A Description of Fatal Car Crashes Occurring Within the Navajo Nation and its Border Towns, 2005-2014

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Introduction

Car crashes are a significant public health problem throughout the United States and within the Navajo Nation. According to the *Navajo Nation Mortality Report, 2006-2009* motor vehicle injuries and pedestrian injuries account for 10.6% of all Navajo deaths. The age adjusted death rate for motor vehicle injuries and pedestrian injuries are 44.80/100,000 and 18.61/100,000 respectively. The age adjusted death rate for all transport accidents in the U.S. in 2014 was 11.9/100,000, and the rate for all American Indian or Alaska Natives was 17.0.[1] The IHS report *Regional Differences in Indian Health 2002-2003 (accessed 11/16/16)* indicates that the leading cause of death among the Navajo Nation was unintentional injury (10.9% of all deaths) between 1999-2001. The Navajo Nation had the second highest motor vehicle crash death rate among the 12 IHS regions (Table 1). Approximately 1 in 7 (14.5%) of these motor vehicle deaths were pedestrian injuries. Motor vehicle deaths in New Mexico affect American Indian populations more than other race/ethnicities (Table 2).

The purpose of this report is to characterize fatal car crashes occurring within the Navajo Nation and its border towns, identify possible clusters of fatal car crashes, and identify key risk factors that may lead to fatalities in these severe crashes. Ideally this information would then be used to implement countermeasures to decrease the most serious car crash injuries. Crashes were included from border areas if it occurred (based on GPS coordinates) within 2 miles of the Navajo Nation legal jurisdiction boundaries. This report is limited because data for all types of car crashes are not available. There may be clusters of crashes that impact health, although not fatal, and quality of life that will not be identified in this report. It is also impossible to compare factors associated in fatal car crashes to other types of injury and non-injury crashes. Consequently, some important crash risk factors might not be identified.

All data were taken from the Fatality Analysis Report System (FARS) managed by the National Highway Traffic Safety Administration (NHTSA). FARS is a census of fatal crash data for the U.S. collected from Police Accident Reports. NHTSA produces reports at the State level and county level but not on the tribal level. Data from car crashes occurring within and near the boundaries of the Navajo Nation were compiled by the author. Crashes included in this report came from the years 2005 through 2014 (2014 is the most recent year data were available at the time this report was completed). Within FARS there are 3 report levels: Crash, Vehicle, and Person. This report will present the results according to those 3 levels. Another limitation of this report is that many data fields are left empty by reporting law enforcement officers, which could lead to identifying false risk factors, missing true risk factors, and missing fatal crash clusters.

1 Kochanek KD, Murphy SL, Xu JQ, Tejada-Vera B. Deaths: Final data for 2014. National vital statistics reports;vol 65 no 4. Hyattsville, MD: National Center for Health Statistics. 2016.

Table 1 Motor Vehicle Crashes by IHS Service Areas

IHS Service Area	Age Adjusted Motor Vehicle	Percent of Motor Vehicle Crash
Aberdeen	**69.1**	**9.9%**
Alaska	**32.2**	**7.8%**
Albuquerque	**45.5**	**23.4%**
Bemidji	**60.0**	**10.8%**
Billings	**81.2**	**4.3%**
California	**25.1**	**4.8%**
Nashville	**23.8**	**10.1%**
Navajo	**80.4**	**14.5%**
Oklahoma	**38.1**	**5.4%**
Phoenix	**60.3**	**5.1%**
Portland	**33.9**	**13.3%**
Tucson	**49.8**	**2.1%**

Table 2 Motor Vehicle Death Rates in New Mexico, 2010-2012 (Source: American Indian Equity Report, 2013)

Race/Ethnicity	2010-2012 Rate (per 100,000)
American Indian	37.2
Hispanic	15.7
White	11.9
African American	11.2*
Asian/Pacific Islanders	14.9*

*Based on fewer than 20 cases and may fluctuate from year to year

Crash Level

There were 927 fatal crashes within the boundaries of or in the border towns of the Navajo Nation from 2005 through 2014 (Table 3). Crashes were selected based on State of crash occurrence and then by GPS coordinates. If GPS coordinates were not available crashes were included if the crash was identified as occurring on a street or highway exclusively found within the Navajo Nation. Any crashes with GPS coordinates within 2 miles of the Navajo Nation were included and are considered "Border" crashes. Crashes occurring on Hopi lands were included if they occurred on State Highway 264 since this is a principal highway connecting the Western Agency and Ft. Defiance Agency of the Navajo Nation. A crash was "likely" within the Navajo Nation if GPS coordinates were unavailable and the road on which the crash occurred is primarily found within the Navajo Nation. A crash was a "possible" Navajo crash if GPS coordinates and road were unknown but the crash occurred on tribal lands and within a county found within the Navajo Nation boundaries. These 927 crashes were stratified into the likelihood that the crash occurred within the Navajo Nation (Table 4). FARS can capture whether a crash occurred on tribal lands. Among the crashes included in this report approximately 75% were reported to be on tribal lands. However, in some crash reports a crash is identified as occurring on non-tribal lands even though the GPS coordinates provided pinpoint the crash on tribal lands.

Three States contain a portion of Navajo Nation lands: Arizona, New Mexico and Utah. State of crash occurrence can be found in Table 5. Based on land mass there are more crashes in New Mexico than expected and fewer crashes in Utah than expected. Much of the Utah portion of the Navajo Nation is uninhabited and no Interstate highways are found in that portion of the State. The presence of Interstate 40 in the southern part of the New Mexico portion likely explains the high number of crashes in New Mexico. The Navajo Nation is organized into 5 geo-political areas (similar to counties). Crashes occurring within these Agencies can be found in Table 6, which includes the border areas, and Table 6a which condenses the border areas into the Agency they are nearest.

The roads with the highest number of crashes can be found in Table 7, and crashes per mile of road are found in Table 8. One of the purposes of this report was to identify potential geographic crash clusters. An image of crash occurrence can be found in Map 1. Table 9 identifies the top 20 crash clusters that warrant additional investigation for prevention measures. Crashes were organized and mapped based on the 110 Navajo Nation Chapter boundaries (Maps 2-5). These maps include basic pins of crash GPS coordinates, crashes per Chapter, crashes per square mile of Chapter occurrence, crashes per Chapter population, and by Chapter residency of drivers.

The vast majority of these crashes occurred away from intersections and interchanges (Table 10) and where the roadway was straight (Table 11).

Crashes were categorized as occurring in 6 distinct time periods. Crashes were more likely to have occurred between 4:00 p.m. and midnight than any other time period. Results can be seen in Table 12.

Adverse road and weather conditions may contribute to the occurrence and frequency of car crashes. Among crashes with data recorded, 91.3% (n=651) occurred on blacktop, and about 7.8% occurred on dirt or gravel. Atmospheric conditions at the time of the crashes can be found in Table 13. The

majority of crashes occurred with no adverse weather conditions. Among crashes with data recorded 88.3% (n=664) occurred on dry roads, only about 1 in 20 (4.7%) occurred with snow or ice on the road, and 1 in 60 (1.5%) occurred on sand, mud, or dirt. Nearly half (46.1%, n = 798) of crashes occurred during daylight, and another 4.8% occurred at dawn or dusk. Among the 389 crashes that occurred in the dark, 5.4% were in lighted areas and 13.4% had unknown lighting conditions.

A crash could have up to 5 adverse conditions (Roadway Alignment, Roadway Surface Type, Roadway Surface Conditions, Light Conditions, and Atmospheric Conditions). There were 812 crashes that had information recorded for at least one of these adverse conditions. About 3 of 5 (61.5%) had at least one adverse condition reported. Table 14 displays the frequency of adverse events.

It is rare that crash time, EMS call time, and EMS arrival time were all recorded. EMS response time could be established for 214 crashes (23.1%), and total response time was available for 209 crashes (22.5%). For these crashes the average EMS response time was 16.8 minutes, and average total response time was 21.65 minutes.

Only a handful of factors related to road conditions were recorded as contributing to the crash. These can be seen in Table 15. Table 16 displays the unique crash identifiers where road conditions were a factor. This information can be used to further investigate the physical location of the crash and if construction or engineering measures can improve road safety. Crashes occurred throughout the year, and there wasn't a significant difference in the number of crashes by month or by quarter (Tables 17 & 18).

Table 3 Crash by Year

Year	Count	Percent	Cumulative Percent
2005	87	9.4	9.4
2006	113	12.2	21.6
2007	111	12.0	33.6
2008	90	9.7	43.3
2009	90	9.7	53.0
2010	82	8.9	61.8
2011	100	10.8	72.6
2012	85	9.2	81.8
2013	86	9.3	91.1
2014	83	9.0	100

Table 4 Crashes within the Navajo Nation

Within Navajo Nation	Count	Percent	Cumulative Percent
Definitely	676	72.9	72.9
Border	99	10.7	83.6
Possible	83	9.0	92.6
Likely	51	5.5	98.1
Hopi	18	1.9	100

Table 5 Crashes by State

State	Count	Percent	Cumulative Percent	Square Miles	Percent Square Miles
Arizona	523	56.4	56.4	15,974	59.5
New Mexico	386	41.6	98.1	8,832	32.9
Utah	18	1.9	100	2,048	7.6

Table 6 Crashes by Agency

Agency	Count	Percent	Cumulative Percent
Ft. Defiance	164	22.7	22.7
Northern	143	19.8	42.5
Western	141	19.5	62.0
Eastern	139	19.3	81.3
Border, Eastern	53	7.3	88.6
Chinle	42	5.8	94.4
Hopi	18	2.5	96.9
Border, Northern	10	1.4	98.3
Border, Western	7	1.0	99.3
Border, Ft. Defiance	5	0.7	100.0

Table 6a Crashes by Agency with Border Areas Condensed

Agency	Frequency	Percent of Crashes	Percent of Population
Chinle	42	6.0	16.0
Eastern	192	27.3	18.3
Ft. Defiance	169	24.0	26.3
Northern	153	21.7	17.8
Western	148	21.0	21.6

Table 7 Most Common Roads of Fatal Crash Occurrence: minimum of 1 crash per year

Road Name	Count	Percent	Cumulative Percent
Interstate 40	113	12.2	12.2
State Route 264	71	7.7	19.8
US 160	65	7.0	26.9
US 491	62	6.7	33.5
US 191	51	5.5	39.1
Navajo Route 12	33	3.6	42.6
US 89	32	3.5	46.1
US 64	31	3.3	49.4
Navajo Route 15	28	3.0	52.4
Navajo Route 36	21	2.3	54.7
AZ State Route 98	20	2.2	56.9
US 163	17	1.8	58.7
NM State Route 371	17	1.8	60.5
US 550	16	1.7	62.2
Navajo Route 13	12	1.3	63.5
Navajo Route 59	11	1.2	64.7
Navajo Route 2	10	1.1	65.8
Navajo Route 9	10	1.1	66.9

Table 8 Most Common Roads of Fatal Crash Occurrence by Crashes per Mile of Road, Minimum 10 Crashes

Road	Crashes	Crashes per mile per year	If each road was 100 miles, fatal crashes per year
Interstate 40	113	0.135	13.52
State Route 264	71	0.079	7.88
Navajo Route 36	21	0.073	7.30
US 550	16	0.068	6.79
US 64	31	0.060	6.02
US 491	62	0.060	6.01
US 160	65	0.041	4.06
US 163	17	0.038	3.85
US 89	32	0.037	3.72
Navajo Route 12	33	0.034	3.41
AZ State Route 98	20	0.032	3.16
US 191	51	0.028	2.85
Navajo Route 15	28	0.027	2.72
Navajo Route 13	12	0.027	2.69
Navajo Route 9	10	0.025	2.53
Navajo Route 59	11	0.025	2.49
Navajo Route 2	10	0.021	2.10
NM State Route 371	17	0.017	1.74

Map 1: Fatal Crashes 2005-2014

723 of the 927 crashes (78.0%) had GPS coordinates recorded

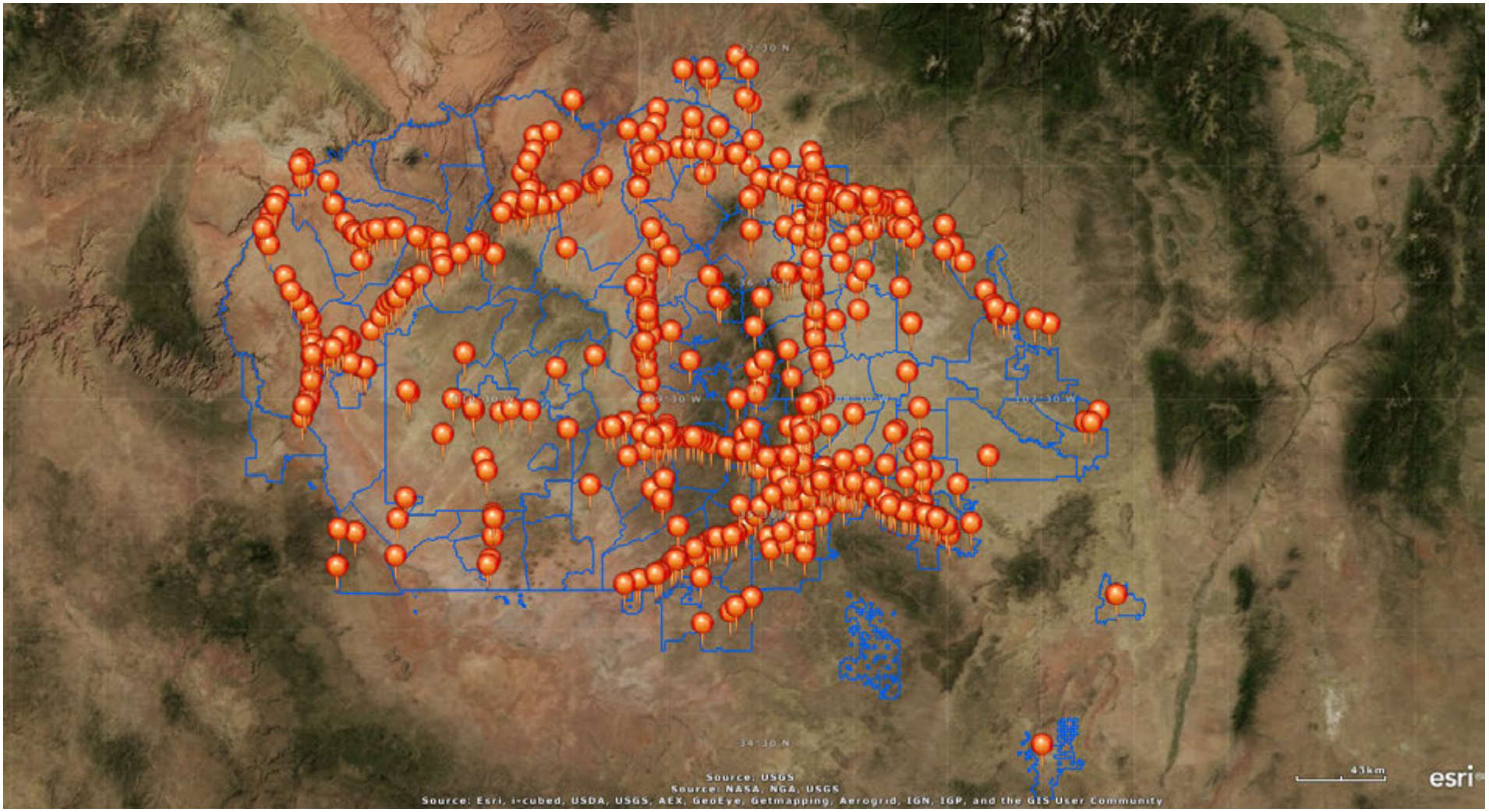


Table 9 Crash locations to investigate further

To be included there had to be at least 2 crashes with one of the crashes occurring since 2010

The average distance needed to be less than half a mile apart

Does not include any of the crashes occurring on Interstate 40 as the Navajo Nation will likely have less influence in making engineering or enforcement changes

State	Road	Number of Crashes	Average distance between crashes	Chapter	Note
NM	US 64	3	0.01 miles	Beclabito	A second cluster of 2 crashes is only 0.58 miles away
NM	**NM 53**	**3**	**0.014 miles**	**Nahata'dziil**	**Right on the border with Zuni**
AZ	SR 264	3	0.069 miles	St. Michael's	At AZ/NM state line
NM	**US 491**	**5**	**0.07 miles**	**Twin Lakes**	
NM	US 491	4	0.075 miles	Shiprock	
NM	**SR 602**	**3**	**0.081 miles**	**Chichiltah**	
AZ	Navajo Route 12	3	0.097 miles	St. Michael's	Near the Tribal Government Road in Window Rock
AZ	**SR 264**	**3**	**0.144 miles**	**Ganado**	**2 crashes right on top of each other at junction**
AZ	SR 264/US 160	4	0.165 miles	Tuba City	At and near the intersection in Tuba City

Table 9 Continued

State	Road	Number of Crashes	Average distance between crashes	Chapter	Note
AZ	SR 264	5	0.196 miles	Coalmine Mesa	2 Crashes on top of each other
NM	**SR 264**	**3**	**0.214 miles**	**Rock Springs**	
AZ	US 160	3	0.27 miles	Tonalea	
AZ	**US 160**	**3**	**0.3 miles**	**Tonalea**	
NM	US 491	6	0.301	Newcomb & Two Grey Hills	4 Crashes right on top of each other: Removing North & South Crashes the average distance is only 0.009
AZ	**US 191**	**4**	**0.396**	**Chinle**	**Near US 191/Navajo Route 6 Junction**
AZ	SR 98	3	0.4 miles	Kaibeto	On a curve near the Kaibeto Chapter House
NM	**US 491**	**3**	**0.407**	**Sheep Springs**	**2 Crashes on top of each other**
AZ	US 160	5	0.425	Dennehotso	This is near the Dennehotso Chapter House
AZ	**US 160**	**3**	**0.446**	**Tuba City**	**2 Crashes on top of each other**
NM	US 491	3	0.466	Sanostee	

Map 2: Fatal Crash Counts by Chapter of Crash Occurrence

Violet = 0 Crashes

Blue = 1-2 Crashes

Green = 3-5 Crashes

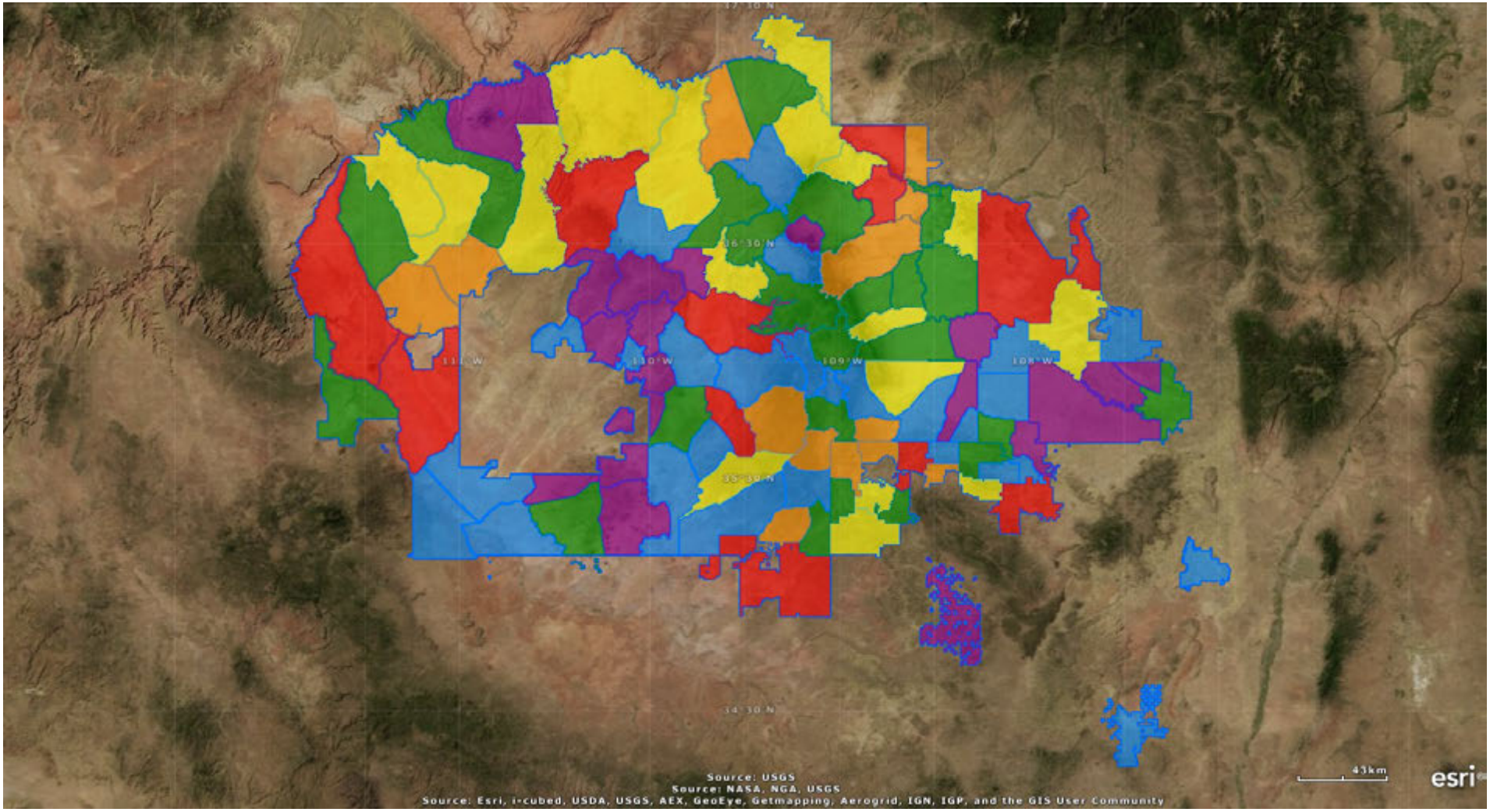
Yellow = 6-10 Crashes

Orange = 11-15 Crashes

Red = 16 or more crashes

75 crashes occurred within 2 miles of the Navajo Nation

18 crashes occurred on Hopi land



Map 3: Crashes per 1,000 square miles, by Chapter Boundaries

No fill = 0

Violet = 0.01– 0.99

Blue = 1-1.99

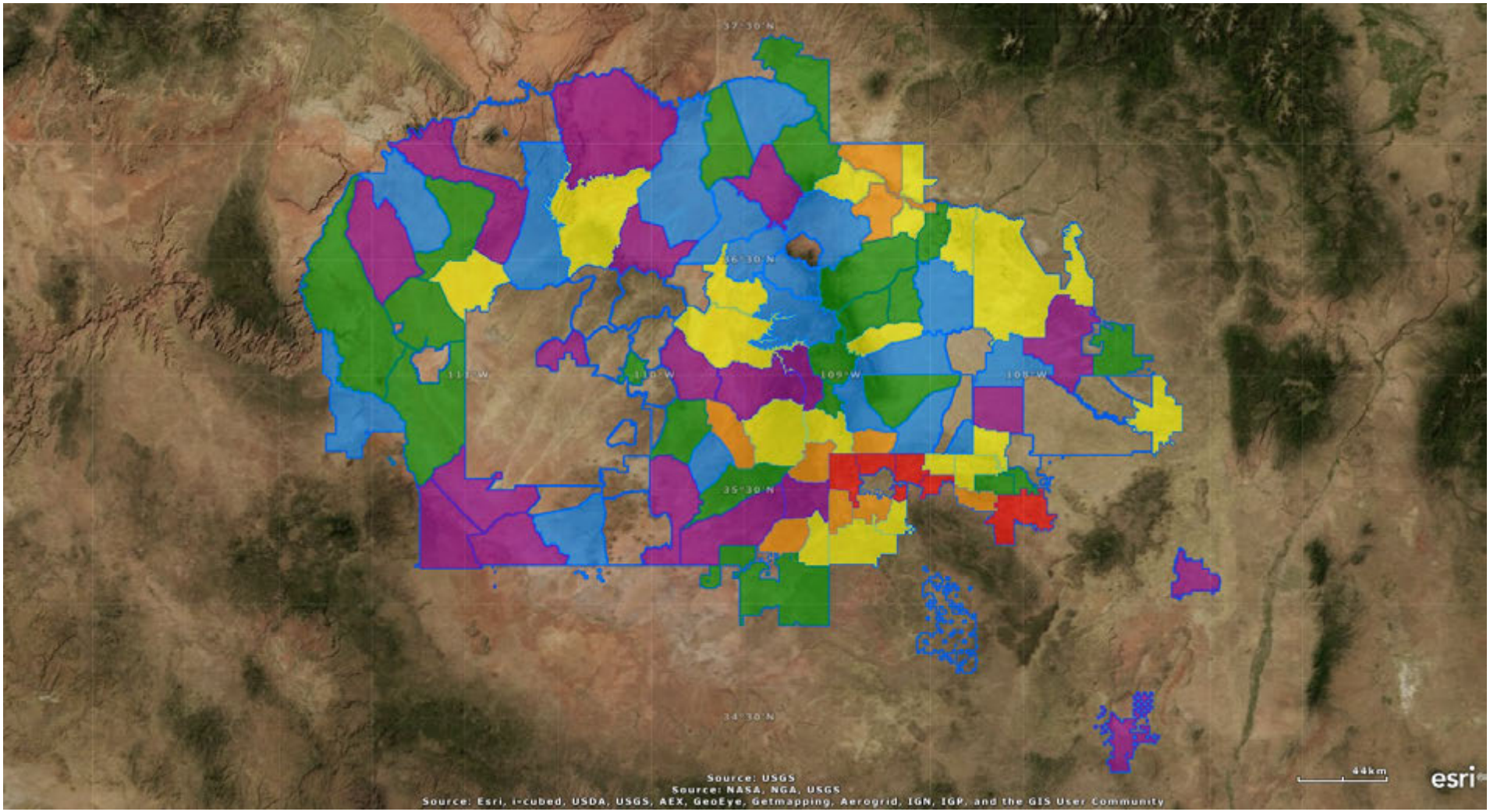
Green = 2-3.99

Yellow = 4-7.5

Orange = 10-19.99

Red = 20+

This is a means to estimate crashes per mile, but these crashes did not necessarily include Navajo drivers, and can't estimate miles driven.



Map 4: Crashes per Chapter Population

No fill = 0

Violet: 5-19.99

Blue: 20-29.99

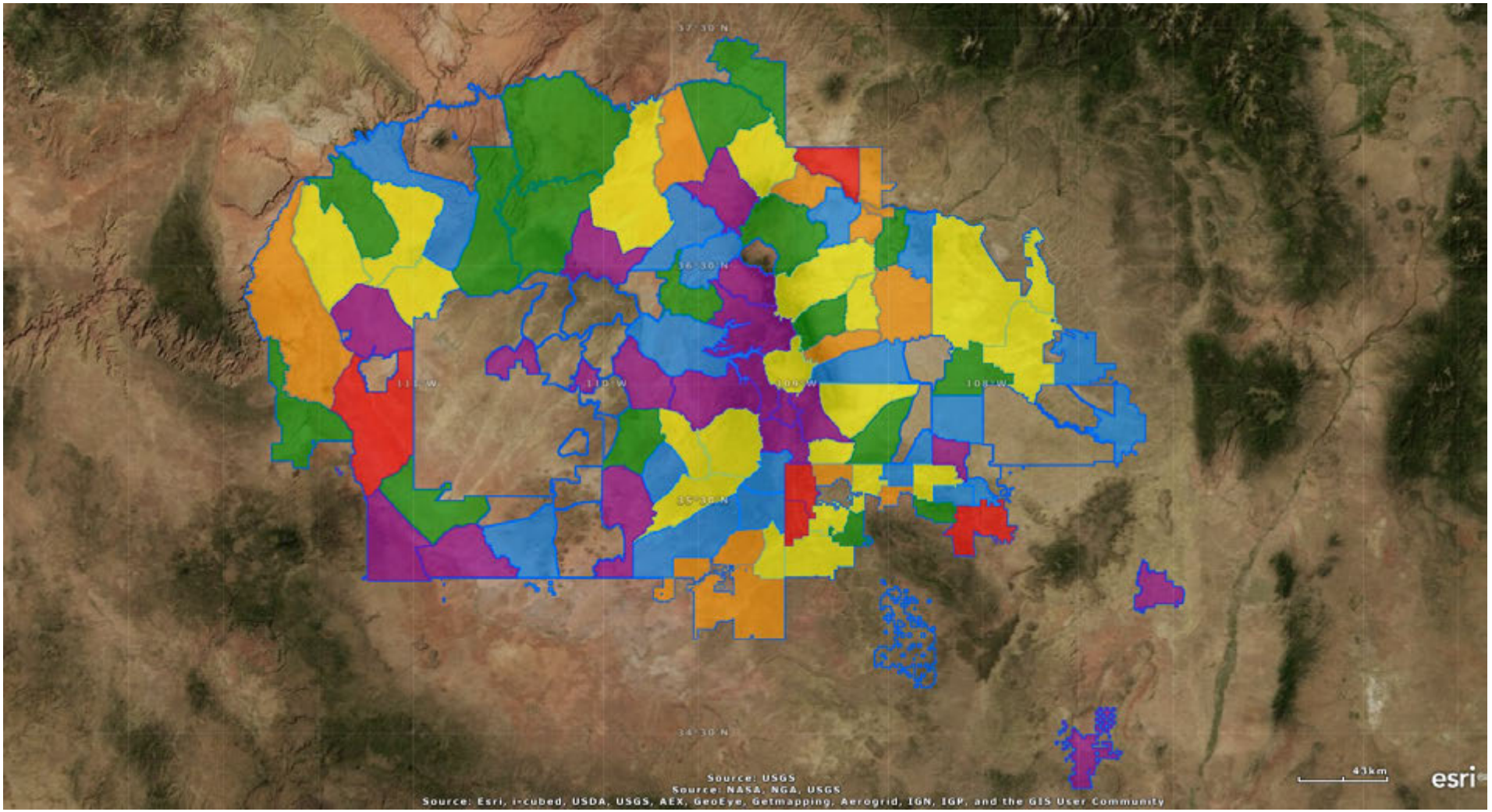
Green: 30-49.99

Yellow: 50-99.99

Orange: 100-199.99

Red: 200+

Just because a crash occurred within the chapter doesn't mean that a chapter member was included in the crash.



Map 5: ZIP code of drivers involved in fatal crashes

961 (80.1%) of the 1,200 drivers had their residency ZIP code recorded. Among vehicles with a recoded ZIP code, 469 (48.8%) of the vehicles had a driver with a Navajo Nation ZIP code. 44 different Chapters were represented. 206 (21.4%) of the vehicles had a driver with a border town or Hopi ZIP code. Among those with a known ZIP code, 70.2% had Navajo Nation, Hopi, or border town ZIP code. 286 (29.8%) of drivers were from outside the Navajo Nation and its border towns. This map illustrates the rate of drivers per 100,0000 Chapter members of driving age.

Violet: <17.0 **Green: 34-50.99** **Orange: 100-149.99**

Blue: 17-33.99 **Yellow: 51-99.99** **Red: 150+**

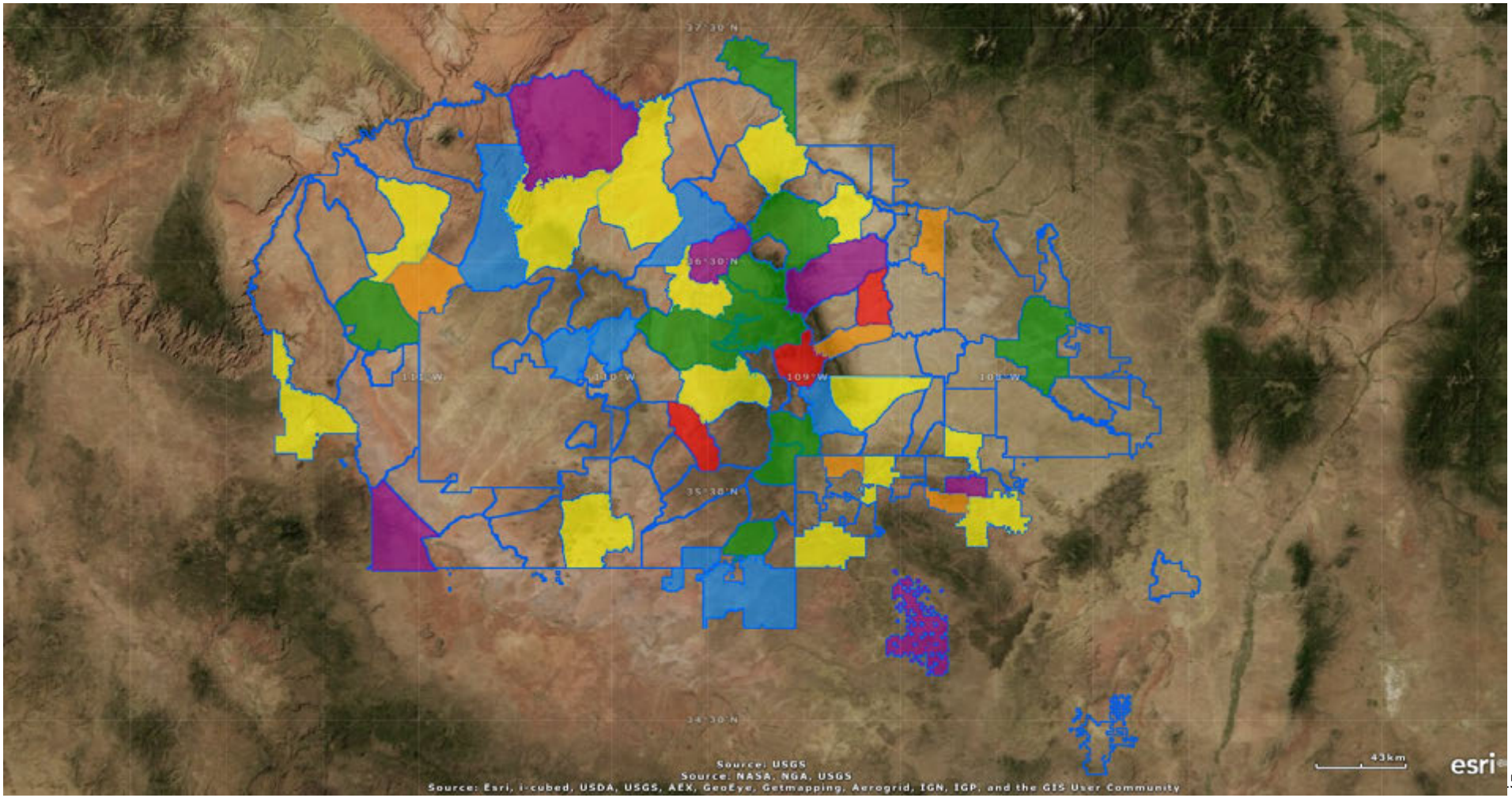


Table 10 Relation to Junction

Relation to Junction	Frequency	Percent	Cumulative Percent
Non-junction	672	72.5	72.5
Unknown	189	20.4	92.9
Intersection or intersection related	46	5.0	97.8
Driveway Related	12	1.3	99.1
Not reported/Missing	3	0.3	99.5
Crossover related	2	0.2	99.7
Entrance/Exit Ramp	1	0.1	99.8
Rail Grade Crossing	1	0.1	99.9
Through Roadway	1	0.1	100

Table 11 Roadway Alignment

Roadway Alignment	Count	Percent	Cumulative Percent
Straight	499	54.4	54.4
Unknown	249	27.2	81.6
Curve	79	8.6	90.2
Curve Left	33	3.6	93.7
Curve Right	32	3.5	97.3
Not Reported	16	1.7	99.0
Curve-Unknown	8	0.9	99.9
Non-traffic	1	0.1	100

Table 12 Time of Crash

Time Period	Count	Percent	Cumulative Percent
0:00-3:59 AM	116	13.7	13.7
4:00-7:59 AM	116	13.7	27.4
8:00-11:59 AM	99	11.7	39.1
12:00-15:59 PM	136	16.1	55.1
16:00-19:59 PM	182	21.5	76.6
20:00-23:59 PM	198	23.4	100

Table 13 Atmospheric Conditions

Atmospheric Condition	Frequency	Percent	Cumulative Percent
No Adverse Weather	620	67.0	67.0
Unknown	222	24.0	90.9
Snow, sleet, hail	28	3.0	94.0
Rain	18	1.9	95.9
Cloudy	18	1.9	97.8
Not reported	8	0.9	98.7
Severe Crosswinds	5	0.5	99.2
Blowing Sand, Soil, Dirt	3	0.3	99.6
Fog, Smog, Smoke	3	0.3	99.9
Other	1	0.1	100

Table 14 Total Adverse Conditions

Number of Adverse Conditions	Count	Percent	Cumulative Percent
0	313	38.6	38.6
1	354	43.6	82.1
2	101	12.4	94.6
3	34	4.2	98.8
4	10	1.2	100

Table 15 Crash Related Factors

Crash Related Factor	Count	Percent	Cumulative Percent
Shoulder design or condition	13	3.6	3.6
Inadequate warning of exits, lanes narrowing, traffic controls, etc.	10	2.8	6.4
Inadequate construction or poor design of roadway, bridge, etc.	5	1.4	7.8
Other maintenance or construction created conditions	4	1.1	8.9
No or obscured pavement marking	1	0.3	9.1
None	328	90.9	100

Tables 16 Year, State and Case Number of Crashes with Road Factors

Shoulder design or condition					
Year	**State**	**Case Number**	**Year**	**State**	**Case Number**
2005	New Mexico	326	2007	New Mexico	354
2009	**Arizona**	**40**	**2012**	**Arizona**	**86**
2012	Arizona	251	2012	Arizona	587
2012	**Arizona**	**751**	**2012**	**New Mexico**	**335**
2013	New Mexico	18	2013	New Mexico	48
2013	**New Mexico**	**139**	**2014**	**Arizona**	**124**
Inadequate Warning of Exits, Lanes Narrowing, Traffic Controls					
Year	**State**	**Case Number**	**Year**	**State**	**Case Number**
2007	Arizona	684	2007	New Mexico	263
2008	**Arizona**	**633**	**2008**	**Arizona**	**700**
2010	Arizona	243	2013	New Mexico	59
2013	**New Mexico**	**241**	**2013**	**New Mexico**	**272**
2014	New Mexico	227			
Inadequate Construction or Poor Design of Roadway, Bridge					
Year	**State**	**Case Number**	**Year**	**State**	**Case Number**
2006	Arizona	978	2006	Arizona	988
2006	**Arizona**	**1079**	**2006**	**New Mexico**	**112**
2012	Arizona	183			

Table 17 Crash by Month

Crash Month	Count	Percent	Cumulative Percent
January	63	6.8	6.8
February	72	7.8	14.6
March	70	7.6	22.1
April	73	7.9	30.0
May	72	7.9	37.8
June	86	9.3	47.0
July	86	9.3	56.3
August	71	7.7	64.0
September	97	10.5	74.4
October	90	9.7	84.1
November	84	9.1	93.2
December	63	6.8	100

Table 18 Crash by Quarter of Year

Quarter	Count	Percent	Cumulative Percent
1: January through March	205	22.1	22.1
2: April through June	231	24.9	47.0
3: July through September	254	27.4	74.4
4: October through December	237	25.6	100

Vehicle Level

There were 1,202 vehicles involved in these 927 crashes. The average number of vehicles in each crash was 1.29. Three in four crashes (75.8%) involved only one car, 20.8% involved 2 cars, and 3.4% involved 3 or more cars. The driver license state was recorded for 971 of these vehicles. Table 19 lists the driver license state if there were 10 or more drivers from the same State. Table 19a indicates if the driver was from the Navajo Nation or the surrounding area. Not all drivers were fully licensed, and some had legal actions against their license (Tables 20 & 21). Previous accidents, legal actions, and other harmful events were recorded for some drivers. Results can be found for each previous event individually in Tables 22-27, and whether or not there were at least one in Table 28.

Speed is cited as a contributing factor in about 1 in 3 crashes (32.5%, n = 424 drivers). Whether or not a violation was charged was only recorded for 429 drivers. At least one violation was given to 19.3% of drivers. The types of violations charged can be found in Table 29. Whether or not there was a driver related factor was recorded for 603 drivers, with about 75% of the drivers having one factor affecting them. The most commonly recorded driver factors (recorded 10 or times) can be found in Table 30. Table 31 displays the most commonly recorded driver distractions. Cell phones are mentioned as a distraction for only two drivers. Driver distraction was not recorded for 58.3% of all drivers, though.

The body type of vehicles involved were known for 920 (76.5%) of the 1,202 vehicles**.** The 35 unique body type codes were organized into 9 categories, and results can be seen in Table 32. Travel speed was known for only 232 (19.3%) of the vehicles involved in these crashes. The average travel speed of these vehicles was 55.6 miles per hour. A histogram of travel speed can be found in Chart 1. A vehicle was recorded as speeding if the reported travel speed exceeded the recorded speed limit. Almost one third (31.5%, n = 213) of vehicles were speeding. The maneuver of the vehicles at the time of the crash was recorded for 904 (75.2%) vehicles. The majority (70.4%) were simply going straight. Full results for vehicle maneuver can be seen in Table 33. Rollover was recorded for 1,200 of the vehicles, with it occurring for 38.1% of vehicles. A crash occurring on a curve was 3.21 (95% CI: 2.28, 4.48, Chi2 = 45.69, p = 0.0001) times more likely to involve a rollover than a crash on a straight section of road. Impact point is recorded for collisions using a traditional clock face as a reference. A crash with impacted point recorded as “12” indicated the first impact point was directly to the front of the vehicle, a “3” is a hit to the right side, a “6” is a rear end collision, and a “9” is a hit to the left side. If the impact point is the undercarriage of the vehicle it is recorded “14”. The first impact point for 1,000 vehicles can be seen in Table 34. Car crashes frequently involve a number of events before and after the most harmful part of the collision or rollover. For the crashes included in this report up to 7 events were recorded**.** These sequence of events were recorded for 1,111 (92.4%) vehicles and can be seen in Tables 35-42. In the crash report both the First Harmful Event and Most Harmful Event are recorded. In 960 (86.4%, n =1,111) of known cases the first harmful and most harmful events were the same. The most common Most Harmful Events can be found in Table 43. Whether or not there was a vehicle related factor was recorded for only 463 (38.5%) vehicles. Among those with information recorded only 5.2% of crashes had a vehicle related factor involved. Results for this field can be seen in Table 44.

Table 19 Driver License State

License State	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Arizona	436	44.9	436	44.9
New Mexico	371	38.2	807	83.1
Utah	29	3.0	836	86.1
California	29	3.0	865	89.1
Texas	18	1.9	883	90.9
Colorado	16	1.6	899	92.6
All other States	63	6.5	962	99.1
Foreign Driver	9	0.9	971	100

Table 19a Navajo Nation Resident Drivers

Navajo Nation Driver	Count	Percent	Cumulative Percent
Yes	459	47.6	47.6
No	320	33.2	80.8
From Border Town	170	17.6	98.4
Hopi	15	1.6	100

Table 20 Driver License Type

License Type	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Full	845	87.7	845	87.7
Not Licensed	115	11.9	960	99.6
Intermediate	3	0.3	963	99.9
Learner's Permit	1	0.1	964	100

Table 21 Driver License Status

License Status	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Valid	753	78.2	753	78.2
Not Licensed	116	12.0	869	90.2
Suspended	70	7.3	939	97.5
Revoked	15	1.6	954	99.1
Expired	5	0.5	959	99.6
Canceled or Denied	4	0.4	963	100

Table 22 Previous Recorded Accidents

Previous Recorded Accidents	Count	Percent	Cumulative Percent
Yes	12	2.2	2.2
No	545	97.8	100

Table 23 Previous Suspensions & Revocation

Number of Suspensions or Revocations	Count	Percent	Cumulative Percent
0	812	87.2	87.2
1	62	6.7	93.9
2	26	2.8	96.7
3	15	1.6	98.3
4	9	1.0	99.2
5	5	0.5	99.8
6	0	0	99.8
7	2	0.2	100

Table 24 Previous DWI Convictions

Number of DWI Convictions	Count	Percent	Cumulative Percent
0	878	94.3	94.3
1	42	4.5	98.8
2	9	1.0	99.8
3	2	0.2	100

Table 25 Previous Speeding Convictions

Number of Previous Speeding Convictions	Count	Percent	Cumulative Percent
0	0	91.4	91.4
1	1	6.4	97.9
2	2	1.2	99.0
3	3	0.9	99.9
4	4	0.1	100

Table 26 Previous Other Harmful Event Convictions

Number of Other Harmful Event Convictions	Count	Percent	Cumulative Percent
0	829	89.0	89.0
1	76	8.2	97.2
2	16	1.7	98.9
3	7	0.8	99.7
4	3	0.3	100

Table 27 Average Total Previous Harmful Events

N	Mean	Standard Deviation	Minimum	Maximum
931	0.61	1.33	0	10

Table 28 Any Previous Harmful Incidents

Any Previous Harmful Incidents	Count	Percent	Cumulative Percent
Yes	250	26.8	26.8
No	681	73.2	100

Table 29 Driver Violations

Description	Count	Description	Count
Manslaughter or Homicide	37	**Driving While Intoxicated**	29
Willful Reckless Driving	16	**Unsafe Reckless Driving**	10
Inattentive, Careless, Improper Driving	10	**Speeding**	7
Other Driver License Violations	6	**Hit and run , fail to stop after crash**	5
Driving while impaired	3	**Speed Greater Than Reasonable & Prudent**	3
Driving While License Withdrawn	3	**Not Reported**	3
Failure to require restraint use	2	**Fleeing or eluding police**	2
Serious violations resulting in death	2	**General alcohol, drug or impairment violations**	2
Improper method and position of turn (too wide, wrong lane)	2	**General non-moving violations**	2
Fail to obey stop sign	2	**Driving under influence of substance not intended to intoxicate**	1
Illegal possession of alcohol or drugs	1	**Turn in violation of traffic control**	1
Fail to Yield, Generally	1	**Following too closely**	1
Lane Violations, Generally	1	**Unknown**	1
Theft, unauthorized use of motor vehicle	1	**Driving on the wrong side of the road**	1
Brake Violations	1	**Failure to carry insurance**	1

Table 30 Driver Related Factors

Driver Factor	Count	Percent of Known (n=923)	Cumulative Percent
Failure to Keep in Proper Lane	185	20.0	20.0
Under the Influence of Alcohol	139	15.1	35.1
Careless/Inattentive Driving	132	14.3	49.4
Driving Too Fast for Conditions or in Excess of Posted Maximum	119	12.9	62.3
Overcorrecting	85	9.2	71.5
Failure to Yield Right-of-way	23	2.5	74.0
Failure to Obey Actual Traffic Sign, Traffic Control Devices or Traffic Officers; Failure to Obey Safety Zone Traffic Laws	19	2.1	76.1
Ice, Snow, Slush, Water, Sand, Dirt, Oil, Wet Leaves on Road	18	2.0	78.0
Non-Traffic Violation Charged-Manslaughter, Homicide or Other Assault Committed Without Malice	18	2.0	80.0
Operating the Vehicle in an Erratic, Reckless or Negligent Manner, Operating at Erratic or Suddenly Changing Speeds	17	1.8	81.8
Passing with insufficient distance or visibility	13	1.4	83.2
Making Other Improper Turn	13	1.4	84.6
Drowsy, Sleepy, Asleep, Fatigued	12	1.3	85.9
Improper or Erratic Lane Changing	10	1.1	87.0
Hit & Run	10	1.1	88.1

Table 31 Driver Distractions

Distraction	Frequency	Percent	Cumulative Percent
While Using Other Components/Controls Integral to Vehicle	223	39.4	39.4
Looked But Did Not See	34	6.0	45.4
By Other Occupants	6	1.1	46.5
While Talking or Listening to Cellular Phone	1	0.2	46.6
While Manipulating Cell Phone	1	0.2	46.8
Not Distracted	301	53.2	100

Table 32 Vehicle Body Type

Body Type	Frequency	Percent	Cumulative Percent
Pickup Truck	295	32.0	32.0
Small Sedan	288	31.2	63.2
Light Utility/Station Wagon	106	11.5	74.6
Truck Tractor	71	7.7	82.3
Van	63	6.8	89.2
Motorcycle/Off road/ATV	38	4.1	93.3
Large Utility	34	3.7	97.0
Single Unit Truck	19	2.1	99.0
Limousine/Motorhome	9	1.0	100

Chart 1 Distribution of Travel Speed

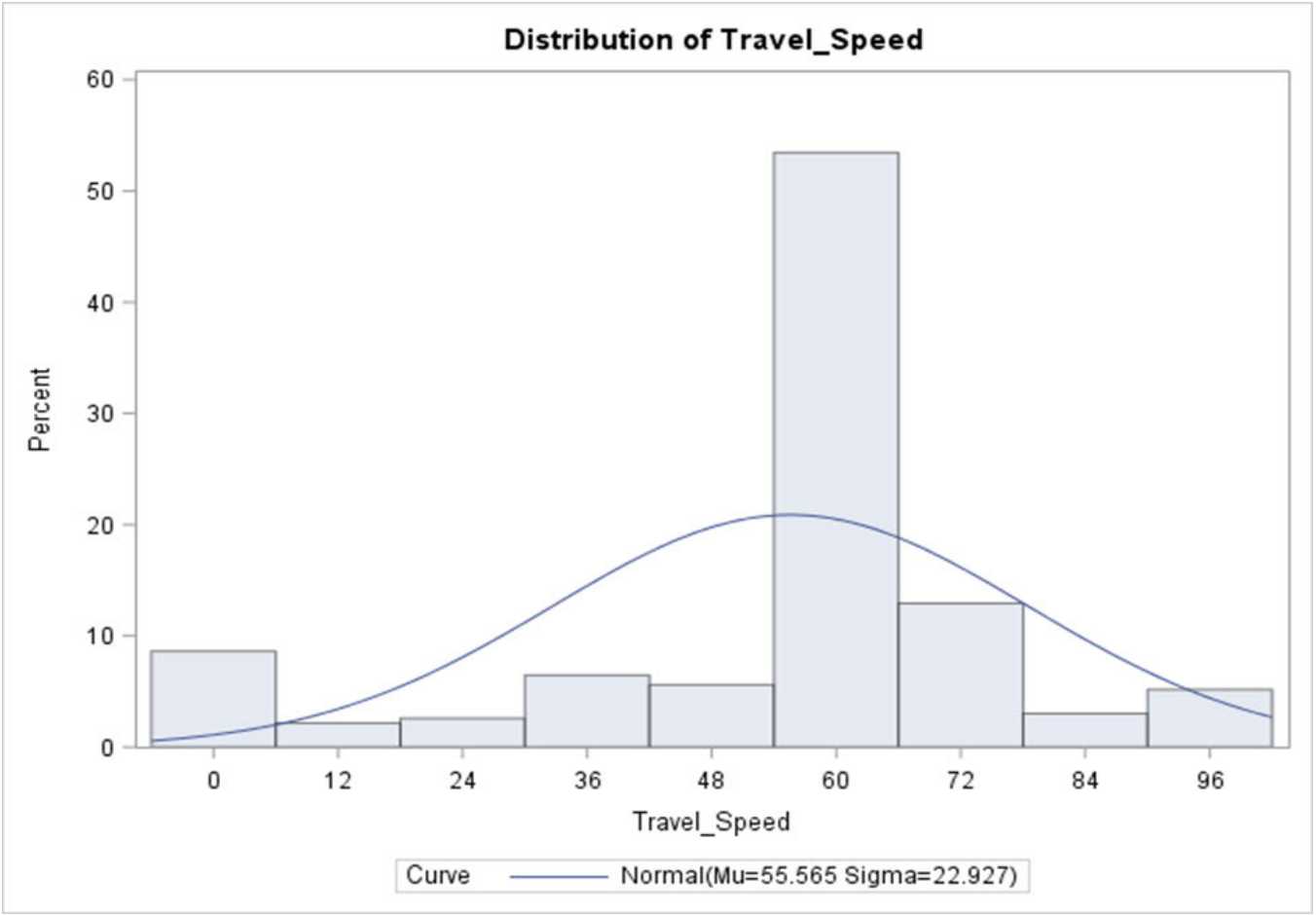


Table 33 Vehicle Maneuver

Maneuver	Frequency	Percent	Cumulative Percent
Going Straight	636	70.4	70.4
Negotiating a Curve	150	16.6	86.9
Passing or Overtaking a Vehicle	37	4.1	91.0
Turning Left	18	2.0	93.0
Stopped in Road/Traffic	17	1.9	94.9
Making a U-turn	11	1.2	96.1
Changing Lanes	9	1.0	97.1
Slowing/Stopping	8	0.9	98.0
Other	5	0.6	98.6
Starting in Traffic/Accelerating in Road	3	0.3	98.9
Controlled Maneuver	2	0.2	99.1
No Driver Present	2	0.2	99.3
Parked	2	0.2	99.6
Successful Avoidance	2	0.2	99.8
Backing Up	1	0.1	99.9
Turning Right	1	0.1	100

Table 34 First Impact Point

Impact Point	Count	Percent	Cumulative Percent
12 o'clock	482	48.2	48.2
Non-collision	310	31.0	79.2
6 o'clock	48	4.8	84.0
1 o'clock	28	2.8	86.8
9 o'clock	28	2.8	89.6
3 o'clock	20	2.0	91.6
10 o'clock	20	2.0	93.6
Undercarriage	18	1.8	95.4
11 o'clock	15	1.5	96.9
8 o'clock	9	0.9	97.8
7 o'clock	8	0.8	98.6
2 o'clock	7	0.7	99.3
4 o'clock	4	0.4	99.7
5 o'clock	3	0.3	100

Table 35 First Sequence of Events

Sequence of Event	Count	Percent	Cumulative Percent
Motor Vehicle in Transport	364	32.8	32.8
Ran off roadway	285	25.7	58.4
Pedestrian	180	16.2	74.6
Cross Median/Centerline	117	10.5	85.1
Rollover	110	9.9	95.0
Fell/Jumped from Vehicle	10	0.9	95.9
Parked Motor Vehicle	9	0.8	96.8
Embankment	7	0.6	97.4
Equipment Failure, blown tire/brake failure/etc.	6	0.5	97.9
Vehicle Struck by Cargo	5	0.5	98.4
Guardrail, concrete traffic barrier, curb	4	0.4	98.7
Live Animal	4	0.4	99.1
Pedacyclist	3	0.3	99.4
Fire/Explosion	2	0.2	99.5
Vehicle Went Airborne	2	0.2	99.7
Railway Vehicle	1	0.1	99.8
Other Object not Fixed	1	0.1	99.9
Shrubbery	1	0.1	100

Table 36 Second Sequence of Events

Sequence of Event	Count	Percent	Cumulative Percent
Rollover	125	23.5	23.5
Motor Vehicle in Transport	102	18.8	42.7
Ran Off Roadway	93	17.5	60.2
Cross Median/Centerline	58	10.9	71.1
Re-entering Roadway	54	10.2	81.2
Guardrail, concrete traffic barrier, curb, other traffic barrier, traffic sign	25	4.7	85.9
Vehicle Went Airborne	16	3.0	88.9
Embankment	13	2.4	91.4
Fence/Shrubbery/Tree	13	2.4	93.8
Fire/Explosion	9	1.7	95.5
Culvert/Ditch	9	1.7	97.2
Pedestrian	4	0.8	97.9
Jackknife	4	0.8	98.7
Vehicle Struck by Cargo/Object	3	0.6	99.2
Immersion	1	0.2	99.4
Fell/Jumped from Vehicle	1	0.2	99.6
Other Object Not Fixed	1	0.2	99.8
Object Fell from Motor-Vehicle In-transport	1	0.2	100

Table 37 Third Sequence of Events

Sequence of Event	Count	Percent	Cumulative Percent
Rollover	94	29.2	29.2
Ran off Roadway	57	17.7	46.9
Cross Median/Centerline	39	12.1	59.0
Motor Vehicle in Transport	28	8.7	67.7
Fence/Shrubbery/Tree	22	6.8	74.5
Embankment	19	5.9	80.4
Vehicle Went Airborne	19	5.9	86.3
Guardrail, concrete traffic barrier, curb, other traffic barrier, traffic sign, bridge pier	12	3.7	90.1
Fire/Explosion	9	2.8	92.9
Culvert/Ditch	7	2.2	95.0
Re-entering Roadway	6	1.9	96.9
Pedestrian	3	0.9	97.8
Vehicle Struck by Cargo/Object	2	0.6	98.4
Separation of Units	2	0.6	99.1
Working motor vehicle	1	0.3	99.4
Equipment Failure	1	0.3	99.7
Cargo/Equipment Loss or Shift	1	0.3	100

Table 38 Fourth Sequence of Events

Sequence of Event	Count	Percent	Cumulative Percent
Rollover	75	42.4	42.4
Ran off Roadway	37	20.9	63.3
Fence/Shrubbery/Tree/boulder/Ground	17	9.6	72.9
Motor Vehicle in Transport	10	5.6	78.5
Vehicle Went Airborne	9	5.1	83.6
Fire/Explosion	6	3.4	87.0
Culvert/Ditch	5	2.8	89.8
Cross Median/Centerline	4	2.3	92.1
Other Miscode	4	2.3	94.4
Embankment	3	1.7	96.0
Guardrail, concrete traffic barrier, curb, other traffic barrier, traffic sign, bridge pier	3	1.7	97.7
Pedestrian	1	0.6	98.3
Pedacyclist	1	0.6	98.9
Vehicle Struck by Cargo/Object	1	0.6	99.4
Re-entering Roadway	1	0.6	100

Table 39 Fifth Sequence of Events

Sequence of Event	Count	Percent	Cumulative Percent
Rollover	38	44.2	44.2
Fence/Shrubbery/Tree/boulder/Ground/Wall	12	14.0	58.1
Re-entering Roadway	5	5.8	64.0
Vehicle Went Airborne	5	5.8	69.8
Cross Median/Centerline	4	4.7	74.4
Culvert/Ditch	3	3.5	77.9
Embankment	3	3.5	81.4
Other Fixed Object	3	3.5	84.9
Motor Vehicle in Transport	3	3.5	88.4
Guardrail, concrete traffic barrier, curb, other traffic barrier, traffic sign, bridge pier	3	3.5	91.9
Ran off Roadway	2	2.3	94.2
Fire/Explosion	2	2.3	96.5
Pedestrian	1	1.2	97.7
Separation of Units	1	1.2	98.8
Miscode	1	1.2	100

Table 40 Sixth Sequence of Events

Sequence of Event	Count	Percent	Cumulative Percent
Rollover	19	55.9	55.9
Injured in Vehicle (non-collision)	7	20.6	76.5
Immersion	6	17.7	94.1
Fire/Explosion	1	2.9	97.1
Gas Inhalation	1	2.9	100

Table 41 Seventh Sequence of Events

Sequence of Event	Count	Percent	Cumulative Percent
Rollover	7	58.3	58.3
Injured in Vehicle (non-collision)	3	25.0	83.3
Immersion	1	8.3	91.7
Fell/Jumped from Vehicle	1	8.3	100

Table 42 All Sequence of Events Combined

Sequence of Event	Count	Percent	Cumulative Percent
Motor Vehicle in Transport	508	22.1	22.1
Ran Off Roadway	474	20.6	42.7
Rollover	468	20.3	63.0
Cross Median/Centerline	222	9.7	72.7
Pedestrian	189	8.2	80.9
Re-entering Roadway	66	2.9	83.8
Fence/Shrubbery/Tree/boulder/Ground/Wall	65	2.8	86.6
Vehicle Went Airborne	51	2.2	88.8
Guardrail, concrete traffic barrier, curb, other traffic barrier, traffic sign, bridge pier	47	2.0	90.9
Embankment	45	2.0	92.8
Other/Miscode	31	1.3	94.2
Fire/Explosion	29	1.3	95.4
Culvert/Ditch	24	1.0	96.5
Fell/Jumped From Vehicle	12	0.5	97.0
Vehicle Struck by Cargo/Object	11	0.5	97.5

Table 42 Continued: All sequence of events combined

Sequence of Event	Count	Percent	Cumulative Percent
Injured in Vehicle (non-collision)	10	0.4	97.9
Parked Motor Vehicle	9	0.4	98.3
Immersion	8	0.3	98.7
Equipment Failure (blown tire, brake failure, etc.)	7	0.3	99.0
Jackknife	4	0.2	99.1
Live Animal	4	0.2	99.3
Pedacyclist	4	0.2	99.5
Other Fixed Object	3	0.1	99.6
Separation of Units	3	0.1	99.7
Other Object Not Fixed	2	0.1	99.8
Cargo/Equipment Loss or Shift	1	0.04	99.9
Gas Inhalation	1	0.04	99.9
Railway Vehicle	1	0.04	99.96
Vehicle Occupant Struck or Run Over by Own Vehicle	1	0.04	100

Table 43 Most Harmful Event

Most Harmful Event	Count	Percent	Cumulative Percent
Motor Vehicle Collision	440	39.3%	39.3%
Rollover	430	38.4%	77.7%
Pedestrian	181	16.2%	93.8%
Fell/Jumped From Vehicle	11	1.0%	94.8%
Embankment	11	1.0%	95.8%
Struck Guardrail, Traffic Sign/Post/Barrier	10	0.9%	96.7%
Parked Vehicle	9	0.8%	97.5%
Fire/Explosion	8	0.7%	98.2%
Struck Natural Feature (e.g. boulder, ditch, tree)	7	0.6%	98.8%
Motor Vehicle Struck by Cargo	5	0.4%	99.3%
Bicyclist	4	0.4%	99.6%
Immersion or Partial Immersion	1	0.1%	99.7%
Railway Train	1	0.1%	99.8%
Struck Animal	1	0.1%	99.9%
Struck Other Object	1	0.1%	100%

Table 44 Vehicle Related Factors

Vehicle Related Factor	Count	Percent	Cumulative Percent
None	439	94.6	94.8
Hit & Run	16	3.4	98.1
Tires	4	0.9	98.9
Safety Belts	2	0.4	99.4
Suspension-Springs, Shock Absorbers, MacPherson Struts, Axle Bearing, Control Arms, ETC	1	0.2	99.6
Steering System	1	0.2	99.8
Vehicle Registration for Handicapped	1	0.2	100

Person Level

There were 2,649 people involved in these 927 crashes**.** The average age of a person involved in these crashes was 33.6 years (n=2,357). The average age of the fatalities in these crashes was 36.5 years (n=1086). Gender was recorded for 2,433 (91.8%) of the people involved. Almost two thirds (64.3%) of people in these crashes were male. Injuries can be put into 5 different classifications: No Injury, Possible Injury, Minor Injury, Serious Injury, Fatal Injury, and Injury Severity Unknown. Injury type by gender can be seen in table 45. After removing the data fields where gender or injury type was unknown, males were 1.33 (95% CI: 1.124, 1.581, p = 0.0009) times more likely to be killed in these crashes than females. Males were 1.252 times (95% CI: 1.054, 1.487, p = 0.0105) more likely to be severely or fatally injured than females.

Persons involved in these crashes could be classified into one of 6 person type categories (e.g. passenger, driver, bicyclist, pedestrian, Table 46). Seating position among car occupants can be seen in Table 47, and more than three quarters were in the front row of a vehicle. Restraint use can be recorded for car occupants, and was recorded for 1,595 persons (Table 48). Almost half of the passengers involved were not restrained. Restraint use among motorcyclists and bicyclists can be seen in Table 49. Among those with known helmet use reported, fewer than 40% were wearing a helmet. Restraint use among passengers less than 11 years old was recorded for 80.5% of children, and results can be found in Table 50. A simple logistic regression model indicated that children under 11 who were not using a seat belt were 6.9 times more likely to be killed in a crash than children who were wearing a seat belt. Children under 11 who were not in a child passenger safety seat were 10.2 times more likely to be killed in a crash than children who were restrained in a child safety seat. Air bag deployment was applicable and known for 1,352 (55.0%) occupants. An air bag was not available for 35.4% of occupants, not deployed for 41.1% of occupants, and deployed for 23.2% of occupants. Among those to whom it applied, 23.6% of vehicle occupants were ejected either entirely or partially. The location of non-motorists (pedestrians, bicyclists) was known for 137 of 191 persons (Table 51). No improper action, or being in the crosswalk was recorded for only 3.6% of non-motorists.

Alcohol use was recorded for 1,297 of persons involved in these crashes and 35.3% of these persons had been drinking alcohol. The method of alcohol determination was recorded for 406 persons with “Observed” being the most common at 59.9%, followed by Evidential (Breathalyzer) at 31.0%. Blood Alcohol Content (BAC) was reported for 507 persons. The average BAC was 9.62% (Minimum 0%, Maximum 54%). Other drug involvement was reported for an additional 14 persons.

Of the 1,100 fatalities, 852 (77.5%) died at the scene, 14 (1.3%) died in route to the hospital, 21 (1.9%) deaths occurred at an unknown (unrecorded) time, and the remaining 213 (19.4%) died sometime after receiving medical attention.

The average number of persons involved in each crash was 2.86. Table 52 displays the distribution of persons involved in crashes. The type of vehicle a person is traveling in might heavily influence the injury severity of occupant. Table 53 displays Vehicle Type and Injury Severity (Known). Passenger cars were classified as small (sedan) and large (Pickup, SUV, Van/Station Wagon) , and injuries were categorized as fatal or non fatal. After removing crashes involving pedestrians and bicyclists people in small cars were 1.75 (95% CI: 1.43, 2.14, p < 0.0001) times more likely to be killed in these crashes than people in large

cars. People in small cars were 1.59 (95% CI: 1.30, 1.94, $p < 0.0001$) times more likely to have a severe or fatal injury than people in larger vehicles. Full tables for odds ratios by vehicle size can be found in Tables 53b and 53c.

The age of the pedestrians was reported for 182 people. The average age was 35.3 years, and the distribution of age can be seen in Chart 2. Among the 95 pedestrians who had alcohol involvement recorded, 64.2% had been drinking**.** The average driver age was 39.3 years, and the distribution can be seen in Chart 3. The average age of motor vehicle occupants was 28.3 years and the distribution can be seen in Chart 4. The person type and gender distribution can be found in Table 54.

Seating position and injury severity can be seen in Table 55. Because so many cells in Table 55 had low counts the data were re-categorized to determine if there was a higher likelihood of fatality based on seating position (Table 55a).

Table 45 Injury Severity by Gender

Gender	None	Possible	Minor	Severe	Fatal	Injury, severity unknown	Missing	Total
Male	273	103	197	202	745	31	14	1565
Female	146	77	136	125	349	28	7	868
Unknown	37	0	197	1	6	27	135	208
Total	456	180	335	328	1100	86	156	2641

Table 46 Person Type

Person Type	Count	Percent	Cumulative Percent
Passenger	1,167	44.1	44.1
Driver	1,114	42.1	86.2
Pedestrian	186	7.0	93.3
Unknown type of Occupant	171	6.5	99.7
Bicyclist	4	0.2	99.9
Occupant not in transport	2	0.1	99.96
Unknown type of non-motorist	1	0.04	100

Table 47 Seating Position

Seating Position	Count	Percent	Cumulative Percent
Driver	1,115	53.2	53.2
Front Right	465	22.2	75.4
Second Row: Right	158	7.5	83.0
Second Row: Left	143	6.8	89.8
Second Row: Middle	77	3.7	93.5
Third Row	39	1.9	95.3
Front Middle	30	1.4	96.8
Cargo Section	29	1.4	98.1
Second Row Other/Unknown	22	1.1	99.2
Sleeper Section of Cab	11	0.5	99.7
Riding on Exterior of Vehicle	5	0.2	99.95
Fourth Row	1	0.05	100

Table 48 Car/Motorcycle Occupant Restraint Use

Restraint Use	Count	Percent	Cumulative Percent
Lap/Shoulder	854	48.2	48.2
None	790	44.6	92.7
Lap Belt	63	3.6	96.3
Child Restraint/Booster	35	2.0	98.3
Helmet	14	0.8	99.0
Restraint: Type Unknown	7	0.4	99.4
Other	5	0.3	99.7
Shoulder Belt Only	5	0.3	100.0

Table 49 Restraint use among motorcyclists and bicyclists

Type of motorist	Helmet	Unknown Helmet type	Other Helmet	None Used	Not Applicable	Missing	Un-known/ Not reported
Motorcycle Driver	8	2	1	19	0	0	6
Motorcycle Passenger	2	0	1	5	0	0	5
Motorcycle Unknown Position	0	0	0	0	0	0	2
Bicyclist	1	0	0	0	1	2	0

Table 50 Restraint Use if <11 Years

Restraint Use	Count	Percent	Cumulative Percent
None	91	45.0	45.0
Belt Only	72	35.6	80.7
Child Restraint/Booster	35	17.3	98.0
Other/Restraint Used but type unknown	4	2.0	100

Table 51 Pedestrian & Bicyclist Location

Location	Count	Percent	Cumulative Percent
Non-Intersection, On roadway, Crosswalk not Available	39	28.5	28.5
Crossing Roadway	25	18.2	46.7
In Roadway, Other (Working, Playing, etc.)	12	8.8	55.5
Non-Intersection, On roadway, Not in Crosswalk	11	8.0	63.5
Movement Along Roadway with Traffic	7	5.1	68.6
In Roadway Improperly	5	3.6	72.3
Improper Crossing (Jaywalking)	5	3.6	75.9
No Improper Action	4	2.9	78.8
Non-Intersection, On roadway, Crosswalk availability Unknown	4	2.9	81.8
Non-Intersection, Unknown	4	2.9	84.7
Jogging/Running	3	2.2	86.9
Intersection, On Roadway, No Crosswalk Available	2	1.5	88.3
Intersection, On Roadway, Not in Crosswalk	2	1.5	89.8
Movement Along Roadway Against Traffic	2	1.5	91.2
Non-Intersection, On Road Shoulder	2	1.5	92.7
Not Visible	2	1.5	94.2
Wrong Way Riding or Walking	2	1.5	95.6
Dart/Dash	1	0.7	96.4
Non-Intersection in Crosswalk	1	0.7	97.1
Non-Intersection, Other, Not on Roadway	1	0.7	97.8
Failure to Yield Right of Way	1	0.7	98.5
In Roadway	1	0.7	99.3
Other	1	0.7	100

Table 52 Number of persons involved in fatal crashes

Number of persons	Count	Percent	Cumulative percent
One	166	18.0	18.0
Two	378	40.9	58.8
Three	141	15.2	74.1
Four	102	11.0	85.1
Five	52	5.6	90.7
Six	38	4.1	94.8
Seven	18	2.0	96.8
Eight	18	2.0	98.7
Nine	5	0.5	99.2
Eleven	2	0.2	99.5
Twelve	2	0.2	99.7
Thirteen	1	0.1	99.8
Fifteen	1	0.1	99.9
Nineteen	1	0.1	100

Table 53 Injury Severity by Vehicle Type, Count

Injury	None	Possible	Minor	Severe	Fatal	Total
Sedan	96	58	84	96	308	642
Pickup	129	45	113	100	248	635
Light Utility/Station Wagon	50	34	46	49	94	273
Van	42	16	42	24	55	179
Large Utility	19	7	29	30	29	114
Tractor Trailer	57	10	7	1	20	95
Motorcycle/ATV	1	6	4	4	36	51
Single Unit Truck	13	2	2	1	12	30
Limousine/Motorhome	3	2	4	2	8	19
Total	410	180	331	307	810	2038

Table 53a Injury Severity by Vehicle Type (Percent of Total)

Injury	None	Possible	Minor	Severe	Fatal
Sedan	15.0%	9.0%	13.1%	15.0%	48.0%
Pickup	20.3%	7.1%	17.8%	15.8%	39.1%
Light Utility/Station Wagon	18.3%	12.5%	16.9%	18.0%	34.4%
Van	23.5%	8.9%	23.5%	13.4%	30.7%
Large Utility	16.7%	6.1%	25.4%	26.3%	25.4%
Tractor Trailer	60.0%	10.5%	7.4%	1.1%	21.1%
Motorcycle/ATV	2.0%	11.8%	7.8%	7.8%	70.6%
Single Unit Truck	43.3%	6.7%	6.7%	3.3%	40.0%
Limousine/Motorhome	15.8%	10.5%	21.1%	10.5%	42.1%

Table 53b Odds Ratio of Fatality by Vehicle Type (Motorcycle is the reference)

The Odds Ratio indicates how much more likely a person on a motorcycle is to be killed than the vehicle type listed

Vehicle Type	Odds Ratio	Lower Estimate	Upper Estimate
Sedan	2.906	1.558	5.419
Light Utility/Wagon	5.029	2.609	9.691
Van	6.560	3.282	13.110
Pickup	4.464	2.388	8.344
Large Utility	7.556	3.598	15.865
Limo/Motorhome	3.771	1.227	11.592
Single Unit Truck	5.400	1.932	15.093
Tractor Trailer	18.460	7.562	45.064

Table 53c Odds Ratio of Fatality by Vehicle Type (Sedan is the reference)

Vehicle Type	Odds Ratio	Lower Estimate	Upper Estimate
Motorcycle	0.344	0.185	0.642
Light Utility/Wagon	1.730	1.275	2.348
Van	2.257	1.548	3.291
Pickup	1.536	1.217	1.938
Large Utility	2.600	1.639	4.124
Limo/Motorhome	1.298	0.496	3.393
Single Unit Truck	1.858	0.796	4.339
Tractor Trailer	6.352	3.226	12.509

Chart 2 Pedestrian Age

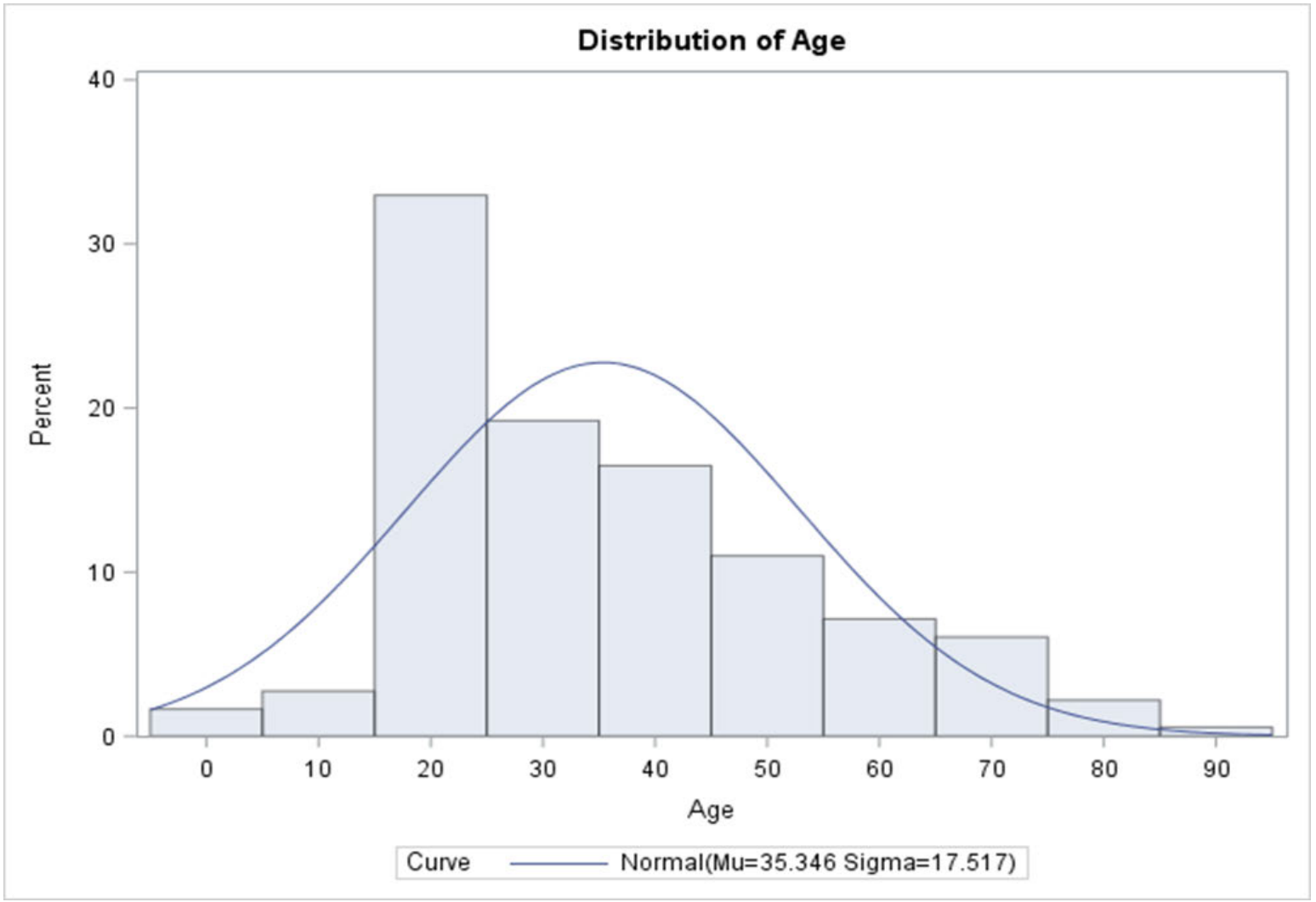


Chart 3 Driver Age

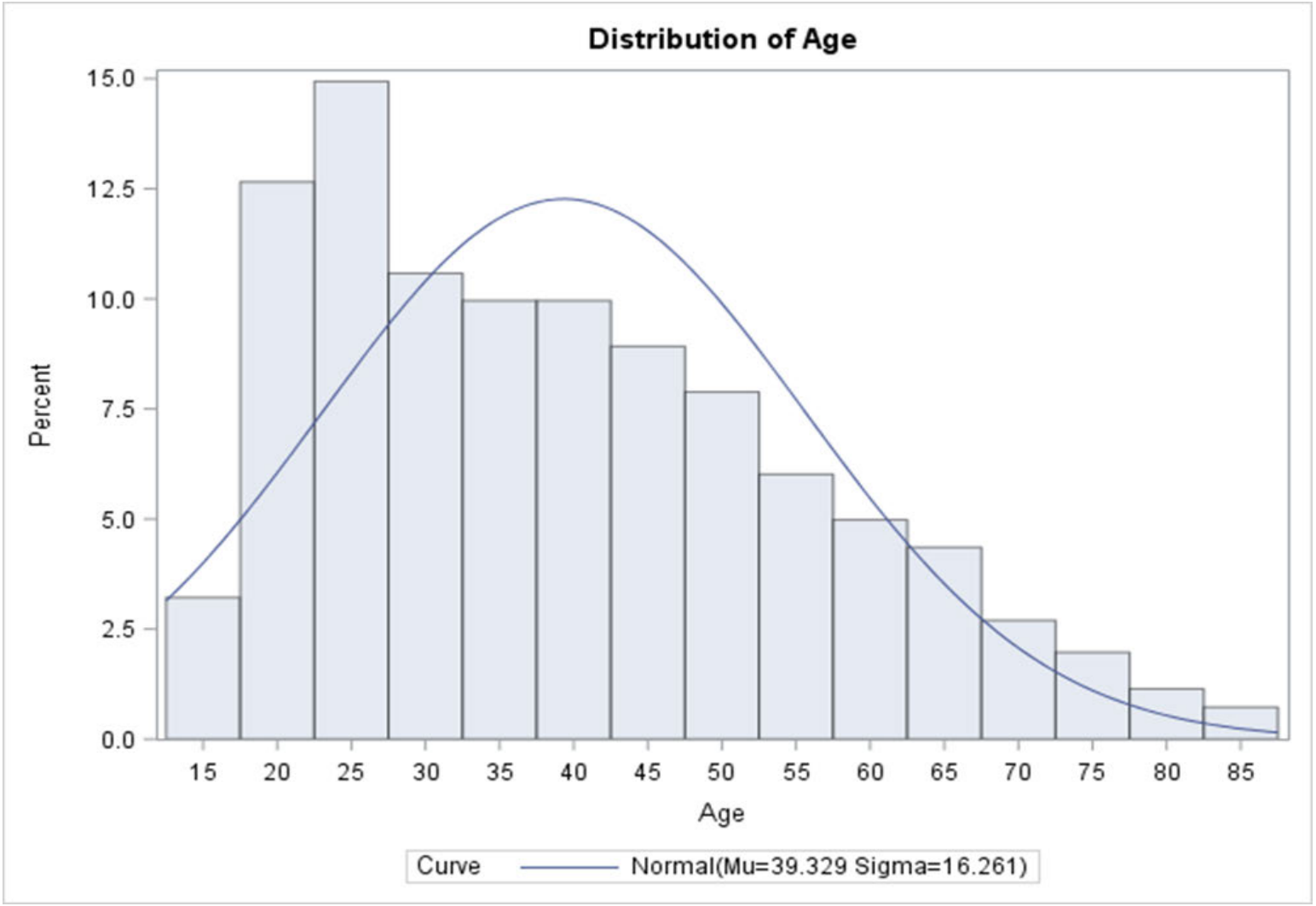


Chart 4 Motor Vehicle Occupant Age

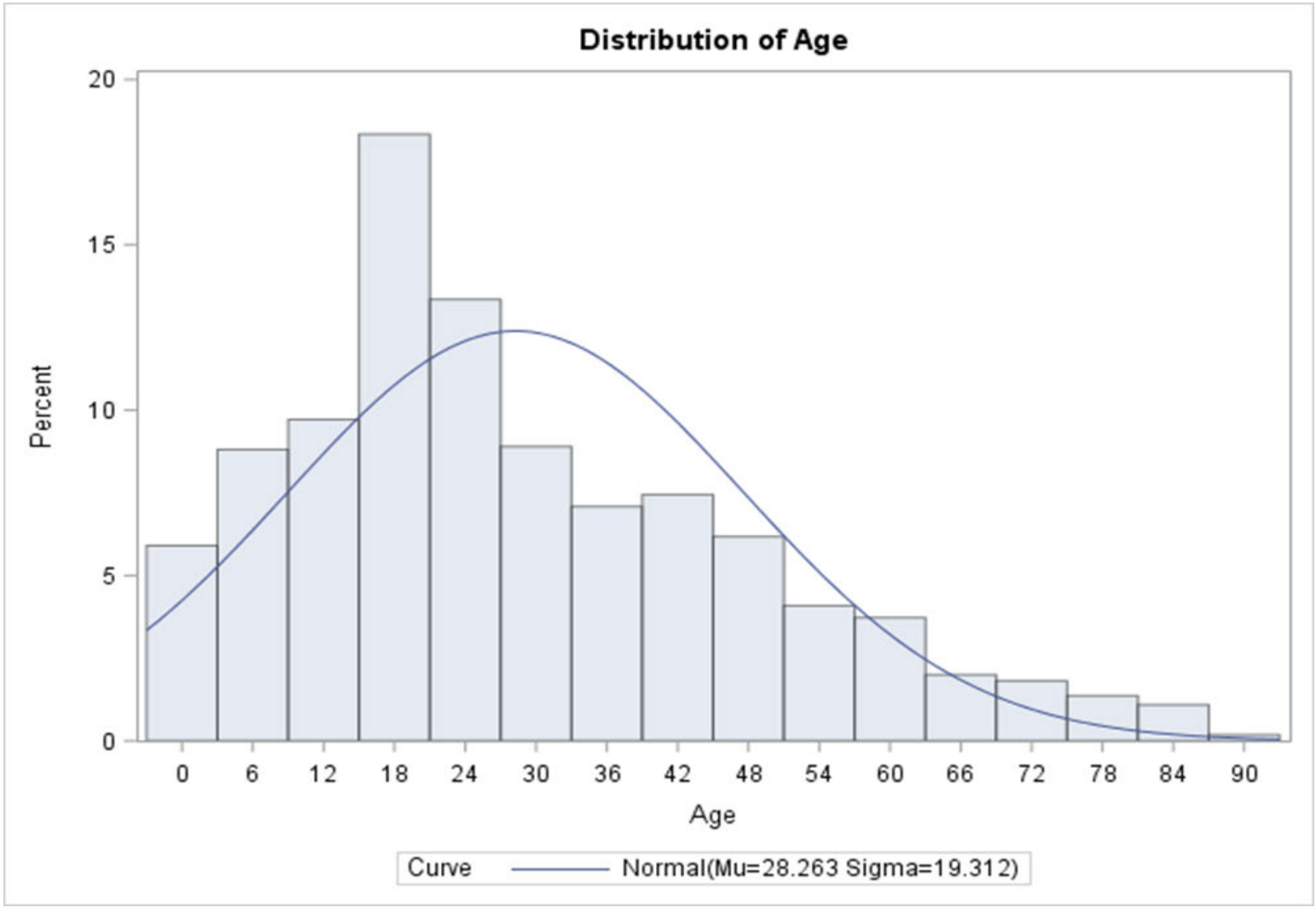


Table 54 Person Type by Gender

Person Type	Female		Male		Unknown		Not Reported	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Driver	260	23.3	730	65.5	121	10.9	3	0.3
Passenger	538	46.1	606	51.9	23	2.0	0	0
Pedestrian	40	21.5	146	78.5	0	0	0	0
Unknown Occupant Type	28	16.5	78	45.9	64	37.7	0	0
Bicyclist	0	0	4	10	0	0	0	0
Occupant not in motor vehicle	1	50	1	50	0	0	0	0
Unknown type of non-motorist	1	100	0	0	0	0	0	0
Total	868	32.8	1,565	59.2	208	7.9	3	0.1

Table 55 Seating Position and Injury Severity

Seating Position	None	Possible	Minor Injury	Severe Injury	Fatality	Total
Driver	263	65	114	95	465	1,002
Front Row Passenger	94	41	90	87	170	482
Second Row Passenger	69	52	87	97	81	386
Cargo Area	18	11	3	3	10	45
Third Row Passenger	2	2	13	11	10	38
Fourth Row Passenger	0	0	0	1	0	1
Unknown	10	6	20	28	167	231
Total	456	177	327	322	903	2,185

Table 55a Seating Position and Fatality

Seating Position	Fatality	Percent Fatal	Non-Fatal	Total
Driver	465	46.4	537	1,002
Front Row Passenger	170	35.3	312	482
Second Row Passenger	81	21.0	305	386
Cargo Area	10	22.2	35	45
Third or Fourth Row Passenger	10	25.6	29	39
Unknown	167	72.3	64	231
Total	903	41.3	1,282	2,185

Logistic Regression Analysis

Logistic regression analysis was conducted to determine which variables included in the FARS system are significantly more likely to lead to fatality or protect from fatality. Identifying these risk factors and protective factors can help in the planning public health programs and projects to reduce the burden of unintentional injury. Analysis was conducted separately for crashes only involving motor vehicles and crashes involving pedestrians and bicyclists. For the motor vehicle analysis 30 unique variables were considered. Variables that were significant in simple logistic models were then included in the multivariate analysis. Twenty-five unique variables were included in the simple logistic models for pedestrian/bicyclist crashes.

Significant simple logistic regression results for motor vehicle collision only are found in Table 56. In the multivariate logistic analysis "Police Reported Alcohol Involvement" was significant. Including this variable reduced the sample size by 40%, however. Table 57 displays significant multivariate results without "Police Reported Alcohol Involvement" and Table 58 displays significant results including "Police Reported Alcohol Involvement". Charts 5 and 6 illustrates the 95% Confidence Intervals for significant results for the model with and without "Police Reported Alcohol Involvement", respectively.

Tables 59 & 60 display significant logistic regression analysis for crashes involving pedestrians and bicyclists. Map 6 illustrates the geographic location of these crashes. Table 61 indicates within which Chapters the pedestrian and bicyclist related crashes occurred, and Table 62 displays the roads that had the most pedestrian and bicyclist crashes.

Table 56 Simple Logistic Regression for Motor Vehicle Collisions, Significant Results

Variable	Odds Ratio (OR)	Lower Estimate	Upper Estimate	Interpretation
Roadway Function Class	**0.923**	**0.889**	**0.958**	**With each step from a local road to an Interstate the probability of being killed decreased by 7.7%. Rural Roads are most dangerous**
Crash occurred within Navajo Nation	0.725	0.587	0.897	Crashes within the Navajo Nation are less likely to have a fatality than probably, likely, Hopi, or Border Crashes
First Harmful Event	**0.671**	**0.606**	**0.742**	**3 levels: MV/MV crash then MV/Object Crash then Rollover** **Rollover crashes were the most dangerous followed by MV/Object, and finally MV/MV**
Roadway Alignment	0.660	0.522	0.833	Curve vs. Straight Crashes on straight stretches of road are protective
Total Previous Harmful Events	**1.125**	**1.037**	**1.220**	**Previous events include accidents, suspensions & revocations of license, DWI convictions, speeding convictions, and harmful motor vehicle convictions. For every additional previous harmful event the probability of a fatality in-creased by 12.5%**
Car Type	1.219	1.153	1.288	Every step decrease in car size increases fatality probability by 21.9%.
Rollover	**1.520**	**1.272**	**1.815**	**Rollovers are more likely to cause fatalities (52% more likely to be fatal)**

Table 56 Continued: Simple Logistic Regression for Motor Vehicle Collisions, Significant Results

Variable	Odds Ratio (OR)	Lower Estimate	Upper Estimate	Interpretation
Most Harmful Event	**0.704**	**0.640**	**0.775**	**3 levels: MV/MV crash then MV/ Object Crash then Rollover (MV protective)**
Age	0.00359		T –value = 6.47	Every one year increase in age increases fatality by 0.4%
Driver	**1.783**	**1.490**	**2.137**	**Driver more likely to be killed (makes sense since all crashes have drivers)**
Sitting Position	2.295	1.846	2.853	More likely to die with each move forward in the vehicle
Unrestrained	**3.191**	**2.588**	**3.934**	**More likely to die without restraint**
Ejected	2.695	2.370	3.067	Remaining in the vehicle is protective
Police Reported Alcohol Involvement	**3.322**	**2.551**	**4.329**	**If the police reported alcohol involvement a person was more than 3 times more likely to be killed**

Table 57 Multivariate Logistic Model for Motor Vehicle Collisions, N = 1,104 (Modeling probability of fatality)

Variable	Odds Ratio	Lower Limit	Upper Limit
Age	1.022	1.014	1.030
Restraint Use	0.559	0.402	0.778
Ejected	2.440	1.995	2.983
Sitting Position	1.965	1.650	2.336
Car Size	1.393	1.188	1.634

Table 58 Multivariate Logistic Mode with Alcohol Involvement, N = 653 (Modeling probability of fatality)

Variable	Odds Ratio	Lower Limit	Upper Limit
Age	1.025	1.014	1.036
Restraint Use	0.586	0.381	0.902
Ejected	2.443	1.868	3.196
Sitting Position	1.538	1.190	1.988
Car Size	1.422	1.160	1.745
Police Reported Alcohol Involvement	1.789	1.224	2.615

Chart 5 Multivariate Logistic Model without Police Reported Alcohol Involvement with 95% Confidence Intervals

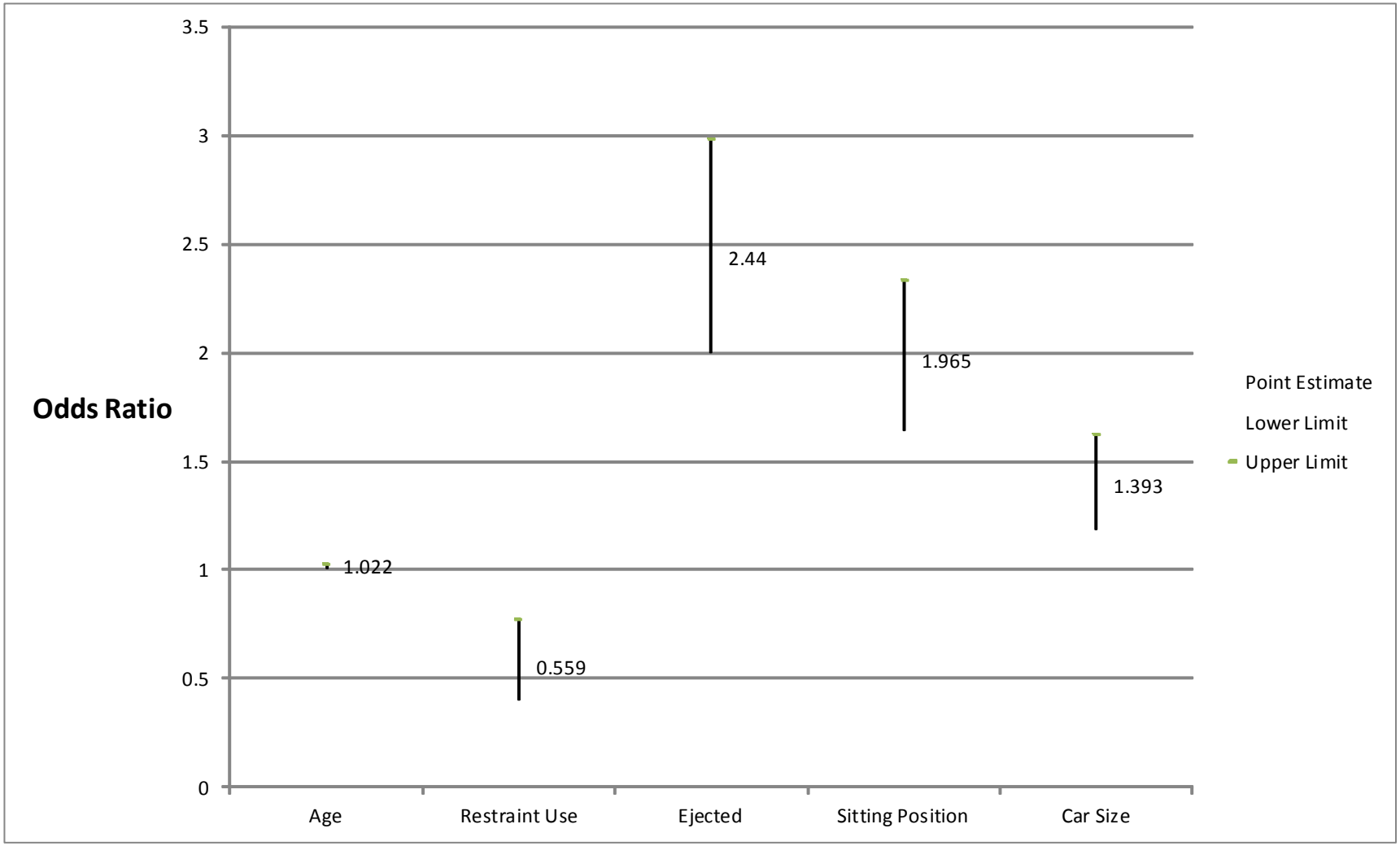


Chart 6 Multivariate Logistic Model with Police Reported Alcohol Involvement with 95% Confidence Intervals

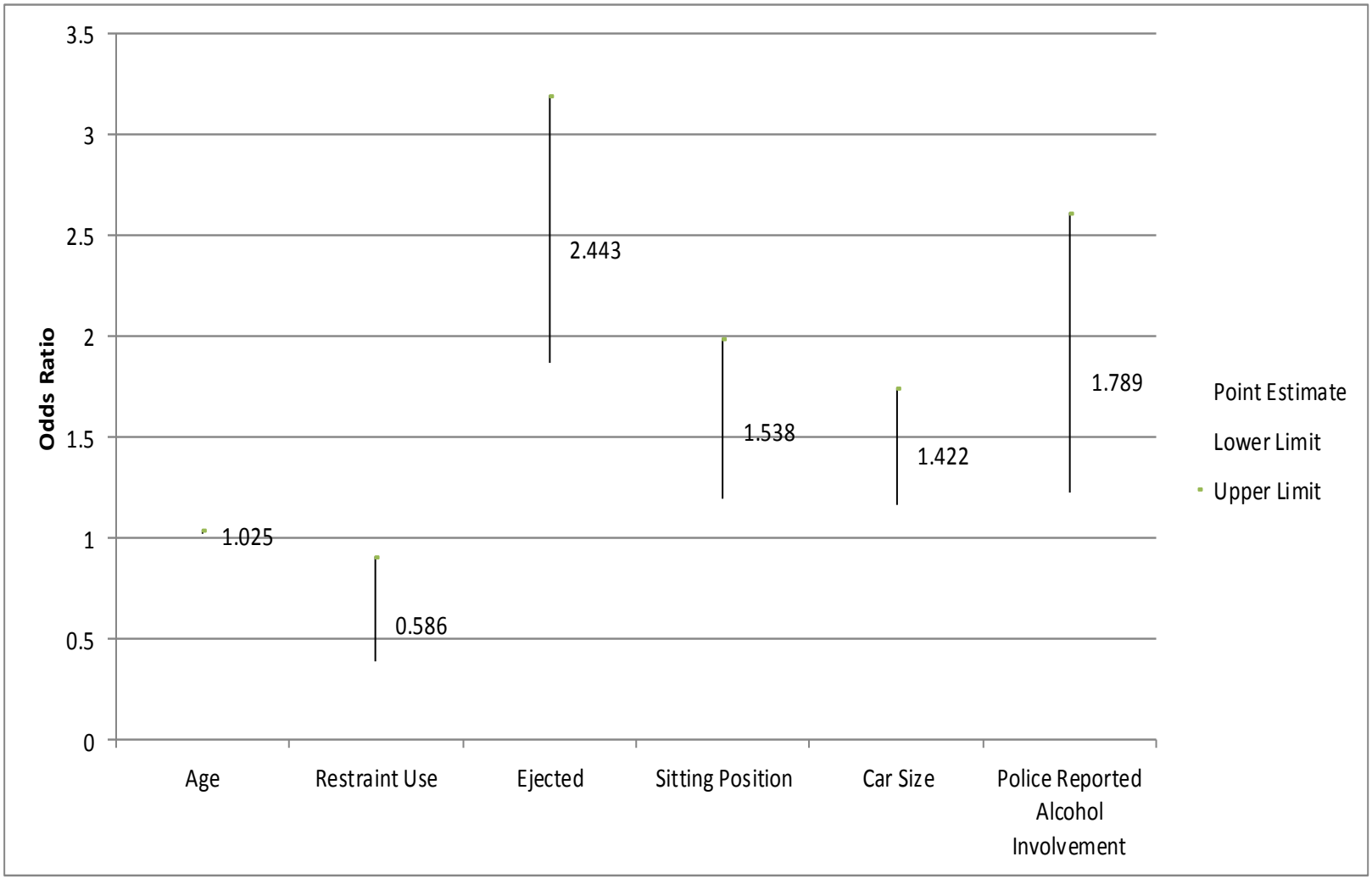


Table 59 Simple Logistic Regression for Pedestrian/Bicyclist Collisions, Significant Results

Variable	Odds Ratio	Lower Estimate	Upper Estimate
Police Reported Alcohol Involvement (N=106)	15.625	1.908	125
Gender: Male (N = 200)	5.076	1.869	13.699
Variable	**Parameter Estimate**	**T-Value**	**P value**
Blood Alcohol Level (N=71)	0.00641	2.91	0.0049

Table 60 Multivariate Logistic Regression for Pedestrian/Bicyclist Collisions

Variable	Odds Ratio	Lower Estimate	Upper Estimate
Gender: Male	1.548	0.368	6.494
Police Reported Alcohol Involvement	14.493	1.715	125

Map 6: Known Sites of Pedestrian/Bicyclist Fatalities

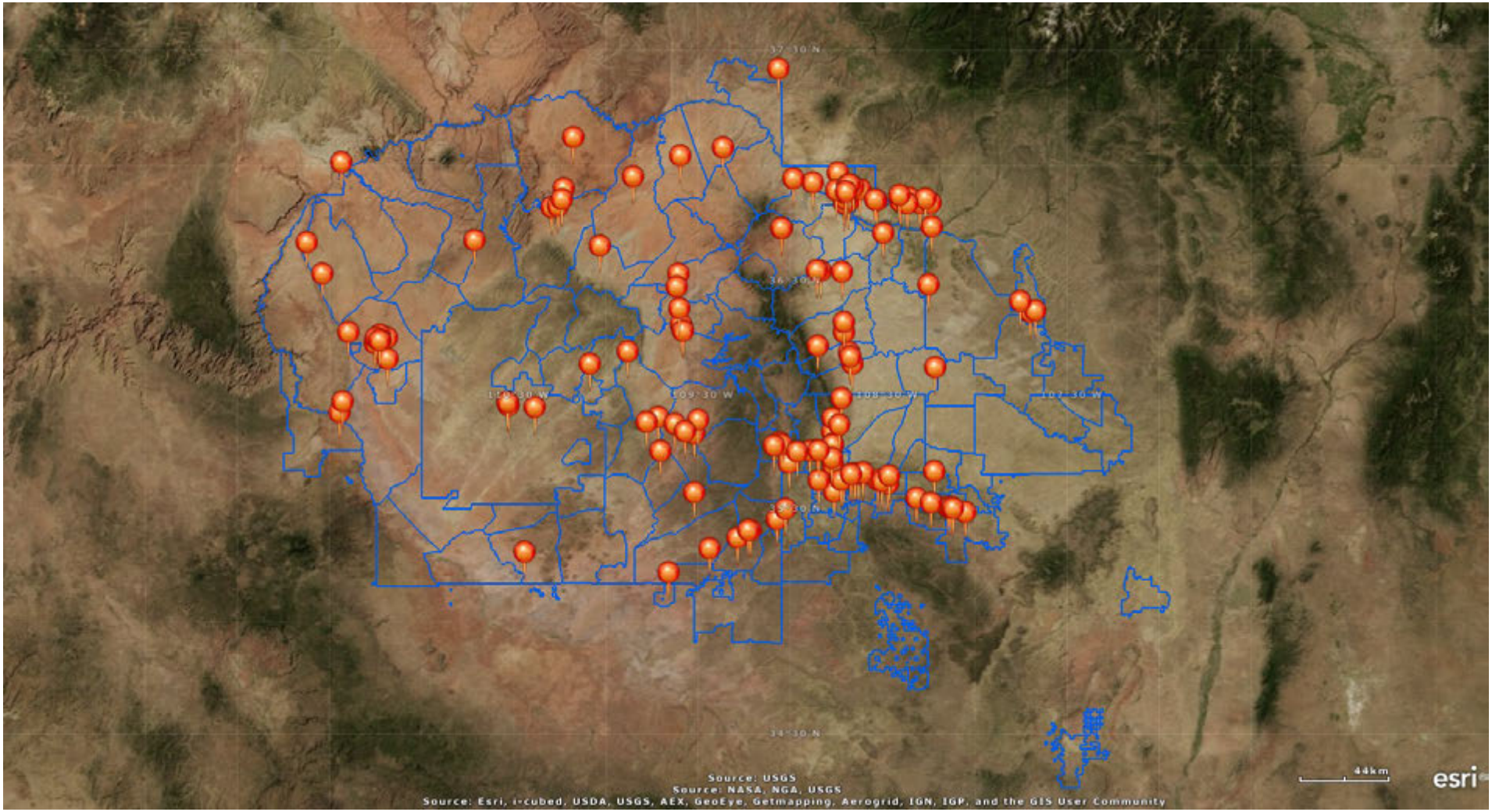


Table 61 Number of Pedestrian/Bicyclist Crashes by Chapter

Chapter	Crashes	Chapter	Crashes	Chapter	Crashes	Chapter	Crashes
Rock Springs	7	Shiprock	7	Border: Hopi	6	Chinle	5
Church Rock	5	Tuba City	5	Baca/Prewitt	4	Border: Church Rock	4
Gadiahi	4	Iyanbito	4	Kayenta	4	Twin Lakes	4
Bodaway Gap	3	Ganado	3	Houck	3	Huerfano	3
Nageezi	3	Naschitti	3	Sanostee	3	Sheep Springs	3
St. Michael's	3	Tsayatoh	3	Beclabito	2	Border: Thoreau	2
Border: Upper Fruitland	2	Cameron	2	Hogback	2	Many Farms	2
Nahata'dziil	2	Nenahnezad	2	Red Valley	2	San Juan	2
Steamboat	2	Upper Fruitland	2	Aneth	1	Border: Lechee	1
Border: Nenah-nezad	1	Border: Red Rock	1	Border: Rock Springs	1	Chilchinbeto	1
Coalmine Mesa	1	Cornfields	1	Dennehotso	1	Dilkon	1
Kinlichee	1	Klagetoh	1	Lake Valley	1	Lupton	1
Manuelito	1	Mexican Springs	1	Mexican Water	1	Oljato	1
Red Rock	1	Shonto	1	Smith Lake	1	Sweet Water	1
Tohatchi	1	Tselani	1	Whippoorwill	1		

Table 62 Pedestrian/Cyclist Crash by Road (Roads with at least 5 crashes)

Road	Number of Crashes	Percent of All Pedestrian Crashes	Cumulative Percent	Crashes per year per 100 miles of Road
SR 264	20	10.9	10.9	2.22
US 491	17	9.3	20.2	1.65
I-40	15	8.2	28.4	1.80
US 160	12	6.6	35.0	0.75
US 64	12	6.6	41.5	2.33
US 191	10	5.5	47.0	0.56
BIA/IR 36	8	4.4	51.4	2.78
BIA/NR 15	6	3.3	54.6	0.58
SR 118/Route 66	6	3.3	57.9	2.49
BIA 12	5	2.7	60.6	0.52
US 89	5	2.7	63.3	0.58

Recommendations/Discussion

Many variables and factors contribute to the burden of car crash fatalities on the Navajo Nation. Several approaches will be required to make an impact on decreasing these fatal car crashes. Some approaches might include health promotion and behavioral modification, mass media campaigns, increased law enforcement, and road improvement and engineering. This report is just the beginning of an effort to identify what strategies might be helpful. The following are some basic recommendations to address this problem.

A disproportionate percentage of crashes occurred on or near the Eastern Agency . This is in large part due to the influence of Interstate 40. The 5 Chapters with the highest crash per square mile are all found along Interstate 40 or State Route 264. The top 15 are all found along Interstate 40, State Route 264, US 491, US 64, and State Route 36. Eleven Chapters had higher crash rates than the other 99 Chapters. These Chapters are spread out amongst all 5 Agencies. While driver ZIP code was not always recorded, three Chapters had higher rates of crashes than the others. These Chapters are Crystal, Ganado, and Newcomb. This might be a good place to start with driver education messages. If these Chapters are unavailable the next 5 for targeting with driver education are Tonalea, Rock Springs, Iyanbito, Sheep Springs, and Upper Fruitland. Driver education could start with discouraging driving under the influence of alcohol, inattentive driving (including cell phone use), and speed reduction. Cell phone use was not recorded very frequently, although "Careless or inattentive driving" was cited for 132 drivers. It is possible that many of these careless drivers were in fact using a cell phone but the reporting officer was unaware. Continued education and enforcement regarding texting and driving should be emphasized. While approximately 6 of 7 drivers were from Arizona, New Mexico, or Utah fewer than half of drivers originated from the Navajo Nation. Therefore local education efforts may be effective but cannot be the only method of crash prevention.

Further investigation of crash clusters identified in Table 9 should be conducted to look at what engineering or signage features could help prevent crashes as well as determining if increased presence of law enforcement to discourage speeding would be helpful. Approximately 1 in 6 vehicles crossed the centerline or median in fatal crashes. The most common roads where this occurred were US 160, US 89, Interstate 40, SR 264, US 191, SR 98, and US 491. Vehicles ran off the roadway in fatal crashes frequently (reported 461 times). This happened most often on Interstate 40, US 160, SR 264, US 191, and US 89. Crash sites could be investigated to learn if beefier medians or guardrails could be constructed to help prevent serious crashes.

Further investigation into the crashes with "Shoulder design or condition" , "Inadequate Warning of Exits, Lanes Narrowing, Traffic Controls, etc." , or "Inadequate Construction or Poor Design of Roadway, Bridge, etc." recorded in *Crash Related Factor* should be conducted.

Public health personnel should look into areas where pedestrians were killed and crosswalks were not available to determine if it would make sense to create crosswalks. If the time of these crashes were at night, or in documented areas that are not well lit, increasing street lights may be necessary. The single most influential variable for pedestrian fatality was police reported alcohol involvement, so partnerships with alcohol prevention and behavioral health programs should be strengthened. Additional investigation should be made into how pedestrian fatalities might be reduced along SR 264, particularly the NM portion, and US 491.

Discussion/Recommendations continued

Work should be done with Navajo courts and law enforcement to find methods to limit or restrict the driving of people who have had previous harmful event convictions, who are not licensed or who drove on a suspended license. Approximately 1 in 5 (21.8%) drivers involved were not driving with a valid license. One in 8 (12.8%) had previous suspensions and revocations. One in 3 (33.3%) drivers with a currently invalid license had a previous action against their license. Slightly more than half (52.9%) with previous license issues had a current action against their license. These data indicate a pattern of poor driver performance. A little more than 1 in 9 drivers (11.8%) with police reported alcohol involvement had a previous DWI conviction. About 3 of 4 drivers (75.6%) with a previous DWI conviction had police reported alcohol involvement.

Promoting seat belt and appropriate car seat use will continue to save lives. Almost half of all motorists (adult and child) were unrestrained. Only 17.3% of all children less than 11 were restrained in a child restraint/booster seat. These devices are proven to save lives and prevent injury. Thirty-three percent of all fatalities on the Navajo Nation are passengers in vehicles, which is 87% higher than the U.S. figure in 2014. Forty-two percent of fatalities were drivers on the Navajo Nation which is 65% lower than the U.S. figure in 2014. This may indicate that vehicles on the Navajo Nation have a higher occupancy rate than the U.S. at large. This may have implications in seat belt and car safety seat use.