Strategic Highway Safety Plan

Navajo Nation

2018

NAVAJO D.O.T.

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1.0 INTRODUCTION

The 2018 Navajo Nation Strategic Highway Safety Plan (NNSHSP) is an agency-wide coordinated plan that provides a comprehensive framework for reducing fatalities and serious injuries on all public roads. The goal of the NNSHSP, developed by the Navajo Nation Division of Transportation (NDOT), is to establish and understand the existing roadway safety conditions, which provides necessary insights for Navajo Nation in the years to come and ultimately give guidance on mitigating safety performance measures.

1.1 STUDY AREA

Encompassing over 27,000 square miles, Navajo Nation is the largest tribal community in the United States. The Nation's territory occupies portions of three states including southeastern Utah, northeastern Arizona, and northwestern New Mexico. Five regional governments and 11 counties help to facilitate transportation funding and projects for tribal and non-tribal roadways throughout the nation.

Figure 1-1 shows the study area geography that the NNSHSP encompasses.

1.2 STRATEGIC HIGHWAY SAFETY PLAN

This is the first Working Paper for the NNSHSP. The focus of this Technical Memorandum is to analyze crash variables and relationships in order to gain understanding of the nature of crashes within the Navajo Nation region. Crash data from 1999 to 2015 was examined to develop a high-level summary of total, fatal and serious injury crash trends.

1.3 DEPARTMENT OF HIGHWAY SAFETY

Navajo Nation is actively working to reduce the number of fatal and serious injury crashes. In 2016, Navajo Nation conducted various trainings and educational seminars to increase the awareness of crashes and their causes with tips on how to avoid them. Some of Navajo's safety efforts have consisted of defensive driving courses, child safety initiatives, traffic safety presentations in the areas of DUI awareness, youth alcohol campaigns, distracted driving, importance of seat belt usage, and bike safety, among other things. In addition, the Navajo Nation Department of Highway Safety staff completed the "Alive at 25" Instructor's course at Phoenix, AZ, in February 2016. The instructor program trains and equips individuals to then teach the program to young drivers. This will assist in efforts to target the age group of 15-29 for specific traffic safety initiatives within Navajo Nation.

Figure 1-1 | Navajo Nation

1.4 STRATEGIC HIGHWAY SAFETY PLAN

This is the compilation of analysis, public involvement, stakeholder, and practitioner interaction. The focus of this Strategic Highway Safety Plan is to identify the needs based on crash data analysis and in order to gain understanding of the nature of crashes within the Navajo Nation region, and identify potential strategies and countermeasures to reduce injury and fatality crashes. Crash data from 1999 to 2015 was examined to develop a high-level summary of total, fatal and serious injury crash trends.

1.5 FOUR E'S OF SAFETY

The four E's of safety define the broad stakeholders who care about safety and are responsible for making roads safe for all users. These stakeholders provide perspective to the SHSP and include the following:

- Engineering - Highway design, traffic, maintenance, operations, and planning professionals.
- Enforcement – State and local enforcement agencies.
- Education – Prevention specialists, communication professionals, educators, and citizen advocacy groups.
- Emergency Medical Services – First responders, paramedics, fire, and rescue.

1.6 STATE EMPHASIS AREAS

Safety funding for Navajo Nation can be received through direct grant source and state safety programs from Arizona, New Mexico, and Utah. Some important differences exist between safety emphasis areas and strategies outlined in individual state SHSP plans that will impact how safety funding can be obtained.

Table 1-1 identifies emphasis areas that are designated in the state SHSP's for Arizona, New Mexico, and Utah. Many of the categories are common between all three states. Speeding/aggressive driving is the top priority amongst all three state safety plans.

Understanding these emphasis areas allows agencies within their respective states to pursue Highway Safety Improvement Program (HSIP) funding which is used to help implement the strategies outlined in the SHSP. Since each state has different SHSP emphasis areas, it is also important to understand where the various safety funding programs can be used, with engineering, education, enforcement and emergency service provider improvements to improve safety conditions.

Table 1-1| Arizona, New Mexico, and Utah State Emphasis Areas

State Emphasis Areas			
	Arizona	New Mexico	Utah
Speeding/Aggressive Driving	X	X	X
Impaired Driving	X	X	X
Distracted Driving	X	X	X
Intersection Crashes		X	X
Motorcycles	X		X
Lane Departure Crashes		X	X
Occupant Protection (Restraints)	X	X	X
Nonmotorized Users (Bike/Ped)	X		X
Public Info/Education		X	X
Age Related	X	X	X
Traffic Records/ Data Improvements	X	X	
Policy Initiatives	X		
Drowsy Driving			X
Emergency Services Response		X	
Infrastructure and Operations	X		
Native Americans		X	
Heavy Vehicles/Transit	X		
Natural Risks	X		
Special Users		X	
Traffic Incident Management	X		
Interjurisdictional	X		

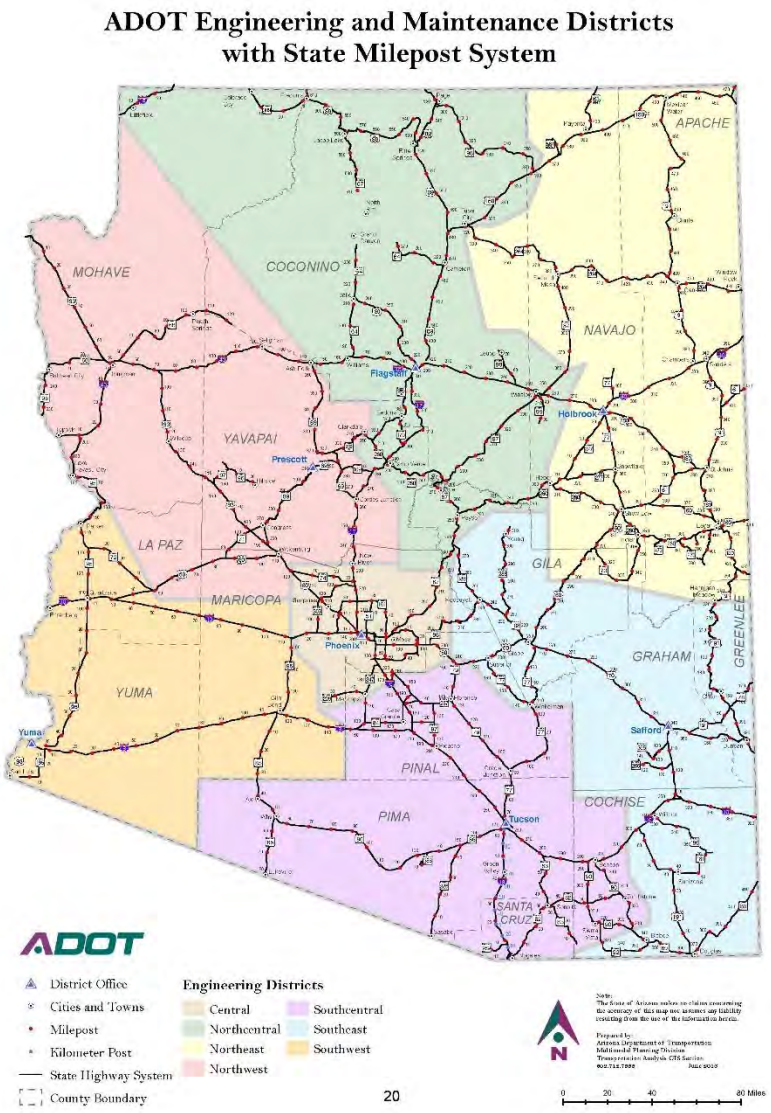
Arizona

As a part of Arizona's 2014 SHSP update, Arizona adopted the national "Toward Zero Deaths" campaign into its vision for safety. The statewide goal is to reduce the occurrence of fatalities and severity of injuries on all of Arizona's public roads. The goal is to reduce the five year average of severe crashes by at least 3% from 2013 to 2018. Additionally, the 2014 update defined twelve emphasis areas focused on improving roadway safety with two additional areas of emphasis designed to support the enforcement of their goals. These emphasis areas were established by the Arizona SHSP Executive Committee using 2005 to 2012 severe crash data and are based on the state goal of reducing the severity of crashes. The Arizona SHSP Executive Committee is comprised of state transportation, health and safety leaders who bear responsibility for the oversight and implementation of the SHSP and coordinates with the SHSP administrator and emphasis area teams. The emphasis area teams facilitate the necessary steps to improve roadway safety.

Tribal organizations within Arizona consult with District Engineers concerning transportation issues as a means for straightforward and collaborative involvement. Federal legislation requires State DOTs to work with tribes in state and regional planning activities. Figure 1-2 shows ADOT Engineering and Maintenance Districts.

Interjurisdictional coordination involving federal and local agencies and safety stakeholders is considered an Emphasis Area of transportation safety. While other Emphasis Areas are comprised of quantitative characteristics, interjurisdictional coordination takes qualitative aspects of spatial locations (urban, rural, and tribal lands) combined with fatal and serious injuries to understand the density of those crashes.

Figure 1-2 | ADOT Engineering and Maintenance Districts

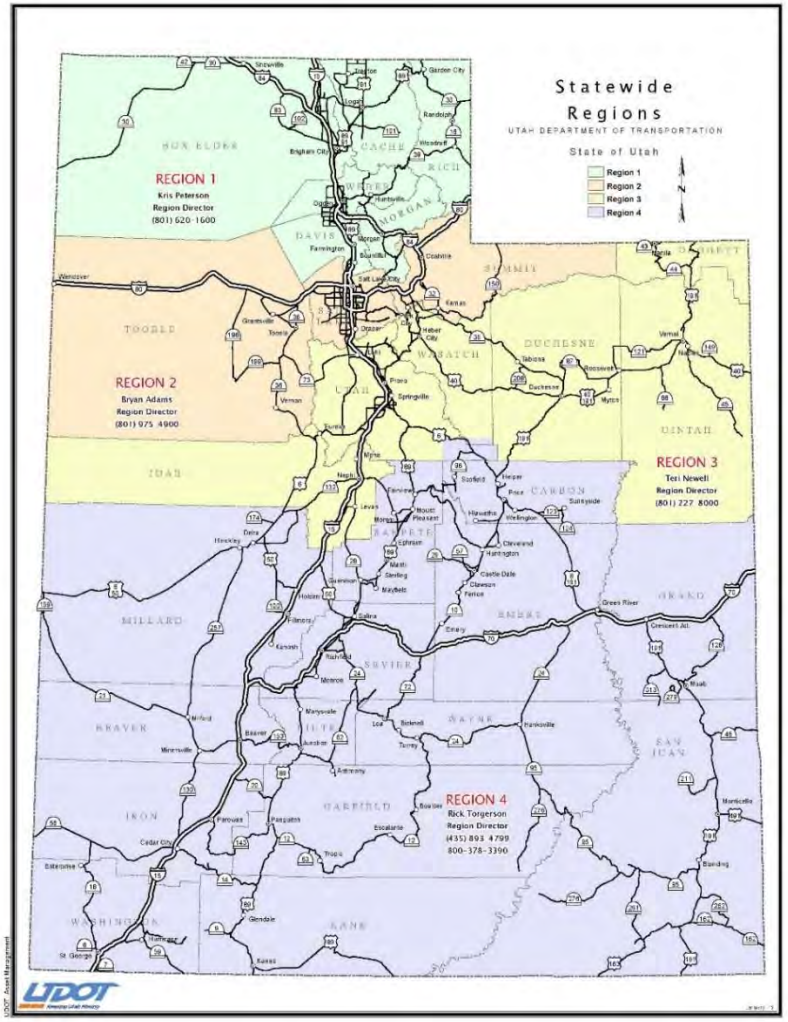


UTAH

Utah, similarly to Arizona, focuses on the goal of zero fatalities in the 2016 SHSP. The Utah Executive Committee which implements the SHSP is comprised of the Utah Department of Transportation (UDOT), the Utah Department of Public Safety (UDPS), the Utah Department of Health (UDOH) as well as U.S. Department of Transportation groups such as the Federal Highway Administration (FHWA) and the Federal Motor Carrier Safety Administration (FMCSA). In addition, Utah focuses on the four E's of safety plus a fifth "E" which represents "Everyone" and the safety accountability of the individual. As established in the SHSP, Utah has adopted the American Association of State Highway and Transportation officials' (AASHTO) mission to reduce fatalities by 50% by 2030, or a 2.5% decrease per year. Data is sourced from the UPDS 2006 to 2015 injury and fatal crash data. The SHSP outlines leaders responsible for management of each of the 12 emphasis safety areas. The SHSP also calls out specific initiatives for each emphasis area such as the "Sleep Smart. Drive Smart." campaign for the drowsy driving emphasis area or the "Drive sober or get pulled over" campaign led by the Utah Highway Patrol to prevent impaired driving. In addition to the twelve safety areas, Utah has established eight Continuing Safety areas that represent programs currently underway within safety agencies and five Special Safety areas that represent opportunities for the safety community to enhance processes.

Navajo Nation's northern section lies within UDOT's District 4 area, as shown in Figure 1-3.

Figure 1-3 | UDOT Engineering Districts



New Mexico

The Traffic Safety Division (TSD) of the New Mexico Department of Transportation (NMDOT) has the prime responsibility for managing safety programs created to reduce the occurrence of fatal and severe injury crashes. TSD staff members assist in the development of the SHSP which outlines twelve emphasis areas within New Mexico and strategies to carry out performance measures that aim at reducing fatal and injury crashes. New Mexico's first HSIP goal is to limit the expected increase in fatalities to 1% from 347 in 2013 to not more than 350 in 2016, based on 5-year averages sourced from the Fatality Analysis Reporting System (FARS). Amongst other goals, New Mexico Safety Plan aims to reduce serious injuries 20% from 2013 to 2016 and reduce the rural fatality rate by 6% from 1.75% in 2013 to 1.65% in 2016. The TSD partners with various state, local and tribal law enforcement, education, health, and media agencies and organizations to develop and carry out the twelve emphasis areas. Data is sourced from the federal FARS and the New Mexico crash reporting system. Past safety performance of emphasis areas is analyzed by TSD partners and can be used to establish new emphasis areas in future SHSP and HSIP safety goals.

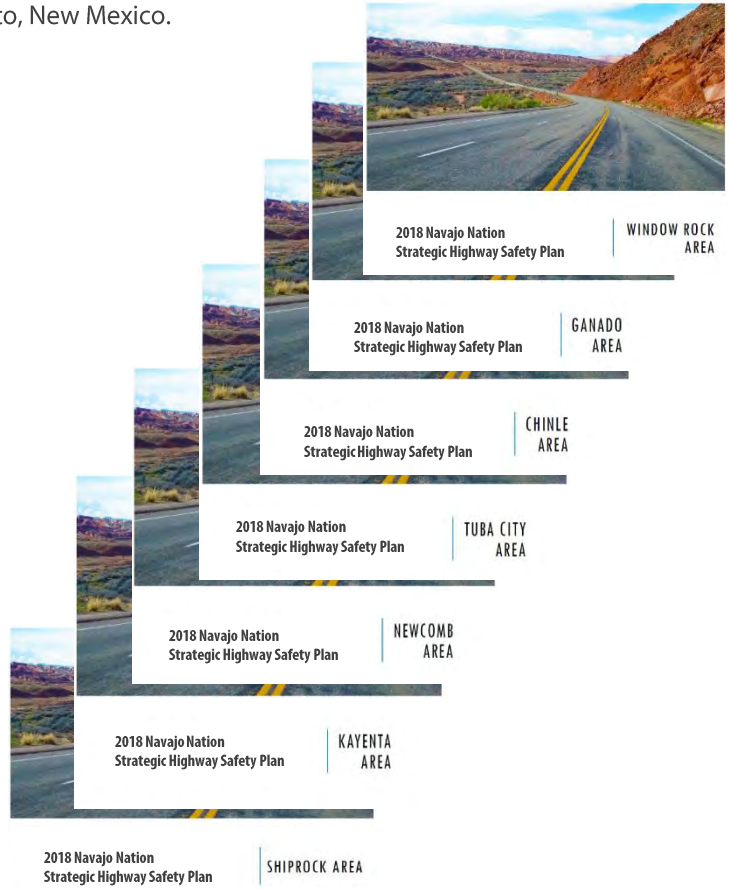
One particular strategy outlined from the New Mexico Comprehensive Transportation Safety Plan is to "Provide Crash Data Analysis Tools, Training Opportunities, and Technical Assistance to Native Americans", whereas the Plan states that crash data and information sharing between New Mexico and tribal organizations is inadequate and that data is often collected and distributed without clear understanding of its purpose. Some tribes simply do not have the technological resources to effectively analyze and/or disseminate this data; therefore NMDOT proposes to provide crash data tools, training, and technical assistance to tribes that would result in better transportation safety planning within tribal areas.

Navajo Nation lies within two NMDOT Districts (Districts 5 and 6) as shown in Figure 1-4.

Figure 1-4 | NMDOT Engineering Districts

1.7 PUBLIC INVOLVEMENT

The public involvement strategy used to develop the NNSHSP was to work with established safety practitioner groups that have current relationships and processes relating to the 4-E's. Additionally, the project team went out to the communities that exhibited the highest crash occurrences so to elevate the importance of locally driven crash reduction strategies. Local meetings were held in Window Rock, Shiprock, Newcomb, Kayenta, Tuba City, Chinle and Ganado. Broader group meetings were held at the NDOT Headquarters complex in Tse Bonito, New Mexico.



2.0 CRASH DATA ANALYSES

1999 -2015 crash data was obtained through NDOT and included Arizona, Utah, and New Mexico state highway crash data. The total number of documented crashes – which included fatal, injury and property damage only– that occurred within Navajo Nation was 17,717 over the course of 17 years. 134 of the total crashes, did not have a year associated with the data and were omitted for this analysis. Therefore, the total crash count used for this analysis was 17,583 crashes. Figure 2-1 displays these crashes by severity.

The analyzed dataset revealed that 12,901individuals suffered injuries in 6,587 crashes (1.96 individuals/crash) and 1,130 were killed in 893 crashes (1.27 individuals/fatal crash). Figure 2-2 shows these figures by year.

Figure 2-1 | Crash Severity in Navajo Nation

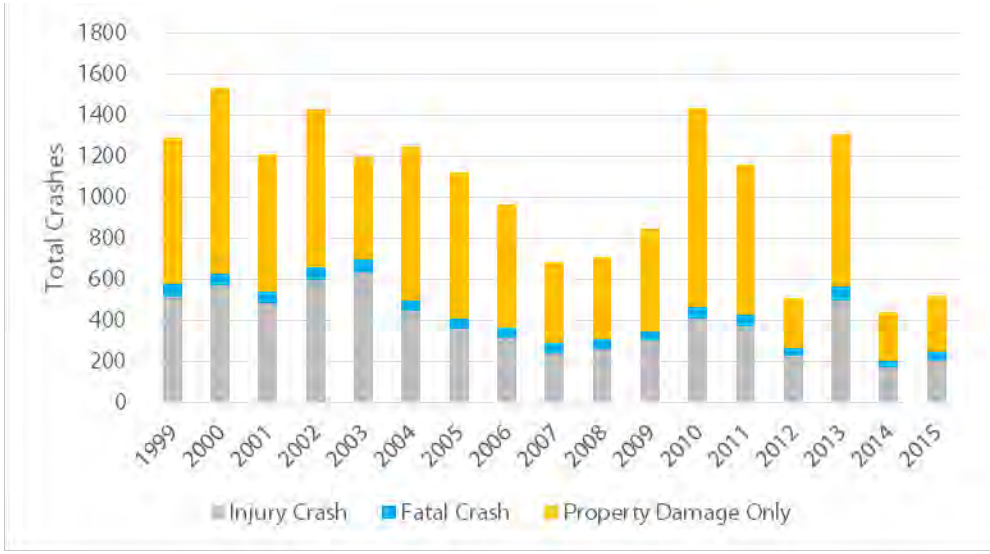
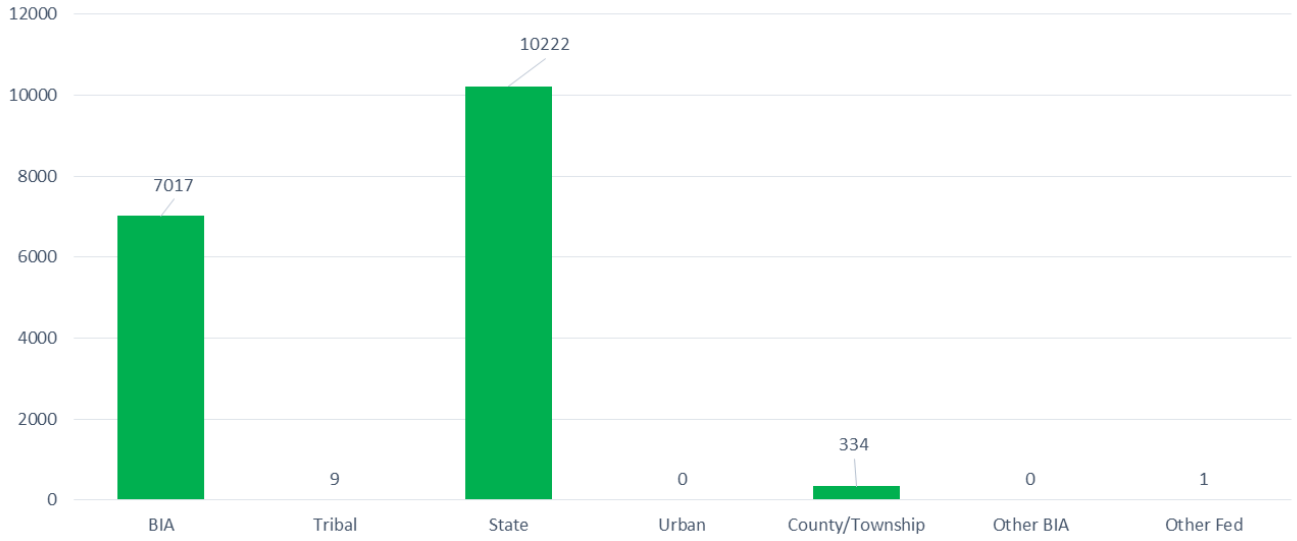


Figure 2-2 | Number of Injuries and Fatalities by Year

Figure 2-3 shows ownership of public roads that the crashes occur on. The majority of crashes occur on state highways where speed limits and vehicle volumes are much higher than local tribal roads. This is important to understand as opportunities for funding safety projects are primarily for locations with the greatest level of crashes to correct.

Figure 2-3| Road Ownership of Crashes



Figures 2-4 and 2-5 display preliminary spatial density mapping through different geoprocessing tools. Figure 2-4 utilized Kernel Density analysis which calculates the spatial distribution of crash points in a given area. Figure 2-5 used Fishnet Analysis which creates a grid that captures and counts crash points within each cell grid. Initial summarization of the dataset was grouped together by coded crash condition.

Crashes were then selected by fatal and injury crashes only, leaving 7,480 crashes.

Figure 2-4 | 1999-2015 All Crashes Kernel Density

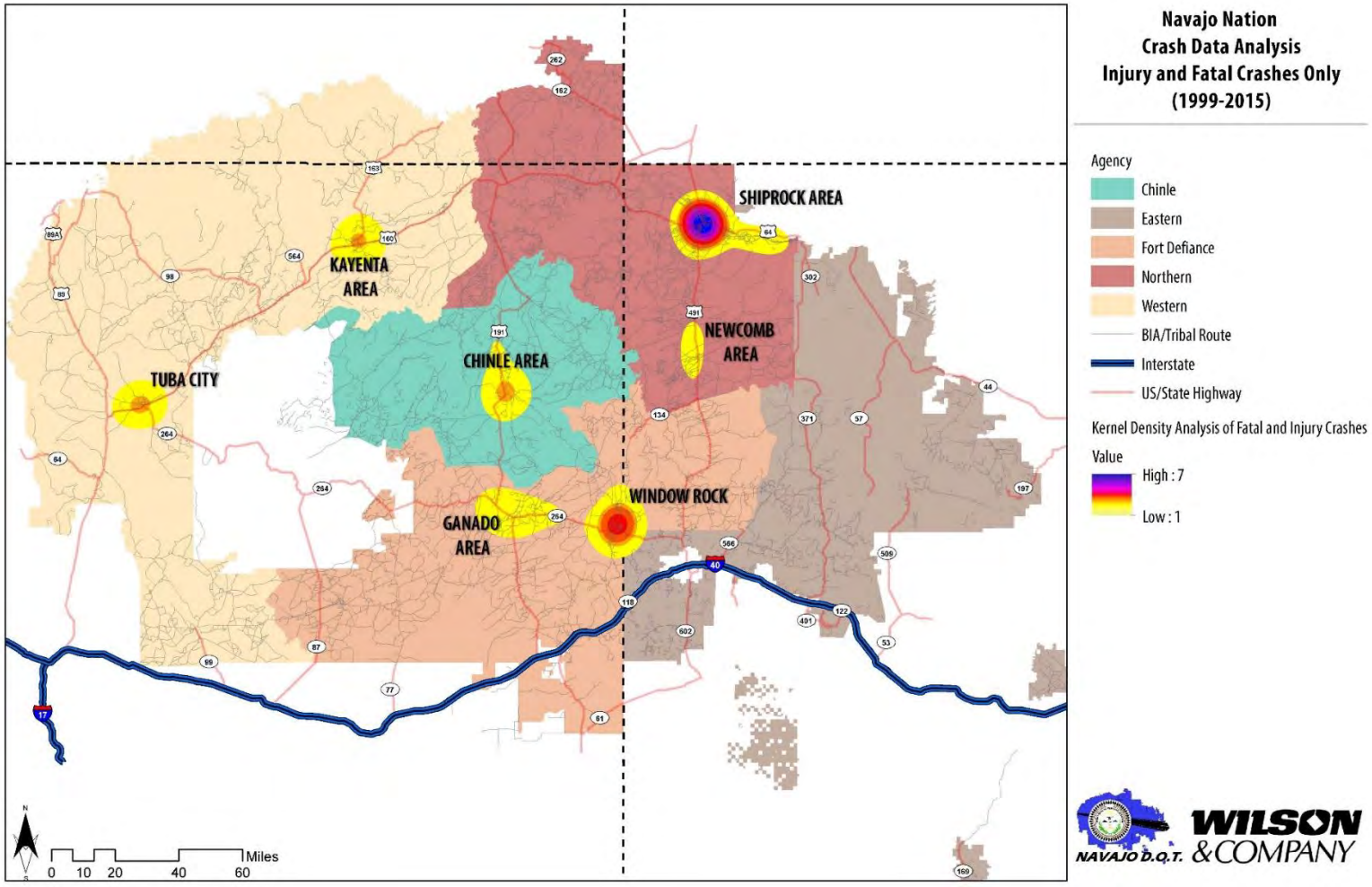
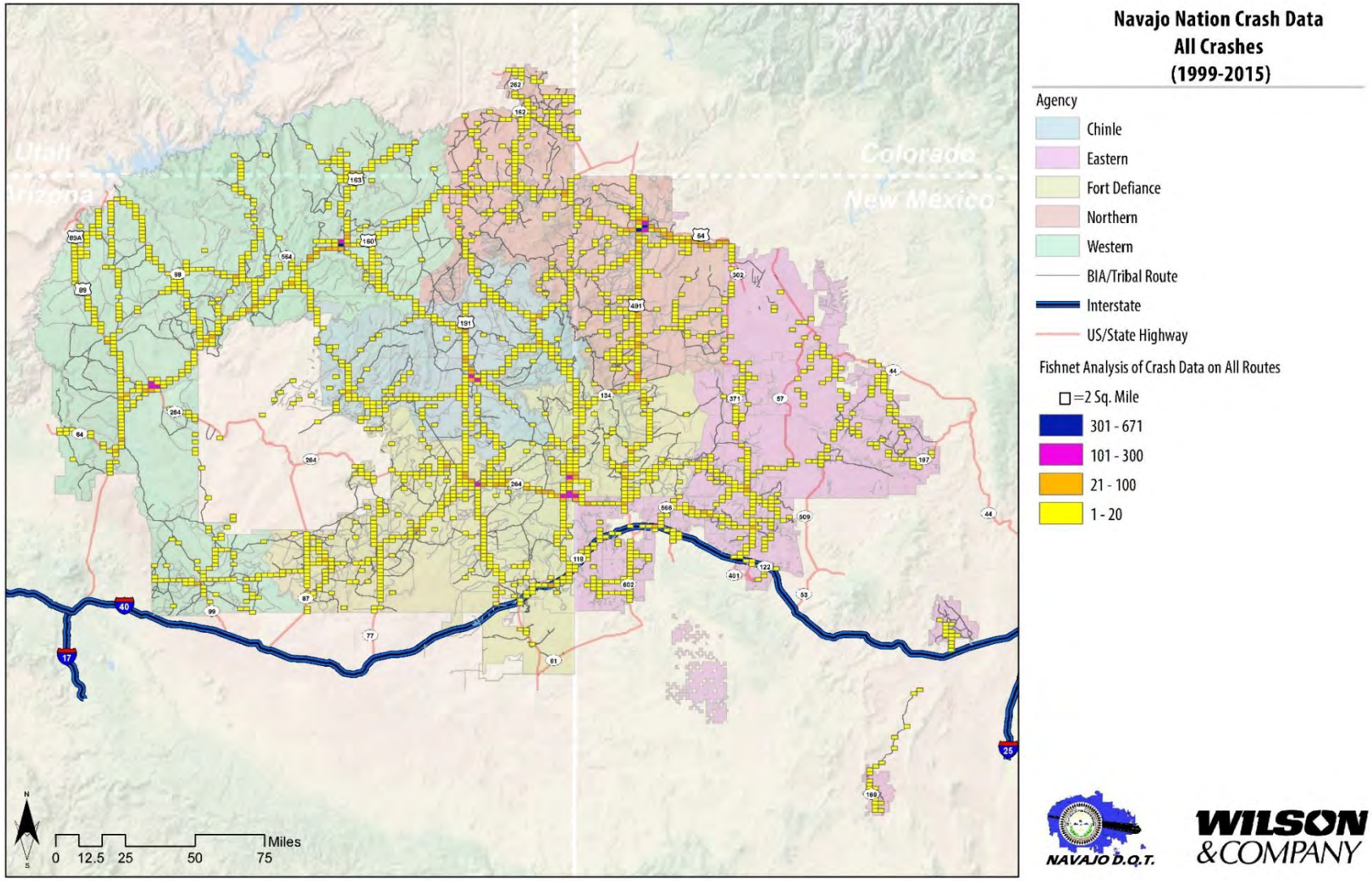


Figure 2-5 | 1999-2015 All Crashes Fishnet Analysis


Navajo Nation Crash Data
All Crashes
(1999-2015)
Agency
Chinle
Eastern
Fort Defiance
Northern
Western
BIA/Tribal Route
Interstate
US/State Highway
Fishnet Analysis of Crash Data on All Routes
=2 Sq. Mile
301 - 671
101 - 300
21 - 100
1 - 20
Utah
Arizona
Colorado
New Mexico
N
S
0 12.5 25 50 75
Miles

2.1 ECONOMIC COST OF CRASHES

The economy is significantly impacted by the total cost of motor vehicle injuries and the National Safety Council concurs. Wage, productivity losses, medical expenses, administrative expenses, motor vehicle damage, and employers' uninsured costs are just a few of the calculable costs associated with motor vehicle collisions. In order to calculate cost per injury crash for Navajo Nation, the average economic cost per incident was based on the National Safety Council crash costs for 1999-2015. For example, in 2015 the estimated national average cost per incident was as follows:

- Fatality = $1,542,240
- Incapacitating Injury = $90,270
- Non-Incapacitating Injury = $26,112
- Possible Injury = $21,420
- Property Damage Only = $11,526

Table 2-1 provides the estimated cost by state of crashes within Navajo Nation from 1999-2015. Injury crashes are not identified as incapacitating, non-incapacitating, or possible injury within the NDOT crash data. In order to give a reasonable estimate of the injury crashes, the proportion of incapacitating, non-incapacitating, and possible injury crashes was used from the Arizona Crash Fact sheets. The total economic cost of crashes in Navajo Nation from 1999-2015 totaled approximately $1.5 billion.

Table 2-1| Economic Cost of Crashes in Navajo Nation from 1999-2015

	ARIZONA	NEW MEXICO	UTAH	TOTAL
K -Fatal Crash	$812,800,120	$516,867,760	$27,840,840	$1,357,508,720
A - Incapacitating Injury Crash	$58,104,221	$29,134,077	$1,717,599	$88,955,898
B - Non-Incapacitating Injury Crash	$6,515,264	$3,271,490	$188,557	$9,975,310
C - Possible Injury Crash	$2,018,703	$1,024,493	$59,508	$3,102,704
O - Property Damage Only	$41,886,760	$33,883,828	$2,107,788	$77,878,376
TOTAL	$921,325,068	$584,181,648	$31,914,292	$1,537,421,008

3.0 GEOGRAPHIC CRITICAL FOCUS AREAS

Between 1999 -2015, crash data was obtained through NDOT and included Arizona, Utah, and New Mexico state highway crash data. The total number of documented crashes – which included fatal, injury and property damage only– that occurred within Navajo Nation was 17,717 over the course of 17 years. 134 of the total crashes, did not have a year associated with the data and were omitted for this analysis. Therefore, the total crash count used for this analysis was 17,583 crashes.

Crashes were then selected by fatal and injury crashes only, resulting in 7,527 crashes. With that extraction, a crash density analysis was performed to identify if there were any areas of crash concentrations. Of the fatal and injury crashes, 43% are within these seven specific geographic areas and representing only 4.1% of the road network.

3.1 CRITICAL AREAS

The crash data was queried to display locations of serious and fatal injury crashes. Geospatial analysis was used to understand crash density per square mile, which resulted in seven distinct areas exhibiting the highest density (Figure 4-1). These seven locations represent the following characteristics, even though they comprise only 4.1% of Navajo Nation road mileage:

- Where crashes have a Cause or Collision type code (17, 17) of pedestrian involved (Cause - 17, Collision - 17), 70% of crashes comprised of this type;
- Where crashes have a Junction type crash code of 2 (intersection related crashes), 63% of crashes comprised of this Junction type;
- Where crashes have a Cause type of 3 (Failed to Yield Right-of-Way), 79% of crashes comprised of this type; and
- Where crashes have a Cause or Collision type code (13, 13) of wildlife or animal involved, 37% comprised of these crash types.

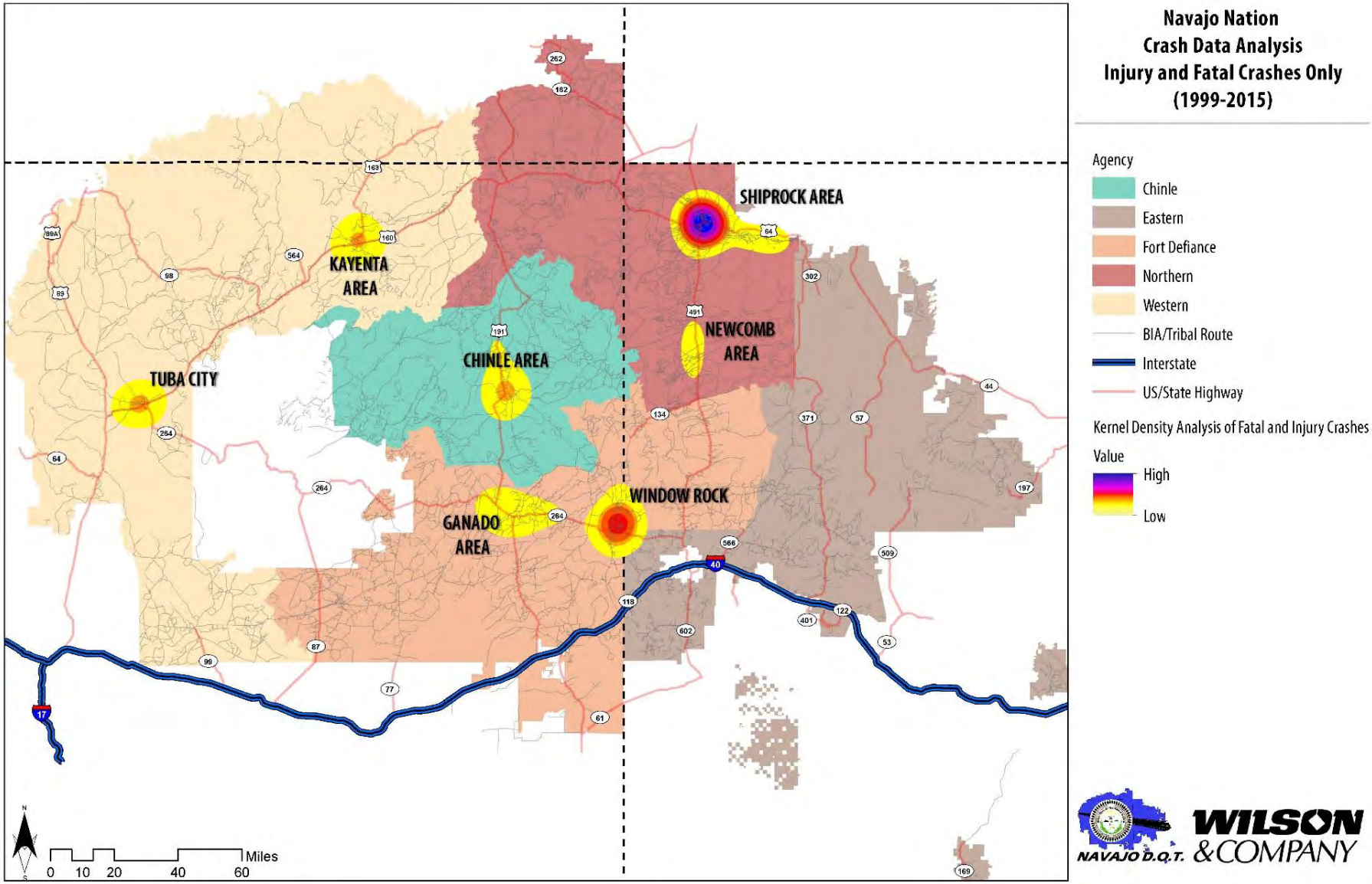
The seven critical zone areas include:

1. Shiprock Area
2. Window Rock
3. Tuba City
4. Kayenta Area
5. Chinle Area
6. Ganado Area
7. Newcomb Area

Figure 3-1 reveals the seven concentrations of fatal and injury crashes, a focus at the state and federal level. Moreover, each area was looked at independently as to comprehend unique or common crash factors resulting in high densities of crashes.

Cause and collision types describe the nature of each crash incident, therefore the three most prevalent cause and collision types are stated for each emphasis areas which helps identify specific issues.

Figure 3-1 | High Crash Density Analysis Areas



Shiprock Area

The Shiprock Area, which comprises 9% of all fatal/injury crashes in Navajo Nation from 1999-2015, is the number one priority for safety. Figure 3-2 illustrates the concentration of crashes, which primarily occurred at the intersection of Highway 504 and Highway 491 and the intersection of Highway 491 and Highway 64. Both intersections are currently regulated by traffic signals. The highest crash factors in this critical zone include the following:

- Under the Influence of Alcohol
- Driver Inattention
- Failed to Yield to ROW

The highest collision factors include the following:

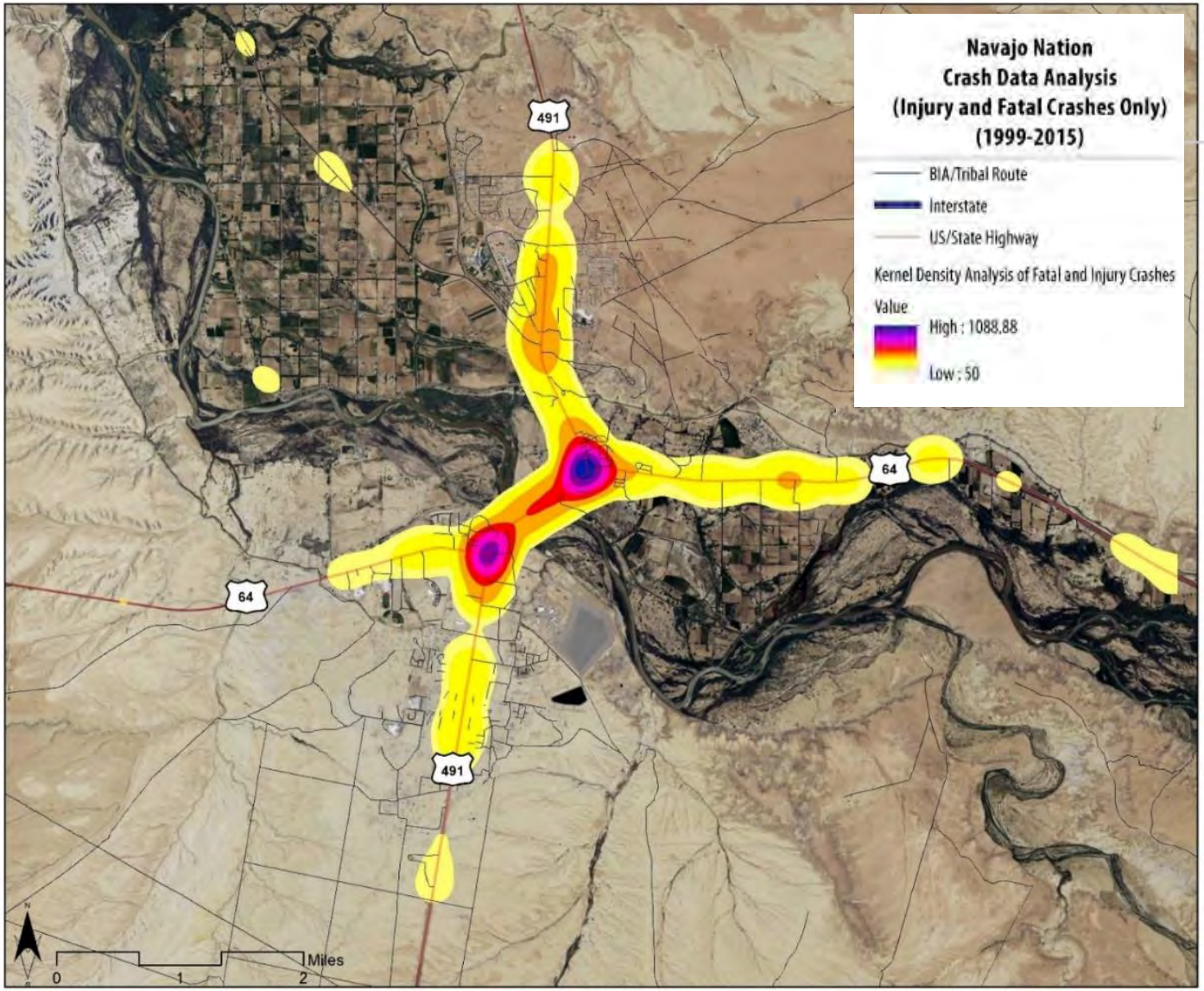
- Rear Ended
- Other Vehicle
- Sideswipe

From 1999 to 2015, 648 severe crashes occurred within this area. Of those approximately 93% were crashes with injuries and 7% were crashes with fatalities.

In comparison with other areas, Shiprock has the highest number of injury and fatal pedestrian crashes at 21%.

Appendix A contains the presentation provided for the Shiprock area, and the detailed summary of crash data.

Figure 3-2 | Shiprock Area Fatal and Injury Crashes



Window Rock Area

Window Rock comprises 9% of all fatal/injury crashes within Navajo Nation from 1999-2015. Figure 3-3 illustrates the concentration of crashes, which primarily occurred along State Highway 264 as well as Indian Route 12. The highest crash factors in this critical zone include the following:

- Under the Influence of Alcohol
- Failed to Yield to ROW
- Driver Inattention

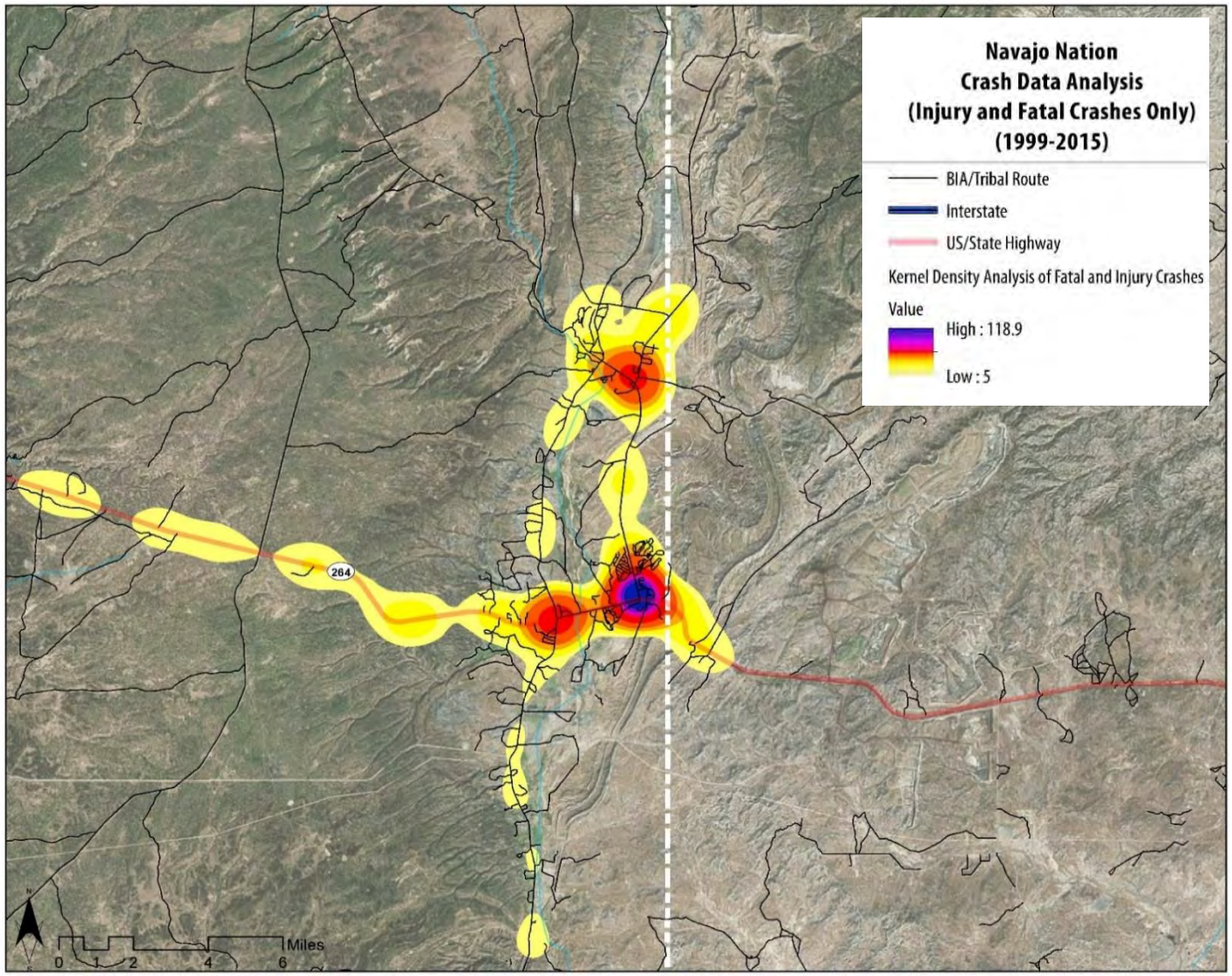
The highest collision factors include the following:

- Rear Ended
- Overturn/Rollover
- Hit Side of Vehicle & Hit Animal

From 1999 to 2015, 645 severe crashes occurred within this area. Of those approximately 90% were crashes with injuries and the remaining 10% were crashes with fatalities.

Appendix B contains the presentation provided for the Window Rock area, and the detailed summary of crash data

Figure 3-3 | Window Rock Area Fatal and Injury Crashes



Tuba City

Tuba City makes up 6% of all fatal/injury crashes within Navajo Nation from 1999-2015. Figure 3-4 shows the concentration of crashes per square mile, which occurred within the core area of Tuba City. The highest crash factors in this critical zone include the following:

- Under the Influence of Alcohol
- Driver Inattention
- Speeding

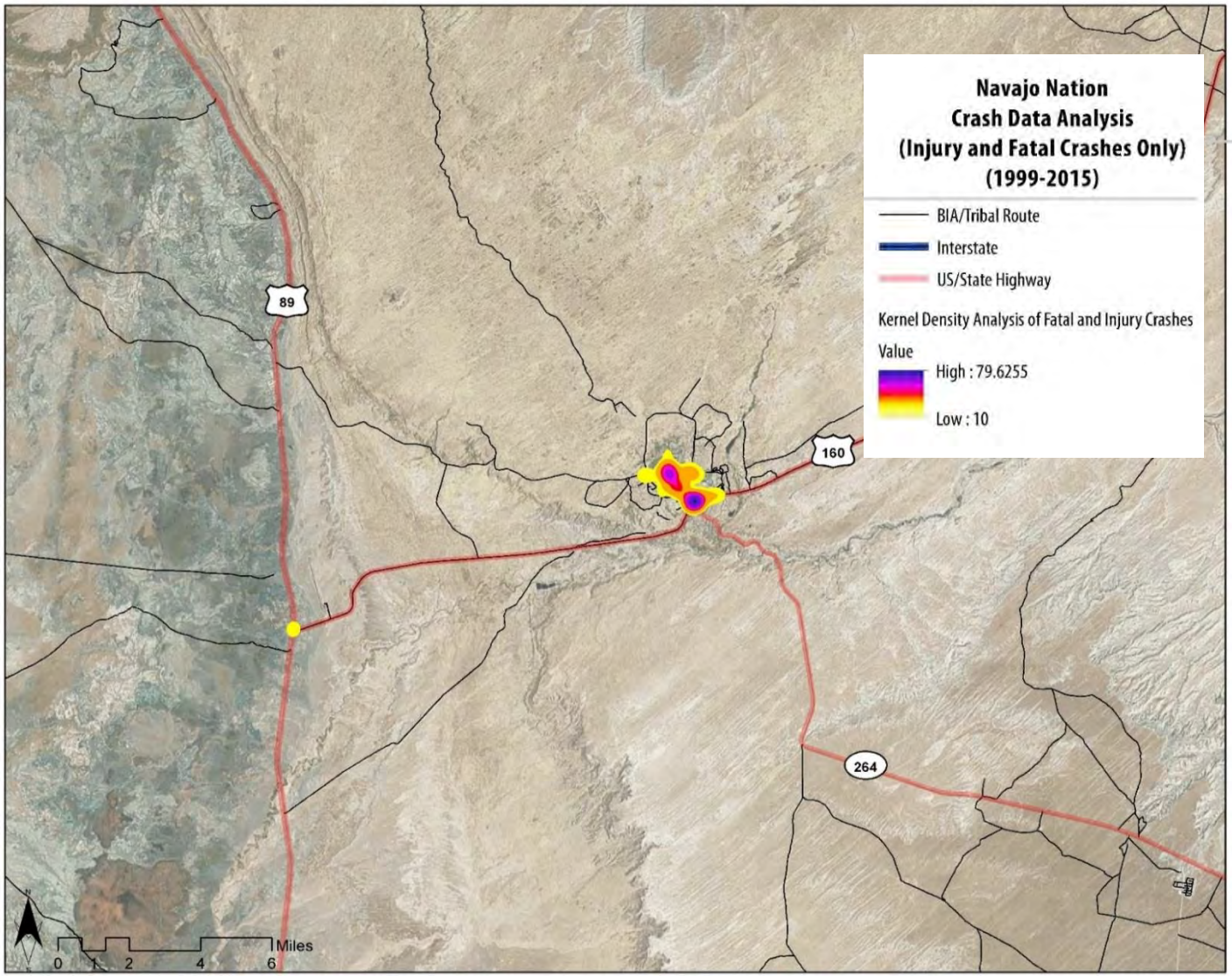
The highest collision factors include the following:

- Overturn/Rollover
- Rear Ended
- Sideswipe

From 1999-2015, 427 severe crashes occurred within this area. Of those approximately 90% were crashes with injuries and 10% were crashes with fatalities.

Appendix C contains the presentation provided for the Tuba City area, and the detailed summary of crash data.

Figure 3-4 | Tuba City Fatal and Injury Crashes



KAYENTA AREA

The Kayenta Area makes up 5% of all fatal/injury crashes within Navajo Nation from 1999-2015. Figure 3-5 highlights the concentration of fatal/injury crashes which occurred along Highway 163 and Highway 160, especially at the intersection of the two highways. The highest crash factors in this critical zone include the following:

- Failed to Yield to ROW
- Under the Influence of Alcohol
- Driver Inattention

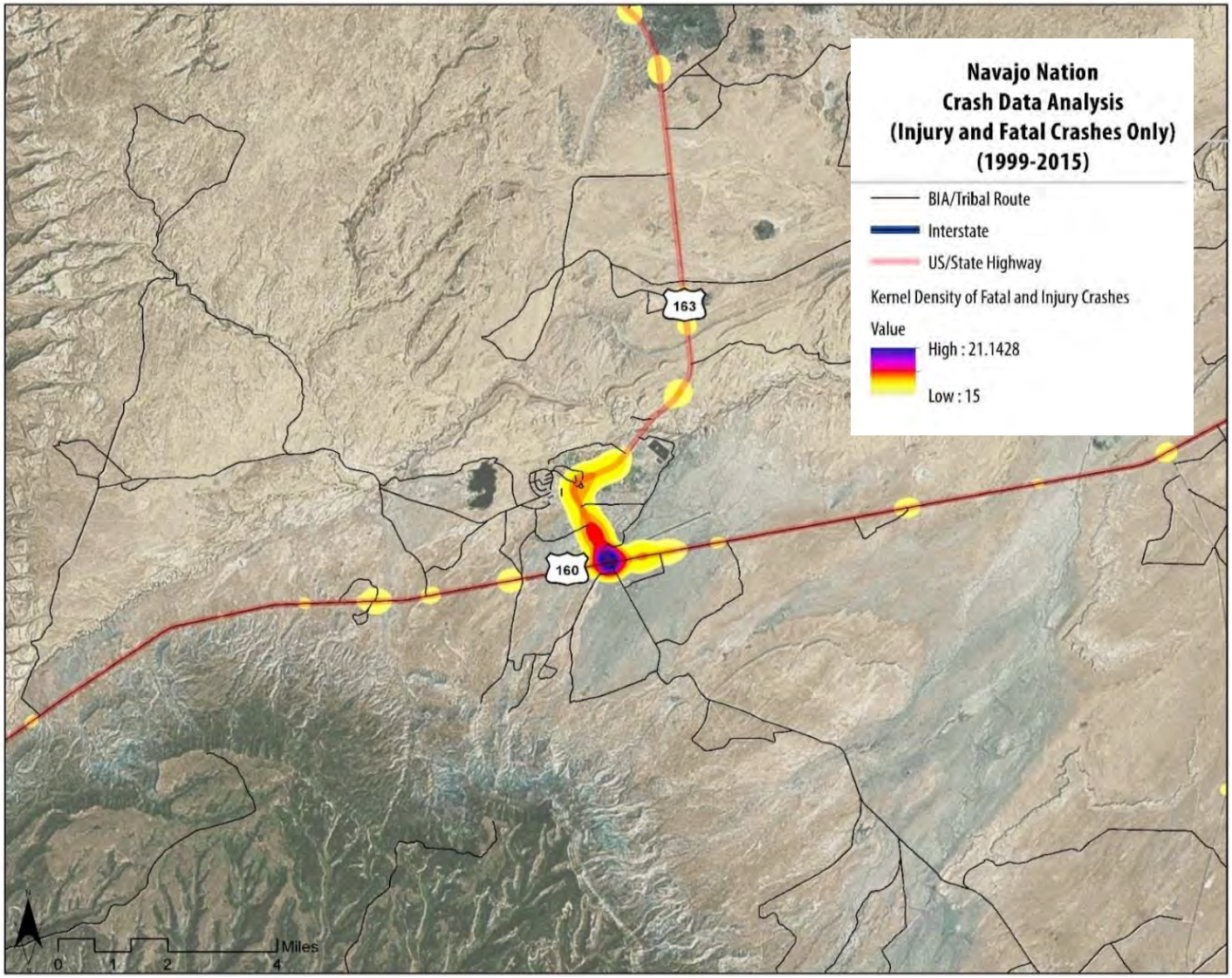
The highest collision factors include the following:

- Single Crash/Non-Collision
- Overturn/Rollover
- Sideswipe & Other Vehicle

From 1999-2015, 337 severe crashes occurred within this area. Of those approximately 92% were crashes with injuries and 8% were crashes with fatalities.

Figure 3-5 illustrates the density of injury and fatal crashes in the Kayenta area. Appendix D contains the presentation provided for the Kayenta area, and the detailed summary of crash data.

Figure 3-5 | Kayenta Area Fatal and Injury Crashes



Chinle Area

The Chinle Area comprises a total of 6% of all fatal/injury crashes within Navajo Nation from 1999-2015. Figure 3-6 portrays the concentration of fatal/injury crashes per square mile. The highest crash factors in this critical zone include the following:

- Driver Inattention
- Under the Influence of Alcohol
- Speeding

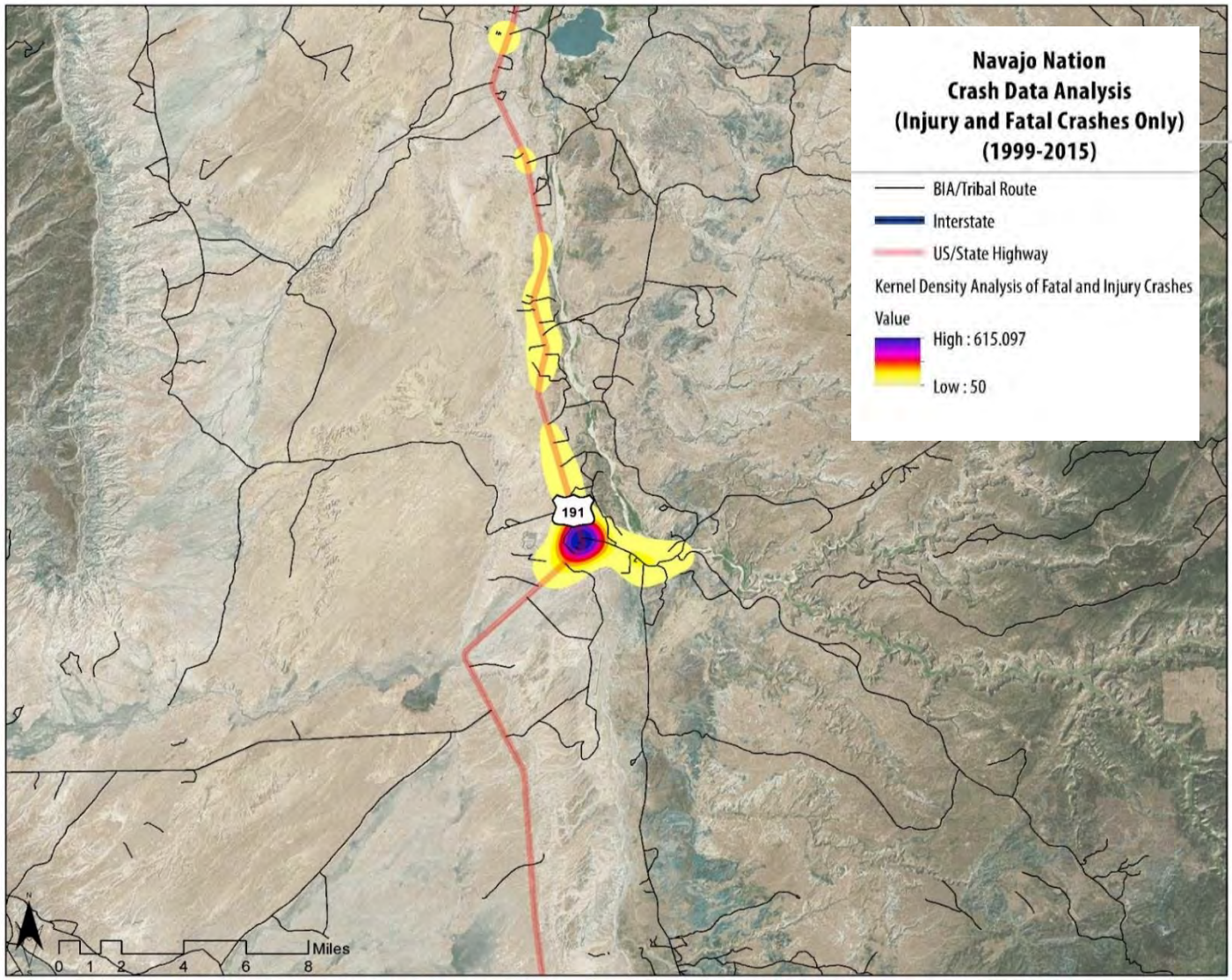
The highest collision factors include the following:

- Rear Ended
- Single Crash
- Overturn/Rollover

From 1999-2015, 476 severe crashes occurred within this area. Of those approximately 91% were crashes with injuries and 9% were crashes with fatalities.

Figure 3-6 illustrates the density of injury and fatal crashes in the Chinle area. Appendix E contains the presentation provided for the Chinle area, and the detailed summary of crash data.

Figure 3-6 | Chinle Area Fatal and Injury Crashes



Ganado Area

The Ganado Area comprises 6% of all fatal/injury crashes in Navajo Nation from 1999-2015. Figure 3-7 depicts the concentration of crashes which primarily occurred at the intersection of Highway 191 and Highway 264. The highest crash factors in this critical zone include the following:

- Under the Influence of Alcohol
- Animal on Road
- Driver Inattention

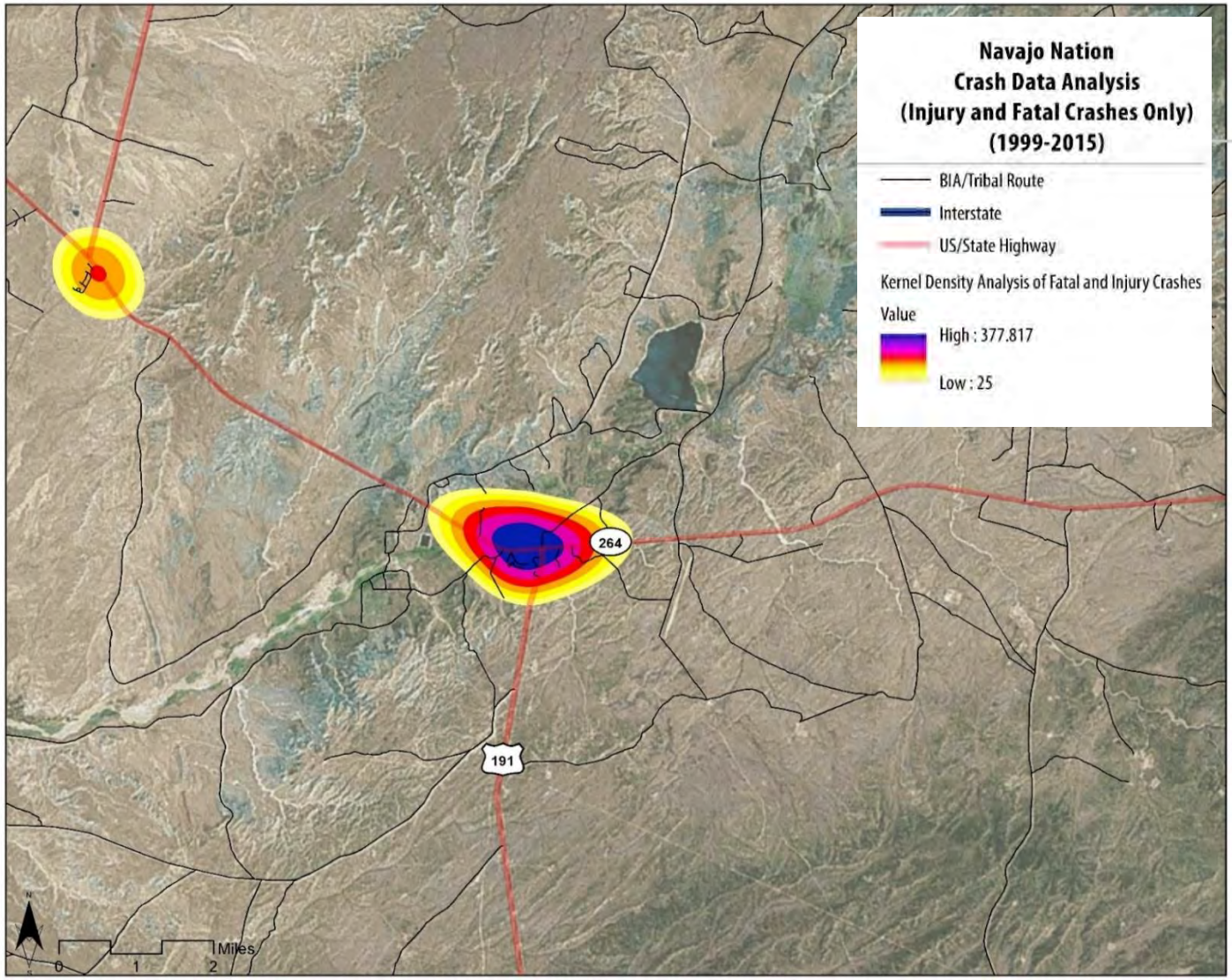
The highest collision factors include the following:

- Overturn/Rollover
- Hit Animal
- Rear Ended

From 1999-2015, 442 severe crashes occurred within this area. Of those approximately 89% were crashes with injuries and 11% were crashes with fatalities.

Figure 3-7 illustrates the density of injury and fatal crashes in the Ganado area. Appendix F contains the presentation provided for the Ganado area, and the detailed summary of crash data.

Figure 3-7 | Ganado Area Fatal and Injury Crashes



Newcomb Area

The Newcomb Area makes up 3% of all fatal/injury crashes within Navajo Nation from 1999-2015. Figure 3-8 displays the concentration of fatal/injury crashes per square mile. The highest crash factors in this critical zone include the following:

- Under the Influence of Alcohol
- Animal on Road
- Driver Inattention

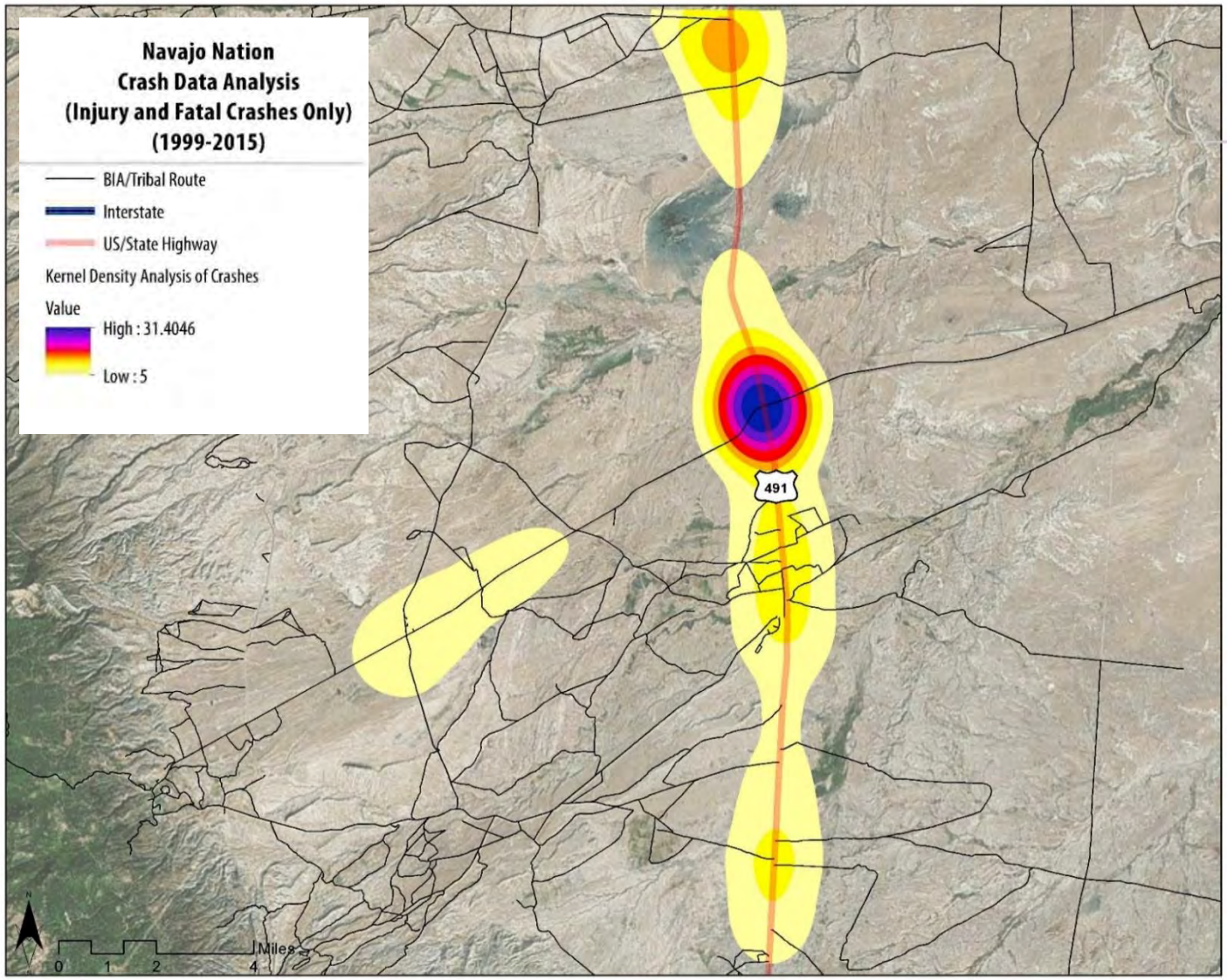
The highest collision factors include the following:

- Overturn/Rollover
- Hit Animal
- Skidded/Sliding

From 1999-2015, 210 severe crashes occurred within this area. Of those approximately 84% were crashes with injuries and 16% were crashes with fatalities.

Figure 3-8 illustrates the density of injury and fatal crashes in the Newcomb area. Appendix G contains the presentation provided for the Newcomb area, and the detailed summary of crash data.

Figure 3-8 | Newcomb Area Fatal and Injury Crashes



3.2 REMAINING SYSTEM EVALUATION

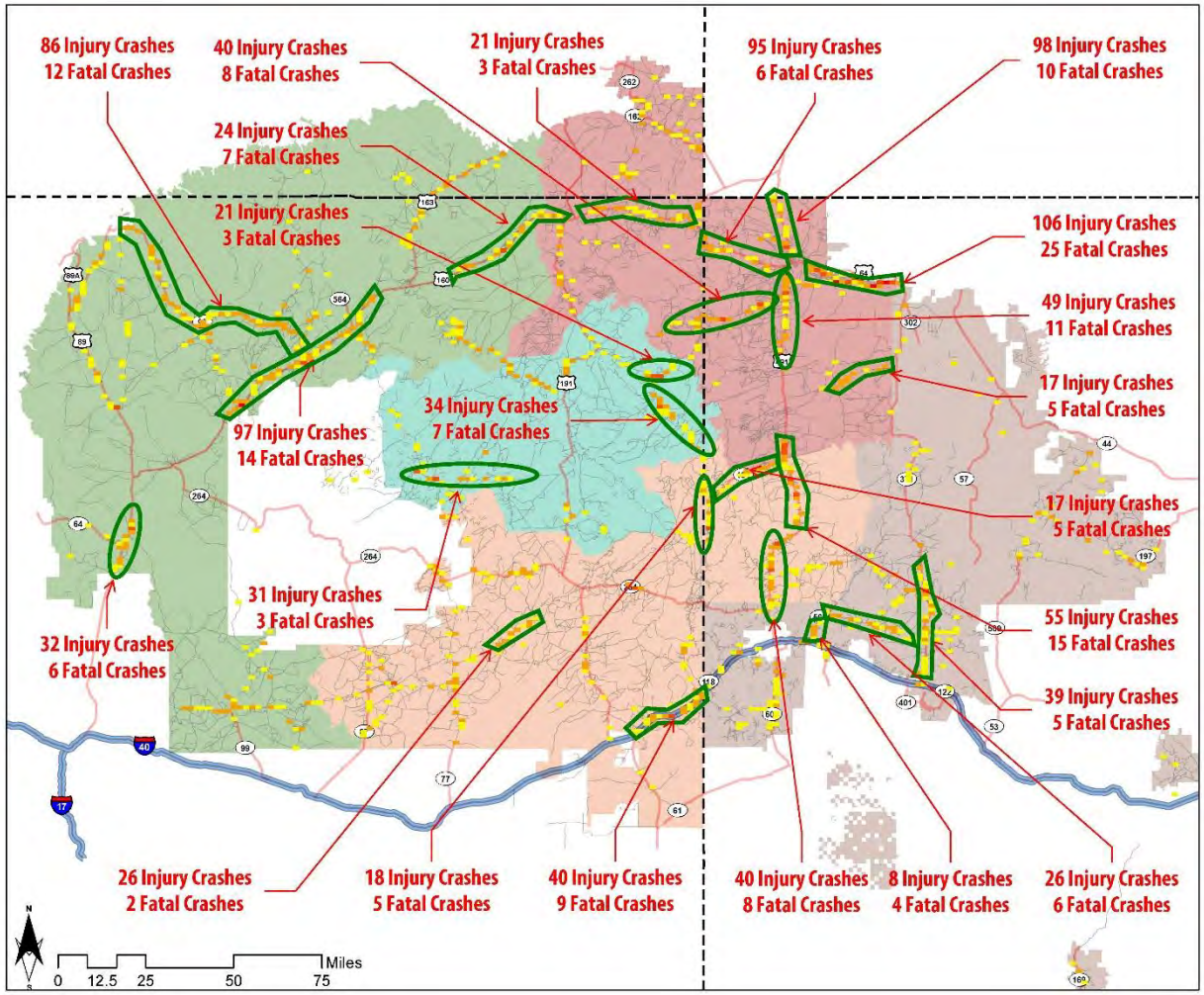
High-level crash analysis was conducted to uncover density of fatal and injury crashes. However, other areas were also examined and analyzed. The seven Critical Areas mentioned earlier were looked at through cause and collision characteristics at the local level, while other crash data were analyzed at the Nation's regional level as these crashes are not spatially dense. A geoprocessing tool called Fishnet Analysis uses spatial union to determine the number of crashes occurring in an approximate one-mile area.

The remaining system was evaluated with the following crash conditions:

- Driver Inattention
- Alcohol Related;
- Animal Involved;
- Failure to Yield ROW;
- Intersection Related;
- Non-Intersection Related;
- Older Drivers;
- Younger Drivers;
- Pedestrian Involved;
- Snow on Road ;
- Speeding Related;
- Wet Road Conditions; and
- Windy/Dusty Weather.

Figure 3-9 illustrates the remaining system crashes. Appendix H contains the presentation provided for the Newcomb area, and the detailed summary of crash data.

Figure 3-9 | Remaining System Crash Summary



4.0 EMPHASIS AREAS AND STRATEGIES

Safety emphasis areas establish the focus for the NNSHSP to achieve transportation safety goals. Specifically, emphasis areas that offer the greatest potential for reducing fatalities and injuries are used to track progress and direct projects and programs for implementation.

A data-driven and coordinated stakeholder process was used to determine the appropriate safety emphasis areas.

4.1 DATA IMPROVEMENT

Data improvement is key to increasing the knowledge and understanding of the safety problems within Navajo Nation.

As Navajo Nation falls within three states, the crash data is not always consistent across the board. Creating a common system to use across Navajo Nation and training the officers on the system will help to give a more complete picture of what is occurring on Navajo Nation's roadways. Additionally, implementing a system-wide electronic on-vehicle crash reporting system that would synchronize with a live database and ultimately relate seamlessly with state DOT crash reporting systems would assist Navajo Nation in obtaining state-sponsored safety grants.

A migration to using KABCO injury classification scale on crash reporting forms will allow for more information to be obtained to help with the understanding of the most severe and fatal crashes.

Other areas that will lead to better crash data include breaking crashes down by KABCO scale. The KABCO scale is widely used and provides information on the severity of the crashes being seen. This will ultimately help to focus the crash mitigation techniques.

4.1.1 Purpose

Improving the quality of data allows for a better assessment and diagnosis of safety problems. Improving the data also assists in the use and completeness of required data items for grant applications and safety reporting.

4.1.2 Goal

Improve data availability and completeness to allow for a better and broader understanding of the crash-related safety problems within Navajo Nation.

4.1.3 States

- Arizona
- New Mexico
- Utah

4.1.4 Strategies to Achieve Goal

ENGINEERING

- Identify critical pieces of crash data.
- Combine crash data with roadway features and traffic volume.
- Correlate crash data to be able to use all three state's crash reporting forms/systems.
- Share crash data reporting with state DOTs for integrated datasets.

ENFORCEMENT

- Use electronic crash data collection such as the CODY or TraCS systems for instant data uploading and use by interested agency partners.
- Collect critical pieces of crash data in all states.
- Train Officers on what data is important and why it is important.
- Develop quality control and quality assurance measures.

EMS

- Connect hospital records with crash records.

4.2 RESTRAINT USAGE

Restraint usage is an emphasis area. Restraint usage is identified within the Fatality Analysis Reporting System (FARS) data. This data indicates that 50% of the fatal crashes did not involve occupant protection.

A consistent tracking of this information will help to enable countermeasure development and project implementation. Primary countermeasures include enforcement and education.

4.2.1 Purpose

To reduce the number of fatal and severe injury crashes due to lack of safety device usage through education and enforcement.

4.2.2 Goal

Reducing fatalities and severe injuries.

4.2.3 States

Arizona, New Mexico, Utah

4.2.4 Strategies to Achieve Goal

ENGINEERING

- Collect data on safety device usage.
- Share data analysis on the restraint usage reported in crashes

EDUCATION

- Conduct education campaigns about proper use of seat belts and child safety devices.
- Improve driver education about safety device usage.

ENFORCEMENT

- Conduct high-visibility safety device usage enforcement.

EMS

- Conduct safety device screenings.

4.3 ALCOHOL AND DRUG RELATED

Alcohol and Drug related crashes include under the influence of drugs, under the influence of alcohol, and unknown / sleeping at the wheel

Alcohol and Drug related crashes are identified within the 2017-2019 Navajo DOT SHSP, the analysis performed for this SHSP, AZ SHSP, NM SHSP, and UT SHSP.

Alcohol and drug related crashes showed up consistently as one of the top contributing factors over the analysis years and areas. There are concentrations of this crash type at the critical areas as well as out in the non-critical areas. Alcohol and Drug related crashes make up 25.8% of all fatal and injury crashes in Navajo Nation with 81.12% being fatal and 18.88% being injury.

Countermeasures tend to be in the EMS, Enforcement, and Education areas.

4.3.1 Purpose

Prevent impaired driving.

4.3.2 Goal

Reducing fatalities and severe injuries due to alcohol and drug related driving.

4.3.3 States

Arizona, New Mexico, Utah

4.3.4 Strategies to Achieve Goal

EDUCATION

- Implement mass media campaigns in conjunction with patrols and checkpoints.
- Partner with Navajo enterprises for billboard and outreach campaigns.
- Partner with IHS for marketing programs.

ENFORCEMENT

- Conduct high visibility saturation patrols and checkpoints.
- Lower legal BAC levels for repeat offenders.

EMS

- Conduct alcohol and drug screenings

4.4 INTERJURISDICTIONAL

Interjurisdictional was identified in the previous SHSP as an emphasis area to increase coordination among the different agencies. The Arizona SHSP, NM SHSP, and Utah SHSP also include interjurisdictional as an emphasis area.

4.4.1 Purpose

To collaborate with other agencies to provide complete crash data.

4.4.2 Goal

Building the crash dataset through collaboration with other agencies.

4.4.3 States

Arizona

4.4.4 Strategies to Achieve Goal

ENGINEERING

- Coordinate with states and local jurisdictions to refine and share crash data.

EDUCATION

- Train local law enforcement on the importance of crash data.

4.5 HEAVY VEHICLES

Navajo Nation identifies heavy vehicles as an emphasis area but it does not show up in our analysis as there is inconsistent data on this factor.

Heavy vehicles are starting to be tracked and need to be consistently tracked. Data right now does not allow for the tracking of this emphasis area. After data is able to be tracked different countermeasures can be presented to help reduce the number of crashes involving heavy vehicles. These countermeasures will primarily be with enforcement and engineering.

4.5.1 Purpose

To reduce the number of heavy vehicle involved crashes through education, engineering, and enforcement.

4.5.2 Goal

Reducing fatalities and severe injuries involving heavy vehicles.

4.5.3 States

Arizona

4.5.4 Strategies to Achieve Goal

ENGINEERING

- Collect data to track the number of heavy vehicle involved crashes.
- Add passing lanes.

EDUCATION

- Educate on how to drive near heavy vehicles.
- Educate drivers of the hazards of driving impaired (alcohol, drug, sleep).
- Run media campaigns on blind spots.

ENFORCEMENT

- Enforce restrictions
- Require seatbelts

4.6 WEATHER

Weather related crashes show up in both the previous SHSP as well as within the data. The most common crashes that are related to weather include snow, wet weather, and dust / wind. Snow related crashes make up 7.0% of all fatal and injury crashes in Navajo Nation with 94.23% being injury and 5.77% being fatal. These are concentrated in the northern region of Navajo Nation.

Wet Road related crashes make up 3.0% of all fatal and injury crashes in Navajo Nation with 87.17% being injury and 12.83% being fatal. There are instances where these are concentrated at horizontal curves. Dust / Wind related crashes make up 1.3% of all fatal and injury crashes in Navajo Nation with 86.46% being fatal and 13.54% being injury. Dust / Wind related crash locations.

4.6.1 Purpose

To reduce the number of weather related crashes through education, engineering, and enforcement.

4.6.2 Goal

Reducing fatalities and severe injuries caused by weather related events.

4.6.3 States

Arizona

4.6.4 Strategies to Achieve Goal

ENGINEERING

- Promote pre-treatment for winter weather.
- Holistic Agriculture
- Implement variable speed limits to change based upon weather type.
- Promote maintenance efforts that reduce weather related crashes.

EDUCATION

- Educate the traveling public on the dangers of weather and driving.
- Educate locals on Holistic Agriculture to reduce the number of dust related crashes.

ENFORCEMENT

- Enforce unsafe speeds during winter weather.

4.7 SPEEDING AND AGGRESSIVE DRIVING

Speeding and aggressive driving shows up in the data as well as is identified in the existing NN SHSP, AZ SHSP, NM SHSP, and the Utah SHSP.

Speeding related crashes make up 15.7% of all fatal and injury crashes in Navajo Nation with 87.89% being injury and 12.11% being fatal. Speeding related crashes are one of the most common crash factors.

Countermeasures for speeding and aggressive driving primarily exist within Enforcement and Education.

4.7.1 Purpose

To reduce the number of crashes due to speeding through education, engineering, and enforcement.

4.7.2 Goal

Reducing fatalities and severe injuries caused by speeding and aggressive driving.

4.7.3 States

Arizona, New Mexico, Utah

4.7.4 Strategies to Achieve Goal

ENGINEERING

- Install mobile and stationary speed cameras.

EDUCATION

- Educate young drivers on the danger of speeding and aggressive driving.

ENFORCEMENT

- Install mobile and stationary speed cameras.
- Perform speed related saturation patrols.

4.8 DISTRACTED DRIVING

Distracted driving is a concern for all states as well as Navajo Nation. It shows up as being a main contributing crash factor within the data.

Distracted Driving related crashes make up 23.4% of all fatal and injury crashes in Navajo Nation with 90.12% being injury and 9.88% being fatal.

Distracted driving countermeasures include strategies within Engineering, Enforcement, and Education.

4.8.1 PURPOSE

To reduce the number of crashes due to distracted driving through education and enforcement.

4.8.2 GOAL

Reducing fatalities and severe injuries caused by distracted driving.

4.8.3 STATES

Arizona, New Mexico, Utah

4.8.4 STRATEGIES TO ACHIEVE GOAL

ENGINEERING

- Install rumble stripes.

EDUCATION

- Educate young drivers on the risk of driving distracted.
- Encourage employers to promote no cell phone policies.

ENFORCEMENT

- Implement a no texting and driving law for all roadway users.

4.9 OLDER DRIVER

Older drivers are vulnerable users. When involved in crashes, they tend to sustain more severe injuries. Both the previous version of the SHSP and the analysis indicate Older Drivers should be an emphasis area. Older driver crashes have been fairly consistent over the last 10 years but there does

Older Driver related crashes make up 3.2% of all fatal and injury crashes in Navajo Nation with 88.33% being injury and 13.97% being fatal.

Countermeasures to decrease the number of older driver involved crashes are primarily within Engineering, Enforcement, Education, and EMS.

4.9.1 PURPOSE

To reduce the number of older driver involved crashes through engineering, education, enforcement, and EMS efforts.

4.9.2 GOAL

Reducing fatalities involving older drivers.

4.9.3 STATES

Arizona, New Mexico, Utah

4.9.4 STRATEGIES TO ACHIEVE GOAL

ENGINEERING

- Encourage engineering practices that are known to benefit older drivers (shoulders, rumble strips, striping, larger signs and sign lettering).

EDUCATION

- Hold Carfit programs.
- Require driving retesting.

ENFORCEMENT

- Implement and enforce driving restrictions.

4.10 YOUNG DRIVER

Young drivers are known to be overrepresented within data and this trend showed up in the current Navajo Nation data.

Young Driver related crashes make up 9.0% of all fatal and injury crashes in Navajo Nation with 86.03% being injury and 13.97% being fatal.

Young driver crash countermeasures include Enforcement, Engineering, Education, and EMS.

4.10.1 Purpose

To reduce the number of young driver involved crashes through engineering, education, enforcement, and EMS.

4.10.2 Goal

Reducing fatalities involving young drivers.

4.10.3 States

Arizona, New Mexico, Utah

4.10.4 Strategies to Achieve Goal

ENGINEERING

- Install rumble stripes.
- Install safety edge.
- Install paved shoulders.

EDUCATION

- Think First program.
- Implement GDL with restrictions.

ENFORCEMENT

- Enforce GDL restrictions.

4.11 ANIMALS

Crashes with animals tend to be less severe as most animals hit are much smaller than the vehicles but if large animals are regularly hit, there is a potential to have more severe and fatal injury crashes. Crashes with animals are fairly concentrated along a few different routes.

Animal related crashes make up 9.1% of all fatal and injury crashes in Navajo Nation with 97.81% being injury and 2.19% being fatal.

Primary countermeasures for animals involves engineering.

4.11.1 Purpose

To reduce the number of crashes with animals through engineering and education.

4.11.2 Goal

Reducing fatalities involving animals.

4.11.3 States

Arizona

4.11.4 Strategies to Achieve Goal

ENGINEERING

- Work with local DNR to determine what Animal Crashes.
- Animal over / underpasses.

EDUCATION

- Educate drivers on the prevalence of animals.

4.12 PEDESTRIANS

Pedestrians have become a focus for the federal government as well as many state governments. It is identified as a focus area for all the states Navajo Nation falls within, the previous SHSP, and in the current data set. The pedestrian crashes occur mainly within the critical areas.

Pedestrian related crashes make up 2.9% of all fatal and injury crashes in Navajo Nation with 43.7% being injury and 56.3% being fatal. Pedestrian crashes have been fairly consistent for the last 10 years with little reduction or gain in the number of crashes.

Pedestrian countermeasures include enforcement, engineering, and education.

4.12.1 Purpose

To reduce the number of crashes with pedestrians through engineering, education, enforcement, and EMS.

4.12.2 Goal

Reducing fatalities and injuries involving pedestrians.

4.12.3 States

Arizona, New Mexico, Utah

4.12.4 Strategies to Achieve Goal

ENGINEERING

- Install sidewalks or paths in populated areas on roads and bridges with higher volumes and/or higher speeds.
- Install paved shoulders on low volume roads.
- Install warning and traffic control signals.
- Install crosswalks.
- Install roadway and/or pedestrian-level lighting.
- Change signal phasing to restrict permissive lefts when pedestrians are present.
- Implement passive pedestrian detection at intersections.
- Provide refuge areas for wide crossing areas.
- Reduce pedestrian crossing distances.

EDUCATION

- Educate motorists on pedestrians.
- Educate pedestrians on safety precautions.
- Increase awareness of locations where high pedestrian activity exist.

ENFORCEMENT

- Enforce pedestrian laws.

4.13 SECONDARY CRASHES

Secondary crashes are identified as a focus area in the AZ SHSP it was not included in the data analysis due to lack of data.

Adding a field to the crash form to allow for tracking of these types of crashes will aid in the understanding of the problem which will allow for countermeasures to be developed. Most countermeasures related to this emphasis area are related to EMS, enforcement, and engineering.

4.13.1 Purpose

To reduce the number of secondary crashes through enforcement, EMS, and engineering.

4.13.2 Goal

Reducing fatalities and serious injuries as a result of secondary crashes.

4.13.3 States

Arizona

4.13.4 Strategies to Achieve Goal

ENGINEERING

- Utilize advance warning systems to let drivers know there is an upcoming slowdown.

EDUCATION

- Create media campaigns to advance slower and more alert driving behaviors near crashes.

ENFORCEMENT

- Track clean up time.
- Reduce traffic backups due to crashes.

4.14 INTERSECTION

Intersection crashes are one of the highest areas within the Navajo Nation with 17.4% of crashes occurring at intersections. Navajo Nation has a range of intersection types including uncontrolled, 2-way stop controlled, 4-way stop controlled, roundabouts, and signalized intersections. The data indicates failure to yield right-of-way as one of the top contributing circumstances.

Intersection related crashes make up 17.4% of all fatal and injury crashes in Navajo Nation with 92.56% being injury and 7.44% being fatal. Intersection crash countermeasures typically include engineering, enforcement, and education.

4.14.1 Purpose

To reduce the number of crashes at intersections through engineering, education, and enforcement.

4.14.2 Goal

Reducing fatalities and serious injuries at intersections.

4.14.3 States

Arizona

4.14.4 Strategies to Achieve Goal

ENGINEERING

- Install red light running cameras or blue lights.
- Install Flashing Yellow Arrows.
- Coordinate Signal Timings.
- Add Reflective Backplates.
- Add STOP or YIELD Signs to uncontrolled intersections.
- Convert / Consider alternative intersection designs such as roundabouts.

EDUCATION

- Educate drivers on new types of intersections and intersection features.

ENFORCEMENT

- Enforce red light running violations.
- Enforce speed limits.

4.15 WORK ZONES

Work zones were identified as an emphasis area in the previous SHSP. As there was little to no data on this topic it was not tracked as part of the update but it is seen as an important topic to keep track of.

Crash data in work zones is limited and should be expanded to include information on this type of crash. Once data is gathered appropriate countermeasures can be applied. Countermeasures for this type is usually a combination of enforcement, education, and engineering.

4.15.1 Purpose

To reduce the number of crashes occurring in work zones through engineering, enforcement, and educations.

4.15.2 Goal

Reducing fatalities and serious injuries occurring in work zones.

4.15.3 States

Arizona

4.15.4 Strategies to Achieve Goal

ENGINEERING

- Track clean up time and backups of crashes.
- Utilize advance warning systems to let drivers know there is an upcoming slowdown.
- Utilize
- Check work zones for MUTCD compliance on a regular basis.

EDUCATION

- Run media campaigns on work zone safety.

ENFORCEMENT

- Track clean up time and backups of crashes.
- Enforce reduced speed limits in work zones.

4.16 RIGHT OF WAY RELATED

Failure to yield right of way was one of the most prevalent crash types.

Right of Way related crashes make up 12.9% of all fatal and injury crashes in Navajo Nation with 5.27% being fatal and 94.73% being injury. Further analysis of these crashes showed a majority of them occurred while the vehicle was making a left turn maneuver. Right of way related crashes are predominately at intersections as such there are engineering, enforcement, and education countermeasures that can be used to mitigate the likelihood of a crash.

4.16.1 Purpose

To reduce the number of crashes occurring due to failure to yield right of way through engineering, enforcement, and education.

4.16.2 Goal

Reducing fatalities and serious injuries occurring due to failure to yield right of way.

4.16.3 States

None

4.16.4 Strategies to Achieve Goal

ENGINEERING

- Install STOP or YIELD signs at uncontrolled intersections that warrant the signs.
- Install Flashing Yellow Arrow.
- Install Red Light Running Cameras or Blue Lights.
- Change intersections to roundabouts or other forms of intersections.

EDUCATION

- Create media campaigns explaining the rule of right of way.
- Think First Campaigns.

ENFORCEMENT

- Utilized blue lights or red light running cameras to help enforce right of way.

4.17 HEAD-ON

Head-on crashes were identified as a main crash type through the analysis of the data.

Head-On related crashes make up 7.4% of all crashes in Navajo Nation with 1.6% being injury and 5.0% being fatal.

Head-on crashes can occur at intersections or non-intersections. Depending on the location there are different types of countermeasures. These countermeasures fall typically within engineering but there are some in enforcement as well.

4.17.1 Purpose

To reduce the number of crashes occurring due to head-on collisions through engineering, enforcement, and education.

4.17.2 Goal

Reducing fatalities and serious injuries occurring due to head-on crashes.

4.17.3 States

None

4.17.4 Strategies to Achieve Goal

ENGINEERING

- Install centerline rumbles.
- Protected Left Turns.
- Install Centerlines.
- Install left-turn striping through intersections.

EDUCATION

- Run media campaigns on distracted driving, driving while intoxicated, driving while tired.

ENFORCEMENT

- Enforce No Passing Zones.

4.18 OVERTURN / ROLLOVER

Overturn / Rollover crashes are predominately found in rural areas. The data shows this is the case in Navajo as well. These are typically associated with speeding as well. These are primarily found not in the critical areas.

Overturn / Rollover related crashes make up 7.4% of all crashes in Navajo Nation with 16.5% being injury and 6.4% being fatal. Overturn / rollover crashes mainly require engineering countermeasures.

4.18.1 Purpose

To reduce the number of overturn / rollover crashes through engineering, enforcement, and education.

4.18.2 Goal

Reducing fatalities and serious injuries occurring in overturn / rollover type crashes.

4.18.3 States

None

4.18.4 Strategies to Achieve Goal

ENGINEERING

- Install chevrons and curve warning signs
- Install paved shoulders
- Install painted edge lines
- Install safety edge
- Install centerline rumble strips and edge line rumble strips

EDUCATION

- Educate on importance of safety devices

ENFORCEMENT

- Enforce speed limits

5.0 THE 4-E'S TO IMPROVE SAFETY

5.1 EMERGENCY MEDICAL SERVICE

The Navajo Nation Emergency Medical Service is one of eight departments within the Navajo Division of Public Safety. The operations of the Navajo Nation Emergency Medical Service are carried out by the Indian Health Service hospitals or clinics that are managed by the Emergency Medical Service (EMS).

5.1.1 Indian Health Service

The Indian Health Service (IHS) is an agency within the Department of Health and Human Services. IHS is the principal federal health provider to American Indians as well as Alaska Natives. Within Navajo Nation there are various hospitals and health centers that provide service to the surrounding area.

5.1.2 Countermeasures

Alcohol and Drug Involved

Alcohol and drug screenings at doctors and emergency locations can help identify at risk individuals for driving impaired.

5.2 EDUCATION

5.2.1 Navajo nation Department of Highway Safety

Navajo Nation Department of Highway Safety helps facilitate the dissemination of information for educating the public in relation to traffic risks.

5.2.2 Legislative Needs

The Navajo Nation office of the President and Vice President, and the Chief Justice, should be informed on the issues related to the contributing factors relating to traffic safety/crashes. This will allow the President and Vice President to assess the needs for changing legislation related to enforcement and strengthen the laws related to the justice system and legislative matters.

5.2.3 Countermeasures

Education countermeasures generally will be able to be applied to all areas within Navajo Nation due to the similarity in the prevalence of the main contributing factors that can be influenced by education related countermeasures. Presented below are the contributing factor with educational strategies.

Young People (18 – 24)

Young drivers can benefit from many proven educational strategies including mass media campaigns, targeted campaigns at schools, seatbelt campaigns, and Think First campaigns.

Older Adults

Older adults can benefit from the following educational strategies: mass media campaigns, driver testing, and CarFIT.

Pedestrian Involved

There have been many programs that address pedestrians. One of the main programs involves educating pedestrians on how to be more conspicuous, educating children, educating drivers on the risks and rights of pedestrians.

Right of Way Related

Mass media campaigns on right of way related crashes may help reduce the number of crashes related to this type of crash.

alcohol and drug related crashes

Mass Media Campaigns in addition to enforcement efforts are effective ways at using education to reduce the number of Alcohol and Drug related crashes.

Driver Inattention

Mass media campaigns are the most common way to educate the public on the risk of distracted driving.

5.3 ENFORCEMENT

Enforcement plays a vital role in reducing the number of injury and fatal crashes.

5.3.1 Navajo Nation Police Department

The Navajo Nation Law Enforcement is comprised of 7 districts who enforce the traffic laws on Navajo Nation. As Navajo Nation spans three different states, the consistency across them is one of the key factors in being able to use the crash data to support enforcement activities.

5.3.2 Countermeasures

Enforcement countermeasures, used in conjunction with educational countermeasures, allow for the number of fatal and injury crashes to be reduced. Presented below are different strategies identified to help reduce the number of crashes that can be applied to the majority of the areas.

Intersection Related Crashes

Intersection related crashes are one of the most prevalent types of crashes occurring in Navajo Nation. To help reduce the number of crashes, the following countermeasures can be used: Red Light Running Cameras, Blue Lights, prohibit stopping in crosswalk, and prohibit right turn on red.

Non-intersection Related Crashes

Non-intersection related crashes incorporate many other factors and the following sections will outline different ways to reduce crashes not within intersections.

Speeding

Enforcement of speeding either through intersections or on a stretch of roadway will lead to a decrease in the number of crashes that are speeding involved. One way to help enforce the speed limits is to use either stationary or mobile speed enforcement.

Right of Way Related

To enforce the right of way related crashes, a use of red light running cameras or blue lights can be used.

Alcohol and Drug Related

Saturation Patrols, checkpoints, lower BAC levels for repeat offenders, lower BAC levels for all drivers help to reduce the risk of intoxicated driving crashes.

Driver Inattention

Saturation patrols for texting and driving laws can help reduce the number of distracted driving crashes when used alongside an educational campaign.

5.4 ENGINEERING

The Navajo Nation Division of Transportation houses the engineering arm of Navajo Nation's roads. The Division of Transportation is responsible for the development, operations and maintenance of all of Navajo Nation's owned and maintained roadways.

5.4.1 Countermeasures

Engineering countermeasures can be either site specific (spot) or systemic and range in cost and difficulty of implementation. A combination of these are presented below for each of the crash types.

Intersection Related Crashes

High severity signalized intersection crashes tend to include angle, left turn, and head on crashes. The crash data shows that at these intersections failure to yield right of way was also selected.

At unsignalized intersections there are many low cost solutions. These include increasing STOP sign size; adding post delineators; and adding STOP bars. Higher cost solutions include installing lighting, eliminating any skew angle, and reducing vertical curves.

Figure 5-1 | Yield Sign

Roundabouts tend to have less severe crashes and it can be seen in the crash data. In Navajo, when the roundabout was installed, the number of fatal crashes decreased. To help reduce the number of crashes that are occurring at the roundabout installing wayfinding signs, enhancing the conspicuity of roundabout, refreshing striping, and reducing speeds prior to the intersection may help reduce the severity of the crashes.

Non-intersection Related Crashes

Non-intersection related crashes tend to be the most common type of crash. With that there are many different ways to reduce the number and severity of the crashes occurring.

Young Driver

Young drivers are the most inexperienced of the driving population and tend to be overrepresented in data. As such, they tend to take greater risks while driving. To help young drivers adding centerlines, edge lines, center and edge rumble stripes, and increasing sign sizes.

Older Driver

Older drivers are vulnerable road users. Simple engineering countermeasures to help reduce the number of Older Driver crashes also help the larger public. Some countermeasures are increased lettering on signing, centerline and edge line rumble stripes, and protected signal left turn phasing.

Figure 5-2 | Edge line Rumble Stripes

Source: https://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_008.cfm

Pedestrian Involved

Many of the pedestrian involved crashes occur near roadways that do not have sidewalks.

Speeding

Depending on the roadway classification there are various engineering methods to reduce speeding.

Chicanes can be used in areas where low speeds are desired such as neighborhoods or downtowns.

Road Diets reduce the total number of lanes and includes a Two-Way Left-Turn Lane. It provides room for bike lanes / parking / sidewalks.

Transverse Rumbles can be used to call attention to a lowering of speed limits by providing sensory cues to the driver.

Figure 5-3 | Transverse Rumble Strips
Source: https://safety.fhwa.dot.gov/hsip/hrrr/manual/sec45.cfm

Automated Speed Enforcement enforces the speed limit through cameras. This is particularly useful to help with enforcing speeds where there are few places where officers can sit to catch / pullover speeders.

Mobile Speed Cameras enforce speed limits through cameras that can be moved to different areas.

Install Changeable speed warning signs. Installation of changeable speed warning signs calls attention to the speed that a vehicle is traveling.

Install dynamic speed feedback. The dynamic speed feedback provides a visual cue to indicate the driver should slow down. These are typically used near curves where people fail to navigate it correctly.

Right of Way Related

Install STOP or YIELD Signs. Installation of traffic control devices help to inform the traveling public of what action should be taken at an intersection.

Increasing the size of the STOP sign may help call attention to the intersection.

Installation of post delineators can help if installed on the STOP or YIELD sign post. Post delineators can also be installed on other posts to provide a landmark for people to judge the distances by.

Red Light Running cameras reduce the number of serious and fatal intersection crashes when there is a problem with people disregarding the traffic signal. It will however, increase the number of rear-ends.

An alternative to Red Light Running Cameras are Blue Lights. The Blue Light is located on each approach by each signal phase, if that approach is red, the blue light is on, if it is green, the blue light is dark. This allows enforcement to sit on the receiving side of the intersection and catch a red light runner without having to run a red light themselves.

Change intersection signal head from dog house / 3 section green ball for permissive left turns to Flashing Yellow Arrow (FYA) configuration.

Change intersection phasing from permissive left to protected left. This eliminates the conflict of a left turning vehicle and a thru vehicle.

Change from a STOP controlled intersection or Signal controlled intersection to a roundabout. Provided the roundabout provides the necessary capacity, roundabouts eliminate 24 conflict points and reduce the number of fatal and serious injury crashes.

Driver Inattention

Transverse Rumbles call attention to an upcoming STOP controlled intersection.

Rumbles Stripes are typically used where many run off the road crashes occur. They alert the driver that the vehicle is exiting the travelway through auditory and tactile queues.

Centerline Rumbles are typically used when there are many head-on crashes or run off the road left crashes.

Snow on Road

Winter maintenance is the main way to help reduce the number of crashes resulting from snow on the roadway. Winter maintenance includes pretreating roadways and increasing the number of plows.

Figure 5-4 | Snow Plow
Source: http://www.kolotv.com/home/headlines/Snow-Plow-Savings-303027391.html

Wet Road
High friction surface treatments are implemented when there is a particular problem with vehicles having a hard time navigating a section of roadway during wet conditions. The high friction surface treatment is a pavement treatment that increases the friction in the area.

Figure 5-5 | High Friction Surface Treatment Typical
Source: https://safety.fhwa.dot.gov/roadway_dept/pavement_friction/high_friction/

Rumble stripes may help in the driver being able to see the edge line and centerlines of the roadways.

Animal On Road
Crashes with animals tend to be property damage only or minor injury however, when large animals are present, crashes can be much more dangerous. Recently, states have been implementing over and underpasses in combination with fencing. This technique has proven to be effective at reducing the number of animal related crashes.

Dusty / Windy
Dust related crashes typically occur in areas where there is little ground cover. Holistic engineering helps to restore the land to previous vegetative state.

Head-On
Head-on crashes are common in rural areas and systemic treatments tend to provide the best reduction in crashes. Prioritizing the segments with the highest concentration of crashes allows for a logical way of implementing the systemic countermeasures.

Centerline rumble stripes are one of the main ways to reduce the number of head-on collisions, if the head-on collisions are due to crossing the centerline.

Figure 5-6 | Centerline Rumble Stripes
Source: https://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_008.cfm

Passing / No Passing Zones also help to inform the driver of when it is safe to pass. These should be evaluated for correct sight distance length as over time this requirement has changed. Install a Passing Lane. On two lane roads, it has been found that installing passing lanes allows for people to safely pass other vehicles. This would be implemented as a spot treatment.

Overturn / Rollover

Overturn / Rollover crashes are common in rural areas. Reducing these crashes through a systemic approach is also the best way to reduce the number of injury and fatal overturn / rollover crashes.

Rumble Stripes are proven to reduce the number and severity of overturn /rollover crashes due to running off the road by providing a tactile and audio signal that the vehicle is departing the lane. CMF's for this countermeasure indicate that there is the potential to reduce fatal crashes by up to 45.3%.

Adding a shoulder (including paving a shoulder) allows for a larger recovery zone. The base shoulder is 8 foot according to HSM. If the shoulder is lower than this the likelihood of having a crash increases. However, if you are going from no shoulder to a two foot shoulder, this will decrease the likelihood of having a crash but not by the same factor as when there is an eight foot shoulder.

Safety Edge is intended to be used to help errant vehicles recover and reenter the roadway. The treatment is generally low cost and has shown to reduce crashes by up to 7.7% for paved shoulders and 11.4% for unpaved shoulders.

Figure 5-7 | Safety Edge
Source: https://safety.fhwa.dot.gov/newsletter/safetycompass/2012/spring/

Chevrons are used for horizontal curves. Currently, it is recommended that chevrons be put up where there is an advisory speed of 15 MPH below the posted speed limit or more.

Figure 5-8 | Chevrons
Source: http://www.roadtrafficsigns.com/chevron-road-signs

Guardrail helps reduce the number of run off the road crashes which in turn may help to reduce the number of overturn / rollover crashes.

Flattening side slopes allows for errant vehicles to recover and return to the travel way. The effectiveness of this treatment depends on the change in the slope.

5.5 LOCAL AREA STRATEGIES

Table 5-1 outlines the strategies identified in the local meetings by the practitioners that participated in the Safety Plan meetings. These strategies are currently being used, or were viewed as desired in the regions where meetings were held.

Table 5-1 | Stakeholder/Practitioner Identified Strategies

Engineering

- Crash Data Sharing Between PD/NDOT/States/Agencies/Traffic Plans
- Active Safety Improvement Studies / RSAs
- Flashing Speed Signs / Speed Radar Signs / Data Collection
- Center/Edge Rumble Strips
- Medians
- Active Sign Replacement Program (size/quality)
- Improved Roadway Signing Program (Chevrons, Warning, Wayfinding, etc…)
- Enhanced Signing (location, mile posts, etc…)
- Roadway Striping Program
- Improved Shoulders / Recovery Zones
- Guard Rail Installation
- Lighting for Intersections and Corridors
- ROW Fencing / Livestock Controls / Cleaning Cattle Guards
- Enhanced Pedestrian Crossings
- Sidewalks
- Bus Pull-outs
- Intersection Treatments/Roundabouts
- Larger Vehicle Accommodation (freight/visitor/etc…)
- Enhance Access Management / Control Driveways
- Mowing Operations on Shoulders
- Traffic Signal Operations – Monitoring Left-turn Warrants
- Cyclist Accommodation Where Needed

Education

- Participation in Navajo Nation Injury Prevention Coalition
- Participation in Safe Kids Program
- Integrated Efforts with Office of Environmental Health
- Education at Events
- Participation in Health Fairs
- Actively Participate in Schools (TigerTot, Head Start, DARE, etc…)
- Alive @ 25 Program (Defensive Driving Class)
- Active Communication with Large Industry
- Coordination with Behavioral Health / Department of Social Services
- "Do Not Call 911" Campaign
- Officer Crash Data Training/Collaboration
- Common Newspaper/Media Announcements for Community Events
- Investigate Organizations to Partner With:
    - SNAPSA
    - Uber/Lyft
    - Educators
    - DWI Program

Enforcement

- Jurisdictional Clarifications for Responding Officers
- Enhanced Laws Related to Fatality/Injury Trends/Council Support
- Multiagency Collaboration – Coordination Beyond Divisions
- Collaboration to Achieve Reporting Efficiencies
- Greater Visibility of Enforcement/Patrols in Communities
- Enhance Community Relationships/Perceptions
- Make Crash Reporting More Efficient/Effective/Easier
- Cross-Deputize Officers
- Crash Data Sharing / Summary with Officers
- Active Officer Participation in Courts
- Animal Registration / Grazing Committee
- Examine Local Chapter "Municipal Officers" to Augment Enforcement
- Develop Traffic Enforcement Division of Police Department

Emergency Medical Services

- Road Block Program – Car Seat Check
- Partnerships with Local Agencies/Schools/Businesses
- Cross Training for Practitioners
- Improve Response Time – Reduce Distances/Time
- Improve Cell Service / Communication / "Firstnet" Safety Priorities
- Improve Coordinated Dispatch
- Develop Serious Incident/Mass Casualty Event Plan(s)
- Traffic Control Certifications
- Develop List of Certifications Available and Who Has Them
- Develop List of Certified Trainers
- Develop List of Resources/Equipment
- Maps of Trauma Service Centers

6.0 COUNTERMEASURE INFORMATION

Topic	Countermeasure Name	Emphasis Area	CMF Ranges
Education	Mass Media Campaigns for Alcohol	Alcohol	proven
Education	Mass Media Campaigns for Speeding	Speeding	proven
Education	CarFit Program	Older Adults	proven
Education	Mass Media Campaigns for Seat Belt	Young Driver / All Drivers	proven
EMS	Alcohol Problem Assessment and Treatment	Alcohol Involved	proven
Enforcement	Publicized Sobriety Checkpoints	Alcohol / Drug Involved	proven
Enforcement	High Visibility Saturation Patrols	Alcohol / Drug Involved	proven
Enforcement	Vehicle Plate Sanctions	Alcohol / Drug Involved	proven
Enforcement	Ignition Interlock	Alcohol Involved	proven
Enforcement	High Visibility Cell Phone / Text Messaging Enforcement	Distracted Driving	proven
Enforcement	Red Light Running Camera	Failure to Yield ROW	16% to 46%
Enforcement	Blue Light	Failure to Yield ROW	*NO Study
Enforcement	Speed Camera	Speeding	1% to 39%
Enforcement	Lower BAC Limits for Repeat Offenders	Alcohol Involved	proven
Enforcement	Zero-Tolerance Law Enforcement	Alcohol Involved	proven
Enforcement / EMS	Alcohol Screening and Brief Interventions	Alcohol Involved	proven
Enforcement / Engineering	Automated Speed Enforcement	Speeding	1% to 39%
Enforcement / Engineering	Mobile Speed Cameras	Speeding	1% to 39%
Enforcement / Engineering	Red Light Running Cameras	Intersection / Failure to Yield ROW	16% to 46%
Enforcement / Engineering	Blue Lights	Intersection / Failure to Yield ROW	*No Study
Engineering	Increase STOP Sign Size & retroreflectivity	Intersection Crash / Failure to Yield ROW / Older Driver / Young Driver	7.60%
Engineering	Install STOP Sign (double)	Intersection Crash / Failure to Yield ROW / Older Driver / Young Driver	55%
Engineering	Install STOP Sign with Flashing STOP sign	Intersection Crash / Failure to Yield ROW / Older Driver / Young Driver	41.50%
Engineering	Install Yield Sign	Intersection Crash / Failure to Yield ROW / Older Driver / Young Driver	*No Study
Engineering	Install Intersection Ahead	Intersection Crash / Failure to Yield ROW / Older Driver / Young Driver	27%
Engineering	Add Post Delineator	Intersection Crash / Failure to Yield ROW / Older Driver / Young Driver	*NO Study
Engineering	Install Lighting	Intersection Crash / Older Driver / Young Driver	38%
Engineering	Eliminate Skew Angle	Intersection Crash / Failure to Yield ROW	f(x)

Topic	Countermeasure Name	Emphasis Area	CMF Ranges
Engineering	Reduce Vertical Curves	Intersection Crash / Failure to Yield ROW	f(x)
Engineering	Install Roundabout	Intersection Crash / Failure to Yield ROW	48%
Engineering	Install Wayfinding Signs	Roundabout Crash	1.60%
Engineering	Increase Lettering Size on Signs	Older Driver	increase to standard size
Engineering	Edgeline Installation	Older Driver / Overturn / Rollover	45%
Engineering	Centerline Striping	Older Driver / head-on	45%
Engineering	Sidewalks	Pedestrian	*NO Study
Engineering	Crosswalks	Pedestrian	37%
Engineering	HAWK Signals	Pedestrian	55%
Engineering	RRFB	Pedestrian	47.40%
Engineering	Chicanes	Speeding	*NO Study
Engineering	Road Diet	Speeding	5% to 44%
Engineering	Transverse Rumbles	Speeding / Intersection Crash / Failure to Yield ROW / Distracted Driving	*No Study on standalone transverse rumbles
Engineering	Changeable Speed Warning Systems	Speeding / Rollover / Overturn	46%
Engineering	Dynamic Speed Feedback	Speeding / Rollover / Overturn	7%
Engineering	Install Flashing Yellow Arrow	Intersection	14.30%
Engineering	Change to Protected Only Left Turns	Intersection	1%
Engineering	Winter Maintenance - Plowing	Snow	*No Study
Engineering	Winter Maintenance - Pretreatment	Snow	*No Study
Engineering	High Friction Surface Treatment	Wet	51.90%
Engineering	Rumble Stripes	Overturn / Rollover / Wet	varies on shoulder width and road type
Engineering	Animal Under / Overpasses with Fencing	Animal	*shown to work in AZ
Engineering	Vegetation Restoration	Dust	*test site chosen in AZ
Engineering	Centerline Rumble Stripes	Head-On / Overturn / Rollover	4% to 77%
Engineering	Passing / No Passing Zone	Head-On	update to be standard
Engineering	Passing Lane	Head-On	9% to 47%
Engineering	Shoulder	Run-Off The Road / Rollover / Overturn	*varies by shoulder width
Engineering	Safety Edge	Run-Off The Road / Rollover / Overturn	*varies by shoulder type but could be 15.5%
Engineering	Paving Shoulders	Run-Off The Road / Rollover / Overturn	f(x)
Engineering	Chevrons	Run-Off The Road / Rollover / Overturn	4% to 64%
Engineering	Curve Warning Signs with chevrons	Run-Off The Road / Rollover / Overturn	23.6% to 53.6%
Engineering	Guardrail	Run-Off The Road / Rollover / Overturn / Snow	2% to 58%
Engineering	Flatten Side slopes	Run-Off The Road / Rollover / Overturn	in HSM, f(x)

Appendix A – Shiprock Area Presentation and Crash Summaries

Appendix B – Window Rock Presentation and Crash Summaries

Appendix C – Tuba City Presentation and Crash Summaries

Appendix D – Kayenta Presentation and Crash Summaries

Appendix E – Chinle Presentation and Crash Summaries

Appendix F – Ganado Presentation and Crash Summaries

Appendix G – Newcomb Rock Presentation and Crash Summaries

Appendix H – Rural Area Crash Summaries