates of change for 2001, 2002, and 2003, with 2003 weighted at 1.0, 2002 weighted at 0.9, and 2001 weighted at 0.8. Please not that if for any year the county score for a particular index is "0," an average rate of change from this baseline cannot be computed, and N/A appears.

When the source data appearing on these tables is placed in the visualization tool, the user can use the tool to select the index they want to examine and plot the county scores on a 2–dimensional grid. Each county's score for a particular index is plotted on the X axis, and the yearly rate of change (representing yearly rate of improvement for the index) is plotted on the Y axis. For every index, the 2001–2003, 2000–2002, and 1999–2001 results are presented in a format that allows the user to easily click through the three scatter plots and observe how the three-year weighted averages for each county move on the plot over time.

Average Urban County Score and Urban Totals / Average Rural County Score and Rural Totals / Average Native American County Score and Native American Totals

For each category, the Average County Score row represents the average score on a particular index for all the counties in a particular category. Because this row represents the average of the final scores for each county, note that the final scores for each county are weighted equally, even though there might be many more crashes in a particular county. The average simply allows the interpreter to compare an individual county's score to the average county score for that category. Please note that if a value is missing and cannot be computed for any particular county, (entered as N/A), the average only represents the average of the available scores. Take care to note what scores are missing. The Totals row represents the final results for all crashes taking place in counties in a particular category. Unlike the average, the Totals row treats all the crashes in counties in a particular category as one data point. Totals should be examined if one wants to explore differences between all of South Dakota's urban county crashes as a whole versus all of South Dakota's rural county crashes as a whole versus all of South Dakota's Native American county crashes as a whole. Please note that comparisons between all three category totals are likely the most valid for indices only pertaining to *fatal* crashes. For other indices, the Native American county totals will likely be skewed due to an over-representation of fatal crashes (and thus an over-representation of crash characteristics typical of fatal crashes).

Average County Score and Statewide Totals

For each index, the Average County Score row simply represents the average score for all the counties in the state. Because this row represents the average of the final scores for every county, note that the final scores for each county are weighted equally, even though there might be many more crashes in a particular county. The average simply allows the reader to compare an individual county's score to the average county score for all counties in the state. Please note that if a value is missing and cannot be computed for any particular county, (entered as N/A), the average only represents the average of the available scores. Take care to note what scores are missing. The Statewide Totals row simply represents the final results for all crashes in the state. Unlike the average, the Statewide Totals row treats all the crashes in all counties in the state as one data point. Totals should be examined if one wants to observe the yearly rate of change and the score for all of South Dakota's crashes as a whole.

Specific Explanations of Indices in Each Table:

Table I–State of South Dakota Problem Identification, Traffic Safety: 1999–2001, 2000–2002, and 2001–2003

Aggressive Driving

Percentage of Crash–Involved Drivers Aggressive

For each driver involved in a crash, the officers can code up to three driver contributing circumstances for a particular driver. If, in his estimation, there were more than three contributing circumstances to a crash attributed to a particular driver, he is instructed to select the top three. The score for this index corresponds to the percentage of all drivers involved in crashes in the county who were coded by the investigating officer as engaging in a crash–contributing behavior that could be classified as "aggressive." These selected behaviors are: speeding (exceeded speed limit or exceeded safe speed but not limit), and other aggressive behaviors (failed to yield to pedestrian, failed to yield to vehicle, failed to stop for stop sign or flashing red, disregarded stop and go signal, disregarded other traffic control device sign, improper signal or failure to signal, turning from wrong lane, improper turn, improper lane change, following too closely, and improper passing). The yearly rate of change for the score is calculated as described above. For example, for 2001–2003, the three-year weighted average for the aggressive driving score for Beadle is 24.65, and this score is changing at an average rate of –2.14 for the three-year period (decreasing an average of 2.14 percent of the score each year).

Percentage of Crash–Involved Drivers Speeding

The score for this index corresponds to the percentage of all drivers involved in crashes in the county who were coded by the investigating officer as engaging specifically in speeding, one of the selected aggressive–driving behaviors (exceeded speed limit or exceeded safe speed but not limit). The yearly rate of change for the score is calculated as described above. For example, for 2001–2003, the three-year weighted average for the speeding score for Beadle is 10.49, and this score is changing at an average rate of 0.84 for the three-year period (increasing an average of 0.84 percent of the score each year).

Percentage of Crash–Involved Drivers Engaging in Other Aggressive Behaviors

The score for this index corresponds to the percentage of all drivers involved in crashes in the county who were coded by the investigating officer as engaging specifically in aggressive–driving behaviors other than speeding, (failed to yield to pedestrian, failed to yield to vehicle, failed to stop for stop sign or flashing red, disregarded stop and go signal, disregarded other traffic control device sign, improper signal or failure to signal, turning from wrong lane, improper turn, improper lane change, following too closely, and improper passing). The yearly rate of change for the score is calculated as described above. For example, for 2001–2003, the three-year weighted average for the other aggressive driving score for Beadle is 16.41, and this score is changing at an average rate of 0.45 for the three-year period (increasing an average of 0.45 percent of the score each year). Note that the speeding score for Beadle of 10.49 and the other aggressive behavior score for Beadle of 16.41 do not add up to the overall aggressive driving score of 24.65, because they are not mutually exclusive subsets of drivers–some officers identified drivers that were both speeding and engaging in other aggressive behaviors.

Restraint Use

Percentage of Fatally Injured and Injured Occupants Restrained, All Ages

The South Dakota crash data is used to determine the percentage of injured or killed occupants that were restrained. (Ideally, all citizens would wear their seat belts, and 100 percent of all fatalities and injuries would be restrained. Fewer citizens would be killed or injured as a result.) The score corresponds to this percentage. All vehicle occupants, with the exception of occupants of motorcycles, mopeds, and snowmobiles, are examined. Anyone using any safety equipment properly is coded as "restrained." For example, the three-year weighted average for the score for killed and injured occupant restrained in Beadle in 2001–2003 was 55.77, with this score increasing at an average rate of 2.68 percent of the score each year.

Percentage of Crash–Involved Drivers Restrained

The South Dakota crash data is used to determine the percentage of all drivers involved in crashes who were wearing their seat belts (both those who were injured and those who weren't). This figure is more representative of an estimate of the overall seat belt use rate for drivers on the roadways (or at least those drivers who were involved in crashes). The score corresponds to this percentage. All vehicle drivers, with the exception of occupants of motorcycles, mopeds, and snowmobiles, are examined. Any driver using any safety equipment properly is coded as "restrained." For example, the three-year weighted average for the score for drivers restrained in Beadle in 2001–2003 was 75.16, with this score increasing at an average rate of 5.94 percent of the score each year.

Percentage of Crash–Involved 14–20 Year–Old Drivers Restrained

The South Dakota crash data is used to determine the percentage of all 14–20 year old drivers involved in crashes who were wearing their seat belts (both those who were injured and those who weren't). This age group has the lowest restraint use rate for drivers involved in crashes in South Dakota, and this figure is representative of an estimate of the overall seat belt use rate in each county for drivers of this age on the roadways (or at least those who were involved in crashes). The score corresponds to this percentage. All vehicle drivers, with the exception of occupants of motorcycles, mopeds, and snowmobiles, are examined. Any driver using any safety equipment properly is coded as "restrained." For example, the three-year weighted average for the score for 14–20 year old drivers restrained in Beadle in 2001–2003 was 67.35, with this score increasing at an average rate of 7.94 percent of the score each year.

Age–Related Crashes

Percentage of 14–20 Year–Old Licensed Drivers Involved in Crashes

This statistic has been calculated by comparing the number of 14–20 year old drivers who were involved in crashes within a county with the total number of licensed drivers in the county in that age group. A score has then been assigned to correspond with this percentage and estimate the crash–involvement rate for 14–20 year old drivers in each county. This age group has the highest crash–involvement rate in the state. For example, the three-year weighted average for the score for the number of drivers age 14–20 involved in crashes per licensed driver for Beadle was 7.70 for 2001–2003; this score decreased at an average rate of 3.70 percent of the score per year.

Percentage of Crash–Involved 14–20 Year–Old Drivers Aggressive

The score for this index corresponds to the percentage of all drivers age 14–20 involved in crashes in the county who were coded by the investigating officer as engaging in a crash–contributing behavior that could be classified as "aggressive." These selected behaviors are: speeding (exceeded speed limit or exceeded safe speed but not limit), and other aggressive behaviors (failed to yield to pedestrian, failed to yield to vehicle, failed to stop for stop sign or flashing red, disregarded stop and go signal, disregarded other traffic control device sign, improper signal or failure to signal, turning from wrong lane, improper turn, improper lane change, following too closely, and improper passing). The yearly rate of change for the score is calculated as described above. Drivers age 14–20 years old involved in crashes had the highest overall rate of aggressive driving in South Dakota, when compared to other age groups. For example, for 2001–2003, the three-year weighted average for the aggressive driving score for 14–20 year olds in Beadle is 36.12, and this score is changing at an average rate of 17.73 for the three-year period (increasing an average of 17.73 percent of the score each year).

Percentage of Crash–Involved 21–24 Year–Old Drivers Aggressive

The score for this index corresponds to the percentage of all drivers age 21–24 involved in crashes in the county who were coded by the investigating officer as engaging in a crash–contributing behavior that could be classified as "aggressive." These selected behaviors are: speeding (exceeded speed limit or exceeded safe speed but not limit), and other aggressive behaviors (failed to yield to pedestrian, failed to yield to vehicle, failed to stop for stop sign or flashing red, disregarded stop and go signal, disregarded other traffic control device sign, improper signal or failure to signal, turning from wrong lane, improper turn, improper lane change, following too closely, and improper passing). The yearly rate of change for the score is calculated as described above. Drivers age 21–24 years old involved in crashes had the second highest overall rate of aggressive driving in South Dakota, when compared to other age groups. For example, for 2001–2003, the three-year weighted average for the aggressive driving score for 21–24 year olds in Beadle is 24.94, and this score is changing at an average rate of 13.95 for the three-year period (increasing an average of 13.95 percent of the score each year).

Percentage of Crash–Involved 25–34 Year–Old Drivers Aggressive

The score for this index corresponds to the percentage of all drivers age 25–34 involved in crashes in the county who were coded by the investigating officer as engaging in a crash–contributing behavior that could be classified as "aggressive." These selected behaviors are: speeding (exceeded speed limit or exceeded safe speed but not limit), and other aggressive behaviors (failed to yield to pedestrian, failed to yield to vehicle, failed to stop for stop sign or flashing red, disregarded stop and go signal, disregarded other traffic control device sign, improper signal or failure to signal, turning from wrong lane, improper turn, improper lane change, following too closely, and improper passing). The yearly rate of change for the score is calculated as described above. Drivers age 25–34 years old involved in crashes had the third highest rate of aggressive driving in South Dakota, when compared to other age groups. For example, for 2001–2003, the three-year weighted average for the aggressive driving score for 25–34 year olds in Beadle is 21.53, and this score is changing at an average rate of –12.69 for the three-year period (decreasing an average of 12.69 percent of the score each year).

Rollover Crashes

Percentage of Fatal Crashes with Rollover as First Harmful Event

For each crash, the very first event that is interpreted to cause harm to vehicle occupants in the crash is coded in the state database. The score for this index corresponds to the percentage of all fatal crashes in the counties that had "first harmful event" coded as being overturning accident. Please note that there are so few fatal crashes in each county that this index is not meaningful on the county level. In fact, the average county score for rate of change has little meaning because so many values for yearly rate of change are missing due to baselines of 0 for many counties. However, for this index, the comparison between the urban county, rural county, and Native American county totals are of interest. For example, for 2001–2003, the three-year weighted average for the fatal crash rollover score for all crashes in an urban–classified county is 20.69, and this score is changing at an average rate of 19.76 for the three-year period (increasing an average of 19.76 percent of the score each year).

Percentage of Injury Crashes with Rollover as First Harmful Event

For each crash, the very first event that is interpreted to cause harm to vehicle occupants in the crash is coded in the state database. The score for this index corresponds to the percentage of all injury crashes in the counties that had "first harmful event" coded as being overturning accident. For example, for 2001–2003, the three-year weighted average for the injury crash rollover score for Beadle is 13.62, and this score is changing at an average rate of 2.67 for the three-year period (increasing an average of 2.67 percent of the score each year).

Percentage of PDO Crashes with Rollover as First Harmful Event

For each crash, the very first event that is interpreted to cause harm to vehicle occupants in the crash is coded in the state database. The score for this index corresponds to the percentage of all PDO crashes in the counties that had "first harmful event" coded as being overturning accident. For example, for 2001–2003, the three-year weighted average for the injury crash rollover score for Beadle is 4.74, and this score is changing at an average rate of 17.87 for the three-year period (increasing an average of 17.87 percent of the score each year).

Percentage of All Crashes with Rollover as First Harmful Event

For each crash, the very first event that is interpreted to cause harm to vehicle occupants in the crash is coded in the state database. The score for this index corresponds to the percentage of all crashes in the counties that had "first harmful event" coded as being overturning accident. For example, for 2001–2003, the three-year weighted average for the all crash rollover score for Beadle is 6.91, and this score is changing at an average rate of –4.01 for the three-year period (decreasing an average of 4.01 percent of the score each year).

Table II–State of South Dakota Outcome Severity, Traffic Safety: 1999–2001, 2000–2002, and 2001–2003

Total Crashes

The score for this index corresponds to the total number of crashes reported in the county. Obviously, those counties with larger populations and more vehicle miles traveled are expected to have a larger number of crashes reported, but this score is still useful in allowing the user to easily sort and rank the counties in terms of those that contribute the largest number of crashes to South Dakota's total (a small change in the total population of these counties would lead to the largest impact if one is considering simply the number of people affected.) For example, for 2001–2003, the three-year weighted average for the total crash score for Beadle is 369.37, and this score is changing at an average rate of –1.58 for the three-year period (decreasing an average of 1.58 percent of the score each year).

Total Crashes per 100 MVMT

The score for this index corresponds to the total number of crashes reported in the county expressed as a rate per 100 million vehicle miles traveled. For example, for 2001–2003, the three-year weighted average for the score for total crashes per 100 MVMT for Beadle is 271.94, and this score is changing at an average rate of –0.60 for the three-year period (decreasing an average of 0.60 percent of the score each year).

Fatal Crashes

The score for this index corresponds to the total number of fatal crashes reported in the county. Obviously, those counties with larger populations and more vehicle miles traveled are expected to have a larger number of fatal crashes reported, but this score is still useful in allowing the user to easily sort and rank the counties in terms of those that the that contribute the largest number of fatal crashes to South Dakota's total (a small change in the total population of these counties would lead to the largest impact if one is considering simply the number of people affected.) Again, the rate of change values do not have much meaning for this index, for some of the counties have years with 0 fatal crashes and rates of change from this baseline value can't be computed. For 2001–2003, the three-year weighted average for the total fatal crash score for Beadle is 1.33, and this score is changing at an average rate of –4.94 for the three-year period (decreasing an average of 4.94 percent of the score each year).

Fatal Crashes per 100 MVMT

The score for this index corresponds to the total number of fatal crashes reported in the county expressed as a rate per 100 million vehicle miles traveled. Again, the rate of change values do not have much meaning for this index, for some of the counties have years with 0 fatal crashes and rates of change from this baseline value can't be computed. For 2001–2003, the three-year weighted average for the score for fatal crashes per 100 MVMT for Beadle is 0.98, and this score is changing at an average rate of –3.55 for the three-year period (decreasing an average of 3.55 percent of the score each year). Note that the fatal crash rate for all crashes in Native American counties is higher than the rural and urban fatal crash rates. However, the overall total crash rate for all crashes in Native American counties is lower than the rural and urban total crash rates. This result is obviously suspected to be due to the underreporting of non–fatal crashes in these areas. If the state had a record of all crashes in these areas, one might expect overall total crash rates to be the highest for the crashes occurring in Native American counties.

Injury Crashes

The score for this index corresponds to the total number of injury crashes reported in the county. Obviously, those counties with larger populations and more vehicle miles traveled are expected to have a larger number of crashes reported, but this score is still useful in allowing the user to easily sort and rank the counties in terms of those that the that contribute the largest number of injury crashes to South Dakota's total (a small change in the total population of these counties would lead to the largest impact if one is considering simply the number of people in affected.) For example, for 2001–2003, the three-year weighted average for the injury crash score for Beadle is 92.48, and this score is changing at an average rate of –9.16 for the three-year period (decreasing an average of 9.16 percent of the score each year).

Injury Crashes per 100 MVMT

The score for this index corresponds to the total number of injury crashes reported in the county expressed as a rate per 100 million vehicle miles traveled. For example, for 2001–2003, the three-year weighted average for the score for injury crashes per 100 MVMT for Beadle is 67.99, and this score is changing at an average rate of –8.30 for the three-year period (decreasing an average of 8.30 percent of the score each year).

PDO Crashes

The score for this index corresponds to the total number of PDO crashes reported in the county. Obviously, those counties with larger populations and more vehicle miles traveled are expected to have a larger number of crashes reported, but this score is still useful in allowing the user to easily sort and rank the counties in terms of those that the that contribute the largest number of PDO crashes to South Dakota's total (a small change in the total population of these counties would lead to the largest impact if one is considering simply the number of people in affected.) For example, for 2001–2003, the three-year weighted average for the total crash score for Beadle is 275.56, and this score is changing at an average rate of 1.68 for the three-year period (increasing an average of 1.68 percent of the score each year).

PDO Crashes per 100 MVMT

The score for this index corresponds to the total number of PDO crashes reported in the county expressed as a rate per 100 million vehicle miles traveled. For example, for 2001–2003, the three-year weighted average for the score for PDO crashes per 100 MVMT for Beadle is 202.97, and this score is changing at an average rate of 2.70 for the three-year period (increasing an average of 2.70 percent of the score each year).

Total Fatalities

The score for this index corresponds to the total number of people actually killed in South Dakota crashes in each county. Obviously, those counties with larger populations and more vehicle miles traveled are expected to have a larger number of fatalities reported, but this score is still useful in allowing the user to easily sort and rank the counties in terms of those that contribute the largest number of fatalities to South Dakota's total (a small change in the total population of these counties would lead to the largest impact if one is considering simply the number of people in affected.) Again, the rate of change values do not have much meaning for this index, for some of the counties have years with 0 fatalities and rates of change from this baseline value can't be computed. For 2001–2003, the three-year weighted average for the total fatality score for Beadle is 1.33, and this score is changing at an average rate of –4.94 for the three-year period (decreasing an average of 4.94 percent of the score each year).

Total Fatalities per 100 MVMT

The score for this index corresponds to the total number of fatalities reported in the county expressed as a rate per 100 million vehicle miles traveled. Again, the rate of change values do not have much meaning for this index, for some of the counties have years with 0 fatalities and rates of change from this baseline value can't be computed. For 2001–2003, the three-year weighted average for the score for total fatalities per 100 MVMT for Beadle is 0.98, and this score is changing at an average rate of –3.55 for the three-year period (decreasing an average of 3.55 percent of the score each year).

Total Injuries

The score for this index corresponds to the total number of people actually injured in South Dakota crashes in each county. Obviously, those counties with larger populations and more vehicle miles traveled are expected to have a larger number of crashes reported, but this score is still useful in allowing the user to easily sort and rank the counties in terms of those that the that contribute the largest number of injuries to South Dakota's total (a small change in the total population of these counties would lead to the largest impact if one is considering simply the number of people in affected.) For example, for 2001–2003, the three-year weighted average for the total injury score for Beadle is 135.00, and this score is changing at an average rate of –8.23 for the three-year period (decreasing an average of 8.23 percent of the score each year).

Total Injuries per 100 MVMT

The score for this index corresponds to the total number of injuries reported in the county expressed as a rate per 100 million vehicle miles traveled. For example, for 2001–2003, the three-year weighted average for the score for total injuries per 100 MVMT for Beadle is 99.25, and this score is changing at an average rate of –7.36 for the three-year period (decreasing an average of 7.36 percent of the score each year).

Percent of all Crashes Fatal

The score for this index corresponds to the total number of fatal crashes expressed as a percentage of all crashes, and represents which counties have a disproportionately high number of fatal crashes compared to crashes of other severities. This index is also a useful way to quickly identify the underreporting issue if one compares the urban Totals, rural Totals, and Native American Totals. For example, for 2001–2003, the Native American county total is 5.08, and this score is changing at an average rate of 16.21 for the three-year period (increasing an average of 16.21 percent of the score each year.) The urban total is only 0.61, and the rural Total is only 0.99.

Table III–State of South Dakota Problem Identification–Alcohol–Related Problems– Traffic Safety: 1999–2001, 2000–2002, and 2001–2003

Percent of all Crashes Alcohol–Related

The score for this index corresponds to the total number of crashes that were alcohol–related expressed as a percentage of all crashes, and represents which counties have a disproportionately high number of alcohol–related crashes compared to non–alcohol–related crashes. A crash is classified as alcohol–related if any driver or pedestrian involved in the crash has drinking entered for any of their reported contributing circumstances, if any driver or pedestrian involved in the crash has their alcohol–involvement coded as “alcohol only” or “alcohol and drugs,” or if any driver or pedestrian involved in the crash has as known positive BAC result. For example, for 2001–2003, Beadle has a score of 5.06, and this score is changing at an average rate of 0.73 for the three-year period (increasing an average of 0.73 percent of the score each year.)

Alcohol–Related Crashes per 100 MVMT

The score for this index corresponds to the total number of crashes that were alcohol–related expressed as a rate per 100 million vehicle miles traveled. For example, for 2001–2003, Beadle has a score of 13.73, and this score is changing at an average rate of –0.42 for the three-year period (decreasing an average of 0.42 percent of the score each year).

Percent of PDO Crashes Alcohol–Related

The score for this index corresponds to the total number of PDO crashes that were alcohol–related expressed as a percentage of all PDO crashes, and represents which counties have a disproportionately high number of alcohol–related PDO crashes compared to non–alcohol–related PDO crashes. For example, for 2001–2003, Beadle has a score of 2.50, and this score is changing at an average rate of 14.13 for the three-year period (increasing an average of 14.13 percent of the score each year.)

Alcohol–Related PDO Crashes per 100 MVMT

The score for this index corresponds to the total number of PDO crashes that were alcohol–related expressed as a rate per 100 million vehicle miles traveled. For example, for 2001–2003, Beadle has a score of 5.16, and this score is changing at an average rate of 21.16 for the three-year period (increasing an average of 21.16 percent of the score each year).

Percent of Injury Crashes Alcohol–Related

The score for this index corresponds to the total number of injury crashes that were alcohol–related expressed as a percentage of all injury crashes, and represents which counties have a disproportionately high number of alcohol–related injury crashes compared to non–alcohol–related injury crashes. For example, for 2001–2003, Beadle has a score of 12.58, and this score is changing at an average rate of 16.11 for the three-year period (increasing an average of 16.11 percent of the score each year.)

Alcohol–Related Injury Crashes per 100 MVMT

The score for this index corresponds to the total number of injury crashes that were alcohol–related expressed as a rate per 100 million vehicle miles traveled. For example, for 2001–2003, Beadle has a score of 8.32, and this score is changing at an average rate of 3.31 for the three-year period (increasing an average of 3.31 percent of the score each year).

Percent of Fatal Crashes Alcohol–Related

The score for this index corresponds to the total number of fatal crashes that were alcohol–related expressed as a percentage of all fatal crashes, and represents which counties have a disproportionately high number of alcohol–related fatal crashes compared to non–alcohol–related fatal crashes. Please note that there are so few fatal crashes in each county, this score is more interesting when the urban totals, rural totals, and Native American totals are examined. For example, for 2001–2003, crashes in urban counties have a score of 38.32, and this score is changing at an average rate of 0.50 for the three-year period (increasing an average of 0.50 percent of the score each year.) Crashes in rural counties have a score of 38.18, and crashes in Native American counties have a score of 66.43.

Alcohol–Related Fatal Crashes per 100 MVMT

The score for this index corresponds to the total number of fatal crashes that were alcohol–related expressed as a rate per 100 million vehicle miles traveled. Please note that there are so few fatal crashes in each county, this score is more interesting when the urban totals, rural totals, and Native American totals are examined. For example, for 2001–2003, crashes in urban counties have a score of 0.62, and this score is changing at an average rate of 7.31 for the three-year period (increasing an average of 7.31 percent of the score each year.) Crashes in rural counties have a score of 0.61, and crashes in Native American counties have a score of 3.10

Percent of 21–24 Year Olds in Crashes that Were Alcohol–Involved

The score for this index corresponds to the total number of 21–24 year old drivers involved in crashes that had some form of alcohol–involvement expressed as a percentage of all 21–24 year old drivers involved in crashes. (Drivers were coded as alcohol–involved if they had drinking entered for any of their three contributing circumstances, they were coded as having “alcohol only” or “alcohol and drugs” for their alcohol–involvement, or they had a positive BAC test result). Drivers age 21–24 years old had the highest overall rate for the state. For example, the score for Beadle is 7.67, and this score is changing at an average rate of 9.93 for the three-year period (increasing an average of 9.93 percent of the score each year).

Percent of 25–34 Year Olds in Crashes that Were Alcohol–Involved

The score for this index corresponds to the total number of 25–34 year old drivers involved in crashes that had some form of alcohol–involvement expressed as a percentage of all 25–34 year old drivers involved in crashes. (Drivers were coded as alcohol–involved if they had drinking entered for any of their three contributing circumstances, they were coded as having “alcohol only” or “alcohol and drugs” for their alcohol–involvement, or they had a positive BAC test result). Drivers age 25–34 years old had the second highest overall rate for the state. For example, the score for Beadle is 4.88, and this score is changing at an average rate of –7.13 for the three-year period (decreasing an average of 7.13 percent of the score each year).

Percent of 35–44 Year Olds in Crashes that Were Alcohol–Involved

The score for this index corresponds to the total number of 35–44 year old drivers involved in crashes that had some form of alcohol–involvement expressed as a percentage of all 35–44 year old drivers involved in crashes. (Drivers were coded as alcohol–involved if they had drinking entered for any of their three contributing circumstances, they were coded as having "alcohol only" or "alcohol and drugs" for their alcohol–involvement, or they had a positive BAC test result). Drivers age 35–44 years old had the third highest overall rate for the state. For example, the score for Beadle is 3.19, and this score is changing at an average rate of –6.54 for the three-year period (decreasing an average of 6.54 percent of the score each year).

Percent of 14–20 Year Olds in Crashes that Were Alcohol–Involved

The score for this index corresponds to the total number of 14–20 year old drivers involved in crashes that had some form of alcohol–involvement expressed as a percentage of all 14–20 year old drivers involved in crashes. (Drivers were coded as alcohol–involved if they had drinking entered for any of their three contributing circumstances, they were coded as having "alcohol only" or "alcohol and drugs" for their alcohol–involvement, or they had a positive BAC test result). Drivers age 14–20 years old had the fourth highest overall rate for the state. For example, the score for Beadle is 4.35, and this score is changing at an average rate of 35.34 for the three-year period (increasing an average of 35.34 percent of the score each year).

Percent of All Drivers in Crashes Tested/Refused a Test

The score for this index corresponds to the total number of drivers involved in crashes were coded as being offered a BAC test (they had a BAC result entered, or they were coded as either refusing the test, BAC test given but sample unusable, or BAC test given but results unobtainable as time report filed.) For example, the score for Beadle is 3.13, and this score is changing at an average rate of 15.43 for the three-year period (increasing an average of 15.43 percent of the score each year).

APPENDIX E: COUNTY CRASH REPORTING MODEL FOR SOUTH DAKOTA TRAFFIC CRASHES

E1. INTRODUCTION

In the state of South Dakota, vehicle miles of travel and roadway miles are available by functional road class on a county by county basis for the years 1998-2003. In addition, 1998-2003 population data is available from the Census Bureau on a county by county basis, and the number of licensed drivers and registered vehicles per county are also available for these years. Finally, the number of traffic crashes in each county can be extracted from the South Dakota Crash Database for 1998-2003. The relationship between the number of traffic crashes and these representative variables for the local traffic flow in each county will be explored and an appropriate model which can describe the relationship will be built.

The main purpose in constructing such a model is to use it to provide an estimate for the number of traffic crashes in counties for which it is suspected that the state does not have accurate traffic crash records. South Dakota contains nine Indian Reservations. Tribal Police are not subject to the same reporting procedures and requirements as state, county, and local law enforcement agencies. Thus, it is widely suspected that a large portion of those traffic crashes investigated by tribal police are not submitted to the state and not included in the South Dakota Crash Database. Those areas under tribal jurisdiction should be considered missing data in the model construction because it is obviously expected that the number of total crashes on record for these areas is incorrect. The objective is to use the data that is believed to be reasonably accurate to construct a model that describes the relationship between key predictive variables and total traffic crashes, and then apply the model to areas with an unknown number of total traffic crashes.

Unfortunately, it is not a simple task to exclude these tribal areas and work only with total crashes and traffic flow descriptors in the remaining portions of the state. Areas under reservation jurisdiction are not contained by simple boundaries that align with county lines. A large majority of the nine South Dakota reservations have “checkerboard” jurisdictions, meaning that the roadways and areas that fall under their jurisdiction are scattered throughout counties like isolated squares on a checkerboard. As one example, the Rosebud Sioux Tribe reports in their 2004 Traffic Crash Information Manual that while the reservation is located in Todd County, the Rosebud Service Unit includes portions of Gregory, Mellette, Lyman, and Tripp Counties. There is also no variable in the South Dakota Crash Database that identifies whether or not a crash that was submitted to the state took place inside or outside of Native American jurisdiction. It is often difficult for officers on the scene of a crash to identify whether they are within tribal jurisdiction lines or not. As a result, it would be a daunting task to map the precise tribal jurisdiction boundaries for all nine tribes throughout the entire state of South

Dakota for the purposes of building the model, as is the case with the Rosebud Reservation. Even if boundaries for all nine tribes could be "mapped" for exclusion from the model, one would then have to find an efficient way to sort through the thousands of crashes in the South Dakota database and place all the crashes into the various jurisdictions to get the corresponding crash counts for each area. Finally, the predictive variables would have to be grouped by these jurisdictions. Vehicle miles of travel are not conveniently collected or summarized at the level of "reservation jurisdiction areas" versus "non-reservation jurisdiction areas." The end result could not even be used to build a model that explored the relationship between traffic volume and total crashes.

However, as stated above, vehicle miles of travel were provided to CATS estimated at the county level. Additionally, population by race, licensed drivers, and registered vehicles are also estimated at the county level. Due to the data available, the simplest approach will be to build the reporting model at the level of the county. Unfortunately, there are hardly any counties that are completely untouched by reservation land - there are some areas of reservation jurisdiction that spill over into a majority of South Dakota counties and this problem cannot be resolved. However, one can attempt to estimate the counties that have *largest* proportion of their traffic crashes falling under tribal jurisdiction, (and thus, are most likely to have crash counts that are the *most* unreliable). A good way to begin this task is to examine those counties with the highest proportion of residents whose race is "Native American." All counties will be sorted by the percentage of their population that is Native American and counties that appear to fall into some distinctly higher category will be classified as probably having the most "untrustworthy" results as far as total reported crashes and excluded from the model. Obviously, for the remaining counties, the small proportion of traffic crashes that do go unreported is an unknown variable that will fluctuate by county and cannot be addressed; however, attempting to only work with those counties that have a minimum of missing information is the best starting point. One must also keep in mind that there are obviously other variables, such as climate, geography, etc. that cannot be quantified and captured in the model.

Between 1998-2003, there is a natural breaking point in the makeup of the population for each county. There were only 12 counties who had an estimated population that was 29.0 percent or higher American Indian or Alaska Native: Bennett, Buffalo, Charles Mix, Corson, Dewey, Jackson, Lyman, Mellette, Roberts, Shannon, Todd, and Ziebach. (Shannon is the highest of these 12, at 94.8 percent, and Charles Mix is the lowest, at 29.0 percent.) The next lowest county in South Dakota after these 12 is Moody (at a level of only 13.0 percent). The state total is 8.6 percent. When these 12 counties are compared to state maps that show official reservation boundary locations, they do correspond to those counties that one would expect to be covered by the largest proportion of tribal jurisdiction area. These 12 counties would be expected to potentially suffer from the *largest* degree of underreporting.

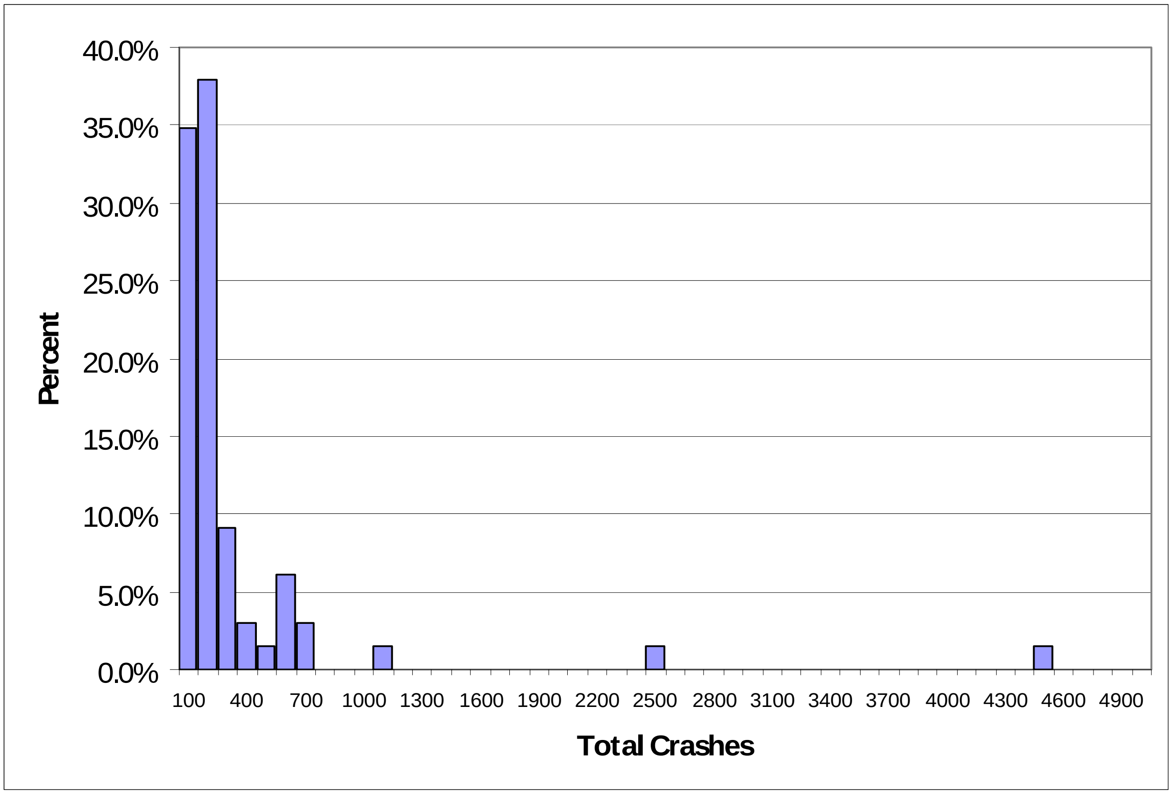
Additionally, there are only 15 counties in the state that have any vehicle miles of travel classified as "urban," so these counties can be seen as having a unique driving environment in that they contain some urban travel somewhere in the county, while the rest do not. None of the 15 "urban" counties would fall under the "Native American" classification as described above (the closest is Hughes, which is partially covered by Crow Creek land and has a population that is only 9.2 percent American Indian or Alaska Native.) Between 1998 and 2003, these 15 counties alone made up an estimated 55.9 percent of the entire state's vehicle miles traveled, 67.1 percent of all South Dakota registered vehicles, 70.2 percent of all licensed drivers, 67.5 percent of the state's total population, 71.3 percent of the state's reported crashes, and 45.3 percent of the state's reported fatal crashes.

One would expect that the 15 "urban" counties would have a unique driving environment. Similarly, one would also expect that the driving environment in the 12 "Native American" counties would be similar to that of the other "rural" counties without a strong Native American presence. The basic approach will be to place the counties of South Dakota into three unique categories ("urban," "rural," and "Native American"), and leave the 12 "Native American" counties out of the model building process since these are the counties suspected to have the most unreliable crash totals. After the model is built based upon the other counties, the model will actually be used to predict how many crashes one would expect to have taken place in the 12 Native American counties (based on their populations, vehicle miles of travel, etc.) and compare these predictions to how many the state actually has a record of. There will obviously be additional error entered into the process because this procedure operates off the assumption that the 12 Native American counties have no additional variable that makes them consistently distinct from the other rural counties aside from their population, VMTs, licensed drivers, etc. However, this is obviously not the case. The Native American counties have a larger percentage of their populations that are Native American and living under tribal customs, laws, and practices, and creating a distinct and unique driving environment. To be sure, this is a crude starting point that is designed to give the state a very broad and general reference point as to what might be the expected crash counts from counties with similar traffic flow variables. The Department of Transportation believes that they do have records of the majority of the *fatal* crashes from these reservation areas, and the 12 Native American counties do typically have a higher fatality rate per vehicle mile traveled than the other counties in South Dakota. One can venture a guess that on average, the fact that the counties are "Native American," if anything, results in *more* traffic crashes per population and vehicle miles traveled, not less. As a result, crash count reference points formulated by the model are most likely systematically low, if anything.

Thus, the objective is to construct a model that excludes data from the Native American counties, and based on the fitted model, the potential underreporting problem for counties that have particularly large Native American populations (and are suspected to have the largest proportion of their traffic crashes underreported) will be investigated. If potential underreporting exists, prediction intervals will be given to estimate the true number of crashes for each county.

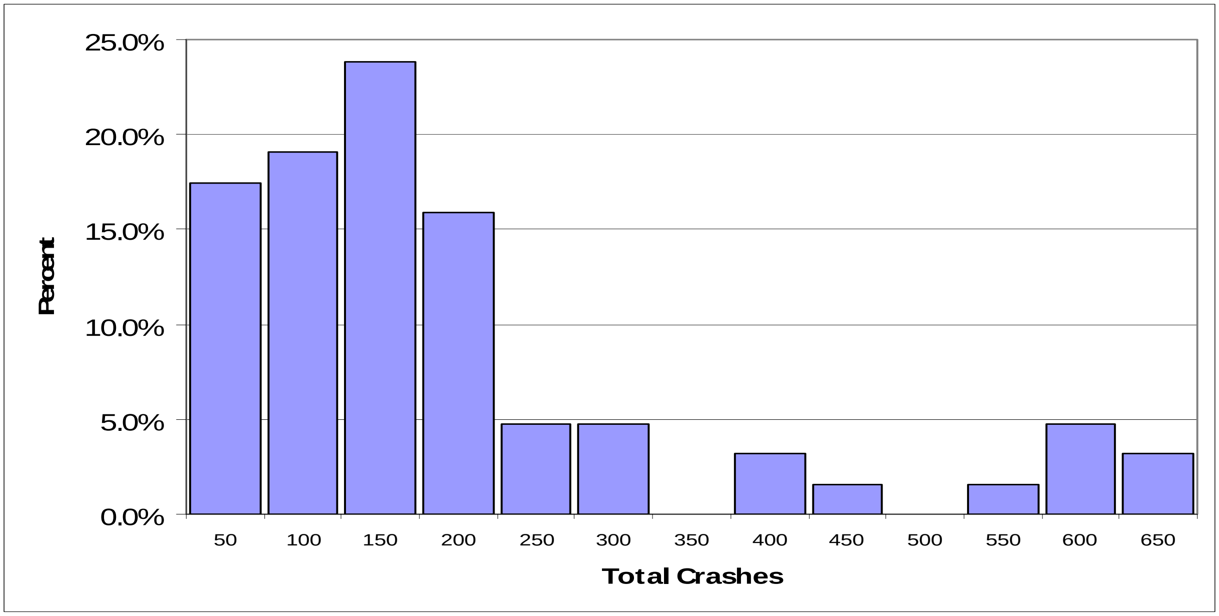
E2. DATA SUMMARY

Figure E1. Frequency Distribution of Average Annual Crash Counts for All South Dakota Counties, 1998-2003



The two extreme points represent Minnehaha (4,468 average crashes per year) and Pennington (2,464 average crashes per year). Figure 2 is made as a subset of the data in Figure 2; it only shows the distribution for the counties where the average crash count is lower than 1,000 (Minnehaha, Pennington, and Brown, all urban counties, are excluded).

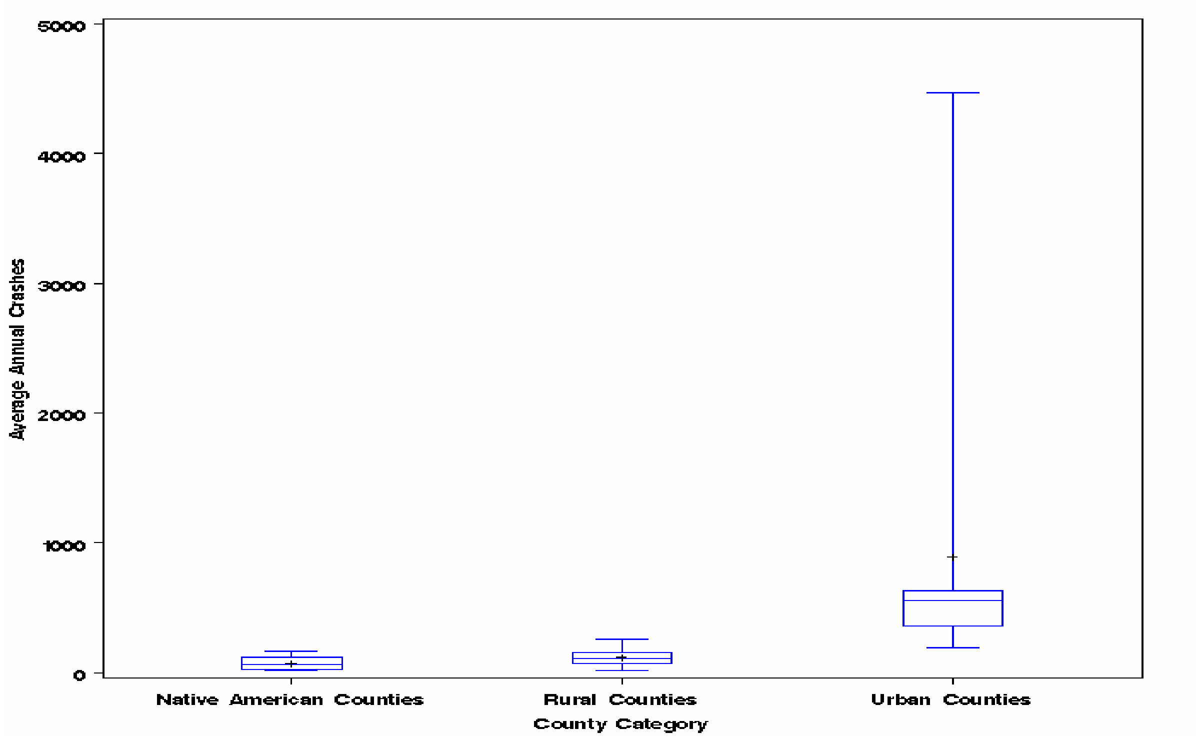
Figure E2. Frequency Distribution of Average Annual Crash Counts for South Dakota Counties with Less than 1,000 Crashes, 1998-2003



Of these 63 counties, 17.5 percent average under 50 crashes, 19.0 percent average between 50 and 99, 23.8 percent average between 100 and 149, 15.9 percent average between 150 and 199, and 23.8 percent average between 200 and 649.

For all 66 counties, the box plot in Figure 3 divides the counties into the three categories (urban, rural Non-Native American, and rural Native American), and plots the first and third quartiles of the average annual number of crashes for the counties in each category. A large box signifies that the crash counts cover a very wide range for the different counties in the category, and on the contrary, a narrow box signifies that most have counties have a similar average annual crash count for the 1998-2003 period. Both the Native American group and the rural group of counties have a tight interval while the urban group has a bigger variation and long tails, which was revealed by the previous plots as well.

Figure E3. Average Number of Annual Crashes per County, by County Category, 1998-2003



Overall, the urban counties have more crashes than the other two categories. The three counties with the much larger average annual crash counts are Minnehaha, Pennington, and Brown. From the above plots, it is clear that the urban counties and rural counties have very different patterns of distributions of crash counts, with there being three very distinct, highly populated, outlying counties in the urban county category. Most likely, it will be better to treat these groups of counties separately when constructing the model. An overall summary of urban county statistics is presented below.

Table E1. Urban County Summary

Basic Statistical Measures, Average Annual Crash Count (1998-2003) for 15 Urban Counties			
Location		Variability	
Mean	889.3778	Std Deviation	1132
Median	553.3333	Variance	1281605
Mode	N/A	Range	4272
		Interquartile Range	269

Urban Quantiles	
Quantile	**Estimate**
100% Max	4468
99%	4468
95%	4468
90%	2464
75% Q3	629.833
50% Median	553.333
25% Q1	360.833
10%	254.167
5%	195.833
1%	195.833
0% Min	195.833

When the average annual crash count for 1998-2003 is examined for all 15 urban counties, the mean is 889 and the variance is very large. However, the interquartile Range, the difference between 1st quartile and 3rd quartile, is 269. This confirms that the large variation is coming from extreme points.

There are 12 counties classified as the most predominantly Native American. Their total reported crash counts are the smallest among the three categories. The average for this group is 71, with a stand deviation 57.

Table E2. Native American County Summary

Basic Statistical Measures, Average Annual Crash Count (1998-2003) for 12 Native American Counties			
Location		Variability	
Mean	71.02778	Std Deviation	56.84055
Median	58.58333	Variance	3231
Mode	N/A	Range	151.83333
		Interquartile Range	96.33333

Native American Quantiles	
Quantile	**Estimate**
100% Max	165.1667
99%	165.1667
95%	165.1667
90%	164
75% Q3	119.5833
50% Median	58.5833
25% Q1	23.25
10%	15.3333
5%	13.3333
1%	13.3333
0% Min	13.3333

Table E3. Rural County Summary

Basic Statistical Measures, Average Annual Crash Count (1998-2003) for 39 Rural Counties			
Location		Variability	
Mean	115.9103	Std Deviation	59.95628
Median	110	Variance	3595
Mode	N/A	Range	237
		Interquartile Range	85.16667

Quantiles	
Quantile	**Estimate**
100% Max	254.1667
99%	254.1667
95%	244.5
90%	202.1667
75% Q3	156
50% Median	110
25% Q1	70.8333
10%	39.6667
5%	25.6667
1%	17.1667
0% Min	17.1667

Now that a basic understanding of the structure of the data has been obtained, the relationship between the crash counts and the available county-wide information will be explored in order to build the prediction model. As the first step, the key variables describing the traffic situation that have the biggest associations with the total crash counts in the county will be identified. Next, these key variables will be used to construct an appropriate prediction model for the total number of crashes. The total fatal crashes will be also considered as a potential variable entered into the model as a prediction of total crashes; since it is believed that fatal crash counts are trusted more so than total crash counts, fatal crash counts in Native American counties could potentially be used as a predictor variable in the model.

For six years, the variables available in the database for analysis are: County Category, Total Population, Native American Population, Fatal Crashes, Registered Trucks and Automobiles, Registered Motorcycles, Total Licensed Drivers, VMT by road class and percentage of total VMTs by road class, (rural Interstate, rural Principal Arterial, rural Minor Arterial, rural Major Collector, rural Minor Collector, rural Local & Other Roads, urban Interstate, urban Principal Arterial, urban Minor Arterial, urban Collector, urban Local Roads), and lane miles for all the previous road class categories.

E3. MODELING

If the model were constructed using known crash counts for all 66 counties, total crash count predictions would be based on the assumption that the data was correctly recorded for all counties. For example, the actual reported crashes from Native American Counties are very low, so if one were to fit these counties into a model, one would expect that the values predicted by the model should be lower for these counties. However, from the traffic capacity data, most of these counties have slightly higher rural vehicle miles traveled, total vehicle miles traveled, and total population when compared to the other rural counties. Additionally, fatal crash counts for these counties are very high, and it would not make sense that they would have a high fatal crash rate but low overall crash rate. As a result, the final model will exclude the 12 Native American counties. After it is built, prediction values will be given for the Native American counties based on their traffic capacity data.

Count data usually has a high frequency of occurrence for the lower values and a low frequency of occurrence for the higher values. Accordingly, a generalized linear model is a good approach for count data which is discrete and not normally distributed. Count outcomes have been viewed as the outcomes of Poisson processes. Naturally occurring count data, however, often displays over-dispersion due to correlated errors in time or space, or other forms of non-independence of the observations. Over-dispersion means there is extra variation than permitted by the Poisson model. As properties of Poisson model, the variance for the event should be equal to its mean, and there is the expectation that the events being counted are independent. For such cases of over-dispersion, the negative binomial distribution is a widely used alternative. The Poisson model was converted to the Negative Binomial model by adding an extra parameter. This parameter will release the assumption about the variation limitation in the Poisson model.

Furthermore, the repeated measure method was used to reduce the variation of the estimators by offering smaller standard deviation. Six years of records for each county were repeatedly listed in the data set for the modeling purpose instead of taking an annual average. The repeated measure method is used when measurements are taken on the same subjects over time. Since the crash data bases are constructed each year, the county variables and total crash counts were generated on yearly bases. If one were to take the annual average for every variable on all years, there would be some loss of valuable information. All six counts for each county also can't be considered to be independent observations, because the correlation structure is different within the same county than between different counties. We can expect less variation within the same county every year than between totally different counties with different roadways. On the other hand, the counts from all the different counties in the same year of data will also be more correlated because they might share the same conditions each year, such as more or less rain and snow. The repeated measure method will make the best use of the current information and take into account the correlation structure correctly. Generalized estimating equations (GEEs) were developed to extend the GLM to accommodate correlated data, and are widely used by researchers in a number of fields.

Thus, in order to accurately estimate the parameters and achieve a more sophisticated prediction model, the GEE model was adopted. GEE stands for generalized estimate equation model, or, the repeated measure of the negative binomial model. The dependent variable, which is the one to be modeled, is the count of crashes. Six years records for each county were repeatedly listed in the data set for the modeling purpose instead of taking an annual average.

The SAS procedure used is called PROC GENMOD, which fits a generalized linear model to the data by the maximum likelihood estimation of the parameter vector. The procedure estimates the parameters of the model numerically through an iterative fitting process. The dispersion parameter is also estimated by the maximum likelihood, which controls the extra variation from Poisson model. A log link function was used for the GENMOD procedure, which means the logarithm of the total number of crashes was used as the dependent variable. It was also determined that due to the differences revealed in the patterns and structures of the data for the 39 rural counties and 15 urban counties, it was reasonable to create a model just for the 39 rural counties. These counties are most similar to the Native American counties, due not contain any extreme outliers which would have to be eliminated, and have the most similar driving environments (don't contain urban VMTs anywhere in the county).

As the first step, the key variables describing the traffic situation that had the largest associations with the total crash counts in the county were identified. Then, these key variables were used to construct a valid prediction model for the total number of crashes. In order to select key variables from all the available ones, a scatter plot between total crashes and each variable was plotted. Several variables appeared to show a strong linear correlation and be very promising as candidate variables for the model. In order to justify the conclusions from plots, a linear regression model was fitted on all the variables and a stepwise model selection method was adopted to determine the best variables to keep. After these two steps, the total population, total rural VMTs (in other words, total VMTs, since all VMTs in these counties were coded as "rural"), the percentage of total VMTs that were on rural minor collector roads, the total roadway lane miles in the county, and the total number of rural major collector VMTs were entered into the model. The following section shows the results for the model.

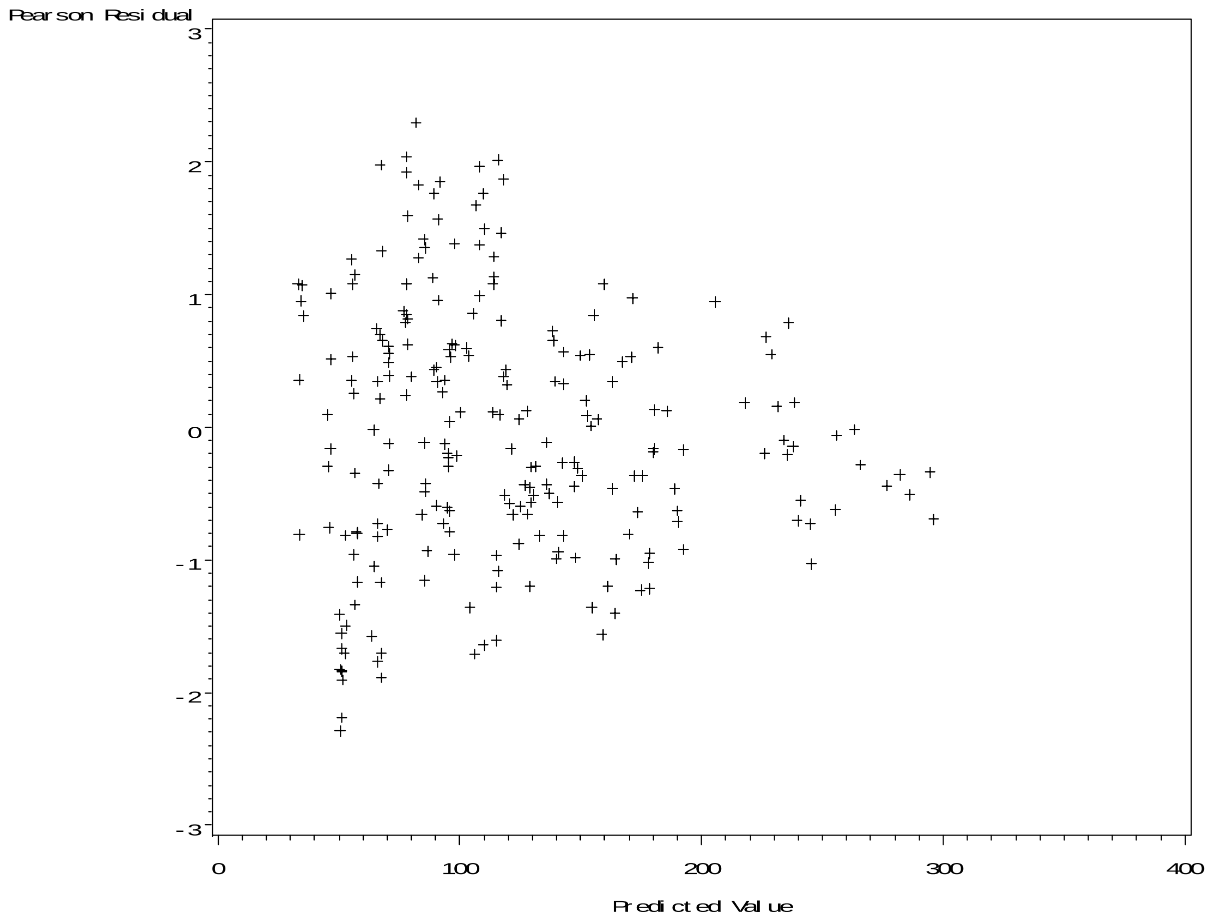
Table E4. Model Goodness of Fit

Criteria For Assessing Goodness Of Fit			
Criterion	**DF**	**Value**	**Value/DF**
Deviance	228	246.0671	1.0792
Scaled Deviance	228	246.0671	1.0792
Pearson Chi-Square	228	218.0536	0.9564
Scaled Pearson X2	228	218.0536	0.9564
Log Likelihood		105246.5750	

Analysis Of GEE Parameter Estimates Empirical Standard Error Estimates						
Parameter	**Estimate**	**Standard Error**	**95% Confidence Limits**		**Z**	**Pr > |Z|**
Intercept	3.7383	0.1454	3.4534	4.0233	25.71	<.0001
Population	0.1161	0.0183	0.0803	0.1519	6.36	<.0001
Rural VMT	0.0071	0.0013	0.0045	0.0097	5.27	<.0001
Percentage of VMT Rural Minor Collector	-7.6083	2.6161	-12.7357	-2.4808	-2.91	0.0036
Total Lane Miles	0.2974	0.1045	0.0926	0.5021	2.85	0.0044
Rural Major Collector VMTs	-0.0195	0.0076	-0.0345	-0.0045	-2.55	0.0108

When assessing the goodness of fit of the model, the deviance degrees of freedom (DF) needs to be close to the value of the deviance. The ratio is 1.0792, which is close enough to 1 to conclude a good fit. For Pearson Chi-square, the ratio is 0.956, which is also good. The plot of Pearson residual versus the predicted values further confirms the model. The plot shows that the Pearson deviance is inside of plus/minus 3 ranges, which is quite reasonable. There is larger variation for deviance at the lower values of predicted value than higher values. However, this is normal because there are more points in the lower value category which bring the larger variation.

Figure E4. Pearson Residual Plot



E4. Results

Listed below are the predicted values for the 12 Native American counties for each of the six years of data.

Figure E5. 1998 Predicted and Actual Native American County Crash Counts

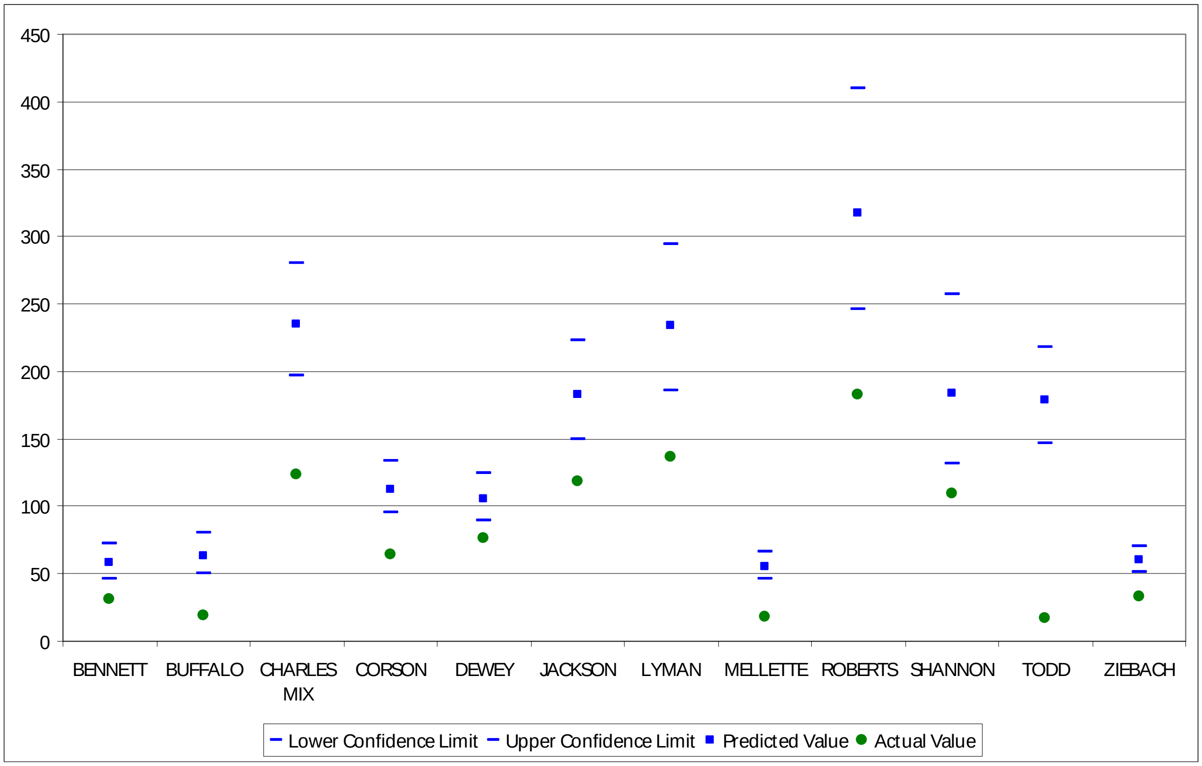


Table E5. 1998 Predicted and Actual Native American County Crash Counts

County	Year	Total Reported	Lower CL	Predicted Value	Upper CL
BENNETT	1998	31	46.5	58.2	72.8
BUFFALO	1998	19	50.3	63.5	80.1
CHARLES MIX	1998	124	196.7	234.9	280.6
CORSON	1998	64	95.1	112.5	133.2
DEWEY	1998	76	89.7	105.6	124.3
JACKSON	1998	119	149.9	182.8	222.9
LYMAN	1998	137	186.1	234.2	294.7
MELLETTE	1998	18	45.7	55.0	66.1
ROBERTS	1998	183	245.8	317.3	409.6
SHANNON	1998	109	131.1	183.7	257.4
TODD	1998	17	146.6	178.6	217.5
ZIEBACH	1998	33	51.2	60.0	70.3

Figure E6. 1999 Predicted and Actual Native American County Crash Counts

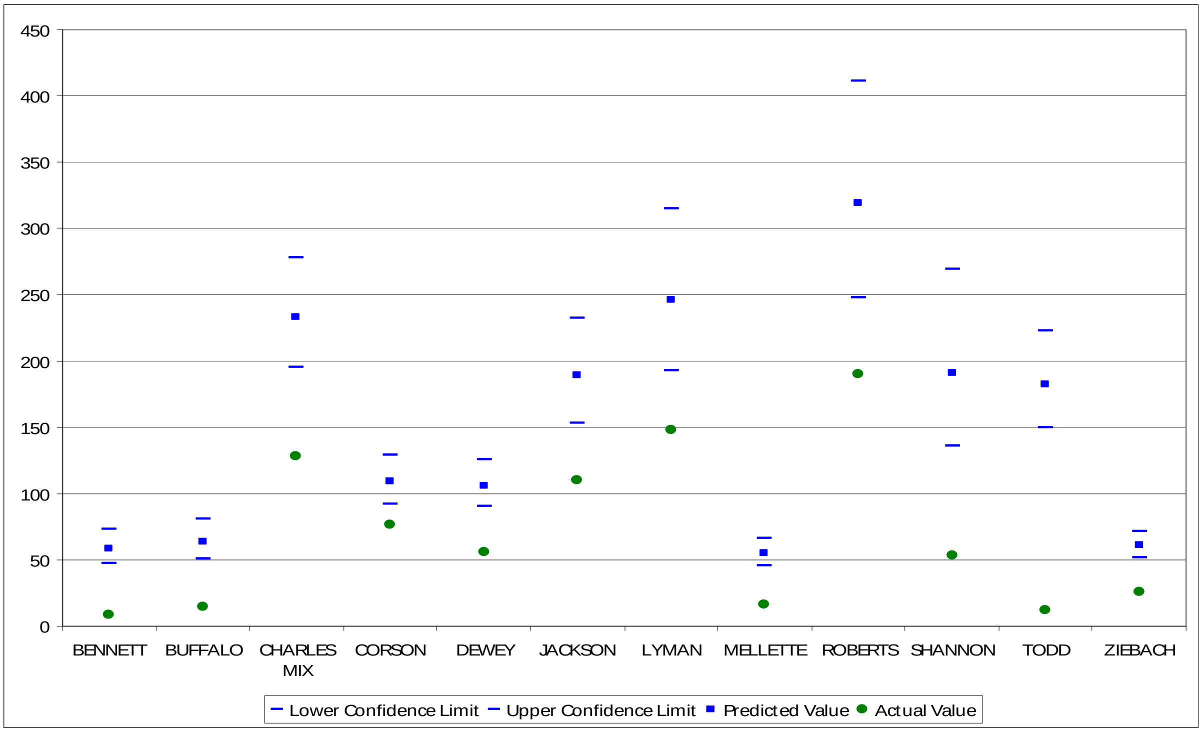


Table E6. 1999 Predicted and Actual Native American County Crash Counts

County	Year	Total Reported	Lower CL	Predicted Value	Upper CL
BENNETT	1999	9	46.9	58.4	72.7
BUFFALO	1999	15	50.6	63.9	80.7
CHARLES MIX	1999	128	195.6	233.1	277.7
CORSON	1999	77	92.2	109.1	129.1
DEWEY	1999	56	90.0	106.2	125.2
JACKSON	1999	110	153.5	189.0	232.7
LYMAN	1999	148	192.3	246.2	315.0
MELLETTE	1999	16	45.7	54.9	66.0
ROBERTS	1999	190	248.1	319.6	411.6
SHANNON	1999	53	135.7	191.2	269.3
TODD	1999	12	149.6	182.6	223.0
ZIEBACH	1999	26	51.8	60.7	71.1

Figure E7. 2000 Predicted and Actual. Native American County Crash Counts

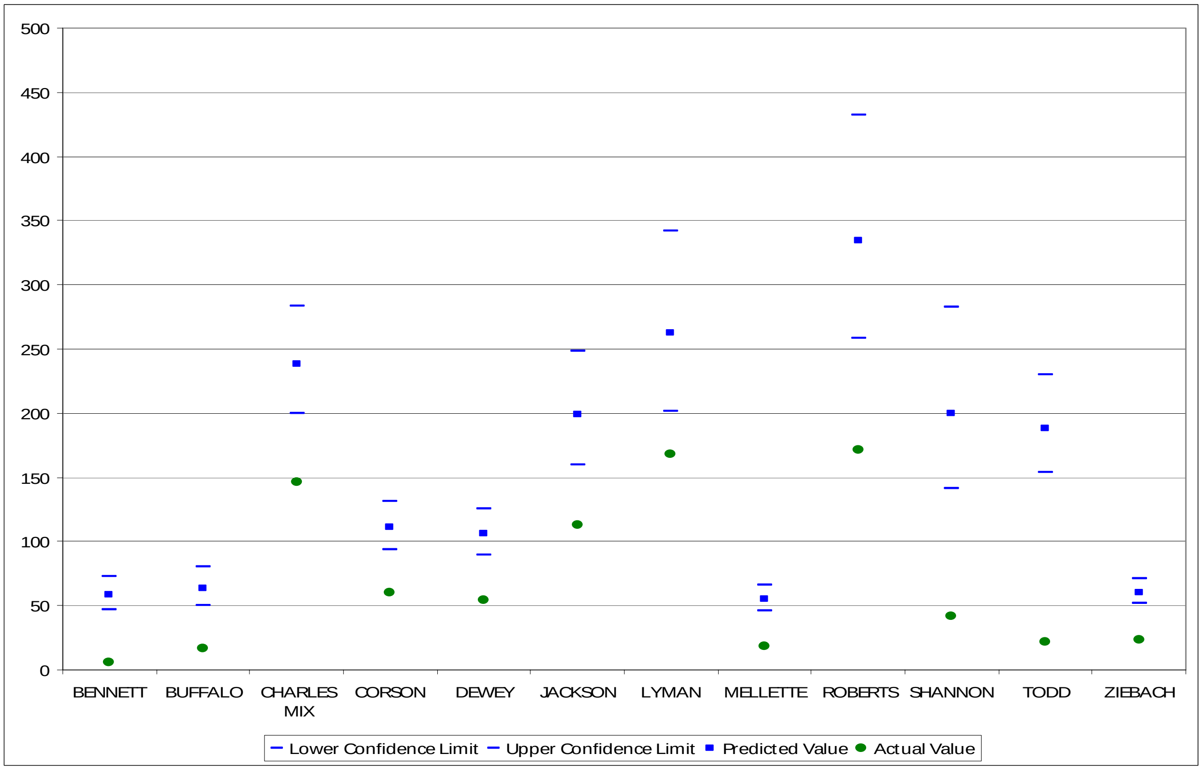


Table E7. 2000 Predicted and Actual Native American County Crash Counts

County	Year	Total Reported	Lower CL	Predicted Value	Upper CL
BENNETT	2000	6	47.1	58.6	73.0
BUFFALO	2000	17	50.6	63.8	80.5
CHARLES MIX	2000	146	199.9	238.1	283.5
CORSON	2000	60	94.0	111.2	131.5
DEWEY	2000	54	89.8	106.2	125.6
JACKSON	2000	113	159.3	198.8	248.0
LYMAN	2000	168	201.3	262.3	341.7
MELLETTE	2000	18	46.1	55.3	66.3
ROBERTS	2000	171	258.5	334.3	432.2
SHANNON	2000	42	141.1	199.8	282.7
TODD	2000	22	153.8	188.2	230.2
ZIEBACH	2000	23	51.8	60.6	70.9

Figure E8. 2001 Predicted and Actual Native American County Crash Counts

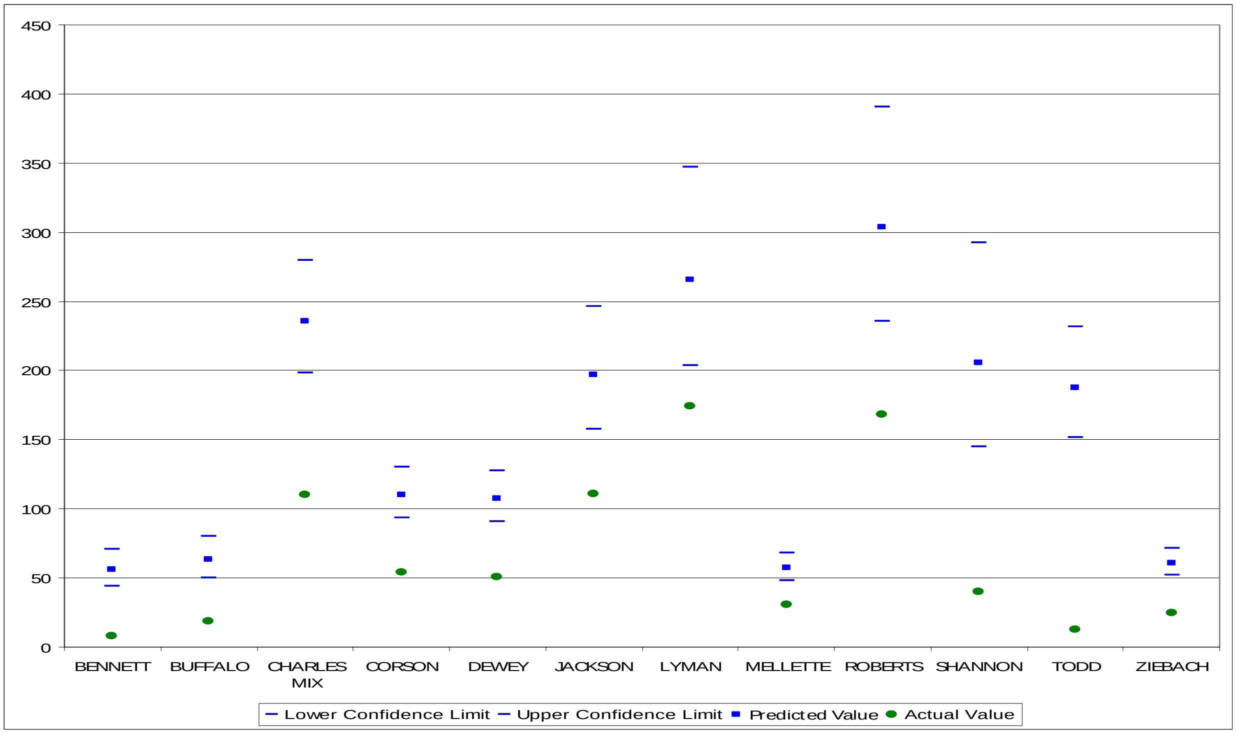


Table E8. 2001 Predicted and Actual Native American County Crash Counts

County	Year	Total Reported	Lower CL	Predicted Value	Upper CL
BENNETT	2001	8	44.2	55.9	70.6
BUFFALO	2001	19	50.2	63.4	80.2
CHARLES MIX	2001	110	198.4	235.6	279.8
CORSON	2001	54	93.5	110.4	130.4
DEWEY	2001	51	91.1	107.6	127.3
JACKSON	2001	111	157.6	196.9	246.1
LYMAN	2001	174	203.4	265.8	347.3
MELLETTE	2001	31	48.4	57.5	68.4
ROBERTS	2001	168	235.8	303.5	390.6
SHANNON	2001	40	144.6	205.7	292.4
TODD	2001	13	151.7	187.4	231.4
ZIEBACH	2001	25	52.0	60.8	71.2

Figure E9. 2002 Predicted and Actual Native American County Crash Counts

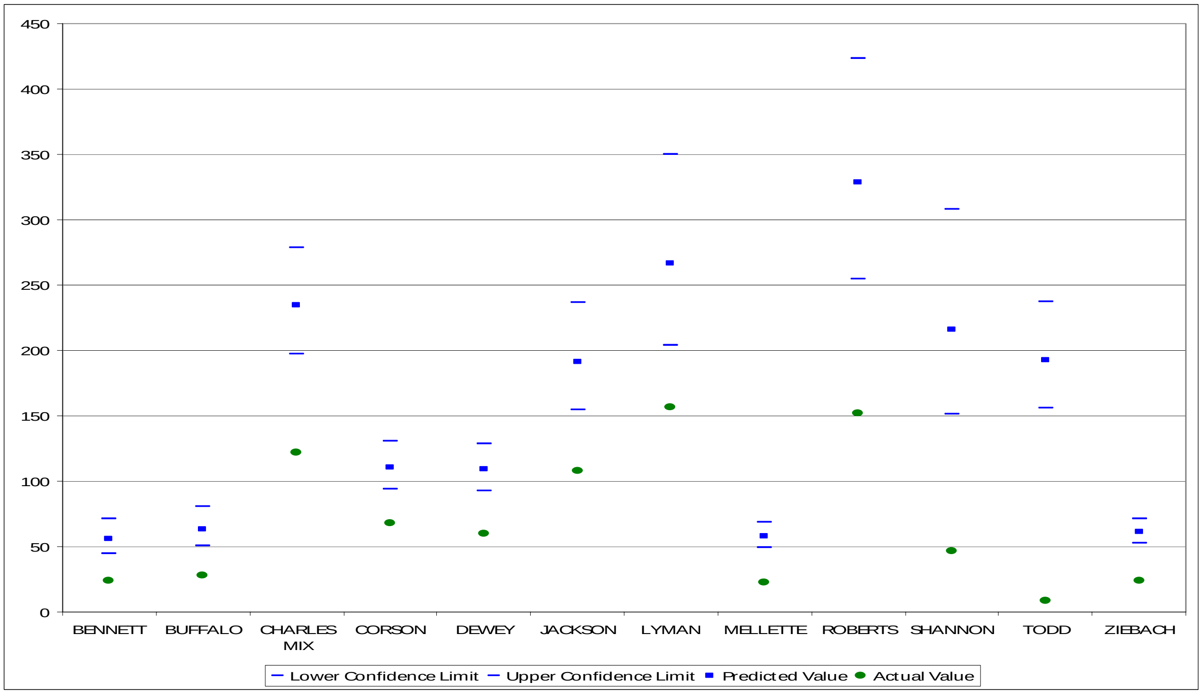


Table E9. 2002 Predicted and Actual Native American County Crash Counts

County	Year	Total Reported	Lower CL	Predicted Value	Upper CL
BENNETT	2002	24	44.6	56.3	71.0
BUFFALO	2002	28	50.4	63.6	80.3
CHARLES MIX	2002	122	197.6	234.6	278.6
CORSON	2002	68	93.9	110.7	130.5
DEWEY	2002	60	92.6	109.2	128.9
JACKSON	2002	108	154.5	191.3	236.8
LYMAN	2002	157	203.8	267.0	349.8
MELLETTE	2002	23	49.2	58.2	68.8
ROBERTS	2002	152	254.6	328.4	423.6
SHANNON	2002	47	151.4	216.0	308.1
TODD	2002	9	155.9	192.4	237.5
ZIEBACH	2002	24	52.4	61.2	71.5

Figure E10. 2003 Predicted and Actual Native American County Crash Counts

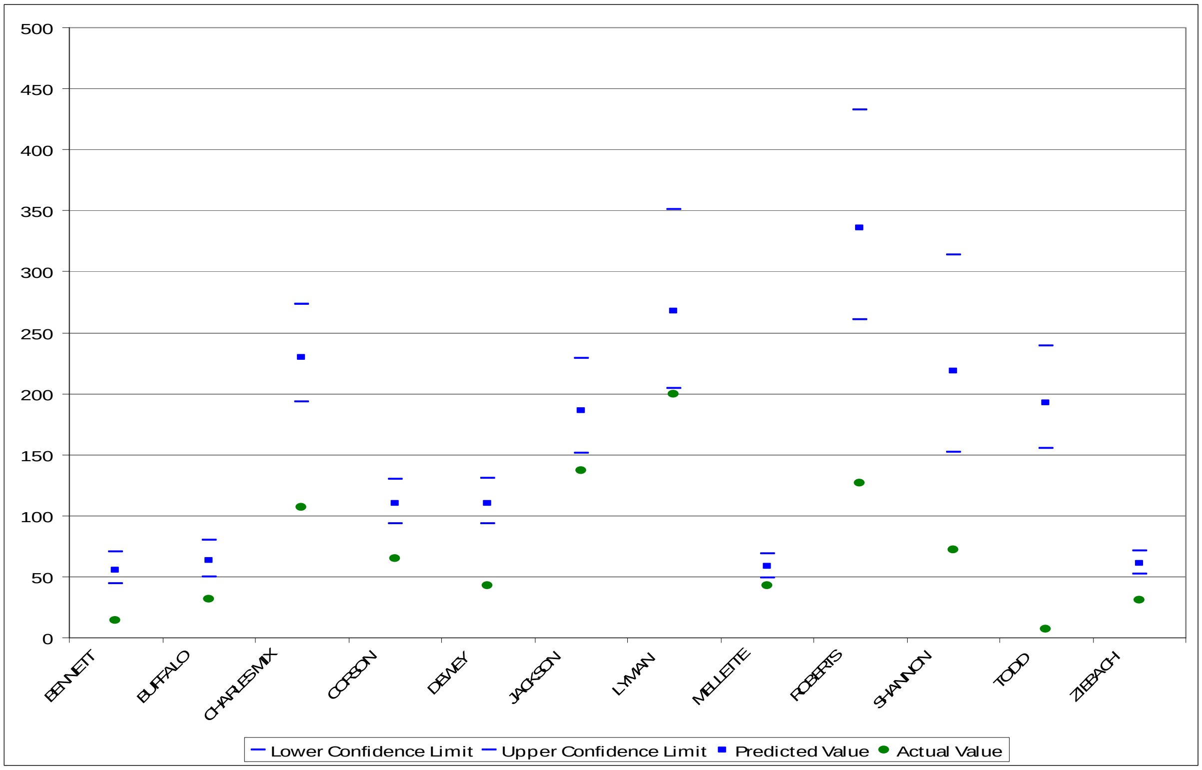


Table E10. 2003 Predicted and Actual Native American County Crash Counts

County	Year	Total Reported	Lower CL	Predicted Value	Upper CL
BENNETT	2003	14	44.1	55.8	70.6
BUFFALO	2003	32	50.2	63.4	80.1
CHARLES MIX	2003	107	193.6	230.0	273.2
CORSON	2003	65	93.4	110.0	129.6
DEWEY	2003	43	93.6	110.5	130.4
JACKSON	2003	137	151.6	186.3	229.0
LYMAN	2003	200	204.4	267.9	351.1
MELLETTE	2003	43	49.3	58.4	69.1
ROBERTS	2003	127	260.4	335.7	432.9
SHANNON	2003	72	152.3	218.7	314.1
TODD	2003	7	155.1	192.5	238.9
ZIEBACH	2003	31	52.2	61.0	71.3

The variation in crash counts from some of these counties from year to year is high, while the variation in the predictor variables is not as high. The association between the predictor variables and the crash counts is not necessarily causal or deterministic. For example, one rural county, Grant, has crash counts between 1998 and 2003 ranging from 106 to 217, one count being more than double the other. There are clearly factors contributing to these crash counts which are not accounted for in the predictor variables entered into the model. Based on the information available, the model has been produced to minimize the residuals, and the resulting predicted crash counts for counties with similar traffic conditions should be used as a rough reference level for what one would expect to see. What is important is the fact that the Native American counties have a clear pattern of always being much lower in their crash counts when compared to counties with similar traffic conditions, again, providing the state of South Dakota with a rough reference level for which to conceptualize the potential extent of the problem.