MONTANA VULNERABLE ROAD USER SAFETY ASSESSMENT

OCTOBER 27, 2023

MONTANA
Department of Transportation

VISION ZERO

Prepared by:
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RPA

MONTANA
Department of Transportation

Malcolm D. Long, Director

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November 3, 2023

Lucia Olivera, Administrator
Federal Highway Administration
Montana Division
585 Shephard Way
Helena, Montana 59602-1230

Subject: MDT Vulnerable Road User Safety Assessment Approval

Dear Ms. Olivera,

All states are required to develop a Vulnerable Road User Safety Assessment (VRU SA) under the *Bipartisan Infrastructure Law (BIL)/Infrastructure Investment and Jobs Act* (IIJA). The Montana Department of Transportation (MDT) has completed a VRU SA as outlined in the October 21, 2022, guidance document to improve safety for Vulnerable Road Users.

The VRU SA, in accordance with federal regulations, identifies areas of high risk to VRU and outlines specific safety improvements and strategies to mitigate safety risks to VRUs.

The VRU SA will be included as an addendum to the State's strategic highway safety plan, known as the Comprehensive Highway Safety Plan (CHSP). The final VRU SA can be found at the following link: https://www.mdt.mt.gov/visionzero/plans/docs/chsp/2023/VRU-Safety-Assessment-2023-10-27.pdf .

As the Governor's Highway Safety representative, I approve Montana's VRU SA.

Sincerely,

Malcolm D. Long

Director

CC: Brian Hasselback-Deputy Division Administrator-FHWA
Rob Stapley, MDT Rail, Transit & Planning Division Administrator
Carol Strizich, Bureau Chief. Multimodal Planning Bureau
Pam Langve-Davis, MDT CHSP Program

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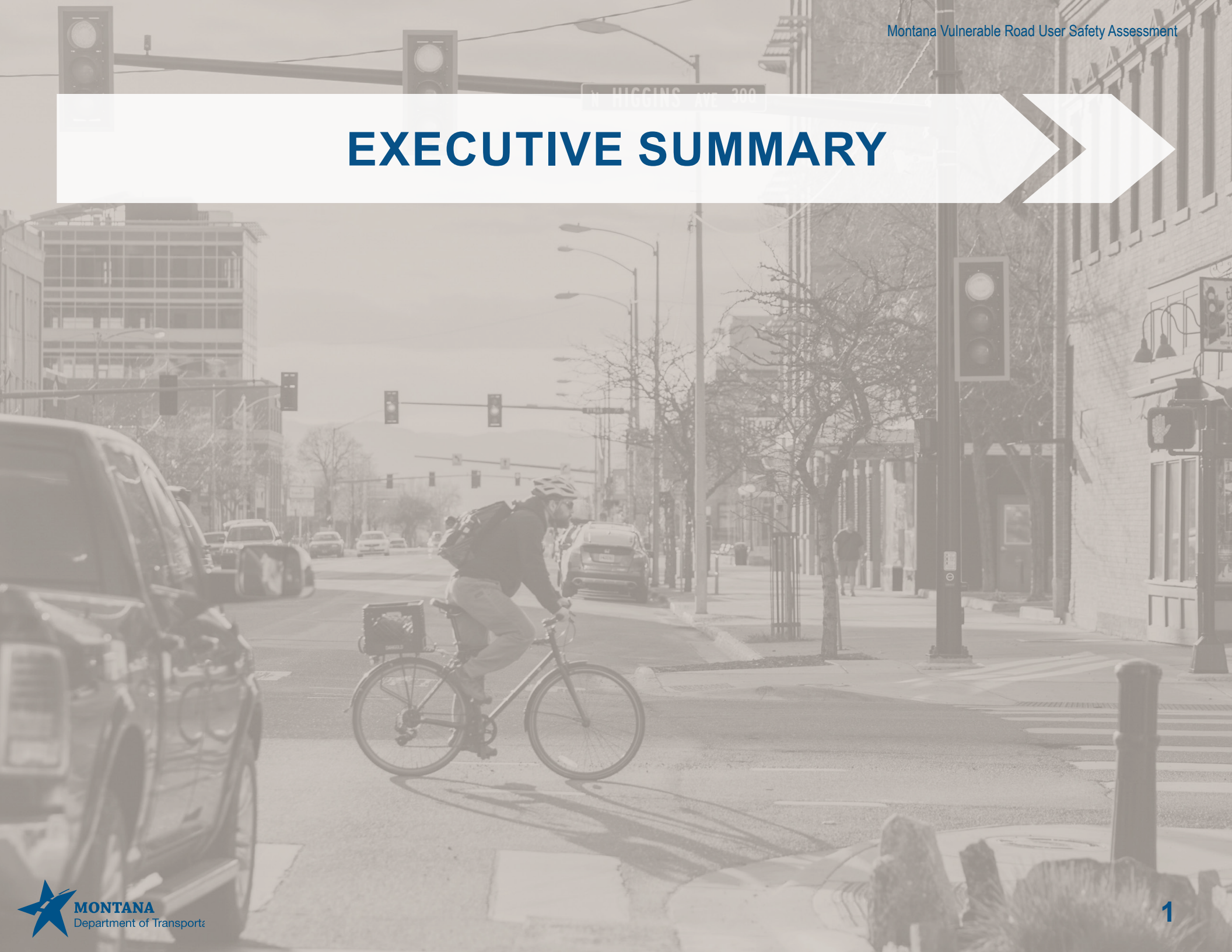
ACRONYMS AND ABBREVIATIONS

AADT	Average Annual Daily Traffic
AC	Advisory Committee
ADA	Americans with Disabilities Act
CAH	Critical Access Hospital
CHSP	Comprehensive Highway Safety Plan
CMF	Crash Modification Factor
CTSP	Community Transportation Safety Plan
DPHHS	Department of Public Health and Human Services
EMS	Emergency Medical Services
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
HAWK	High-intensity Activated crossWalKs
HIN	High Injury Network
HSIP	Highway Safety Improvement Program
IIJA	Infrastructure Investment and Jobs Act
ITS	Intelligent Transportation Systems
J40	Justice40 Initiative
LPI	Leading Pedestrian Interval
MCA	Montana Code Annotated
MDT	Montana Department of Transportation
MHP	Montana Highway Patrol
MMUCC	Model Minimum Uniform Crash Criteria
mph	miles per hour
MPO	Metropolitan Planning Organization
MUTCD	Manual on Uniform Traffic Control Devices
NHTSA	National Highway Traffic Safety Administration
NRSS	National Road Safety Strategy
PDO	Property Damage Only
PHB	Pedestrian Hybrid Beacon
PPE	Personal Protective Equipment
RRFB	Rectangular Rapid Flashing Beacon
SSA	Safe System Approach
TIM	Traffic Incident Management
TRCC	Traffic Records Coordinating Committee
US DOT	United States Department of Transportation
USC	United States Code
VMT	Vehicle Miles Traveled
VRU	Vulnerable Road User
VRU SA	Vulnerable Road User Safety Assessment

EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

To address the nationwide trend of increasing pedestrian and bicyclist fatalities and serious injuries, the *Infrastructure Investment* and *Job Act* implemented regulations that require all states to develop a Vulnerable Road User Safety Assessment (VRU SA) as part of their Highway Safety Improvement Program. In accordance with federal regulations, the VRU SA must identify areas of high risk to vulnerable road users (VRU) and outline specific safety improvements and strategies to mitigate safety risks to VRUs. A VRU is defined as a non-motorist, including pedestrians, bicyclists, other cyclists, persons on motorized and non-motorized personal conveyances, persons in or on buildings, and other types of non-motorists who are walking, cycling, rolling, or stationary.

The Montana VRU SA represents the collaborative efforts of the Montana Department of Transportation (MDT) and safety partners across the state to reduce VRU safety risks in support of federal, state, and local goals. The VRU SA is intended to align with and reflect MDT's overall safety program and strategic framework, including the Montana *Comprehensive Highway Safety Plan (CHSP)*, and historic safety performance and safety goals outlined in local Community Transportation Safety Plans. To ensure consistency with national planning efforts, the Safe System Approach, illustrated in **Figure ES-1**, was foundational to the development of the VRU SA.

The Montana VRU SA provides a baseline analysis of historic VRU-involved crashes occurring in Montana and presents individual strategies that could be implemented in Montana to improve VRU safety and accessibility.

Source: FHWA, modified for the Montana VRU SA.

Figure ES-1: Safe System Approach

ES.1 BASELINE DATA ANALYSIS SUMMARY

A data-driven analysis of historic VRU-involved crash data over the five-year period from January 1, 2017, to December 31, 2021, was conducted to help identify contributing factors in VRU fatalities and suspected serious injuries. Analysis of factors such as demographics, roadway characteristics, and behavioral trends helped identify commonalities that put a location type or individual at a higher risk of being involved in a VRU crash. This review helped MDT understand how and why VRU crashes occurred in the past and predict where VRU fatalities and serious injuries are likely to occur in the future so conditions can be proactively addressed. A summary of generalized takeaways is provided below.

- In general, pedestrian crashes were more common than bicycle crashes, and both crash types were more common in urban areas. A disproportionate number of VRU-involved crashes, especially severe crashes, occurred on Montana's Tribal Reservations. Native Americans were disproportionately represented in the fatal crash dataset, especially for pedestrian crashes.
- In urban areas, VRU-involved crashes at intersections were more common, while crashes at non-junction locations were more common in rural areas.
- Crashes in urban areas involving a VRU commonly occurred on two-lane, undivided, low-speed local roadways or on multi-lane principal arterials with two-way left-turn lanes and lower speed limits. In rural areas, crashes commonly occurred on local roadways, but were also common on high-speed, two-lane arterials.
- Many crashes occurred where there were no pedestrian or bicycle facilities available, especially in rural areas. However, when there were facilities available, they were not always used by non-motorists due in part to maintenance issues, accessibility issues, convenience, general comfort level, or personal preference of the non-motorist. Many non-motorists chose to cross at mid-block locations, even if there was an adjacent crosswalk available.
- Drivers were often unaware of the pedestrian or bicyclist either because they were difficult to see, they did not expect a non-motorist, the non-motorist was in an improper position, or they failed to look for and yield to non-motorists.
- Many VRU-involved crashes occurred at night in locations without street lighting, making it difficult for drivers to see VRUs in the roadway. Several non-motorists were noted as wearing dark clothing with no personal lighting.
- Impairment of both drivers and non-motorists was prevalent in the crash dataset, especially for severe crashes.
- Pedestrians not in transport were involved in multiple VRU crashes, including former occupants of motor vehicles standing in the roadway, emergency service/work zone situations, building occupants, and other unusual circumstances.

EXECUTIVE SUMMARY

ES.2 STRATEGY IDENTIFICATION

A comprehensive set of strategies were identified with the intention of improving VRU safety and reducing VRU fatalities and suspected serious injuries in Montana. The descriptions and attributes associated with each strategy can be used by state and local authorities to inform investment decisions as available funding is applied to achieve these goals. Identified strategies include educational campaigns, investments in infrastructure projects, new technologies, maintenance practices, policies, enforcement, and training to address VRU safety from numerous angles using the 4 E's of Safety approach (Engineering, Education, Enforcement, and Emergency Medical Services [EMS]). **Table ES-1** lists the identified strategies, relation to the E's of Safety, partners, and example actions and efforts.

Table ES.1: Summary of Strategies

	Strategy	E's of Safety	Partners	Example Actions/Efforts
Safe Road Users	**Reduce Driver and Non-Motorist Impairment**	Education, Enforcement, EMS	Behavioral Health/Substance Abuse/Prevention Specialists, Bicycle Clubs, EMS Responders/Medical Providers, Individuals, Law Enforcement, Local Governments, MDT, Walking and Disability Groups	• Focused alternative transportation communication campaigns • Partnerships with behavioral health, substance abuse, and prevention specialists • Penalties for impaired driving and biking
Safe Road Users	**Reduce Driver and Non-Motorist Distraction**	Education, Enforcement	City/County Public Health/Injury Prevention Specialists, Individuals, Law Enforcement, Local Governments, MDT, School Districts	• Education campaigns focused on safety awareness (e.g., avoidance of texting, headphones, ear buds) • Distracted driving/biking/rolling/walking laws • Penalties for distracted driving/biking/rolling/walking

Safe Road Users	**Increase Pedestrian Visibility**	Education, Enforcement	City/County Public Health/Injury Prevention Specialists, Individuals, Law Enforcement, Local Governments, MDT, School Districts, Walking and Disability Groups	• Education campaigns & incentives
				  • Light/white/bright clothing
				  • Reflective gear and personal lighting (flashlights, headlamps)
				  • Safety awareness (e.g., avoidance of texting, headphones, ear buds)
				  • Rules of the road
				• Walking buses, crossing guards

Safe Road Users	**Increase Bicyclist Visibility and Function**	Education, Enforcement	Bicycle Clubs and Bike Shops, City/County Public Health/Injury Prevention Specialists, Homeless Shelters/Pre-Release Centers, Individuals, Law Enforcement, Local Governments, MDT, School Districts	• Education campaigns & incentives
				  • Light/white/bright clothing
				  • Reflective gear and personal lighting (flashlights, headlamps)
				  • Safety awareness (e.g., avoidance of texting, headphones, ear buds)
				  • Rules of the road
				• Helmet laws

Safe Vehicles	**Enhance Bicycle Visibility and Protection**	Education	Bicycle Clubs and Bike Shops, City/County Public Health/Injury Prevention Specialists, Individuals, Local Businesses/Community Groups, Local Governments, MDT, School Districts	• Education campaigns & incentives
				  • Bicycle lamps/reflectors
				  • Functioning brakes
				  • Regular bicycle maintenance
				• Tool kits

Safe Roads	**Reduce Crossing Distances**	Engineering	Local Governments, MDT	• Roadway reconfiguration • Curb bulbouts/extensions • Pedestrian refuge islands • Roundabouts

EXECUTIVE SUMMARY

Table ES.1: Summary of Strategies

	Strategy	E's of Safety	Partners	Example Actions/Efforts
Safe Roads	**Increase Crosswalk Visibility and Accessibility**	Engineering	Local Governments, MDT	• Accessible curb ramps • High-visibility pavement markings • Rectangular Rapid Flashing Beacons (RRFBs) • Pedestrian Hybrid Beacons (PHB)/High-intensity Activated crossWalKs (HAWK) • Intelligent Transportation Systems (ITS)
Safe Roads	**Enhance Signalized Crossings**	Engineering	Local Governments, MDT	• Accessible curb ramps • High-visibility pavement markings • Pedestrian push buttons, audible/visual cues • Leading Pedestrian Intervals (LPI) • Increased pedestrian walk phase
Safe Roads	**Increase Roadway Visibility**	Engineering	Local Governments, MDT	• Street lighting • High-visibility pavement markings • Signage • Daylighting intersections • Maintenance of facilities (i.e., street sweeping, snow removal, vegetation management, etc.)
Safe Roads	**Enhance On-Road Bicycle Facilities**	Engineering	Local Governments, MDT	• Bike lanes • Sharrows, bike route signage • Widened shoulders • Appropriately placed shoulder rumble strips • Maintenance of facilities (i.e., street sweeping, snow removal, vegetation management, etc.)
Safe Roads	**Enhance Off-Road VRU Facilities**	Engineering	Local Governments, MDT	• Separated bike lanes • Shared-use paths • Sidewalks with curb ramps • Boulevards, raised curbs, planters, concrete barriers between travel lanes and VRU facilities • Overpasses, underpasses, pedestrian bridges • Maintenance of facilities (i.e., street sweeping, snow removal, vegetation management, etc.)
Safe Roads	**Designate Non-Motorized Corridors**	Education, Engineering	Local Governments, MDT	• Low-volume/low-speed walking/rolling/bicycle routes • Connected facilities – businesses, neighborhoods, schools, parks • Signage, striping • Educational and wayfinding materials • Maintenance of facilities (i.e., street sweeping, snow removal, vegetation management, etc.)
Safe Speeds	**Review Posted Speed Limits**	Enforcement, Engineering	Law Enforcement, Local Governments, MDT, School Districts	• Speed studies • Variable speed limit trailers • Special speed zones (schools, high-use areas, work zones) • Jurisdiction-wide speed limits

EXECUTIVE SUMMARY

Table ES.1: Summary of Strategies

	Strategy	E's of Safety	Partners	Example Actions/Efforts

Safe Speeds	**Reduce Vehicular Travel Speeds**	Enforcement, Engineering	Business Districts, Law Enforcement, Local Governments, MDT, School Districts	• Traffic calming
				  • Speed bumps/humps/speed tables/raised crosswalks
				  • Visual friction (paint, art, vegetation, objects)
				  • Narrowed roadways/curb extensions
				  • Roundabouts/traffic circles
				  • Horizontal roadway shifts (chicanes)
				  • ITS/dynamic speed feedback signage
				• Speed enforcement

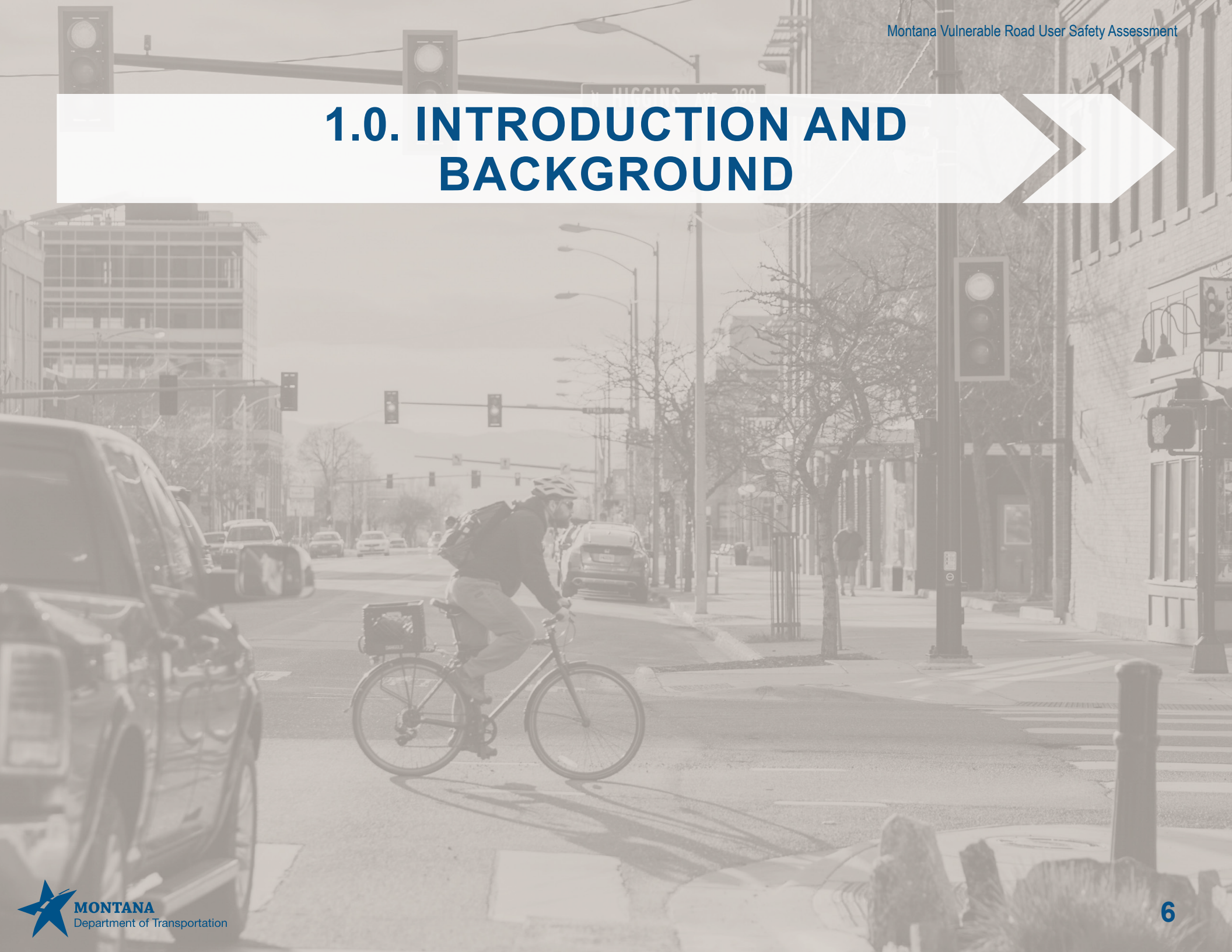
Post-Crash Care	**Improve Post-Crash Care for Injured VRUs**	Education, Enforcement, EMS	Department of Health and Human Services (DPHHS), EMS Responders, Law Enforcement, Local Governments, MDT	• Bystander training and education • Dispatch training • Post-crash arrival/transport and continued EMS/trauma care • On scene and hospital/clinic care • Database enhancements • Policy development and Legislative action
	Enhance Emergency Responder Safety	Education, Enforcement, EMS	City/County Public Health/Injury Prevention Specialists, Emergency Responders, Individuals, Law Enforcement, Local Governments, MDT	• ITS – portable, dynamic signage • Construction cones, reflective striping, signage • Reflective strips/clothing/personal protective equipment (PPE) • Traffic Incident Management (TIM) training • Educational campaigns • Enforcement
	Improve Data Collection and Reporting Strategy	Education, Enforcement, EMS	DPHHS, EMS Responders, Hospitals/Healthcare Facilities, Law Enforcement, MDT, State Agencies	• Officer web-based crash reporting training • Crash records management • Crash, injury, and traffic citation data integration • Interagency coordination • Legislative action requiring crash reporting training for all law enforcement

ES.3 IMPLEMENTATION AND NEXT STEPS

In partnership with local governments, metropolitan planning organizations, Tribal agencies, and other safety partners across the state, MDT will use the Montana VRU SA as a guide when considering, nominating, and implementing projects across the state to ensure VRUs are fully and equitably considered in transportation investment decisions. The projects and strategies provided herein can be implemented through a combination of federal, state, local, and private funding sources.

In accordance with federal regulations, the Montana VRU SA will be included as an addendum to the current CHSP. The VRU SA will be updated with subsequent updates of the CHSP which occur on a five-year rolling basis. Future updates will summarize continuing efforts to gather and analyze VRU crash data, refine the crash analysis and identification of high-risk areas, and document progress made toward reducing VRU safety risks in Montana.

1.0. INTRODUCTION AND BACKGROUND



1.0. INTRODUCTION AND BACKGROUND

Nationally, the number of vulnerable road user (VRU) roadway fatalities and serious injuries has been growing, with bicyclist and pedestrian fatalities increasing from 2019 to 2021. To address this growing safety issue, the Infrastructure Investment and Job Act (IIJA), enacted on November 15, 2021, implemented regulations that require all states to develop a Vulnerable Road User Safety Assessment (VRU SA) as part of their Highway Safety Improvement Program (HSIP) in accordance with 23 United States Code (USC) 148(l). The VRU SA is intended to evaluate VRU safety performance and outline specific improvement projects or strategies through a comprehensive, collaborative approach to allow full and safe transportation access for all roadway users.

Federal regulations and guidance outline specific requirements for the contents of the VRU SA. In general, the VRU SA must support efforts to reduce VRU fatalities and serious injuries. To do so, the VRU SA must identify areas of high risk to VRUs and identify specific safety improvements and strategies to mitigate safety risks to VRUs. In fulfillment of these requirements, **Chapter 1** presents an overview of existing national, statewide, and local policies, plans, and programs to establish a basic understanding of goals and initiatives related to VRU safety in Montana. **Chapter 2** discusses the efforts MDT took to consult with various agencies and safety partners during the VRU SA development process. **Chapter 3** provides a detailed analysis of historic VRU-involved crash data and other associated demographic information to identify high-risk areas for VRU crashes and contributing factors in VRU fatalities and suspected serious injuries. **Chapter 4** presents individual strategies that could be implemented by the Montana Department of Transportation (MDT) and its partners to improve VRU safety across Montana. Strategy attributes, including example actions and implementation efforts, potential partners, additional considerations, resources, and references can be used to assist in the future identification, development, and implementation of specific projects across the state. **Chapter 5** discusses implementation and next steps for the Montana VRU SA.

1.1. DEFINITION OF A VULNERABLE ROAD USER

A VRU is defined under 23 USC 148 as a non-motorist. This category includes pedestrians, bicyclists, other cyclists, persons on motorized and non-motorized personal conveyances, persons in or on buildings, and other types of non-motorists as defined under National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS) code attributes. A VRU may be walking, cycling, rolling, or stationary. Highway workers on foot in a work zone and anyone ejected from a transport vehicle and subsequently struck are considered a pedestrian in this category. Persons using personal conveyance devices for personal mobility assistance or recreation are considered pedestrians as well. These devices can be motorized or human powered but are not propelled by pedaling, such as roller skates, skateboards, wagons, wheelchairs, segways, and motorized or battery powered rideable toys, such as a motorized skateboard or toy car. Persons on motorized or self-propelled mobility assistance scooters and motorized or non-motorized two-wheeled scooters with a floorboard that can be stood upon by the operator and which can be powered with or without human propulsion at maximum speeds less than 20 miles per hour (mph) are also considered VRUs. Bicyclists include all persons riding a non-motorized vehicle propelled by pedaling such as a bicycle, tricycle, unicycle, or pedal car. Cyclists on e-bikes and persons on motor scooters, mopeds, or motorcycles are not considered VRUs.

In general, this report uses the term “non-motorist” interchangeably with “VRU” and is intended to encompass all categories of VRUs. Crashes involving VRUs are broadly categorized into pedestrian- and bicycle-involved crashes, which include all the applicable definitions described previously.

1.2. FEDERAL GUIDANCE

The **National Road Safety Strategy** (NRSS) outlines the United States Department of Transportation's (US DOT) commitment to reduce serious injuries and fatalities of all road users on public roadways in pursuit of the goal of achieving zero highway deaths. A key component of the NRSS is the **Safe System Approach** (SSA) addressing the safety of all road users, with specific focus on improving safety culture, increasing stakeholder collaboration, and considering the human element in crash severity reduction. When developing the VRU SA, the Federal Highway Administration (FHWA) encourages states to apply the SSA and consider other potential methods for reducing VRU fatalities and serious injuries such as encouragement of safer travel speeds, application of **Americans with Disabilities Act** (ADA) provisions, and use of complete streets design principles to accommodate the safety needs of all users. The VRU SA should also address equity by considering the impacts of fatalities and serious injuries on underserved and disadvantaged populations including children, elderly, people with disabilities, racial and religious minorities, people in rural areas, and other persons who are otherwise adversely affected by persistent poverty or inequality. States are also encouraged to use the VRU SA to prioritize projects that can help reduce emissions by encouraging increased walking, biking, and rolling trips. Using a data-driven approach to identify high-risk and underserved areas, the VRU SA enables MDT to fully consider and prioritize safety for all road users in support of its collaborative **Vision Zero** campaign which strives for the goal of zero deaths and zero serious injuries on Montana's roadways in alignment with federal US DOT goals.

1.3. RELEVANT SUPPORTING DOCUMENTS

To ensure the VRU SA aligns with and reflects MDT's overall safety program and strategic framework, relevant MDT policies, programs, and statewide plans were reviewed. Historic safety performance and safety goals outlined in local Community Transportation Safety Plans (CTSP) were also considered to help establish a background understanding of previously identified safety performance concerns and VRU risk areas in Montana. **Table 1.1** summarizes relevant documents as they relate to VRU safety or VRU-specific infrastructure. A detailed review of each document is contained in **Appendix A**, including a summary of how each document is relevant to the VRU SA.

Table 1.1: Previous Efforts Related to VRU SA

Plans and Programs		Year	Vulnerable Road User	
			Safety	Infrastructure
TranPlanMT		2017	✓	✓
Comprehensive Highway Safety Plan (CHSP)/ Highway Safety Improvement Program (HSIP)		2020/ Annual	✓	✓
Statewide Transportation Improvement Program		2022	✓	✓
Highway Safety Plan and Annual Report		2022/ 2023	✓	
Montana Pedestrian and Bicycle Plan		2019	✓	✓
ADA Transition Plan		2021	✓	✓
Local Community Transportation Safety Plans	Billings CTSP	2022	✓	✓
	Missoula CTSP	2019	✓	✓
	Bozeman CTSP	2013	✓	✓
	Greater Helena Area CTSP	2013	✓	✓
	Butte-Silver Bow CTSP	2012	✓	✓
	Hamilton CTSP	2011	✓	✓
	Shelby-Toole County CTSP	2011	✓	✓

2.0. CONSULTATION

2.0. CONSULTATION

Under 23 USC 148(l)(4)(B), states are required to consult with local governments, Metropolitan Planning Organizations (MPOs), Tribal agencies, and groups representing underserved communities during the VRU SA development process. In fulfillment of federal consultation requirements, an Advisory Committee (AC) was formed comprised of a multidisciplinary group previously established to support the MDT CHSP process. In addition to current CHSP AC members, representatives from MPOs, government agencies, Tribal entities, planning organizations, transit agencies, community groups representing underserved communities, and other stakeholders were invited to participate in the VRU Safety Assessment planning process. The US Census Bureau defines MPOs based on a population threshold of 50,000. Results of the 2020 Census indicate that there are now five MPOs in Montana, including Great Falls, Billings, Missoula, Bozeman, and Helena. Prior to the 2020 Census, the three MPOs in the state were Great Falls, Billings, and Missoula. Since Bozeman and Helena did not yet have their MPOs established at the time of this assessment, only the three previous MPOs were considered and consulted for the development of the VRU SA. The Bozeman and Helena MPOs will be included in future updates of the VRU SA. Additionally, there are seven land-based Tribal Reservations in Montana including the Blackfeet, Crow, Flathead, Fort Belknap, Fort Peck, Northern Cheyenne, and Rocky Boy's-Chippewa Cree, which are home to several Native American Tribes. Representatives from these Tribes were invited to participate in the development of the Montana VRU SA.

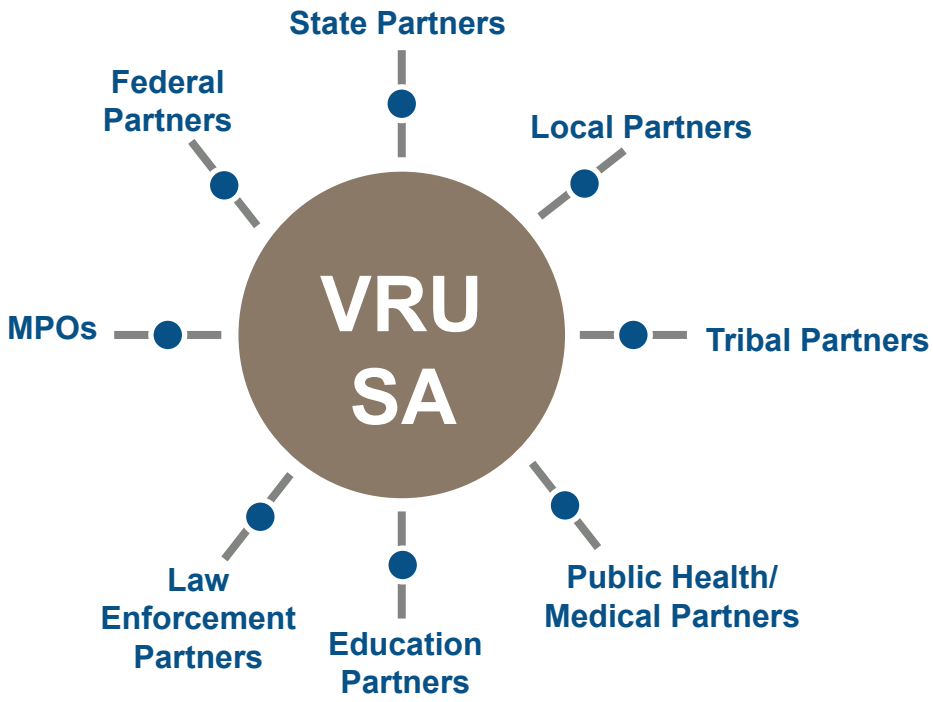
A series of three virtual AC meetings were held over the course of the VRU SA development process. The purpose of the meetings was to solicit relevant data, gain local knowledge about factors contributing to VRU safety concerns and high-risk areas, and to identify potential policies, projects, or strategies to improve VRU safety. Virtual meetings provided an opportunity for AC members to share ideas and data, coordinate strategies, and provide input on development of the VRU Safety Assessment.

- **AC Meeting #1 – April 24, 2023**: Review VRU Safety Assessment process, applicability to AC representatives, proposed analysis methodologies, and summary of VRU safety issues and high-risk areas
- **AC Meeting #2 – July 17, 2023**: Discuss strategies and recommendations
- **AC Meeting #3 – September 25, 2023**: Review draft VRU Safety Assessment

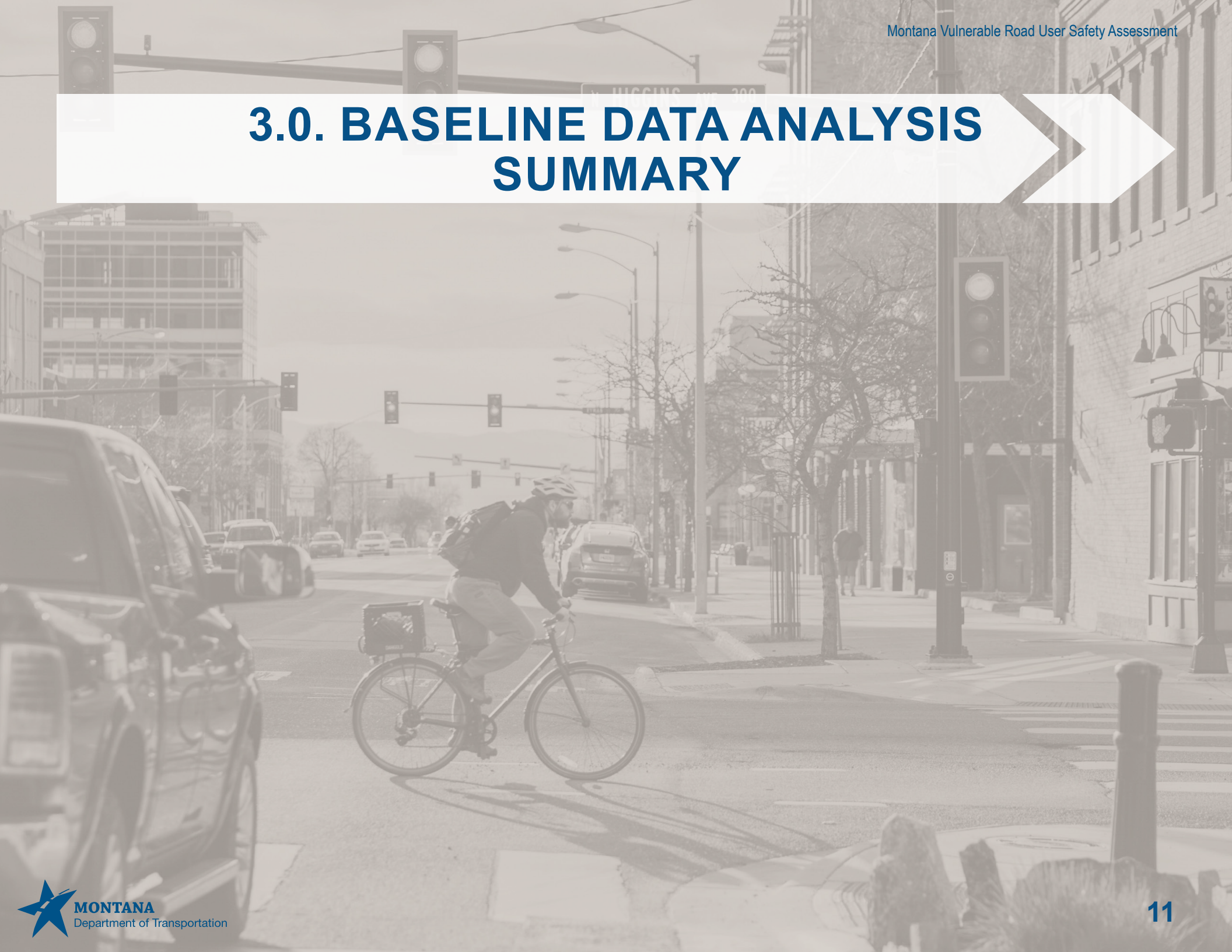
In addition to the three AC meetings, follow-up conversations were conducted with representatives from the MDT Traffic and Safety Engineering Bureau and staff from the Department of Public Health and Human Services (DPHHS) Emergency Medical Services [EMS] and Trauma Systems section to discuss data availability, analyses, and linkages.

Outside of these meetings, AC members were invited to review and comment on deliverables. Comments on the VRU SA were received from federal, state, and MPO partners.

The Montana VRU SA represents the collaborative efforts of MDT and federal, state, Tribal, and local community safety partners to address VRU safety, including DPHHS, FHWA, Montana Highway Patrol (MHP), Montana Association County Officials, Montana League of Cities & Towns, Montana's MPOs, Office of Public Instruction, and Tribal representatives. Information presented in the Montana VRU SA is intended to assist transportation officials and other partners in making funding allocation decisions for individual projects and implementation actions to achieve the greatest reduction in VRU safety risks given available funding, contextual considerations, and alignment with federal, state, and local goals.



3.0. BASELINE DATA ANALYSIS SUMMARY



3.0. BASELINE DATA ANALYSIS SUMMARY

An extensive analysis of historic VRU-involved crash records was conducted to identify trends contributing to VRU crashes in Montana including behavioral characteristics, roadway characteristics, demographics, and other contributing circumstances to determine commonalities that put a location or individual at a higher risk of being involved in a VRU crash. This review helped MDT understand how and why VRU crashes occurred in the past and predict where VRU fatalities and suspected serious injuries are likely to occur in the future so conditions can be proactively and systematically addressed.

3.1. CRASH RECORD OVERVIEW

For this effort, the MDT Traffic and Safety Engineering Bureau provided data for all VRU-involved crashes occurring within Montana over a five-year period beginning January 1, 2017, and extending to December 31, 2021. The records included all crash reports submitted to the MHP from their patrol officers and from local city, county, Tribal, and federal law enforcement officials. The crash reports are a summation of information from the scene of the crash provided by the responding officer. As such, some of the information contained in the crash reports may be subjective. It is important to note that only reported crashes are included. Many VRU crashes, especially those where individuals and vehicles are unharmed, do not get reported to law enforcement.

Crash records were analyzed to determine contributing factors, high-risk circumstances, and behavioral characteristics. User behavior, such as the use of proper safety equipment (i.e., helmets, lighting, reflective clothing), impairment, and adherence to bicycling and pedestrian laws, is analyzed only when a crash occurs. There are likely many other instances in which these and other improper or unlawful behaviors occur without resulting in a crash. The purpose of this effort was only to analyze the circumstances of the VRU-involved crashes that have occurred within Montana to identify trends and contributing factors in these crashes so that MDT, in coordination with local entities, can address these issues and improve VRU safety on the state's roadways.

3.1.1. Challenges and Limitations

There are several challenges and limitations associated with analyzing bicyclist- and pedestrian-involved crashes which make a traditional safety analysis approach difficult. The following are examples of the challenges and data limitations that were faced when analyzing Montana's VRU crash data, along with methodologies used to address these limitations.

- **Frequency of Crashes:** Unlike vehicle crashes, bicyclist- and pedestrian-involved crashes typically occur much less often. In performing a traditional safety analysis, the frequency of crashes is typically used to identify hot spots, or geographic locations with high frequencies of crashes, and statistically significant trends. Consequently, when traditional approaches are applied to bicyclist and pedestrian crashes, misleading conclusions or locations with variable safety performance may be identified. For this reason, the analysis focused on the characteristics of crash sites rather than the physical location of crashes.
- **Exposure Data:** Crash analyses typically consider traffic exposure data when evaluating crash rates to determine relative safety compared to other similar roadways, segments, or intersections. Exposure data for vehicle traffic is common and accessible and is typically expressed in terms of Vehicle Miles Traveled (VMT) or Average Annual Daily Traffic (AADT). However, vehicle volumes do not necessarily translate to pedestrian and bicyclist activity and are not appropriate for determining VRU crash rates. Counts for pedestrian and bicyclist traffic, on the other hand, are much less common and are typically only collected for certain projects or locations. Currently, MDT does not collect statewide non-motorist usage data, however, some Montana localities have begun implementing jurisdiction-wide count programs. Accordingly, crash frequencies, rather than crash rates, were primarily used in the analysis and reporting of VRU crash data.
- **Underreported Data:** Traditionally, crashes involving pedestrians and bicyclists have been underreported, especially if no injuries occurred. In general, crashes on Tribal lands, especially pedestrian- and bicycle-involved crashes, are also severely underreported. This underreporting can skew the available data more heavily towards higher severity crashes. For these reasons, much of the analysis focused on fatal and suspected serious injury VRU crashes, although data for all VRU-involved crashes was also considered and analyzed.
- **Unknown Data:** For many crash records, various fields were left blank by the reporting officer. Occasionally, a report listed "unknown" rather than a blank field. Without the missing information, it was difficult to capture a complete understanding of what happened before, during, and after a crash. To gain a better understanding of contributing circumstances, crash narratives for fatal and suspected serious injury crashes were reviewed in detail.
- **Inconsistent Data:** Discrepancies in reporting, either by the reporting officer or by the individual entering data into the database, can also lead to misrepresentation of crash details. Although protocols have been established and training for filling out crash reports is provided to law enforcement, there may still be inconsistencies or errors in data reporting. In general, this analysis did not attempt to correct crash details, and the data is reported as provided. When reviewing crash narratives, however, efforts were made to update crash details for consistency and thoroughness.

3.1.2. Crash Narrative Review

Crash reports compiled by the investigating officer contain narratives of the crash occurrence, statements from the individuals involved and witnesses, crash diagrams, citations, and officer opinions as to cause of the collision, which can all help provide a fuller understanding of the crash. Since it was time prohibitive to review narratives for the nearly 1,500 VRU-involved crashes that occurred in Montana over the past five years, the data analysis primarily considered only the data contained in simplified crash records.

Separately, the crash narratives for only fatal and suspected serious injury crashes were reviewed to understand contributing circumstances in severe VRU crashes and identify underlying trends. Separate from the global dataset of all VRU-involved crashes, efforts were made to update severe crash records for consistency and thoroughness. The effort included a review of the spatial relationship between crashes and their location as well as an analysis of road characteristics that may not be otherwise available in the simplified crash records. The information obtained from these reports is presented separately in **Section 3.5.** For the remainder of the analysis contained in this chapter, the original crash records remained unchanged and are reported as received.

3.2. CRASH CHARACTERISTICS

A total of 1,484 VRU-involved crashes were reported in Montana over the five-year analysis period extending from January 1, 2017, to December 31, 2021. The following sections summarize crash details and other characteristics associated with these VRU crashes that occurred within Montana over the analysis period. The characteristics summarized in this section were evaluated as reported by the responding officer, and no efforts were made to correct inconsistencies or fill in missing fields.

3.2.1. Severity

Crash severity is categorized based on the most severe injury resulting from the crash. For example, if a crash results in a possible injury and a suspected serious injury, the crash is reported as a suspected serious injury crash. For the purposes of crash reporting, a suspected serious injury is defined in the *Model Minimum Uniform Crash Criteria* (MMUCC) as an observed injury, other than a fatality, which would prevent the injured individual from walking, driving, or normally continuing the activities they were capable of performing before the injury.[1] The term "suspected" references an officer's observation at the time of the crash without follow-up confirmation of the nature of the person's injury. The term "severe injuries" is used to refer to the combined total of fatal and suspected serious injuries.

During the five-year analysis period, a total of 1,484 VRU-involved crashes occurred involving 1,384 non-motorists. Although each crash involved at least one VRU, in some cases the bicyclist was categorized as a driver rather than a non-motorist or the person type was listed as unknown so it appears that fewer non-motorists were involved in crashes. Of the 1,484 VRU-involved crashes, about 72 percent (1,072) resulted in some level of injury and about 20 percent (304) were severe (resulting in a fatal or suspected serious injury). There were 84 fatal crashes, resulting in 84 total non-motorist fatalities, and 220 suspected serious injury crashes, resulting in 220 total suspected serious injuries. A total of 1,081 of the 1,384 non-motorists involved in crashes, about 78 percent, were injured to some degree as a result of a crash. As noted previously, VRU-involved crashes may skew more heavily towards higher severity crashes due to underreporting of non-injury crashes. Approximately 28 percent of VRU crashes were reported as causing property damage only (PDO) or as unknown severity.

To compare the severity of crashes across several different characteristics, a severity index was calculated by assigning weighting factors to the number of crashes or injuries that occurred within a specific area or by a specific crash characteristic. The weighting factors used for this calculation were derived by MDT's Traffic and Safety Engineering Bureau from typical crash costs in Montana. The severity index can be calculated on a person basis or on a crash basis. This index was used as a means for comparing the severity of crashes that occurred within specific geographic areas or with certain characteristics. No defined threshold was used to identify abnormal or extreme severity. The equation used to calculate severity index for the purposes of this report is presented below.

$$\text{Severity Index} = \frac{(66.7 * \text{Fatal}) + (3.53 * \text{Serious Injury}) + (1.29 * \text{Minor Injury}) + (0.73 * \text{Possible Injury}) + (0.12 * (\text{PDO} + \text{Unknown}))}{\text{Total Crashes or Injuries}}$$

Of the 1,384 Non-Motorists Involved in Crashes…

Fatalities

77 Pedestrian
7 Bicycle

Suspected Serious Injuries

154 Pedestrian
64 Bicycle
2 Unknown

Minor/Possible Injuries

439 Pedestrian
334 Bicycle
4 Other

PDO/Unknown

188 Pedestrian
112 Bicycle
3 Unknown/Other

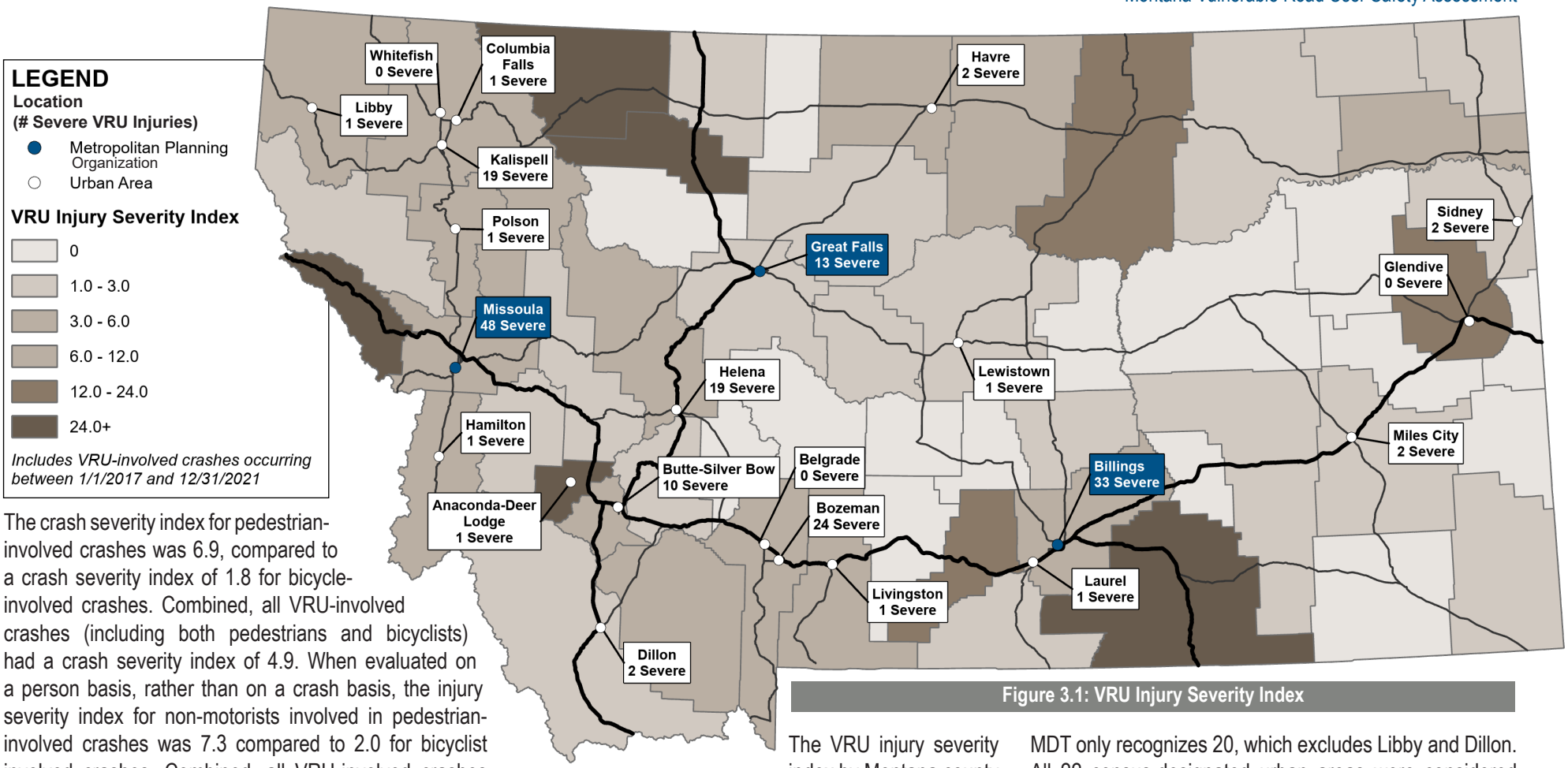


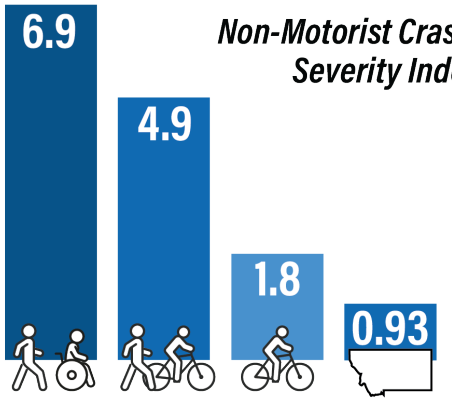
Figure 3.1: VRU Injury Severity Index

The crash severity index for pedestrian-involved crashes was 6.9, compared to a crash severity index of 1.8 for bicycle-involved crashes. Combined, all VRU-involved crashes (including both pedestrians and bicyclists) had a crash severity index of 4.9. When evaluated on a person basis, rather than on a crash basis, the injury severity index for non-motorists involved in pedestrian-involved crashes was 7.3 compared to 2.0 for bicyclist involved crashes. Combined, all VRU-involved crashes had an injury severity index of 5.2. These values account for multiple non-motorists involved in a single crash. For motor vehicle occupants involved in the 1,484 VRU crashes, including drivers and passengers, the injury severity index was 0.2, which indicates that the majority of motor vehicle occupants involved in these crashes experienced minor, if any injuries.

For all 113,190 crashes that occurred in Montana over the same five-year period, the overall crash severity index was 0.93 and the overall injury severity index was 0.58. This indicates that reported VRU-involved crashes tend to be more severe than the average crash in Montana.

The VRU injury severity index by Montana county is presented in **Figure 3.1.** The total number of severe VRU injuries that occurred in each urban area is also identified on the map. The map indicates that while the urban areas have higher numbers of severe VRU injuries, there are higher concentrations of severe injuries occurring in rural counties, especially within Tribal Reservations.

The US Census Bureau defines urban areas as those encompassing at least 5,000 people or at least 2,000 housing units. Per state statute (Montana Code Annotated [MCA] Title 60), MDT defines urban areas only as those encompassing at least 5,000 people. Accordingly, the US Census Bureau identifies 22 urban areas in Montana, while MDT only recognizes 20, which excludes Libby and Dillon. All 22 census-designated urban areas were considered during the development of the VRU SA.

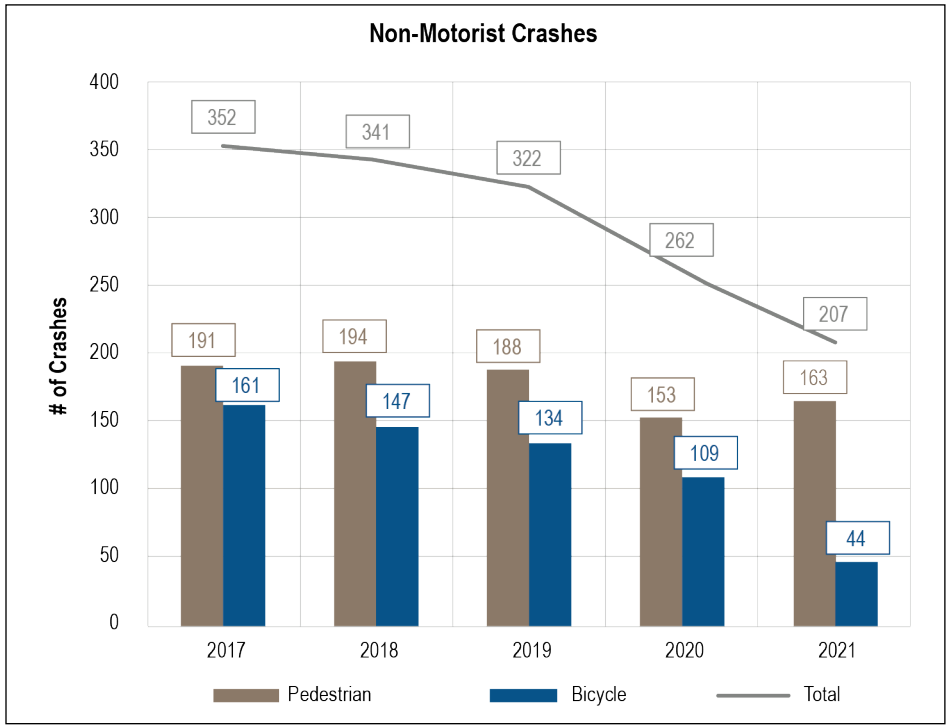


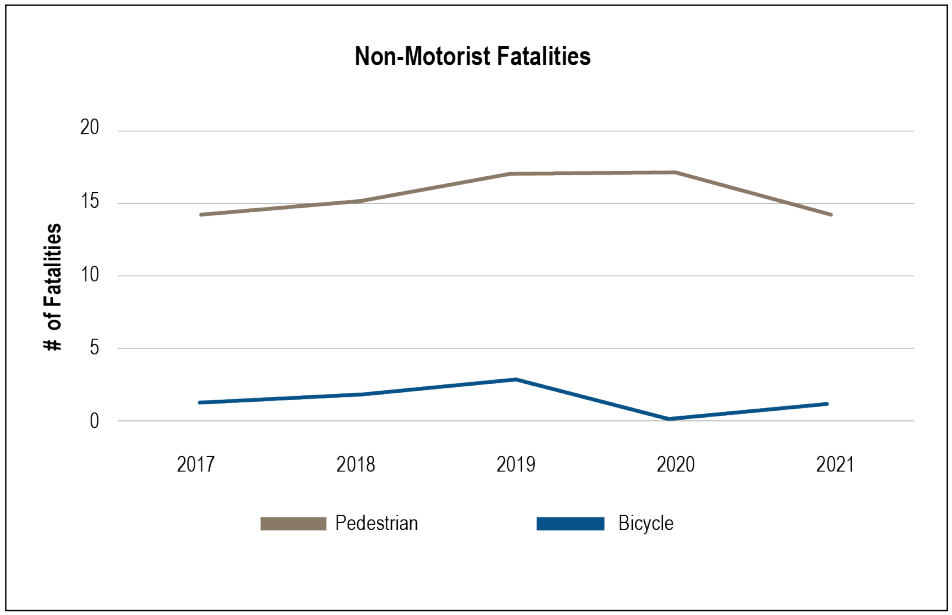
3.2.2. Crash Period

Crash data were evaluated based on the period of time when the crash occurred, as summarized in the following sections. This analysis helps identify temporal trends such as day of the week, month, or hour of the day as well as providing a comparison year over year.

Year

The number of non-motorist-involved crashes and severe injuries per year is presented in **Figure 3.2**. Overall, the number of VRU-involved crashes has generally been declining, with the exception of pedestrian crashes, which increased between 2020 and 2021. The non-motorist fatalities chart indicates the number of pedestrians and bicyclists who died in crashes. Pedestrian deaths increased from 2017 to 2020 but dropped to 2017 levels in 2021. There were relatively few bicyclist fatalities, with three or less occurring per year over the analysis period. The number of pedestrians that sustained suspected serious injuries increased from 2017 to 2018, then declined through 2021. The total number of bicyclists who sustained suspected serious injuries remained relatively steady between 2017 and 2020 but experienced a sharp decline in 2021.





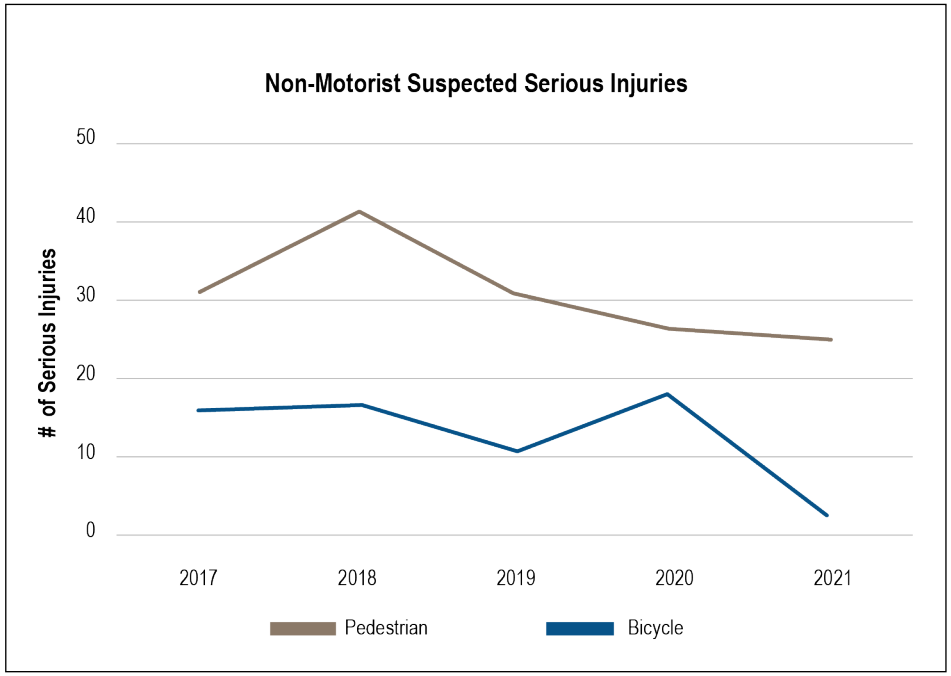
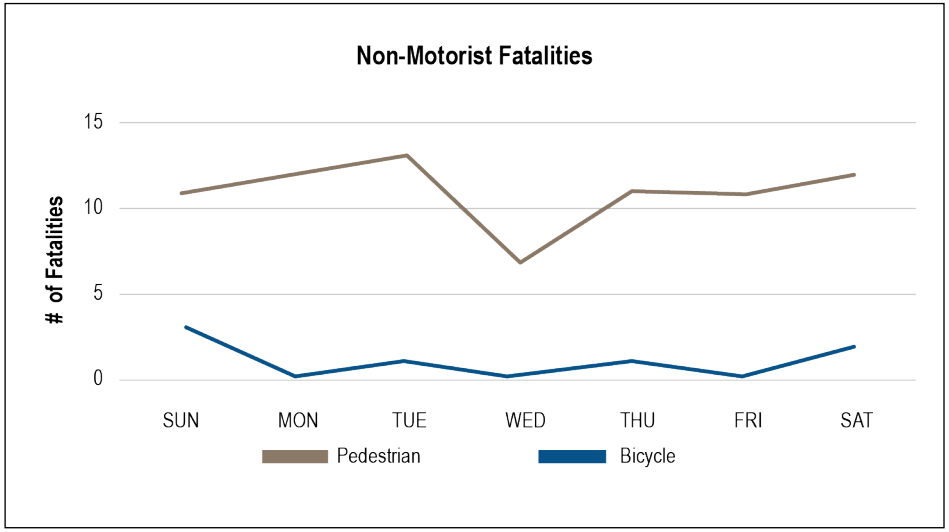


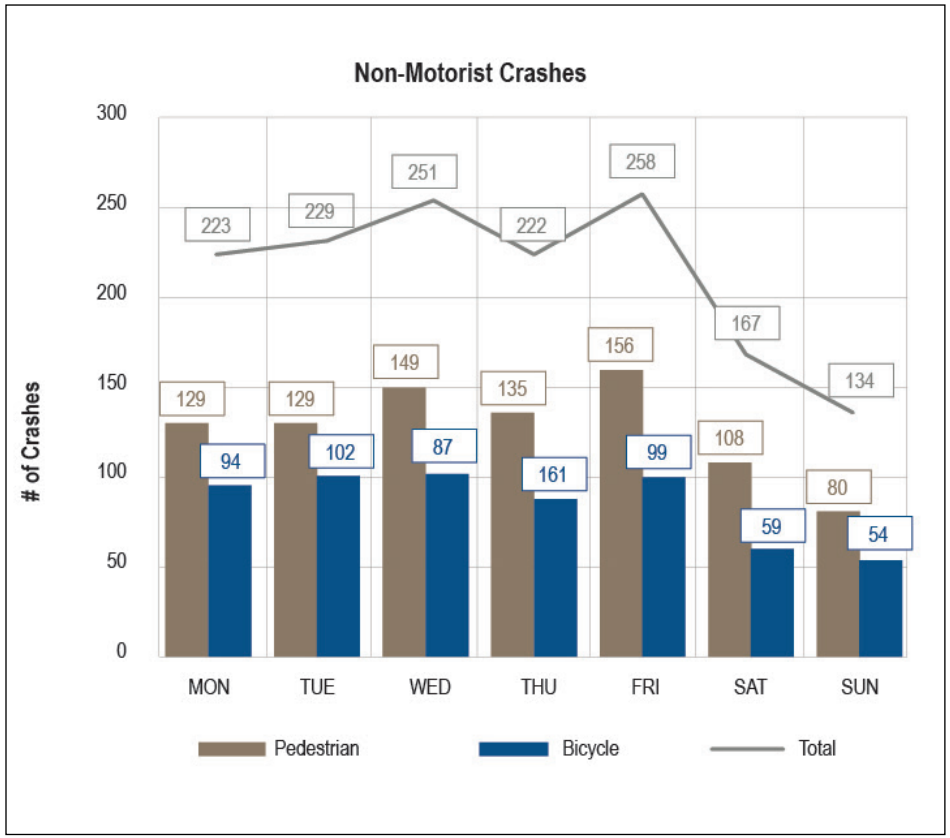
Figure 3.2: Non-Motorist Crashes and Severe Injuries by Year

Day of the Week

With respect to the day of the week in which non-motorist-involved crashes occurred, a higher number of crashes occurred on weekdays (80 percent) compared to weekends. This suggests a possible trend with regular commuting patterns and generally higher traffic exposure on weekdays. The highest number of reported pedestrian fatalities occurred on Tuesdays (13), while Saturdays and Sundays accounted for the most bicyclist fatalities (5 total). Again, Tuesdays were the highest for pedestrian suspected serious injuries (29), while Fridays were the highest for bicyclist suspected serious injuries (17) with generally lower numbers on weekends (14 total). The distribution of crashes and severe injuries based on the day of the week in which the crash occurred is presented in **Figure 3.3**.

Urban crashes exhibited these patterns more clearly, with a higher percentage of crashes during weekdays. Rural crashes remained steady throughout the week.





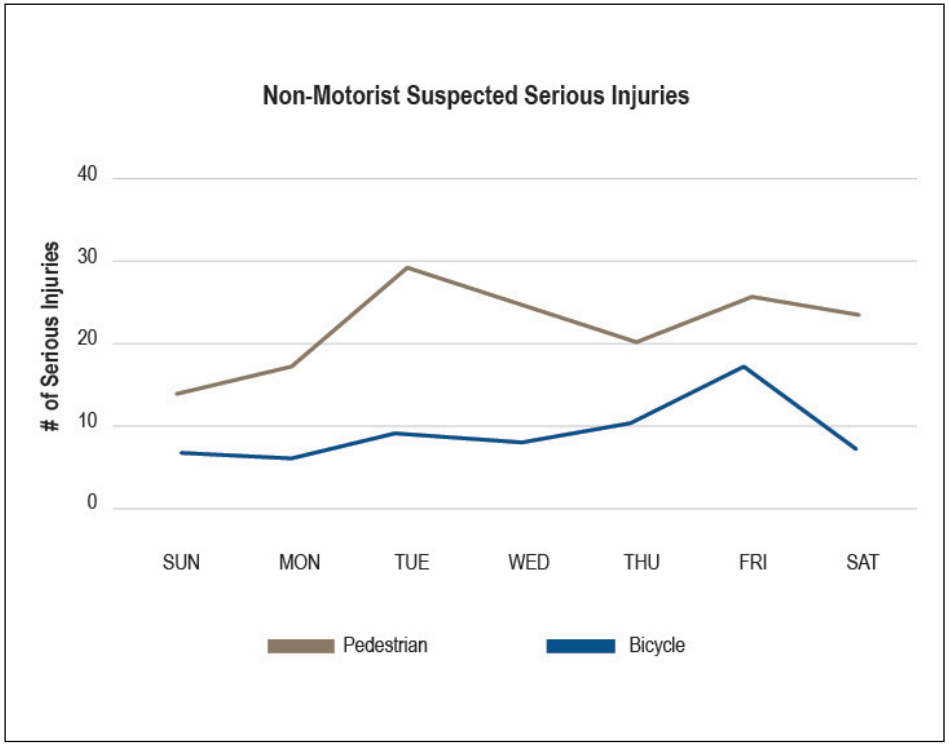
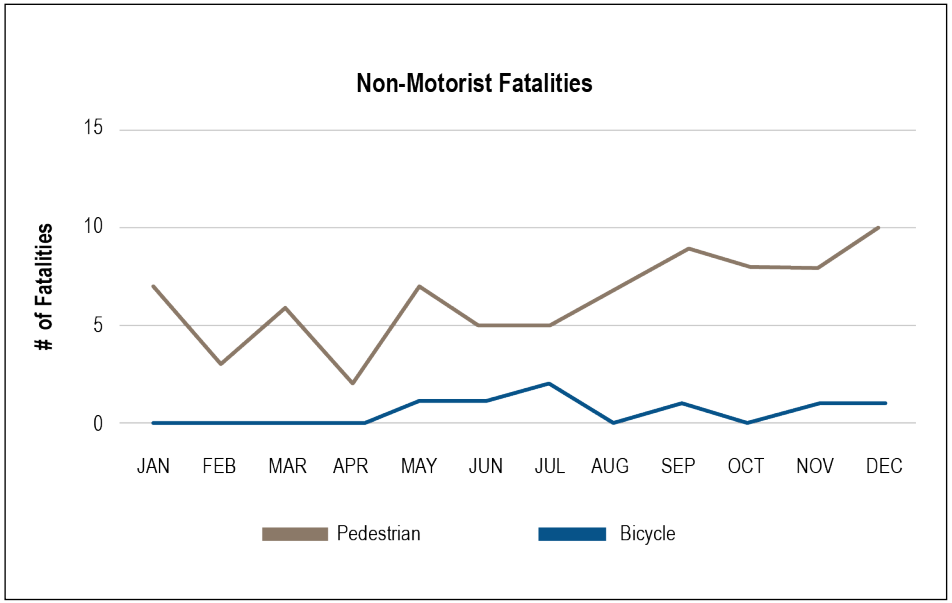


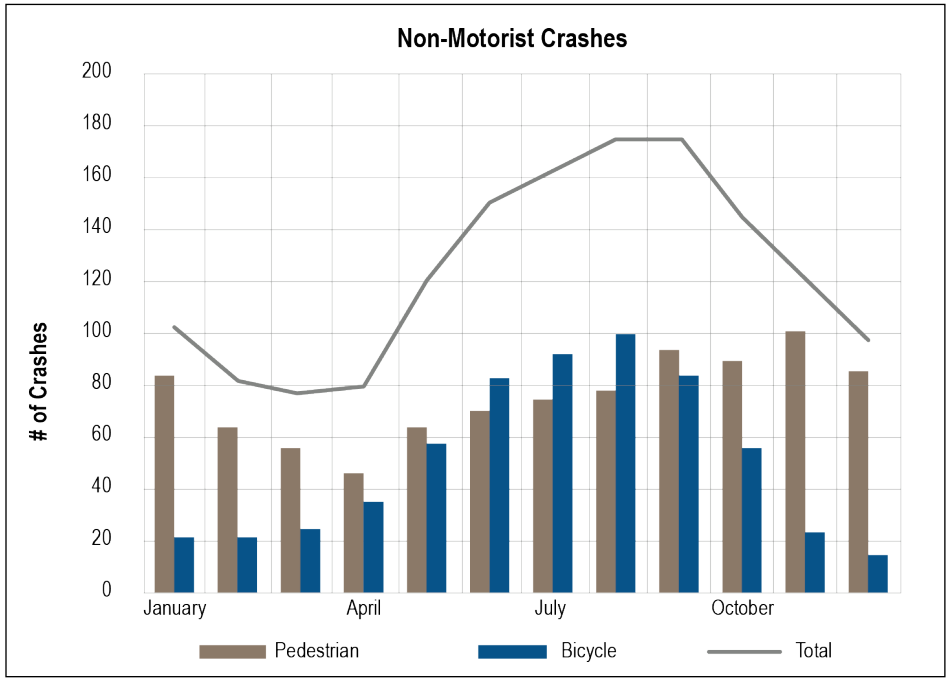
Figure 3.3: Non-Motorist Crashes and Severe Injuries by Day of the Week

Month

Figure 3.4 shows the distribution of reported non-motorist-involved crashes based on the month of the year in which the crash occurred. Approximately 68 percent of bicycle-involved crashes occurred in the summer and fall months (June through October) while 57 percent of pedestrian-involved crashes occurred in the fall and winter months (September through February). Total VRU-involved crashes were highest in the summer months (June through September, 45 percent of crashes) and lowest in the winter months (December through April, 29 percent of crashes). Pedestrian fatalities peaked in December while pedestrian suspected serious injuries were highest in October, February, and July. Bicyclist fatalities and suspected serious injuries both peaked in July. These findings may suggest more bicyclist activity during warmer months as well as higher traffic volumes due to increased travel and tourism. The higher frequency of pedestrian-related crashes during winter months may point to issues with winter maintenance of pedestrian facilities and consideration of daylight savings time.

Urban crashes exhibited these patterns more clearly, with a pronounced peak occurring in summer months (June through September). Rural crashes remained relatively steady throughout the year, with only a slight increase in summer months.





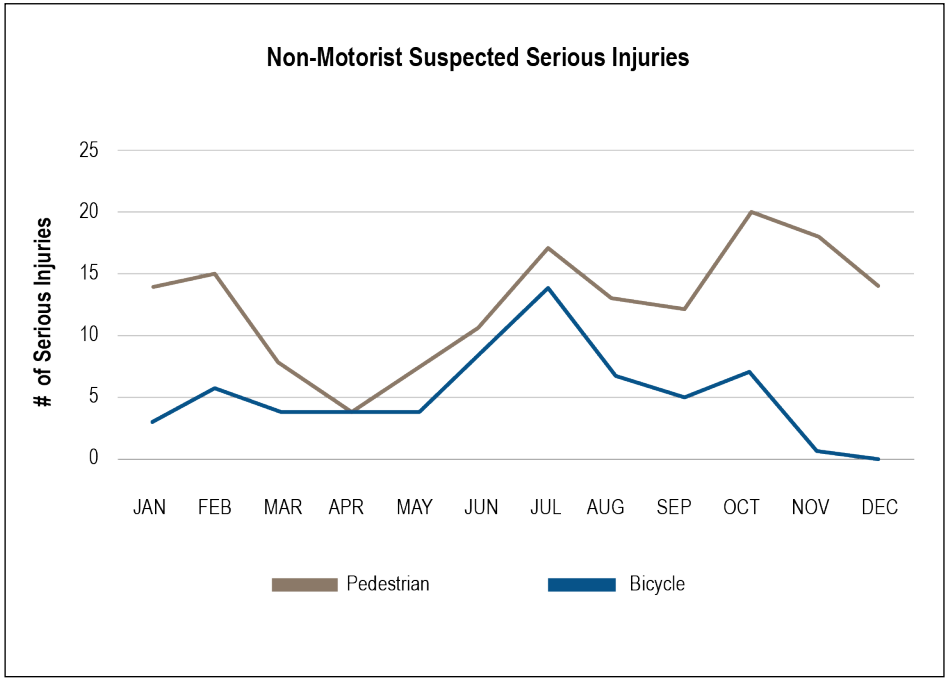
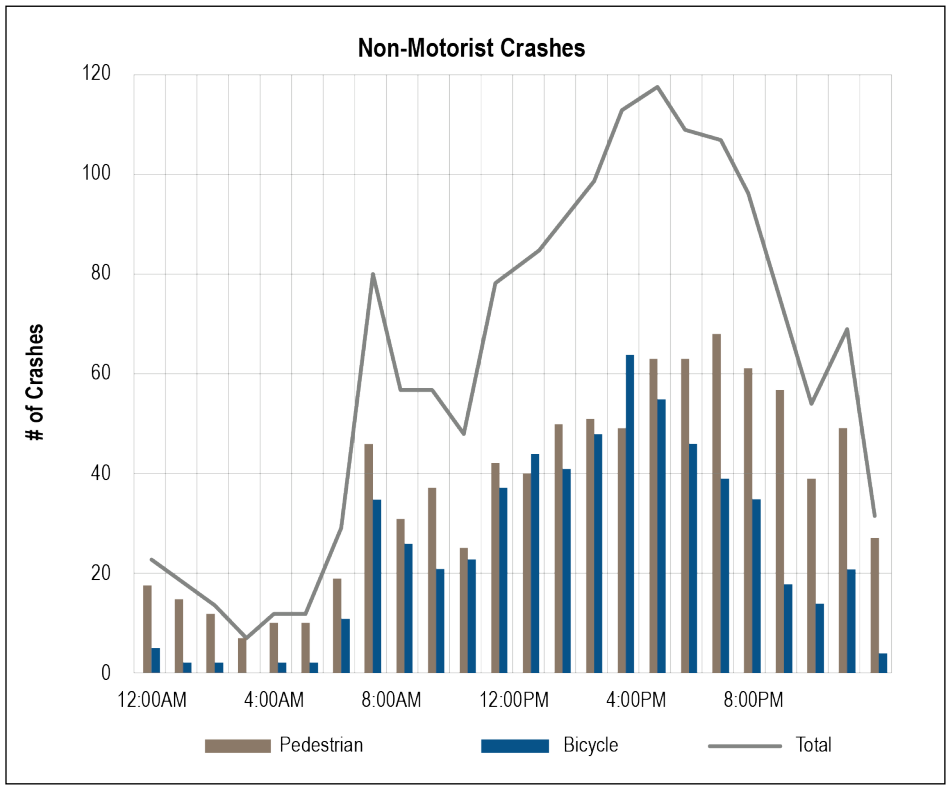


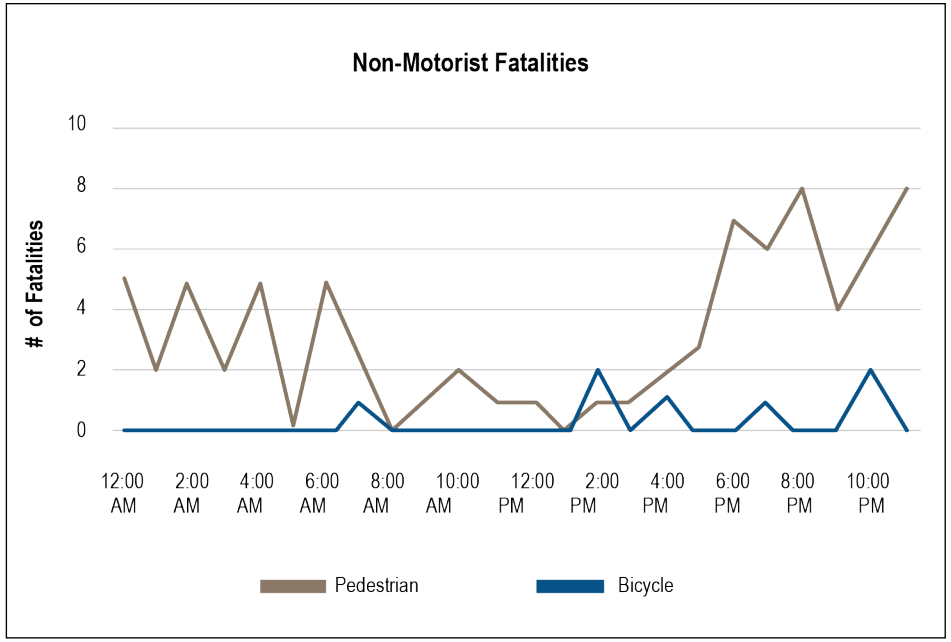
Figure 3.4: Non-Motorist Crashes and Severe Injuries by Month

Time of Day

The time-of-day distribution for crashes and severe injuries is presented in **Figure 3.5.** Two prominent peaks can be seen, with one around 7:00 AM and the other between 3:00 PM and 6:00 PM, likely corresponding to morning and evening commutes as well as school start and release times. Another less drastic peak is observed at night around 10:00 PM. Pedestrian fatalities were highest in the evening and early morning hours, from approximately 6:00 PM to 12:00 AM. Small peaks in bicyclist fatalities were observed at 7:00 AM, 2:00 PM, and 11:00 PM. Non-motorist suspected serious injuries occurred more randomly throughout the day, with the greatest number of pedestrian suspected serious injuries at 1:00 PM, between 5:00 and 6:00 PM, and at 9:00 PM. Bicyclist suspected serious injuries peaked between 11:00 AM and 4:00 PM.

Urban crashes exhibited these patterns more clearly, with pronounced peaks at 7:00 AM and between 3:00 PM and 6:00 PM. Rural crashes remained relatively steady throughout the day, with only slight increases at 4:00 PM and 7:00 PM.





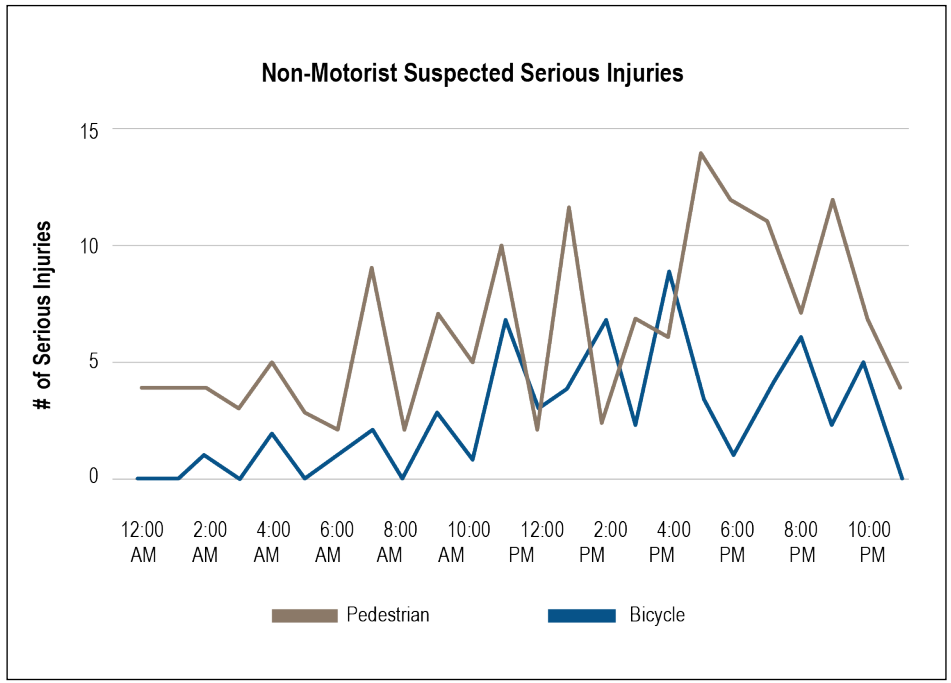


Figure 3.5: Non-Motorist Crashes and Severe Injuries by Time of Day

3.2.3. Location

When analyzing VRU-involved crashes, it is important to understand where they are occurring to identify any concentrations or areas with a higher risk of occurrence. **Figure 3.6** indicates the total number of VRU-involved crashes that occurred in each county and notes the number of VRU crashes within each urban area. This map shows higher concentrations of VRU crashes in counties with large urban areas and MPOs. These areas have higher population densities, greater traffic volumes, and are also typically more condensed, offering greater opportunities for walking and bicycling as transportation modes. These circumstances can lead to greater traffic exposure and a higher risk of collisions.

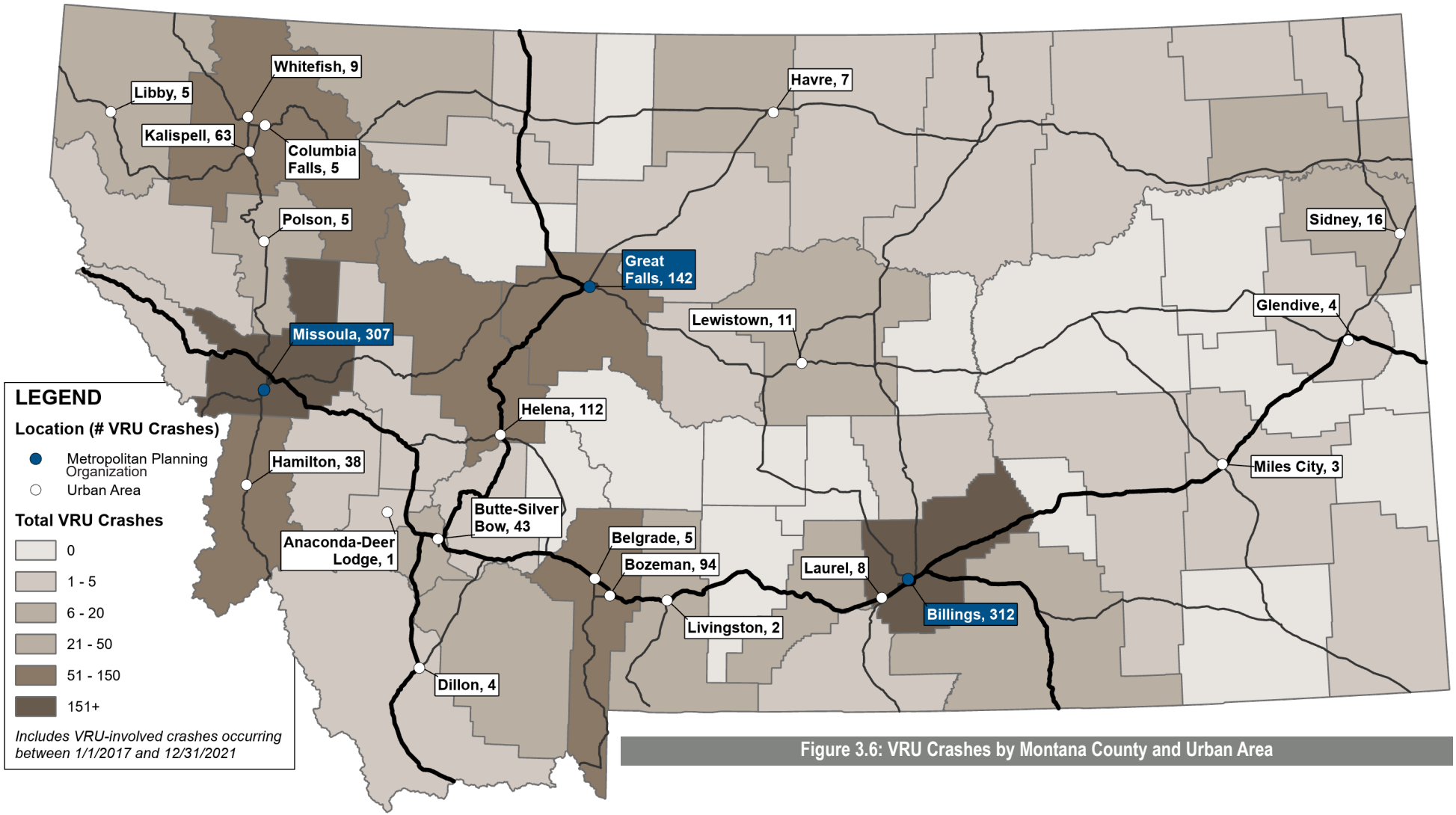


Figure 3.6: VRU Crashes by Montana County and Urban Area

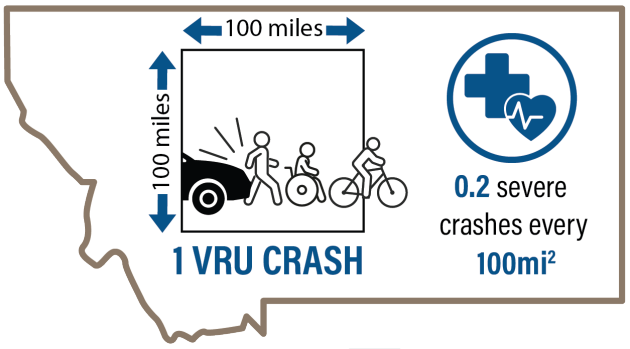
Urban vs. Rural

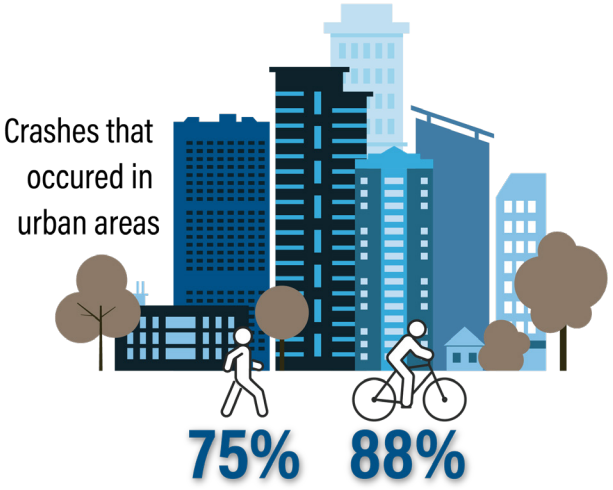
Montana is a large state with a relatively low population density. Accordingly, the number of VRU crashes within Montana is also relatively low compared to more populous states. When translated to a statewide crash density, approximately one VRU-involved crash occurred per 100 square miles over the five-year analysis period. Approximately 0.2 severe VRU crashes occurred per 100 square miles over the same period.

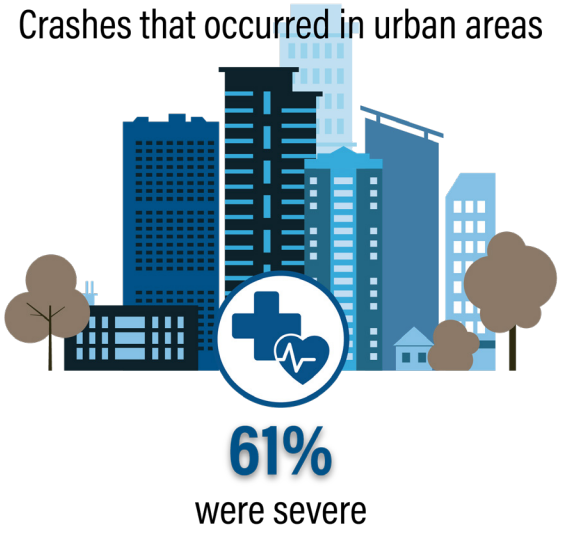
Over 80 percent of all VRU-involved crashes occurred in urban areas. When considering the 1,196 VRU crashes that occurred in the 292 square miles constituting Montana's 22 urban areas identified by the US Census Bureau, approximately 410 VRU crashes occurred per 100 square urban miles. Furthermore, there were approximately 590 VRU crashes per 100 square miles in Montana's three MPOs (Billings, Great Falls, and Missoula). Conversely, there were approximately 0.2 VRU crashes per 100 square miles in rural areas of Montana.

Of the 889 pedestrian-involved crashes that occurred over the five-year analysis period, 670 (or 75 percent) occurred in an urban area. Of the 595 bicyclist-involved crashes, 526 (or 88 percent) occurred in an urban area. Of those urban area VRU crashes, 61 percent were severe. Interestingly, the crash severity index for urban areas was 3.1 while the crash severity index for rural areas was 12.3 over the five-year period. This indicates that although there were fewer VRU-involved crashes in rural areas, these crashes tended to be more severe.

In terms of individual injuries, 60 percent of all non-motorist fatalities and 33 percent of suspected serious injuries occurred in rural areas of Montana, compared to 40 percent of fatalities and 67 percent of suspected serious injuries that occurred in urban areas. This reinforces the observation that rural crashes were more severe in terms of personal injury.





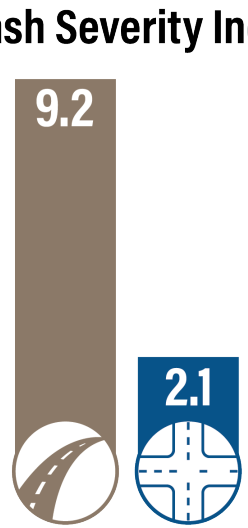


Intersection Relation

With respect to physical location, approximately 54 percent of all VRU-involved crashes occurred at an intersection or were related to an intersection. In all, 46 percent of pedestrian-involved crashes and 67 percent of bicyclist-involved crashes occurred at intersections. In urban areas, 63 percent of crashes occurred at intersections while only 18 percent of crashes in rural areas occurred at intersections.

In terms of severity, approximately 13 percent of intersection crashes were severe while 31 percent of non-junction crashes were severe. Furthermore, 34 percent of severe injuries occurred at intersections and 55 percent occurred at non-junction locations. Overall, the crash severity index at intersections was calculated to be 2.1 while the severity index at non-junction locations was 9.2. By comparison, the overall VRU-involved crash severity index was 4.3.

Although more VRU-involved crashes occurred at intersections, they tended to be less severe than those that occurred at non-junction locations. Typically, non-junction locations, such as highways, have higher speeds which increases the risk of injury when a crash occurs.

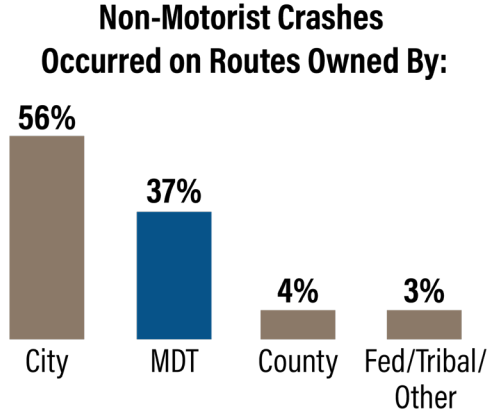


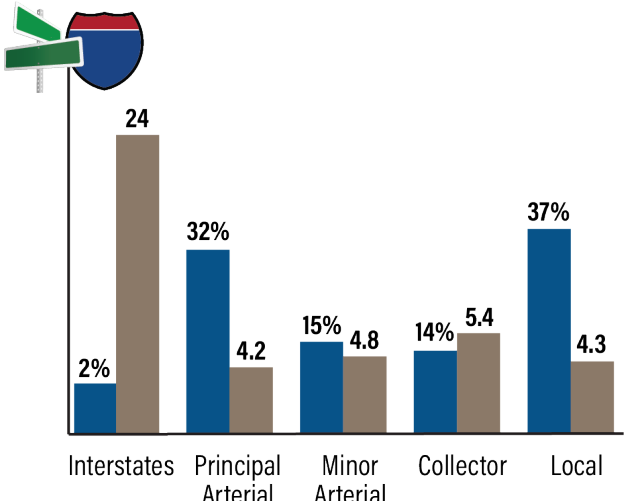
3.2.4. Road Characteristics

At the location of a crash, the data point is matched spatially to the roadway on which the crash occurred and select characteristics of the route are drawn from various MDT databases and tied to each crash record. A summary of the route characteristics for each crash is provided in the following sections.

Route Ownership

Understanding the owner of the roadway on which a crash occurs can help identify jurisdictions that are responsible for the maintenance and improvement of the route. Approximately 37 percent of VRU-involved crashes occurred on MDT-owned roadways, while 56 percent occurred on routes owned and maintained by cities or other municipal agencies, and 4 percent occurred on county-owned routes. The remaining 3 percent of crashes occurred on routes owned by Tribal agencies, the US Forest Service, or other state and federal agencies. Pedestrian and bicycle-involved crashes were similarly distributed among these route ownership types with slightly more pedestrian-involved crashes occurring on state-owned routes and slightly more bicycle-involved crashes occurring on city-owned routes. These findings point out the importance of inter-agency coordination since it is not just one agency that is responsible for the roadways where VRU crashes are occurring. This data also has a strong correlation to the urban nature of many VRU-involved crashes where routes are primarily city owned.



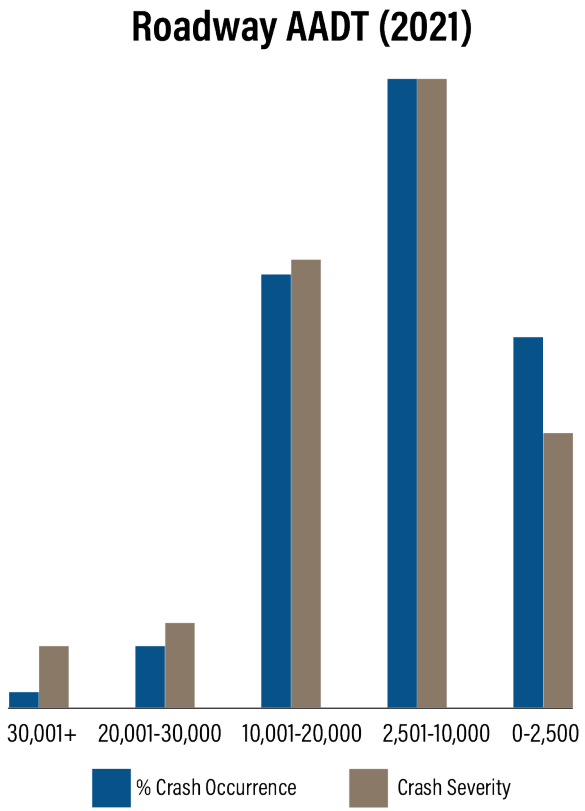


Functional Classification

The transportation system is made up of a hierarchy of roadways classified by parameters such as geometric configuration, traffic volumes, spacing in the community's transportation grid, speed, and adjacent land uses. The method by which these roles are defined is widely known as functional classification, which classifies roadways as interstates, principal arterials, minor arterials, collector streets, and local streets. The majority of crashes occurred on local streets (37 percent) and principal arterials (32 percent). The fewest number of crashes (2 percent) occurred on interstates, although the crash severity on interstates was the highest (24 percent). While crashes most frequently occurred on local roads and principal arterials, the overall crash severity on these systems was comparatively lower (4.3 and 4.2, respectively). Still, 57 percent of all fatalities and 67 percent of all suspected serious injuries occurred on local roads and principal arterials. Minor arterials and collectors each had approximately 15 percent of total crashes with crashes occurring on collectors being slightly more severe.

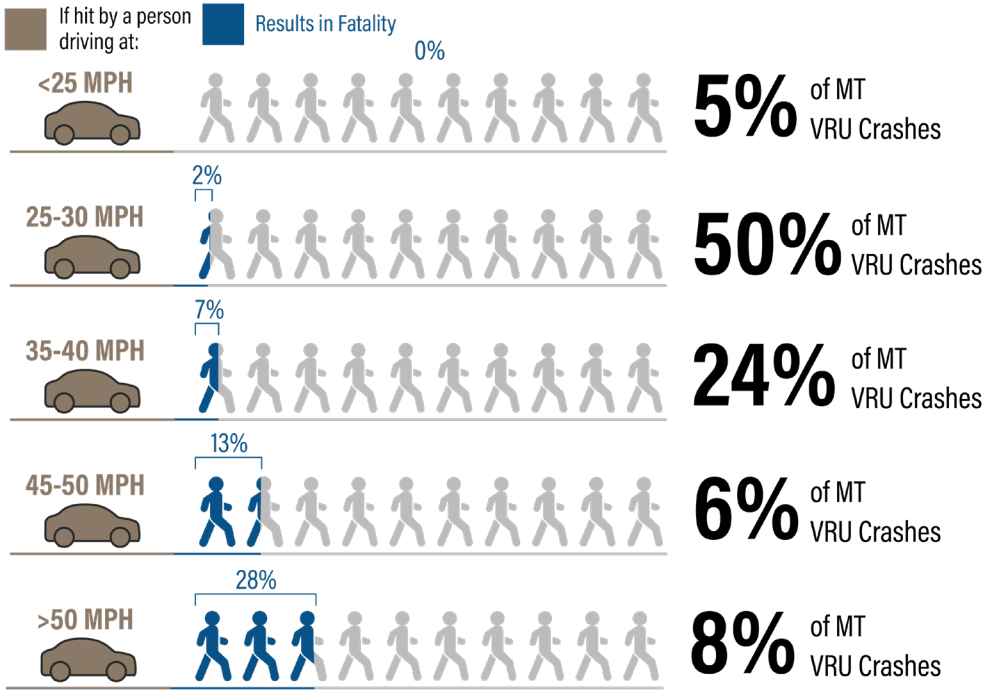
Traffic Volumes

Traffic volumes of the roadway on which a crash occurred can point to the level of exposure to vehicle traffic. For vehicle crashes, higher traffic volumes typically indicate a heightened risk of conflict and therefore a higher frequency of crashes. This isn't always the case for VRU-involved crashes since non-motorists and vehicles typically occupy separate spaces, such as sidewalks or paths versus the roadway. Overall, the highest percentage of crashes and the highest percentage of severe injuries occurred on roadways with 2,500 to 10,000 vehicles per day. Lower percentages of crashes occurred on higher volume roadways, although higher percentages of severe injuries, comparatively, occurred on higher volume roadways.



Speed

The speed limit on the roadway on which the crash occurred is also provided in crash data. While the posted speed limit doesn't necessarily indicate the speed at which a vehicle was traveling at the time of the crash, it is generally a good indication. Approximately 56 percent of VRU-involved crashes occurred on roadways with a posted speed limit of 30 miles per hour (mph) or less, which is a standard speed limit for local and collector streets. Approximately 8 percent of crashes occurred on roadways with speed limits greater than 50 mph which is typical of rural principal arterials and interstates. Pedestrian and bicycle-involved crashes were similarly distributed among roadways with these speed limits, with slightly higher percentages of pedestrian crashes occurring on higher speed roadways. Rural crashes were more likely to occur on roadways with speed limits greater than 50 mph (37 percent) compared to only 2 percent in urban areas. In urban areas, 83 percent of crashes occurred on roadways with posted speeds between 25 and 35 mph. In general, crashes occurring at higher speeds have a greater likelihood of resulting in a fatality. In Montana, 28 percent of VRU-involved crashes occurring on roadways with posted speeds in excess of 50 mph resulted in one or more fatalities while only 2 percent of crashes on roadways with posted speeds of 25 or 30 mph resulted in fatalities.



The speed limit was not listed in 7% of crashes.

Source: Condor36/Adobe Stock

3.2.5. Other Factors

In addition to the time and location of the crash, other factors contribute to the occurrence and severity of a crash. These factors may include weather conditions, road surface conditions, lighting conditions, or the type of vehicle involved in the crash. The following sections summarize these circumstances for VRU-involved crashes over the five-year analysis period.

Environmental Conditions

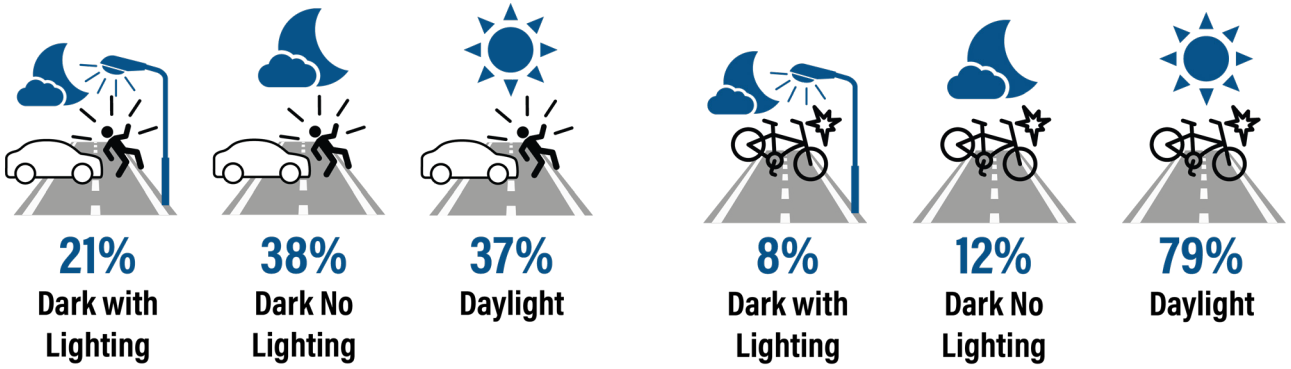
The majority of VRU-involved crashes occurred when the weather was clear or cloudy (73 percent). Approximately 3 percent of crashes occurred when it was either snowing or raining, respectively. Pedestrian-involved crashes were slightly more frequent during severe weather conditions compared to bicyclist involved crashes. This is interesting to consider since many of the pedestrian-involved crashes occurred during winter months when weather is typically variable in Montana. Since VRUs do not have the protection of a vehicle, they are typically less likely to be active when the weather is poor, which may explain the lower frequency of crashes during poor weather conditions. Poor weather also didn't appear to be correlated to severe crashes, with 82 percent of fatal and 75 percent of suspected serious injury crashes occurring under clear or cloudy conditions.

Likewise, most VRU-involved crashes occurred when the road surface was dry (80 percent). Nearly all bicyclist-related crashes occurred on dry roads (91 percent) with 6 percent occurring on wet roads and only 2 percent occurring on snow, ice, or frost-covered roads. Pedestrian-involved crashes were more likely to occur under adverse road conditions, with 12 percent occurring on snow, ice, or frost-covered roads and 13 percent occurring on wet roads. Approximately 78 percent of fatal crashes and 80 percent of suspected serious crashes occurred on dry roads. Crashes occurring under adverse road or weather conditions could indicate a lack of maintenance of non-motorized facilities, forcing pedestrians or bicyclists into the travel way, however, this finding is inconclusive.

Lighting Conditions

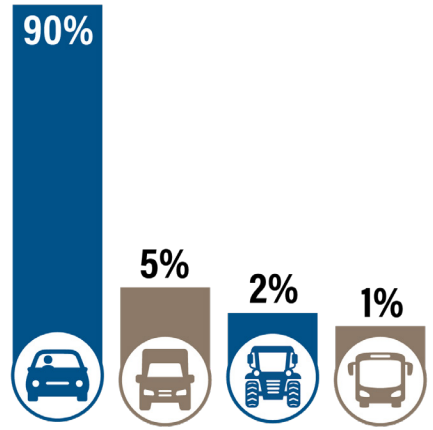
Lighting conditions are another important factor in VRU-involved crashes since non-motorists are typically much smaller and more difficult to see, especially in low light or darkness. Overall, 66 percent of VRU-involved crashes occurred during daylight with more bicyclist-involved crashes (84 percent) than pedestrian-involved crashes (55%) occurring under these conditions. Over 40 percent of pedestrian-involved crashes occurred when it was dark outside, with 21 percent occurring when there was street lighting present. Conversely, only about 13 percent of bicyclist-involved crashes occurred when it was dark, with 9 percent occurring where lighting was available.

Severe pedestrian-involved crashes were more likely to occur at night (59 percent), especially in areas without street lighting (38 percent). The majority of severe bicyclist-involved crashes still occurred during daylight hours, however, 12 percent occurred under dark lighting conditions with no street lighting and 8 percent occurred at dark with street lighting. These trends may point to a need for more street lighting in areas with heavy VRU activity, or the need for education for pedestrians and bicyclists on the use proper equipment to enhance visibility of their person.



Vehicle Type

When a crash is reported, the responding officer documents details about the types of vehicles involved in each crash. Bicycles are typically, but not always, coded as a low-speed vehicle. In total, 2,215 vehicles were involved in the 1,484 VRU-involved crashes, accounting for multiple vehicles involved in a single crash. A total of 584 bicyclists involved in the 595 bicycle crashes were classified as low-speed vehicles. Excluding low-speed vehicles from the dataset, 86 percent of vehicles involved in all VRU crashes and 90 percent of vehicles involved in severe VRU crashes were passenger cars, which includes SUVs and pickup trucks. Large trucks accounted for 3 percent of vehicles involved in all crashes and about 5 percent of vehicles involved in severe crashes. Machinery, such as farm equipment and snowplows, were involved in 5 percent of all crashes and 2 percent of severe crashes. Buses and motorhomes were involved in less than 1 percent of all crashes and approximately 1 percent of severe crashes.



Vehicles Involved in Severe Non-Motorist Crashes

3.3. DEMOGRAPHICS

An important component of the VRU SA crash data analysis process includes consideration of VRU demographics in terms of both the demographics of the location where VRU fatalities and suspected serious injuries occurred as well as the characteristics of the individuals involved in crashes. The following sections include an analysis of demographic details provided in crash data as well as an analysis of demographics sourced by the US DOT Justice40 Initiative (J40).[2]

3.3.1. Demographics of Location

J40 was created to address decades of underinvestment in disadvantaged communities. The initiative allows US DOT to identify and prioritize projects that benefit rural, suburban, Tribal, and urban communities facing barriers to affordable, equitable, reliable, and safe transportation. The US DOT has compiled a mapping tool to help identify disadvantaged communities. Version 2.0, released in May 2022, includes data for 22 indicators collected at the census tract level and grouped into six categories of transportation disadvantage.[3] The data is sourced from the Center for Disease Control's Social Vulnerability Index, the US Census Bureau's American Community Survey, the Environmental Protection Agency's Smart Location Map and Environmental Justice Screen, the United States Department of Housing and Urban Development's Location Affordability Index, and the Federal Emergency Management Agency's Resilience Analysis & Planning Tool and National Risk Index. The six categories of transportation disadvantage are listed below with the numbers in parentheses showing how many of the 22 indicators fall within each category:

1. **Transportation Access Disadvantage**: identifies communities and places that spend more, and take longer, to get where they need to go. (4)
2. **Health Disadvantage:** identifies communities based on variables associated with adverse health outcomes, disability, as well as environmental exposures. (3)
3. **Environmental Disadvantage:** identifies communities with disproportionately high levels of certain air pollutants and high potential presence of lead-based paint in housing units. (6)
4. **Economic Disadvantage:** identifies areas and populations with high poverty, low wealth, lack of local jobs, low homeownership, low educational attainment, and high inequality. (7)
5. **Resilience Disadvantage:** identifies communities vulnerable to hazards caused by climate change. (1)
6. **Equity Disadvantage:** identifies communities with a high percentile of persons (age 5+) who speak English "less than well." (1)

Within each census tract, the percentile value was calculated for each of the 22 indicators, where the 99th percentile represents the most disadvantaged. Within each category, the average percentile for each tract was calculated. For each category, a tract is assigned a value of one (1) if it is in the 50th percentile or higher and zero (0) otherwise. For the resilience category only, a tract is assigned a value of one (1) if it is in the top 75th percentile of disadvantage. A census tract is considered transportation disadvantaged if it exceeds these thresholds in at least four of the six categories. The resulting analysis for Montana is provided in **Figure 3.7**.

The **Justice40** Initiative has a goal that **40%** of the benefits of certain federal investments flow to disadvantaged communities to help advance equity across the United States.

Prioritize Investments

Measure Impact and Improve Effectiveness

Strengthen Communities

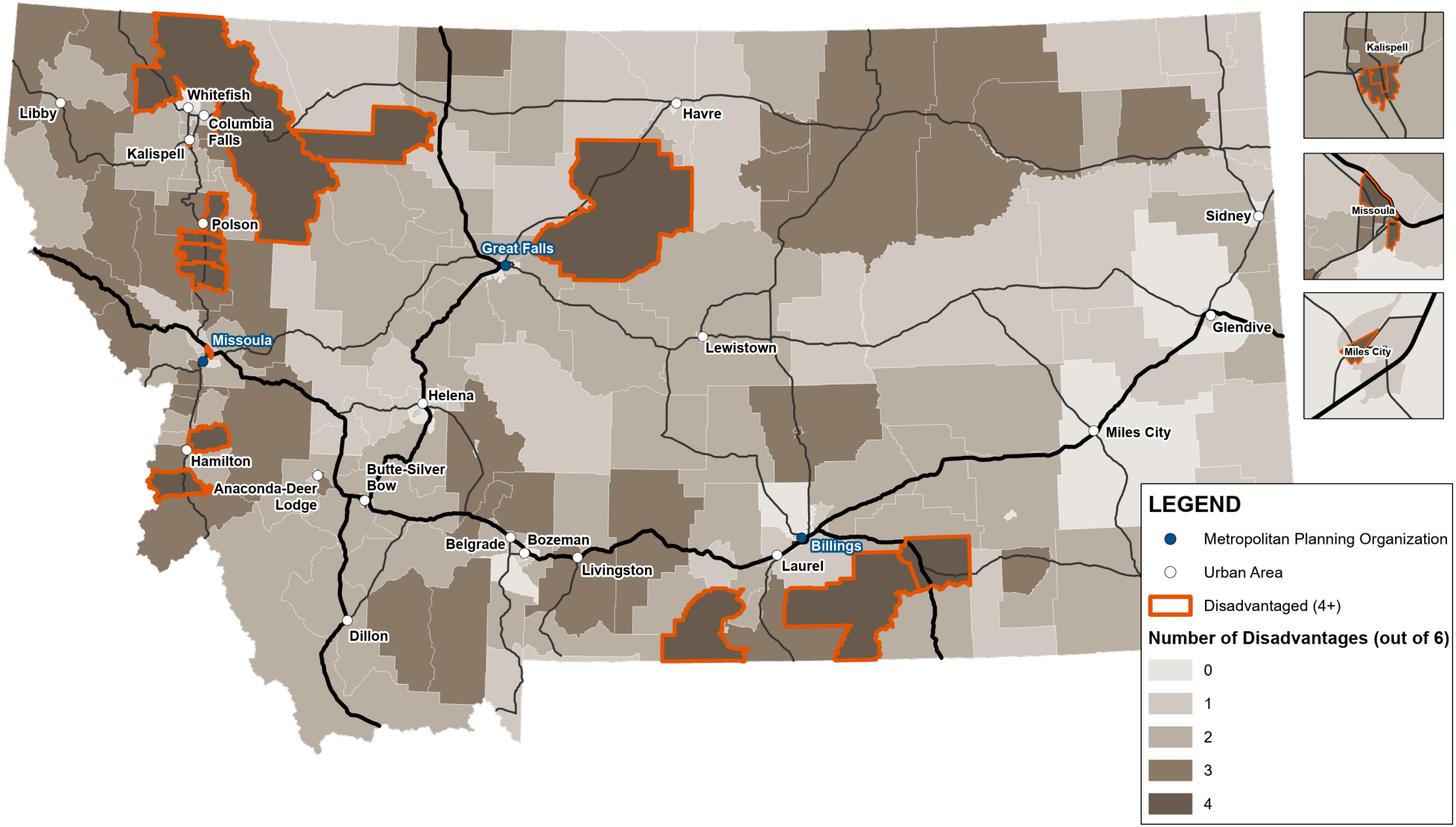


Figure 3.7: Transportation Disadvantages (US DOT J40)

The mapping in **Figure 3.7** shows that there are 17 census tracts that were identified as having 4 or more disadvantages. Interestingly, none of the census tracts exceeded 4 disadvantages. The disadvantaged census tracts are located primarily in areas where there are Tribal Reservations, including the Blackfeet, Crow, Flathead, Rocky Boy's-Chippewa Cree, and Northern Cheyenne. Several areas of Montana were identified as having no disadvantages.

17 highly disadvantaged communities identified in MT (out of 271)

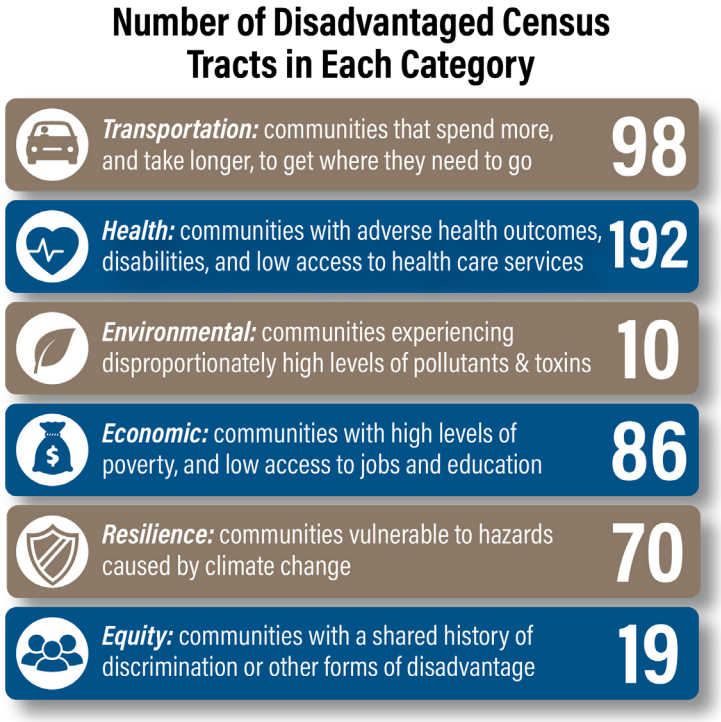


Figure 3.8: Number of Disadvantaged Census Tracts by Category

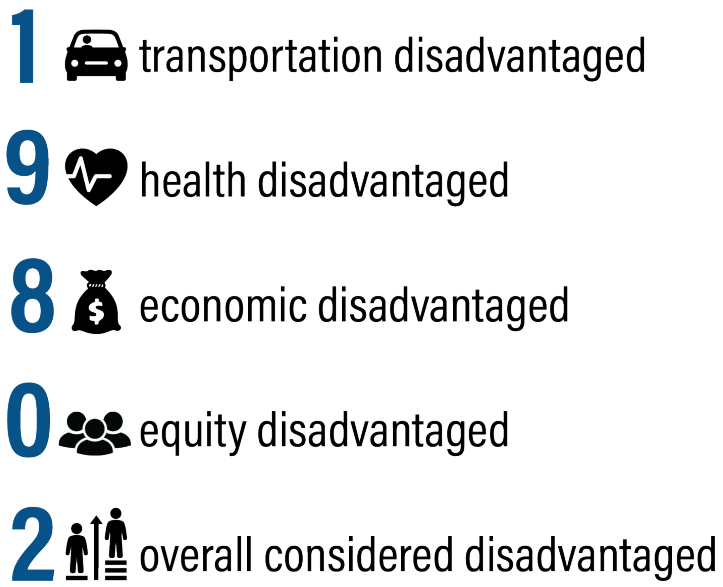


Figure 3.9: Disadvantages in Areas with High Severity Rates

Figure 3.8 indicates the number of census tracts, out of 271 total census tracts in the state, which were identified as exceeding the 50th percentile (75th percentile for Resilience) in each category. Of note, over 70 percent of Montana census tracts are identified as being health disadvantaged. These census tracts are primarily in rural parts of the state with low access to health care services and don't necessarily indicate high concentrations of people with disease or disabilities. Census tracts identified as being economically disadvantaged or transportation disadvantaged may be areas where there are large populations of low-income earners who may rely on walking and bicycling as their primary transportation modes.

Figure 3.10 on the following page maps the number of VRU severe injuries per 2,500 people within each census tract and compares the severe injury per capita rate to the J40 Disadvantaged Communities information. Above, **Figure 3.9** indicates the number of disadvantages associated with the 10 census tracts with the highest VRU severity per capita rates. In general, more crashes and many of the higher-severity crashes are occurring in urban areas, which are generally not considered disadvantaged. The two census tracts with the highest VRU severe injury per capita rate are located on the western border of the Blackfeet Reservation and on the eastern half of the Fort Peck Reservation, both of which are not considered disadvantaged.

Figure 3.9 also indicates that the majority of census tracts where high rates of VRU severe injuries are occurring are considered health and economic disadvantaged (9 and 8 census tracts, respectively). Two of the census tracts are considered highly disadvantaged, meaning they exceed the minimum thresholds in four or more disadvantage categories. These tracts are located northeast of Columbia Falls and south of Polson. This information may indicate a need to focus efforts in areas with either or both health and economic disadvantages as these areas may have populations at higher risk of involvement in a crash as a VRU due to health or economic circumstances.

Source: Snehit Photo/Adobe Stock

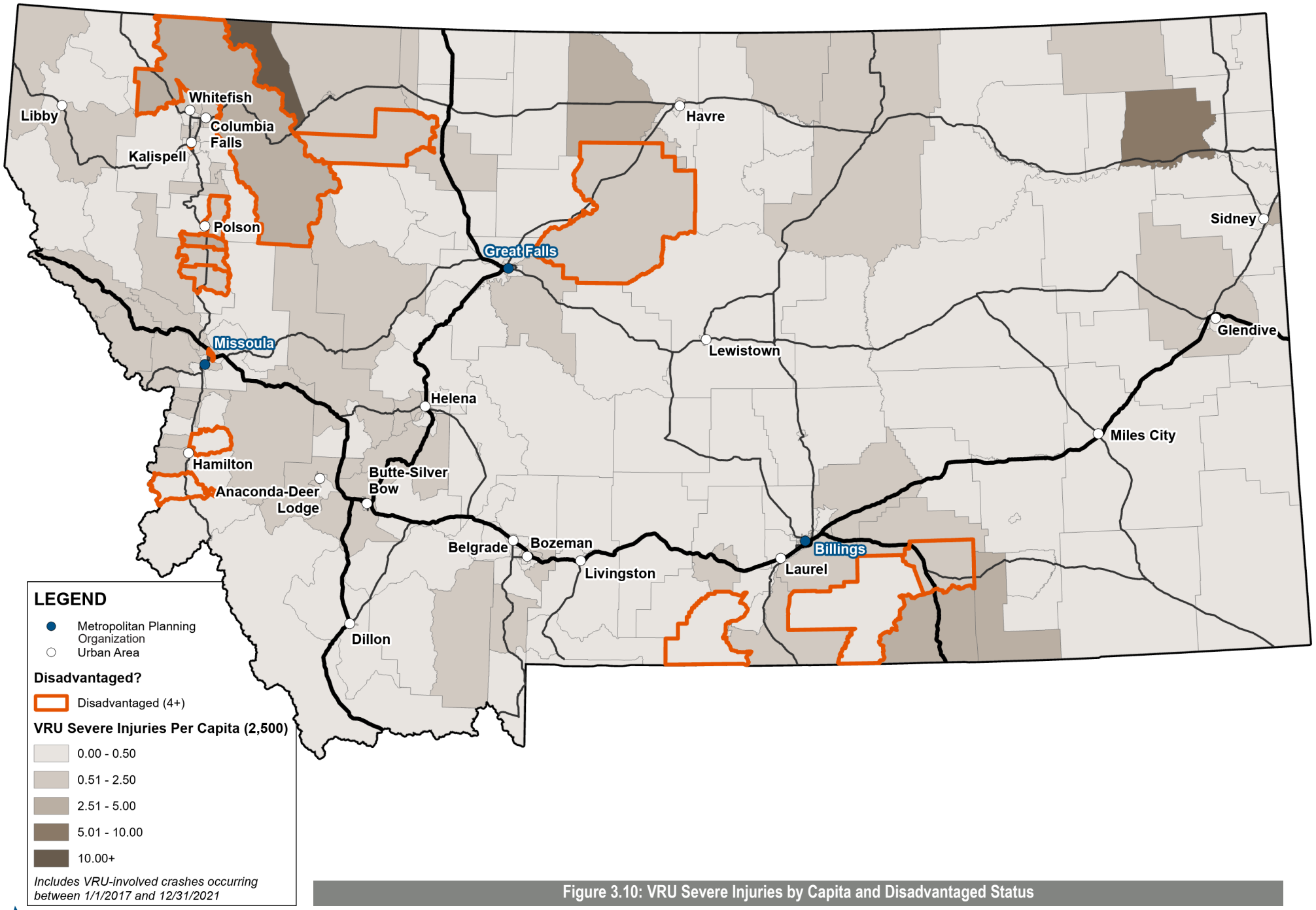


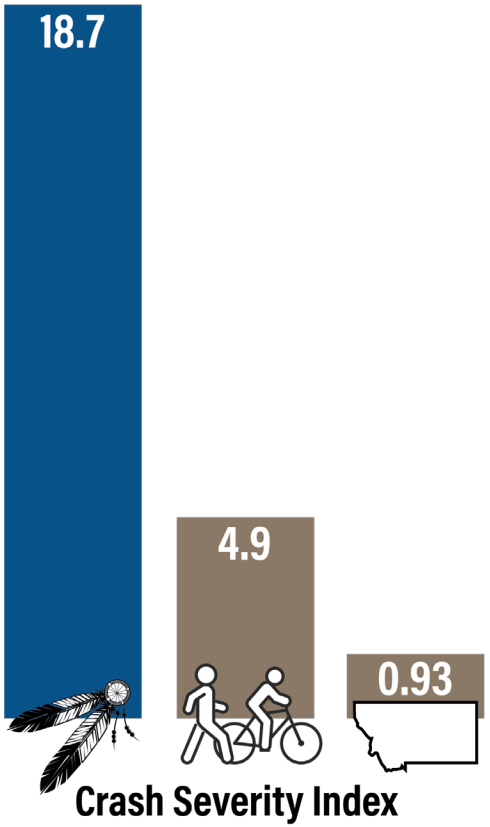
Figure 3.10: VRU Severe Injuries by Capita and Disadvantaged Status

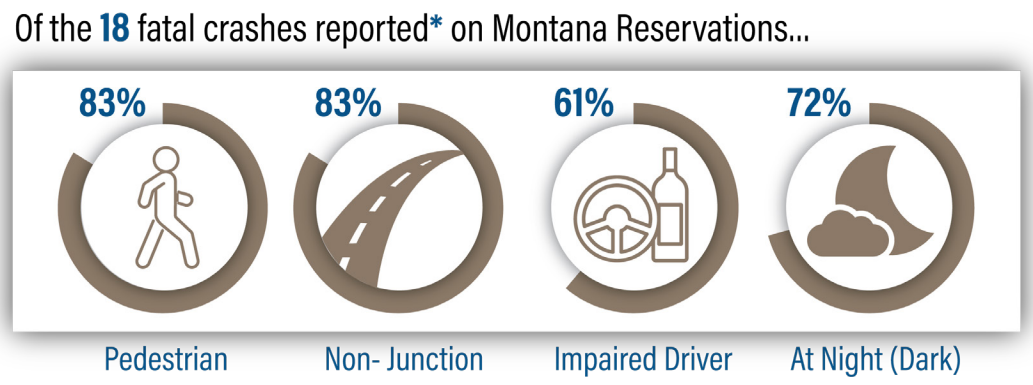
3.3.2. Tribal Areas

Tribal Reservations in the United States are disproportionately poverty stricken. Nationwide, low-income residents use walking and bicycling as primary transportation modes. In Montana, 76 percent of the census tracts overlapping the seven land-based Tribal Reservations are considered economically disadvantaged and 68 percent are considered transportation disadvantaged. These disadvantages are indicators that walking and bicycling for transportation on Tribal Reservations is likely prevalent. Anecdotally, MDT has observed that residents often use these modes to travel within their respective communities as well as for travel between neighboring communities, often on high-speed rural highways lacking dedicated pedestrian and bicycle facilities.

Figure 3.11 on the following page illustrates the boundaries of the seven land-based Tribal Reservations in Montana and indicates the VRU injury severity index for each. The census tracts identified by J40 as being disadvantaged are also shown on the map, 8 of which overlap with the boundaries of the Blackfeet, Crow, Flathead, and Rocky Boy's. Combined, the Tribal Reservations have an injury severity index of 18.4 and a crash severity index of 18.7, which are both much higher than the statewide VRU injury and crash severity indices of 5.2 and 4.9, respectively. Approximately 21.4 percent of all fatal crashes and 23.8 percent of all fatal injuries occurred on Tribal Reservations. The higher proportion of severe injuries on Tribal Reservations contributes to these higher indices. **Figure 3.11** shows that the Crow and Rocky Boy's Reservations both had an injury severity index of 66.7, which is a result of only fatalities occurring on each (4 VRU fatalities on Crow and 1 on Rocky Boy's). No VRU-involved crashes occurred on the Fort Belknap Reservation during the five-year analysis period.

Of the 70 VRU-involved crashes reported on Montana Tribal Reservations, 18 were fatal. Historically, non-fatal crashes have been chronically underreported on Montana Tribal Reservations while fatal crashes are regularly reported to the coroner's office. Therefore, fatal crash data is considered the most reliable dataset to understand crashes on Montana's Tribal Reservations. Of the 18 fatal crashes, 83 percent were pedestrian-involved crashes and 83 percent occurred at a non-junction location. About 61 percent of the crashes involved an impaired driver. Anecdotally, the overwhelming majority of these crashes involved either or both impaired drivers and VRUs. Furthermore, 72 percent of fatal VRU crashes on Tribal Reservations occurred at night when it was dark outside, both with (17 percent) and without (55 percent) street lighting.





*Non-fatal crashes are chronically underreported on Montana Reservations. The fatal crash data is the most reliable data for Montana's Reservations.

Source: Kushnirov Avraham/Adobe Stock

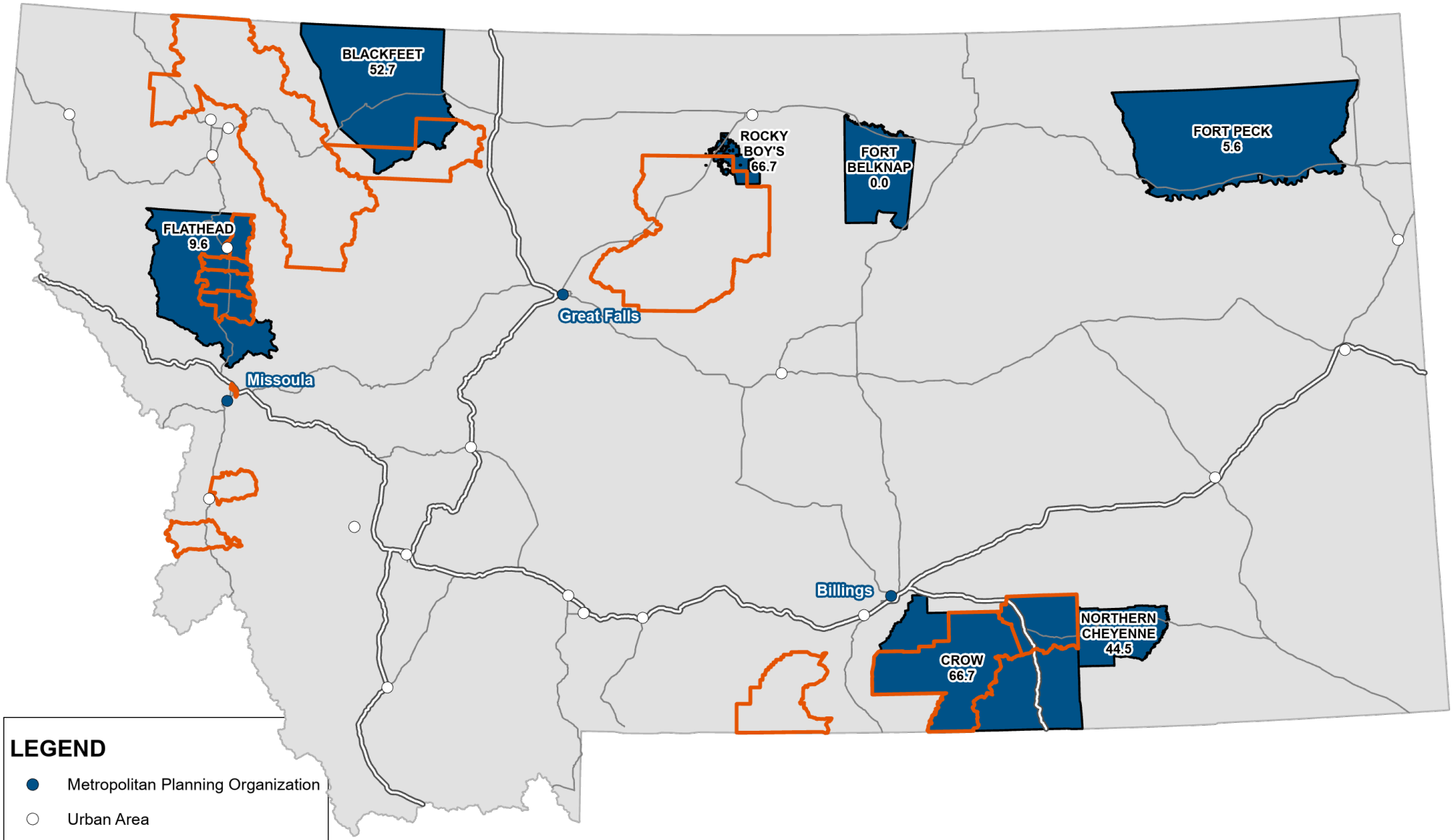


Figure 3.11: VRU Injury Severity by Tribal Reservation

3.3.3. Demographics of Individuals

Understanding the characteristics of individuals involved in crashes may help identify populations to focus for education campaigns or identify groups that are chronically involved in non-motorist crashes that may need special consideration during design phases. The following sections discuss the available person demographics reported in the crash data.

Gender

Overall, about 37 percent of individuals involved in crashes were female including 33 percent of non-motorists, and 40 percent of drivers. Males accounted for 53 percent of all individuals involved in crashes, including 66 percent of non-motorists and 49 percent of drivers. For approximately 10 percent of people involved in crashes, the gender type was listed as unknown. Males also accounted for 66 percent of all non-motorist fatalities and 69 percent of non-motorist suspected serious injuries.

Age

The age distribution for non-motorists involved in crashes follows a typical bell curve, as shown in **Figure 3.12**, with the highest proportion of involved individuals in the 31- to 50-year age range. About 23 percent of male non-motorists were aged 18 years and younger while only about 10 percent of female non-motorists were minors. About 14 percent of all non-motorists were under the age of 15, representing the population of individuals who typically do not have the ability to drive a vehicle for transportation. Approximately 8.6 percent of male and 10.9 percent of female non-motorists were over the age of 65.

About 51 percent of drivers involved in crashes were young- to middle-aged adults (19 – 50 years). Approximately 13 percent of drivers involved in VRU crashes were aged 66 or older and about 5 percent were aged 18 or younger. Additionally, 5 drivers were under the legal driving age of 14.5 in Montana.

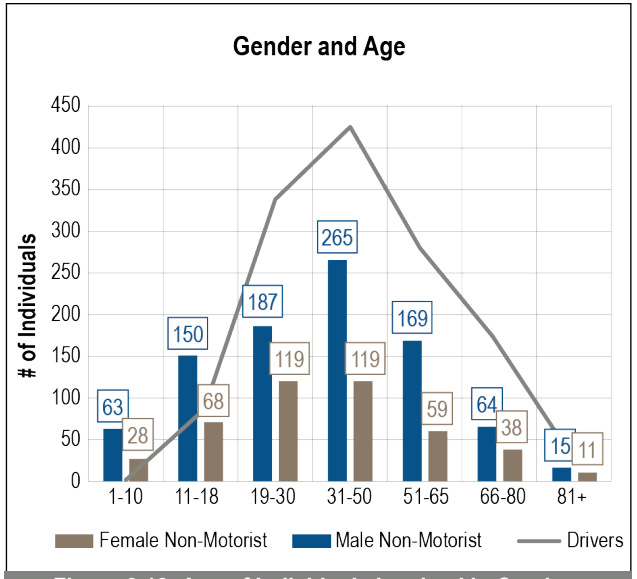


Figure 3.12: Age of Individuals Involved in Crashes

Of the 1,384 non-motorists involved in crashes, **9%** were **66 years or older**.

33% Female **66% Male**

Non-motorists involved in crashes

Race/Ethnicity

Race and ethnicity data is severely underreported and often incomplete as it is based on officer observations at the scene and is not always verified. Race was only reported for about 36 percent of drivers and 41 percent of VRUs. Of those reported, about 87 percent of VRUs were identified as White, 12 percent were identified as Indian, and a combined 1 percent were identified as Asian or Black. For drivers, 92 percent were identified as White, 7 percent Indian, and a combined 1 percent were identified as Asian or Black. For VRUs who died in crashes, the race is indicated for 68 percent. Of those, 39 percent were identified as Indian and the remaining 61 percent were identified as White.

The FARS database is a nationwide census of data regarding fatal injuries suffered in motor vehicle traffic crashes. The database obtains race information from death certificates and is considered the most reliable source of this information. For the 2017-2021 data analysis period, 27 pedestrians and 3 bicyclists killed in VRU crashes in Montana were American Indian or Alaska Native. This equates to approximately 36 percent of all VRU fatalities in the state over the five-year period. Based on results of the 2020 Census, American Indian or Alaska Natives make up approximately 6.6 percent of the state's population. This means Native Americans are disproportionately represented in VRU fatalities.

Of the Native American VRU fatalities, 17 pedestrian and 2 bicyclist fatalities occurred on a Montana Tribal Reservation. This means that 63 percent of Native American VRU fatalities occurred on Tribal Reservations.

Of the 84 non-motorists who died in crashes, **36%** were **Native American**.


Source: RPA

3.4. HIGH-RISK AREAS

Federal regulations require the state's VRU SA to identify high-risk areas for vulnerable road users. Federal guidance notes multiple data-driven safety analysis approaches may be used to identify these locations, including development of a high injury network (HIN), predictive analysis to identify locations with the greatest potential for improvement and quantify the expected safety performance of different project alternatives, and systemic safety analysis to identify high-risk roadway features that correlate with particular crash types and determine locations at risk for severe crashes even if there is not a high crash frequency at these locations. The following sections describe the methods considered for the analysis of high-risk VRU locations in Montana.

METHOD 1: Mapping Analysis

Figure 3.13 on the following page maps the fatal and suspected serious injuries that occurred throughout the state over the five-year analysis period. As shown in the map, the majority of severe injuries occurred in urban areas. For reference, severe injury densities for the three MPOs are also provided in the figure.

Since Montana is such a vast state, and the number of severe VRU injuries is relatively low in comparison to the geographic expanse, it is difficult to draw conclusions about high-risk areas for VRU-involved crashes from this type of mapping analysis. The densities in the MPO inset maps in **Figure 3.13** represent the number of severe VRU injuries in a 500-foot by 500-foot area, or the equivalent of 2 to 3 city blocks. One area in Bozeman had a concentration of 4 severe injuries and 5 areas in Billings, Great Falls, Missoula, and Poplar had one or more concentrations of 3 severe injuries resulting from one or multiple crashes. Each of these areas had considerably different characteristics in terms of roadway infrastructure, surrounding land uses, and crash circumstances making it difficult to draw broad conclusions about risk levels. For this reason, a high-risk analysis based on spatial mapping of past VRU crashes was not pursued further.

METHOD 2: Crash Rate Analysis

Another method considered for identifying high-risk areas was to calculate crash rates along segments of the transportation network based on traffic exposure. However, due to inconsistencies in how the roadway network is segmented, crash rates were heavily influenced by the length of an individual segment rather than the number of crashes occurring on each segment. Furthermore, basing a crash rate on traffic exposure, or VMT, can offset VRU-crash rates especially on high-volume roads. Vehicle traffic exposure also ignores non-motorist traffic activity and does not provide the full picture of vehicle and non-motorist interactions. For these reasons, an analysis based on crash rates was not pursued.

Source: MDT/Big Sky Public Relations

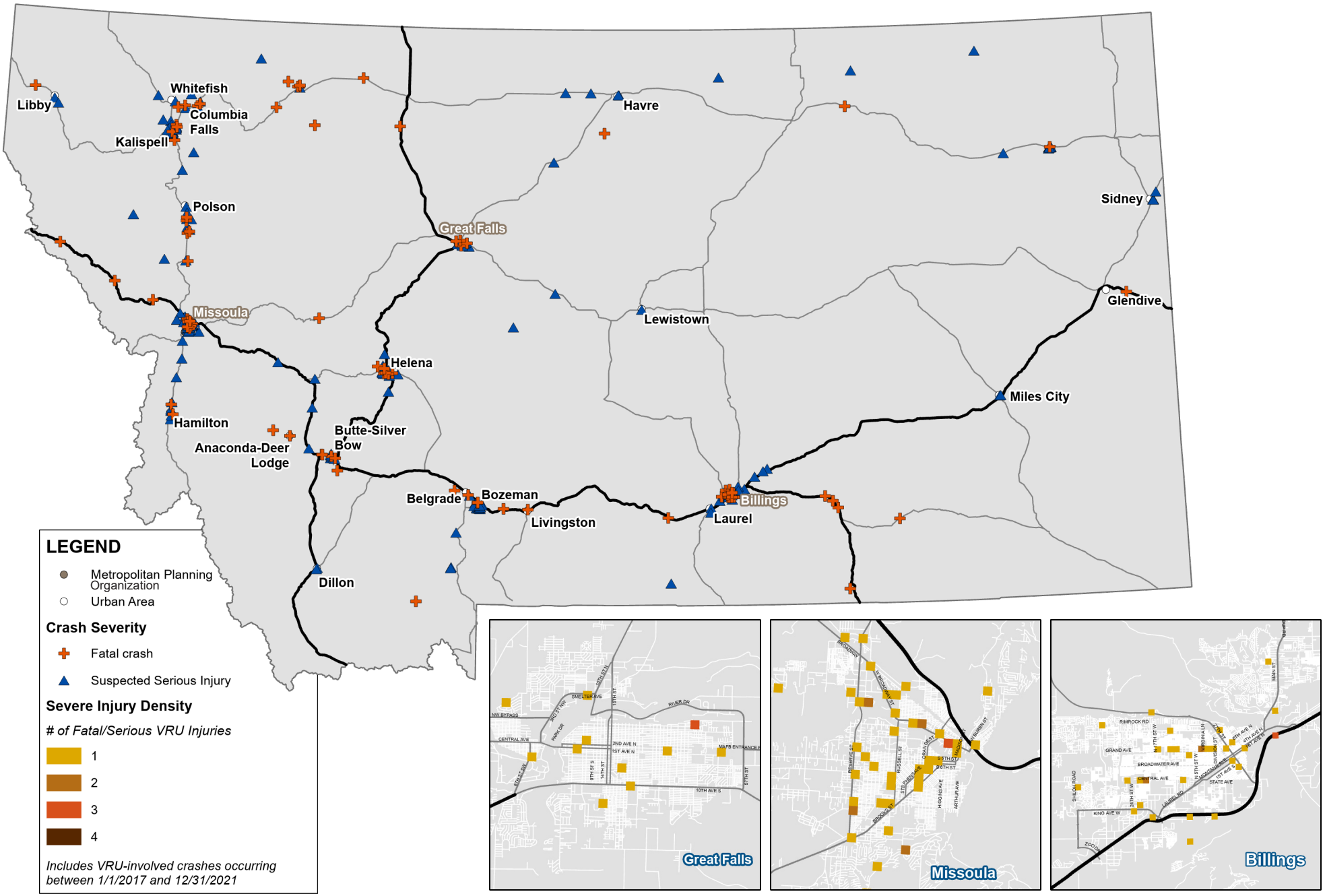


Figure 3.13: VRU Severe Injury Locations

METHOD 3: Infrastructure Indicators Analysis

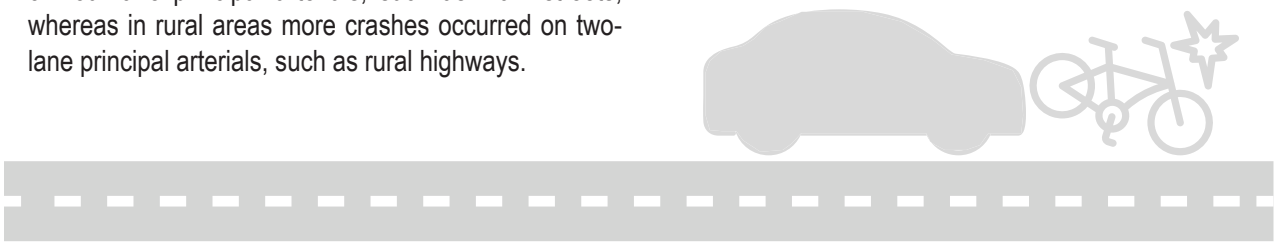
An analysis was performed to examine commonalities between the infrastructure attributes of areas where crashes have occurred. Using a systemic safety analysis approach, this analysis will help MDT define strategies addressing specific design challenges and proactively identify similar circumstances across the state where VRU-involved crashes have not occurred but may occur in the future. **Figures 3.14** and **3.15** illustrate key infrastructure indicators for severe pedestrian and bicycle crashes, respectively. These figures highlight characteristics of the roadways on which a severe crash occurred including shoulder widths, functional classification, number of lanes, speed limit, street lighting, and vehicle operator or non-motorist behaviors.

Figure 3.14 indicates 22 percent of severe pedestrian-involved crashes occurred at intersections in urban areas and 27 percent occurred at non-junction locations in urban areas. Approximately 36 percent of severe pedestrian-involved crashes occurred at rural non-junction locations. Key takeaways about pedestrian-involved crashes include the following:

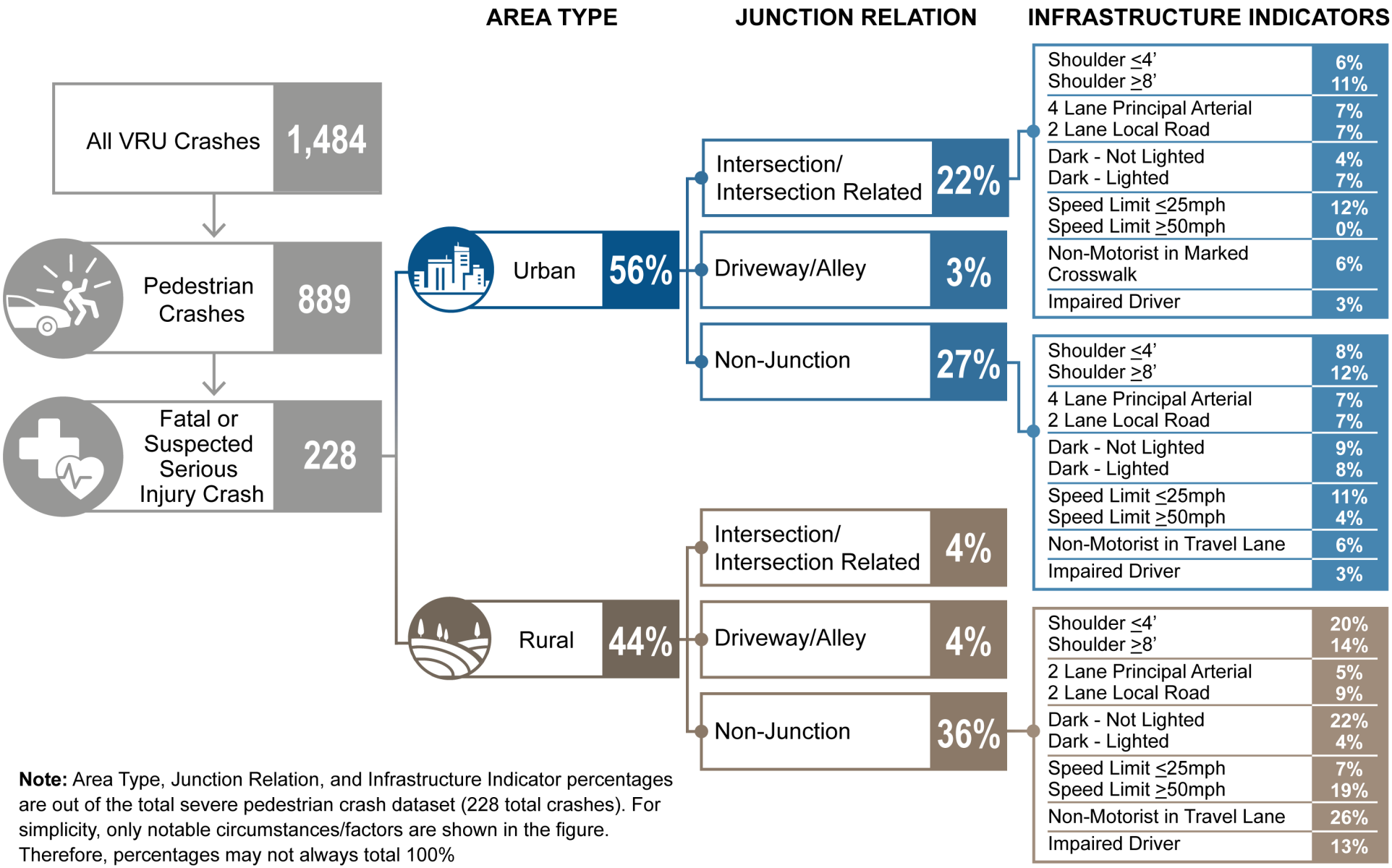
- Intersection crashes in urban areas occurred at junctions of roadways with shoulders greater than or equal to 8 feet, indicating possible long crossing distances for pedestrians.
- In urban areas, crashes typically occurred on roadways with lower speed limits, whereas in rural areas crashes primarily occurred on high-speed roadways.
- Crashes occurred primarily on two-lane local roads. In urban areas, a higher percentage of crashes occurred on four-lane principal arterials, such as main streets, whereas in rural areas more crashes occurred on two-lane principal arterials, such as rural highways.
- At non-junction locations, a large percentage of pedestrians who suffered severe injuries were in the travel lane. Additionally, multiple rural non-junction crashes occurred on roadways with narrow or no shoulders indicating a lack of available space for pedestrians to walk outside the travel lane.

Figure 3.15 indicates 51 percent of severe bicycle-involved crashes occurred at intersections in urban areas and 12 percent occurred at non-junction locations in urban areas. Approximately 17 percent of severe bicycle crashes occurred at rural non-junction locations. Key takeaways bicycle-involved crashes include the following:

- Non-junction crashes were more likely to occur on roadways with narrow or no shoulders, indicating the bicyclist likely did not have adequate room to ride outside of the travel lane.
- In urban areas, severe bicycle-involved crashes were more likely to occur on low-speed roadways compared to crashes in rural areas, which occurred more often on higher-speed roadways. Spatially, it was observed that non-junction rural crashes typically occurred on roadways between communities rather than within rural communities.
- Street lighting was less of a factor in urban areas compared to rural areas.
- At urban intersections, bicycle-involved crashes tended to be a result of vehicles turning right or left.
- More severe bicycle-involved crashes occurred on two-lane local roads than multi-lane arterials, suggesting a possible preference to ride in roadways of this type.

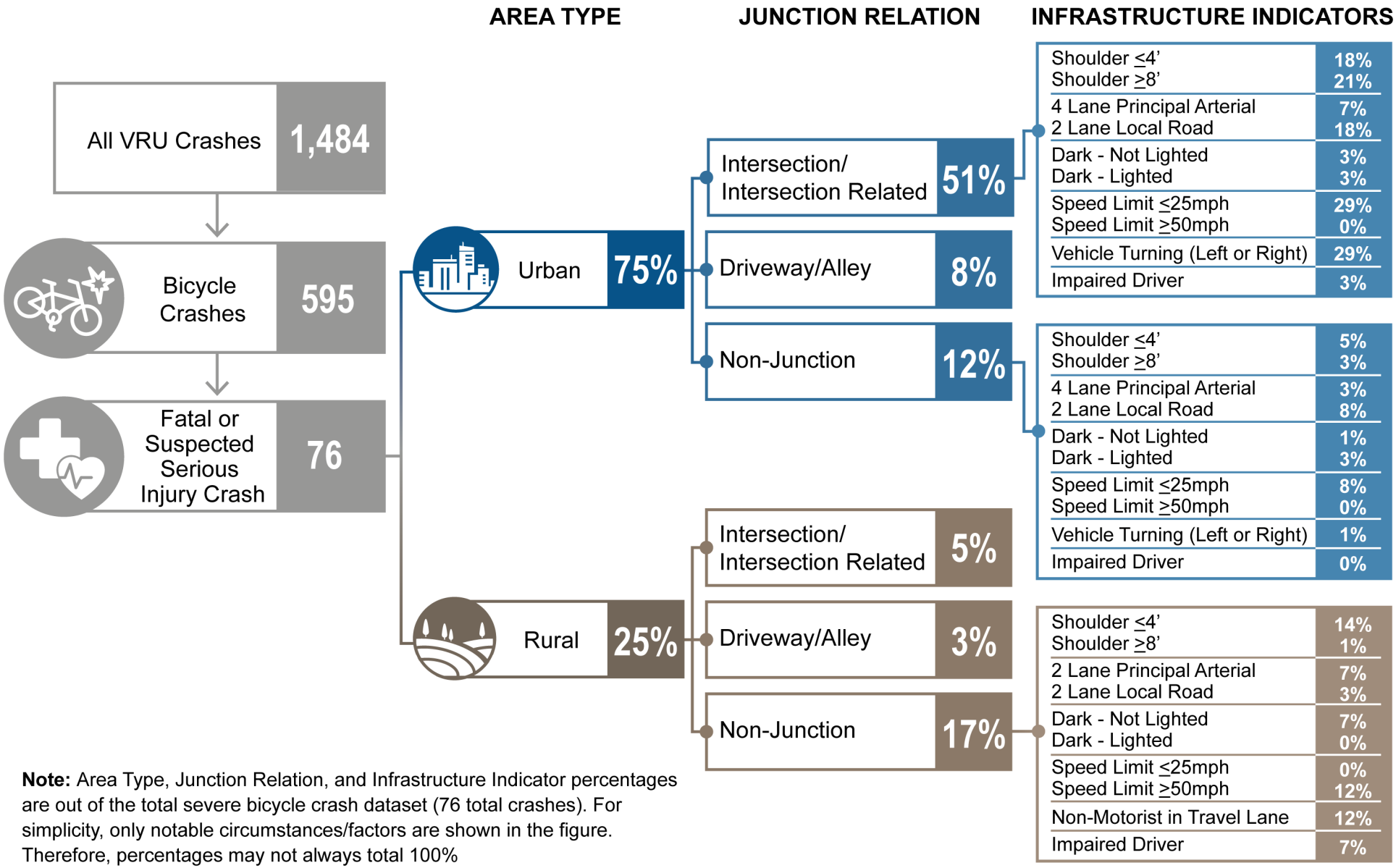


Source: RPA



Note: Area Type, Junction Relation, and Infrastructure Indicator percentages are out of the total severe pedestrian crash dataset (228 total crashes). For simplicity, only notable circumstances/factors are shown in the figure. Therefore, percentages may not always total 100%

Figure 3.14: Infrastructure Indicators in Severe Pedestrian Crashes



Note: Area Type, Junction Relation, and Infrastructure Indicator percentages are out of the total severe bicycle crash dataset (76 total crashes). For simplicity, only notable circumstances/factors are shown in the figure. Therefore, percentages may not always total 100%

Figure 3.15: Infrastructure Indicators in Severe Bicycle Crashes

3.5. CRASH NARRATIVE REVIEW

While analyzing and reporting the crash data contained in the previous sections, it was determined that more information was needed to understand the circumstances surrounding fatal and suspected serious injury VRU-involved crashes to determine commonalities and trends. Accordingly, the crash narratives, including descriptions from individuals involved and responding officers, were reviewed for the severe VRU-involved crashes. Based on these narratives, behavioral trends were identified. Additionally, a review of each severe injury crash location was performed using available aerial imagery to determine various infrastructure indicators at the scene of each crash. It is recognized that some aerial imagery may be outdated, or some infrastructure conditions may have changed since the time when the crash occurred. The original crash records were systematically reviewed and updated as necessary to catalogue the information more precisely and consistently. As such, some of the information in this section may not match previously discussed trends. Furthermore, the updated information is still only as accurate as the details provided in the crash narratives, and some relevant circumstances may not have been recorded.

3.5.1. Flagged Crashes

Through a review of the crash narratives, it was observed that several of the crashes were correctly coded as pedestrian-involved crashes, according to the definition in **Section 1.1**, but were not reflective of individuals walking for transportation purposes. For example, some pedestrian-coded crashes involved emergency responders or individuals who had exited a disabled or crashed vehicle and were then hit by an oncoming vehicle. A total of 63 crashes were identified as involving individuals who were not involved in pedestrian transport. These circumstances are important to understand as they point to trends that are not otherwise applicable to VRUs injured while in transport and may therefore require different considerations.

Table 3.1 summarizes the number of crashes by each flagged crash type in addition to other characteristics such as the resulting severity and location. As a result of some crashes being flagged in more than one category, there were a total of 71 flags raised during the crash narrative review. All flagged crashes were coded as pedestrian-involved crashes. All severe bicycle-involved crashes involved bicyclists in transport.

Table 3.1: Flagged Crash Types - Pedestrian Not In Transport

Flagged Crash/Type (Multiple Types) *(Numbers indicate crash incidents as opposed to individuals involved.)*	Crash Severity		Location		On Reservation	Total
	Fatal	Serious	Urban	Rural		
Argument	2	4	1	5	3	**6**
Vehicle Backing	2	9	4	7	3	**11**
Building Occupant	2	2	3	1	0	**4**
Emergency Worker/Work Zone Flagger	1	3	1	3	1	**4**
Former Occupant of Crashed/Disabled/Other Vehicle	13	19	8	24	4	**32**
Faulty Equipment	1	0	0	1	0	**1**
Intentional (Non-Motorist or Driver)	3	2	0	5	2	**5**
Jumped from Vehicle	1	2	2	1	0	**3**
Fell in Roadway/Waving Down Vehicle	0	5	1	4	1	**5**
Total	**25**	**46**	**20**	**51**	**14**	**71**

3.5.2. Observed Trends Summary

Several trends were noted from the review of crash narratives. These trends appeared to be contributors to crashes and may help identify strategies to address VRU-involved crashes. The trends are summarized in the following sections based on whether they were related to only non-motorists or only drivers, respectively, or whether they were applicable to both person types. These summaries are qualitative only and no attempt was made to quantify the occurrence of such circumstances.

Non-Motorists Only

- Several pedestrians were hit while crossing an unmarked, mid-block location within a roadway. Often, these pedestrians were cited with jaywalking. In many instances, there was a nearby intersection with marked crosswalks, according to a review of recent aerials.
- Many non-motorists involved in crashes during the night were wearing dark clothing with no reflective gear or personal lighting.
- Several non-motorists were observed to be in the roadway improperly at the time of the crash. This includes pedestrians, especially impaired individuals, walking in the travel lane. These instances primarily occurred in rural non-junction settings where other pedestrian facilities were unavailable, although in some cases an adjacent sidewalk was available but not used. A few disabled individuals using wheelchairs were also hit while operating in the roadway, despite an adjacent sidewalk being available. In these cases, the pedestrian cited poor sidewalk maintenance or lack of traversable curb ramps as reasons for riding in the roadway.
- Some pedestrians were hit while in marked crosswalks, however, in some cases it was noted that the pedestrian failed to wait for the pedestrian signal to be activated before entering the crosswalk. Similarly, some bicyclists failed to stop at a stop sign before proceeding through the intersection.

- Many bicyclists involved in crashes were riding on the sidewalk and did not slow down or yield before entering intersections and crosswalks. In a handful of instances, bicyclists were riding in marked bike lanes but were riding against traffic rather than with traffic when they were hit.
- Several pedestrians were noted as darting or dashing across a street prior to a collision. In these cases, it appeared that the pedestrians either did not look for oncoming traffic, misjudged the gaps between vehicles, or were attempting to beat an oncoming vehicle. Several children were hit as a result of darting into the travel path of a vehicle.
- A few crashes involving a pedestrian darting into traffic or standing in a roadway travel lane were flagged as intentional crashes and were assumed to be suicide attempts based on evidence at the scene. Additionally, several pedestrians were identified as having been diagnosed or treated for mental health, dementia, or other medical conditions affecting decision making.

Drivers Only

- Several flagged crashes involved a vehicle backing and hitting a pedestrian who was behind the vehicle. In some cases, the injured pedestrian was known to the driver and contact between the driver and pedestrian occurred just prior to the crash. Most drivers noted that they either did not look before backing up or that they could not see the pedestrian behind them.
- Some drivers were speeding at the time of the crash and either did not have enough time to react to a pedestrian or bicyclist in the roadway or lost control of the vehicle and hit a nearby non-motorist. This was also true of bicyclists riding too fast and not being able to stop before a collision. In a couple of instances, a driver lost control of the vehicle and crashed through a building, injuring a building occupant, which was coded as a pedestrian crash.
- In some crashes, the driver cited obstructed views as a contributor in the crash. This included pedestrians emerging into the roadway from between multiple vehicles as well as glare from the sun or oncoming headlights.
- Some crashes involved a driver failing to yield to a pedestrian in a crosswalk. Often these crashes occurred when turning vehicles did not yield to a pedestrian crossing on the street that the vehicle was turning onto. There were several instances of turning vehicles taking a tight turning path and clipping a bicyclist who was waiting at an intersection. Additionally, there were instances on multi-lane roadways where some vehicles had stopped to yield to a pedestrian and an approaching vehicle swerved around the stopped cars and hit the crossing pedestrian.
- In a few instances, a bicyclist was hit due to a driver failing to give enough room to the cyclist when passing.

Non-Motorists & Drivers

- Many of the severe injury non-motorist-involved crashes involved impairment by either the non-motorist, driver, or both. Impaired crashes were especially prevalent in rural areas and on Tribal Reservations. Nearly all impaired VRUs involved in crashes were pedestrians.
- Some VRUs and drivers involved in crashes admitted to being distracted at the time of the crash, including headphone/device usage and reaching for an object inside a vehicle.
- Environmental factors were contributors in several VRU crashes including dark lighting conditions with no or poor street lighting, poor weather conditions, and other visibility issues mentioned previously.
- Of the children who were involved in severe VRU crashes, many were left unattended. These crashes involved children darting into a street or running after a vehicle, standing behind a vehicle, or playing in a vehicle and accidentally shifting it into motion.
- Faulty vehicles or equipment were cited by some drivers and non-motorists involved in crashes, however, investigators rarely found these accusations to be true for vehicles. Several bicyclists cited poor or absent brakes.
- Several pedestrian-involved crashes were a result of an argument or displays of aggression, especially between known parties. In some cases, one party was outside the vehicle while the argument was taking place and the driver of the vehicle either intentionally or haphazardly put the car into motion, hitting the other person involved in the argument. In an extreme case, a driver intentionally ran off the road and hit a pedestrian on two separate instances and was later apprehended. Other reports of disputes between drivers and pedestrians turning violent and ending in a collision were also noted.
- Based on aerial reviews, several of the crashes occurred around parks, schools, bus stops, and recreation sites. A couple of crashes also involved transient individuals with at least one crash occurring outside of a food bank.

Source: RPA

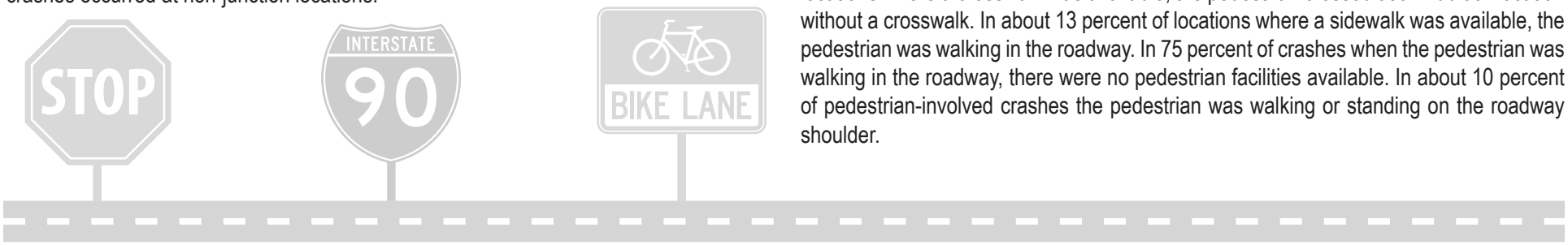
3.5.3. Infrastructure Indicators

For only the fatal and suspected serious injury VRU-involved crashes, a detailed review of infrastructure characteristics was conducted using aerial imagery and MDT databases. The following analysis is based on information reviewed in the spring of 2023, recognizing that available aerial imagery may not fully match the conditions that were present at the time of a crash that occurred during the 2017 to 2021 period. Furthermore, in some instances aerial imagery was poor or unavailable. Various infrastructure details were catalogued according to observed conditions and the detailed crash narratives. These details may differ slightly compared to the analyses provided in previous chapters which relied solely on the information contained in the simplified crash records. All fatal and suspected serious injury VRU-involved crashes were included in the analysis, including those that were flagged (**see Section 3.5.1**).

Junction Characteristics

Approximately 35 percent of the severe VRU-involved crashes occurred at intersections or were intersection related. About 9 percent occurred at a driveway or alley while 54 percent occurred at non-junction locations. The intersections at which crashes occurred were primarily two-way stop controlled (51 percent) but were also often controlled by traffic signals (32 percent). About 7 percent of crashes occurred at an uncontrolled intersection. About 88 percent of crashes that occurred at a signalized intersection caused suspected serious injuries while 12 percent resulted in fatalities. Nearly all (86 percent) of crashes that occurred at driveways, either residential driveways or commercial access points, did not have any form of traffic control device. About 4 percent of severe crashes occurred at a skewed intersection and another 4 percent occurred at offset intersections; about 88 percent of these intersections were in urban areas. Overall, intersection crashes occurred primarily in an urban setting (90 percent) and involved a pedestrian (60 percent).

Non-junction crashes occurred more often in rural settings (58 percent) and involved primarily pedestrians (87 percent). Of all the VRU-involved fatal and severe injury crashes that occurred on Tribal Reservations, 78 percent occurred at a non-junction location. Approximately 74 percent of fatal crashes and 46 percent of suspected serious injury crashes occurred at non-junction locations.



Roadway Characteristics

About 33 percent of severe VRU-involved crashes occurred on principal arterials while 26 percent occurred on local streets. Of the principal arterials where crashes occurred, 43 percent were undivided, 41 percent had a center two-way left-turn lane, and 17 percent had a concrete median or other physical divider. About 67 percent of principal arterials where crashes occurred had four lanes, and about 29 percent had two lanes. Almost all (90 percent) of local roads where crashes occurred were undivided and had two lanes. The majority of routes where crashes occurred were two-way streets; about 7 percent of roadways were one-way roadways.

About one-third of crashes occurred on roadways with a speed limit of 25 mph, including a mixture of local, collector, and arterial roadways. About 25 percent of crashes occurred on roadways with a 35 mph speed limit, of which about 41 percent were principal arterials. About 15 percent of severe VRU-involved crashes occurred on arterials and interstates with a speed limit of 65 mph or greater.

Nearly 29 percent of roadways where VRU-involved crashes occurred had no shoulder, including 21 percent of principal arterials and 42 percent of local roads. About 47 percent of principal arterials had 8-foot shoulders. Overall, 47 percent of roadways had shoulders of 4 feet or less while 39 percent had shoulders greater than or equal to 8 feet.

Non-Motorist Facility Characteristics

At locations where a bicycle crash occurred, 36 percent of roadways had marked bicycle facilities including bike lanes, sharrows, or a separated path. In 4 percent of bicycle crashes, the bicycle facility ended (or started) at the location where the crash occurred. About 13 percent of bicyclists were riding on the sidewalk at the time of the crash, and in 60 percent of those crashes there was an on-street bicycle facility available.

At locations where a pedestrian-involved crash occurred, there was a sidewalk or separated path available 55 percent of the time, a crosswalk available 20 percent of the time, and a pedestrian signal about 7 percent of the time. In about 25 percent of locations where a crosswalk was available, the pedestrian crossed at a midblock location without a crosswalk. In about 13 percent of locations where a sidewalk was available, the pedestrian was walking in the roadway. In 75 percent of crashes when the pedestrian was walking in the roadway, there were no pedestrian facilities available. In about 10 percent of pedestrian-involved crashes the pedestrian was walking or standing on the roadway shoulder.

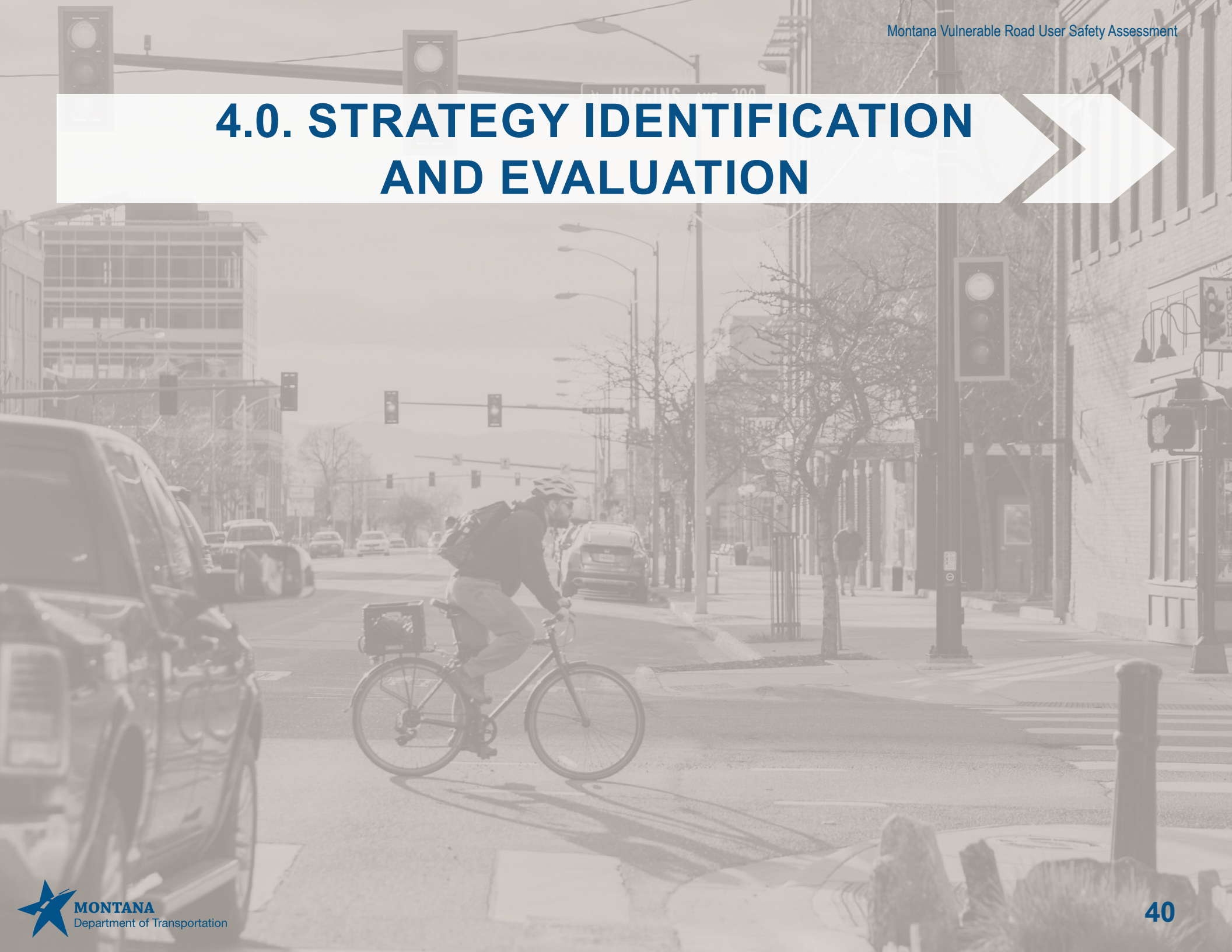
Source: MDT

3.6. CRASH ANALYSIS SUMMARY

This chapter identified VRU safety risks within Montana through a data-driven analysis of historic VRU-involved crash data over the five-year period from January 1, 2017, to December 31, 2021. This analysis helped identify contributing factors in VRU fatalities and suspected serious injuries including demographics, roadway characteristics, and behavioral trends to determine commonalities that put a location type or individual at a higher risk of being involved in a VRU crash. These findings provided the basis for development of recommended strategy to address VRU safety risks which are contained in the next chapter. A summary of generalized takeaways from the baseline crash analysis is provided below.

- In general, pedestrian crashes were more common than bicycle crashes, and both crash types were more common in urban areas. A disproportionate number of VRU-involved crashes, especially severe crashes, occurred on Montana's Tribal Reservations. Native Americans were disproportionately represented in the fatal crash dataset, especially for pedestrian crashes.
- In urban areas, VRU-involved crashes at intersections were more common, while crashes at non-junction locations were more common in rural areas.
- Crashes in urban areas involving a VRU most commonly occurred on two-lane, undivided, low-speed local roadways or on multi-lane principal arterials with two-way left-turn lanes and lower speed limits. In rural areas, crashes most commonly occurred on local roadways, but were also prevalent on high-speed, two-lane arterials.
- Many crashes occurred where there were no pedestrian or bicycle facilities available, especially in rural areas. However, when there were facilities available, they were not always used by non-motorists due in part to maintenance issues, accessibility issues, convenience, or general comfort level of the non-motorist. Many non-motorists chose to cross at mid-block locations, even if there was an adjacent crosswalk available nearby.
- Drivers were often unaware of the pedestrian or bicyclist either because they were difficult to see, they did not expect a non-motorist, the non-motorist was in an improper position, or they failed to look for and yield to non-motorists.
- Many VRU-involved crashes occurred at night in locations without street lighting, making it difficult for drivers to see VRUs in the roadway. Several non-motorists were noted as wearing dark clothing with no personal lighting.
- Impairment of both drivers and non-motorists was prevalent in the crash dataset, especially for severe crashes.
- Pedestrians not in transport were involved in multiple VRU crashes, including former occupants of motor vehicles standing in the roadway, emergency service/work zone situations, building occupants, and other unusual circumstances.

4.0. STRATEGY IDENTIFICATION AND EVALUATION



4.0. STRATEGY IDENTIFICATION AND EVALUATION

Individual strategies were identified with the intention of improving VRU safety and reducing VRU fatalities and serious injuries in Montana. The descriptions and attributes associated with each strategy can be used by state and local authorities to inform investment decisions as available funding is applied to achieve these goals. Although the VRU SA does not outline specific implementation actions, example projects, programs, and policies are provided for reference. VRU strategies can be used to assist in the future identification, development, and implementation of specific projects across the state.

4.1. OVERVIEW OF STRATEGY ATTRIBUTES

Strategies were categorized according to multiple attributes. The following sections provide an overview of the attribute categories, which are intended to help inform future project identification and development.

Safe System Approach

Strategies were organized according to the SSA, a national framework that aims to improve transportation safety by reinforcing multiple layers of protection to both prevent crashes from happening and minimize the harm caused to those involved when crashes do occur.[4] It is a holistic and comprehensive approach that prioritizes the elimination of crashes that result in death and serious injuries. The approach recognizes that humans are vulnerable and make mistakes, the responsibility for roadway safety is shared, safety partners should be proactive and address deficiencies before crashes occur, and redundancy in the transportation system is crucial. To support these objectives, the SSA is categorized according to the five elements below.

Safe Road Users: Encourage safe, responsible behavior by people who use Montana's roads and create conditions that prioritize their ability to reach their destination unharmed. This element focuses on the behaviors of both drivers and non-motorists.

Safe Vehicles: Expand the availability of vehicle systems and features that help to prevent crashes and minimize the impact of crashes on both occupants and non-occupants. In the NRSS, this element is mainly targeted at vehicle manufacturers and rulemaking at the federal level.[5] For the Montana VRU SA, this element focuses on bicycles and other VRU conveyance devices such as wheelchairs, scooters, and skateboards.

Safe Roads: Design roadway environments to mitigate human mistakes and account for injury tolerances, to encourage safer behaviors, and to facilitate safe travel by the most vulnerable users.

Safe Speeds: Promote safer speeds in all roadway environments through a combination of thoughtful, equitable, context-appropriate roadway design, appropriate speed-limit setting, targeted education, outreach campaigns, and enforcement.

Post-Crash Care: Enhance the survivability of crashes through expedient access to emergency medical care, while creating a safe working environment for vital first responders and preventing secondary crashes through robust traffic incident management practices.

4 E's of Safety

Improving transportation safety requires a comprehensive approach that employs multiple approaches. A common framework is referred to as the "4 E's of Safety" which includes Education, Enforcement, Engineering, and EMS. For each strategy, the relevant 4 E's of Safety are identified to indicate the field of technical expertise, related program of example actions, and the coordinated approach necessary to effectively implement the strategy.

Education

Enforcement

Engineering

EMS

Observed Trends

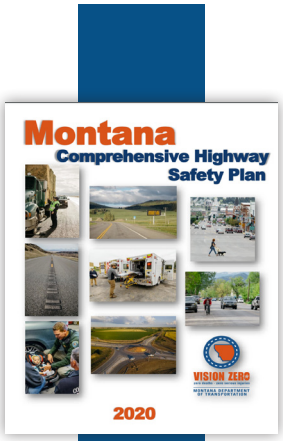
The proposed strategies are intended to address crash trends that were identified through the baseline safety analysis (**Chapter 3**). The observed trends were derived from an analysis of crash records, a review of crash narratives for severe VRU crashes, and analysis of aerial imagery of locations where severe VRU crashes occurred. Although the observed trends can help justify implementation of the strategy, the absence of a strong crash trend in Montana does not discount the viability or necessity of the strategy.

Example Actions and Efforts

A variety of example projects, programs, policies, actions, and other efforts that may relate to the proposed strategy were provided to indicate how the strategy could be applied to achieve safety goals. From educational campaigns, investments in infrastructure projects, new technologies, maintenance practices, policies, enforcement, and training, strategies are intended to address safety from numerous angles. The list of examples is meant to be illustrative as opposed to exhaustive. Other projects and actions not listed in the examples could be applicable to the strategy. Not all examples will be suitable in all cases, and additional studies may be necessary to determine the most appropriate solution for each individual location.

Partners

Although MDT is serving as the lead agency for development of the VRU SA, implementation of VRU safety strategies across the state will require coordination, cooperation, and support from multiple partners. In addition to MDT, supportive efforts from partners including MPOs, other state and local governing bodies (including road maintenance and highway crews), user organizations and associations, state and local law enforcement, emergency responders, school districts, and individuals will be needed to successfully improve VRU safety in Montana. The term emergency responders is intended to include all personnel that may respond at the site of an incident, including EMS responders, highway workers, fire and rescue, law enforcement, tow truck operators, and local government personnel such as public works staff. Entities that are expected to play a role in implementation of the strategies are listed in alphabetical order rather than order of responsibility.



CHSP Connection

Many of the proposed strategies overlap with efforts MDT is already conducting as part of the statewide CHSP. MDT also plans to append the strategies identified in the VRU SA to the CHSP and integrate strategies into the work of each emphasis area as appropriate. The Montana CHSP currently identifies four emphasis areas including (1) Impaired Driving, (2) Unrestrained Vehicle Occupants, (3) Roadway Departure & Intersection-related Crashes, and (4) Emergency-Response – Post-Crash Care. Although the CHSP does not isolate VRU crashes as a stand-alone emphasis area, three of the four emphasis areas overlap with VRU strategies (all except Unrestrained Vehicle Occupants). The proposed strategies are intended to reinforce and build upon existing CHSP strategies under the current emphasis areas.

Additional Considerations

Not all strategies and example actions will be suitable in all cases. Application of the strategies and individual actions or projects will vary depending on the project location and other contextual considerations. Various circumstances that should be considered when pursuing a proposed strategy were listed where applicable. These considerations are intended to help identify the locations, populations, or circumstances where a strategy will be most effective and identify any considerations that will help optimize strategy implementation.

Resources and References

Several of the proposed strategies were developed based on federal guidance and proven countermeasures. Where applicable, references to the FHWA *Proven Safety Countermeasures*[6], the NHTSA *Countermeasures that Work*[7], and the *Crash Modification Factor (CMF) Clearinghouse*[8] are provided. Additionally, various resources are provided to assist partners with implementation efforts.

4.2. STRATEGIES

A range of potential strategies aimed at reducing VRU safety risks were considered for the Montana VRU SA. Based on coordination with MDT and safety partners across the state, the following strategies selected for inclusion in the VRU SA are likely to address historic VRU crash trends and proactively address other potential safety risks in the transportation system. The strategies include projects, programs, policies, and strategies included in other MDT plans and documents as well as safety countermeasures which have been proven to reduce VRU crashes and improve VRU safety.

Source: MDT

Safe Road Users

4.2.1. Safe Road Users

The following strategies are intended to address the behaviors of drivers and non-motorists which were observed to play a role in VRU-involved crashes including impairment, distraction, visibility, and protection.

REDUCE DRIVER AND NON-MOTORIST IMPAIRMENT

Nationally, driver impairment—including consumption of alcohol, drugs, and medications—increases both the risk of a crash occurring as well as the likelihood of death or serious injury as a result. However, non-motorist impairment can be just as risky as driver impairment. The influence of mind-altering substances can impair perception, judgment, coordination, focus, and reaction time for people walking, rolling, riding a bike, or driving.

In Montana, a person is considered to be driving under the influence if the person drives or is in actual physical control of a vehicle and has an alcohol concentration of 0.08 percent or more. For those operating a commercial vehicle, the threshold is 0.04 percent, and for drivers under the age of 21, the limit is 0.02. A driver of any age operating a commercial or non-commercial vehicle with a delta-9-tetrahydrocannabinol (THC) level of 5 nanograms per milliliter or more is also considered impaired in the state of Montana. MCA 61-8-1002 covers drivers under the influence of alcohol, drugs, or a combination of alcohol and drugs. The statute specifically defines a driver as a person who is operating a vehicle, excluding bicyclists (MCA 61-8-1001(15)). Except in an authorized crosswalk, a pedestrian who is under the influence of alcohol or any drug is permitted to walk or stand in public rights-of-way, but not on a roadway or a shoulder (MCA 61-8-508).

Observed Trends

- **28%** of severe VRU crashes (84) involved an impaired driver or non-motorist. About **13%** of those crashes (11) involved both impaired drivers and impaired non-motorists.
- **78%** of fatal VRU crashes (14) on Tribal Reservations involved an impaired driver or non-motorist. About **36%** of those crashes (5) involved both impaired drivers and impaired non-motorists.

E's of Safety

Education Enforcement EMS

Example Actions and Efforts

- Focused alternative transportation campaigns (i.e., Safe Ride Home, Decide to Ride, Drive Sober, Designated Driver, etc.)
- Partnerships with behavioral health, substance abuse, and prevention specialists
- Penalties for impaired driving and biking

Partners

- Behavioral Health, Substance Abuse, and Prevention Specialists, EMS Responders, and Medical Providers can provide brief intervention and referrals for impaired individuals involved in crashes, in addition to promoting proactive education campaigns focused on the importance of not operating a bicycle or driving impaired.
- Bicycle Clubs can help share information and promote educational campaigns to local bicyclists.
- Individuals are responsible for their own behavior. Everyone can play a role in reducing impaired walking, rolling, biking, and driving.
- Law Enforcement can help educate communities about impaired driving/walking/rolling/bicycling, encourage appropriate behavior, and enforce traffic laws.
- Local Governments can work with local safety partners to coordinate educational campaigns, implement ordinances, and enforce penalties through city courts.
- MDT can help promote and share safety information, messaging, and other materials with local partners and state agencies.
- Walking and Disability Groups can help share information and promote educational campaigns to local individuals engaged in walking/running/rolling and to other stakeholder groups.

REDUCE DRIVER AND NON-MOTORIST IMPAIRMENT

CHSP Connection

- Impaired driving is an emphasis area in the CHSP with a dedicated Executive Leadership Team tasked with promoting and supporting the associated strategies. The strategies include deterrence and enforcement; prevention and education; criminal justice system; screening and brief assessment, treatment, and rehabilitation; communication program; and program evaluations and data monitoring.

Additional Considerations

- Increased traffic safety education and opportunities on Tribal Reservations may be warranted given the number of fatal crashes involving impairment that occurred on Tribal Reservations.
- Biking under the influence laws could be pursued at the Legislative level.

Source: NHTSA

Resources

- *Countermeasures That Work*[3] provides guidance on a variety of strategies to reduce impaired driving, biking, and walking.
- *Getting to Zero Alcohol-Impaired Driving Fatalities*[9] identifies numerous evidence-based policies, programs, and system changes to accelerate national progress in reducing alcohol-impaired driving fatalities.

Source: MDT

Source: MDT

REDUCE DRIVER AND NON-MOTORIST DISTRACTION

Distractions are prevalent in our daily lives and have become more commonplace while driving, bicycling, rolling, and walking. Any activity that diverts a person's attention from the roadway, including talking or texting on a cell phone, eating or drinking, talking to passengers, or interacting with audio/video equipment, electronic gaming devices, or a navigation system, can increase the risk of a crash. Distracted driving is defined in three main categories: visual, manual or tactile, and cognitive distractions. It has been the focus of many national campaigns in recent years, however, campaigns targeting non-motorist distractions are less commonplace, especially in rural areas.

Montana is the only state in the nation that has no laws banning cellphone use or texting while driving. However, 15 Montana communities, including Anaconda-Deer Lodge County, Baker, Billings, Bozeman, Butte-Silver Bow, Columbia Falls, Cut Bank, Great Falls, Hamilton, Havre, Helena, Missoula, Shelby, Whitefish, and the Fort Peck Tribal Reservation, have local laws that prohibit the use of handheld cell phones or electronic devices while driving. Some localities across the state have laws specifically banning bicyclists from using headphones and others, such as Bozeman, Helena, and Missoula, have enacted laws prohibiting bicyclists from using handheld devices when operating a bicycle within city limits. Individual states and localities have also started enforcing laws against distracted walking and fining pedestrians that are using cell phones while walking. Furthermore, although Montana does not have a state law against cell phone use while driving, a driver can be held accountable for negligence and incur liability for damages if they are involved in a crash while using a mobile device.

Observed Trends

- Approximately **2%** of drivers (6) involved in severe VRU crashes were issued citations or warnings for careless driving. An additional **5%** of drivers (14) were cited for failure to yield to a non-motorist in a crosswalk.
- Crash records indicate that **26%** of drivers (385) involved in all VRU crashes drove in a distracted, inattentive, or careless manner at the time of the crash.
- **2%** of non-motorists (26) involved in crashes were noted as being inattentive (talking, eating, etc.) at the time of the crash.

E's of Safety

Education

Enforcement

Example Actions and Efforts:

- Education campaigns focused on safety awareness (e.g., avoidance of texting, headphones, ear buds)
- Distracted driving/biking/rolling/walking laws
- Penalties for distracted driving/biking/rolling/walking

Partners

- City/County Public Health/Injury Prevention Specialists can promote safety education materials and media campaigns focused on reducing traffic distractions within local communities.
- Individuals are responsible for their own behavior. Everyone can play a role in reducing distractions while driving, biking, rolling, and walking.
- Law Enforcement can help educate communities about distracted driving/biking/rolling/walking, encourage appropriate behavior, and enforce traffic laws.
- Local Governments can implement and enforce local traffic laws and work with local community members and safety partners to develop and share distracted in traffic safety initiatives and media campaigns.
- MDT can provide and promote safety education, information, and campaign materials with local, state and federal partners.
- School Districts can share and promote educational materials and campaigns for students and those operating in school zones.

Source: Vision Zero Network

REDUCE DRIVER AND NON-MOTORIST DISTRACTION

CHSP Connection

- The Roadway Departure and Intersection-related Crashes Emphasis Area includes strategies to continue to promote and support educational campaigns to encourage road users to behave safely, pay attention, and drive without distractions.
- The Roadway Departure and Intersection-related Crashes Emphasis Area includes a potential future strategy to support awareness of community cell phone ordinances.

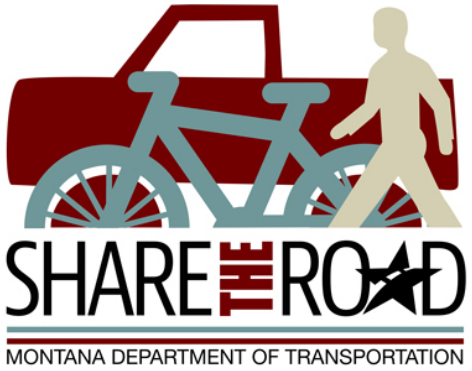
Additional Considerations

- Providing separated facilities for bicyclists and pedestrians can help minimize the risk of being involved in a crash due to a distracted driver.
- App incentives, like This App Saves Lives, can reward drivers who abstain from phone-based distracted driving.
- Driver's license exams can encourage diligent driving.
- In Montana, a person operating a bicycle or moped may not carry any package, bundle, or article that prevents the person from keeping at least one hand on the handlebars (MCA 61-8-606).

Resources

- NHTSA's Traffic Safety Marketing program and the National Safety Council, among others, provide materials relating to Distracted Driving campaigns.[10,11]
- *Countermeasures That Work*[3] provides guidance on a variety of strategies to reduce distracted driving, biking, and walking.

Source: This App Saves Lives



Source: MDT

Source: NHTSA

INCREASE PEDESTRIAN VISIBILITY

Everyone is a pedestrian at various times. An individual walking to a parked car, standing in a driveway, running on the sidewalk, or rolling a wheelchair across a curb ramp, is considered a pedestrian. Drivers are required to yield to pedestrians in marked and unmarked crosswalks and on sidewalks (MCA 61-8-502; 61-8-516). However, pedestrians should be vigilant about ensuring drivers can see them before entering the vehicle's path. Some ways to enhance visibility include wearing bright colors during the day, wearing light/white/bright/reflective clothing at night, and carrying a flashlight or headlamp when walking in the dark. Per MCA 61-8-502, pedestrians are not permitted to suddenly walk or run into the path of a vehicle that is so close that it is impossible for the operator to yield. Pedestrians should always attempt to stay out of drivers' blind spots, watch for vehicles entering or exiting driveways, and always ensure they are seen by the driver before attempting to cross a street. Reducing external distractions, such as cellphones or headphones/ear buds, when walking, rolling, or running is also important to maintain proper roadway awareness.[12]

Observed Trends

- In **12%** of severe VRU crashes (36), the officer noted that the non-motorist was wearing dark clothing. The majority of these crashes occurred at night, further reducing visibility of the pedestrian.
- **9%** of severe VRU crashes (27) involved a non-motorist darting or dashing into the road. This behavior decreases the likelihood of drivers being able to see a pedestrian in time to react.
- Many of the crash reports do not comment on the pedestrians' clothing or actions; crashes involving these trends are likely underreported.

E's of Safety

Education

Enforcement

Example Actions and Efforts

- Education campaigns & incentives
  - Light/white/bright clothing
  - Reflective gear and personal lighting such as flashlights or headlamps
  - Safety awareness (e.g., avoidance of texting, headphones, ear buds)
  - Rules of the road
- Walking school buses, crossing guards

Partners

- City/County Public Health/Injury Prevention Specialists can provide and promote safety and educational materials and campaigns; share the importance of being safe and being seen; and encourage pedestrian visibility through the use of reflective equipment and gear.
- Individuals are responsible for their own behavior. Everyone can play a role in increasing their street visibility.
- Law Enforcement can help educate communities about pedestrian visibility, encourage proper behavior, and enforce traffic laws.
- Local Governments can work with local safety partners to coordinate and promote educational campaigns, provide incentives, and enforce traffic laws.
- MDT can provide and promote safety education, information, and campaign materials with local, state and federal partners.
- School Districts can share information, conduct educational campaigns, and promote safe walking routes through the use of crossing guards and walking school buses.
- Walking and Disability Groups can help share information about pedestrian visibility and promote educational campaigns to local stakeholder groups.

INCREASE PEDESTRIAN VISIBILITY

CHSP Connection

- The Roadway Departure and Intersection-related Crashes Emphasis Area includes the following strategies related to pedestrian visibility:
  - Encourage all road users to comply with the rules of the road and avoid distractions
  - Promote and support VRU safety education

Additional Considerations

- Educational campaigns should be tailored to different audiences as appropriate.
- Increasing the consistency of noting non-motorist safety equipment such as the use of reflective wear and lighting in crash reports can help identify education needs, enhance awareness, and promote VRU safety education.

Source: Volodymyr/Adobe Stock

Resources

- *Countermeasures That Work*[3] discusses pedestrian safety in many regards and breaks down different strategies and difficulties depending on population and location.

Source: FHWA

Source: flatvectors/Adobe Stock

INCREASE BICYCLIST VISIBILITY AND PROTECTION

Montana law does not require bicyclists to wear helmets, although research shows that helmets provide a 66% to 88% reduction in the risk of head, brain, and severe brain injury for bicyclists.[13] Other states have adopted helmet laws for minors specifically.[14,15,16]

Approximately 81% of bicycle-involved crashes (479) in Montana occurred during daylight hours (7:00 AM to 7:00 PM) when bicyclists would be the most visible to drivers. About one-third of severe bicycle-involved crashes (24) occurred outside those hours (7:00 PM to 7:00 AM), when it is typically dark outside. Although lighting can be a primary factor, the volume of crashes occurring during daytime hours speaks to other issues. Anecdotally, crashes most commonly occur when motorists do not detect or expect a bicyclist on the roadway, or when a bicyclist makes unpredictable movements that are contrary to the rules of the road. In the US, bicyclists are expected to follow the same standard practices as motorists, such as riding on the right side of the roadway, and are considered a vehicle when sharing the roadway. Since bicycles do not have turn signals, cyclists must use arm movements to indicate their intended turning direction. Bicyclists in Montana are legally allowed to ride on the right-hand side of a two-way roadway or on the left side of a one-way roadway with two or more marked traffic lanes and are permitted to ride on sidewalks and crosswalks but must yield right-of-way to pedestrians and give audible signals before passing a pedestrian traveling in the same direction (MCA 61-8-605 and 61-8-608).

MDT provides best practices for bicyclist safety and encourages riders to actively scan their surroundings, wear light/white/bright colors and a helmet, use hand signals, ride to the right side of the lane when traveling at less than the normal speed of traffic, keep both hands ready to brake, and use common sense as scenarios on the roadway change.[13] Since bicycles are much smaller than motorized vehicles, bicyclists should abide by “see and be seen” principles such as communicating intent with looking, yielding, and signaling; avoiding vehicle blind spots; and using extreme caution near commercial vehicles and buses that have a harder time spotting smaller modes of travel.

E’s of Safety

Education

Enforcement

Example Actions and Efforts

- Education campaigns & incentives
  - Light/white/bright clothing, helmets
  - Reflective gear and personal lighting such as flashlights or headlamps
  - Safety awareness (e.g., avoidance of texting, headphones, ear buds)
  - Rules of the road
- Helmet laws

Partners

- Bicycle Clubs and Bike Shops can help share information, promote educational campaigns, and encourage cyclists to use proper protective and reflective clothing and equipment.
- City/County Public Health/Injury Prevention Specialists can provide and promote safety and educational materials and campaigns; share the importance of being safe and being seen; and encourage bicyclist visibility through the use of reflective equipment and gear.
- Homeless Shelters and Pre-Release Centers can help promote educational campaigns, safety equipment, and reflective materials to their clients.
- Individuals are responsible for their own behavior. Everyone can play a role in increasing their street visibility and protection.
- Law Enforcement can help educate communities about bicyclist visibility and protection, encourage safe operating and Be Safe Be Seen behaviors, and enforce traffic laws.
- Local Governments can work with local safety partners to coordinate educational campaigns and implement traffic laws and local ordinances, as applicable.
- MDT can provide and promote safety education, information, and campaign materials with local, state and federal partners.
- School Districts can share information, promote educational campaigns, and work with local community partners and other agencies to offer safe biking behavior education and skills training, and identify safe routes to schools.

INCREASE BICYCLIST VISIBILITY AND PROTECTION

Observed Trends

- **9%** of bicyclists involved in crashes (47) were noted as using some form of safety equipment, including helmets, reflective clothing, or lighting.
- **11%** of bicyclists (8) who suffered severe injuries were noted as wearing a helmet at the time of the crash; 7% (5) were using some other type of safety equipment (lighting, reflective clothing, etc.), **23%** (17) were noted as not having any protective equipment; and the bicyclist's safety equipment was not provided in **59%** of severe crashes (44).
- Since many of the crash reports do not comment on cyclists' use of protective equipment, clothing, or reflective gear; crashes involving this trend are likely underreported.

CHSP Connection

- The Roadway Departure and Intersection-related Crashes Emphasis Area includes the following strategies related to pedestrian visibility:
  - Encourage all road users to comply with the rules of the road and avoid distractions
  - Promote and support VRU safety education

Additional Considerations

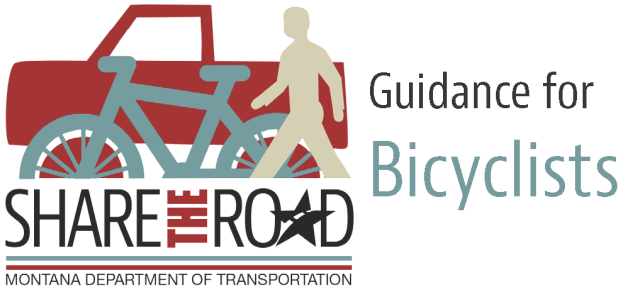
- Bicyclists fall under many demographic categories, and educational programs must take these factors into account to target specific audiences.
- Bicyclist-involved crashes and the use of bicyclists' protective equipment are underreported. Safety measures to increase bicyclist visibility and protection might be more important than the data indicates.
- Low-income communities face a higher risk of bicycle crashes due to the affordability of using bicycles and the trend of lower-quality infrastructure and services provided to these communities.[17,18]

Resources

- *Countermeasures That Work*[3] discusses many bicyclist safety topics and details different strategies and considerations depending on demographics and location.

Source: MDT

Source: MDT



Source: MDT

Safe Vehicles

4.2.2. Safe Vehicles

The following strategies are intended to enhance the safety of vehicles. In the realm of VRU safety, the term ‘vehicles' is intended to apply primarily to bicycles.

ENHANCE BICYCLE VISIBILITY AND FUNCTION

Montana law requires bicyclists to travel with lamps emitting a front white light and a back red light visible from at least 500 feet away when traveling at dusk, dawn, and nighttime (MCA 61-8-607). Although it is not required by law, traveling during the daytime with bicycle lamps helps drivers' contrast sensitivity and recognition of a cyclist.

The functionality of a bicycle is also important on the roadway. MDT recommends that every bicycle is adjusted to properly fit the rider and is given regular brake, chain, and tire maintenance. Without routine checks, the likelihood of an equipment malfunction and possible crash increases. MDT suggests that frequent riders, such as commuters, travel with a basic took kit and tire pump so they can quickly get out of an exposed scenario in the case of a breakdown. Regular brake maintenance is also important. As the smallest vehicles on the roadway, bicyclists must be able to stop quickly because they are less likely to be seen and more likely to be injured in a collision, whereas motorized vehicles travel faster and have less time and space to react because of their speed.

Observed Trends

- **12%** of severe bicycle-involved crashes (9) occurred when it was dark outside with no street lighting.
- Some severe VRU crash reports indicated that faulty bicycle brakes were contributors to a crash.

E's of Safety

Education

Example Actions and Efforts

- Education campaigns & incentives
  - Bicycle lamps/reflectors
  - Functioning brakes
  - Regular bicycle maintenance
- Tool kits

Partners

- Bicycle Clubs and Bike Shops can promote and provide tool kits to ensure each bicycle is functioning as intended.
- City/County Public Health/Injury Prevention Specialists can help provide and promote safety education campaigns on the importance of wearing bicycle helmets and safety equipment.
- Individuals are responsible for their own behavior. Everyone can play a role in maintaining their bicycle and ensuring it is properly equipped with lamps, reflectors, and basic tool kits.
- Local Businesses and Community Groups can help share information, promote safety educational campaigns, and offer potential incentives or services to local bicyclists.
- Local Governments can work with local safety partners to coordinate and promote bicycle maintenance education.
- MDT can help promote bicycle maintenance safety in coordination with local and state agencies.
- School Districts can promote bicycle maintenance as a safety component and work with local community groups to develop bike rodeos teaching the importance of proper function and maintenance of bicycles in addition to rules of the road, importance of visibility, and proper helmet and safety equipment use.

ENHANCE BICYCLE VISIBILITY AND FUNCTION

CHSP Connection

- Providing VRU safety education is included in the Roadway Departure and Intersection-related Crashes Emphasis Area.

Additional Considerations

- Bicyclists fall under many demographic categories, and educational programs must take these factors into account to target specific audiences.[3]
- Low-income communities face a higher risk of bicycle crashes due to the affordability of using bicycles and the trend of lower-quality infrastructure and services provided to these communities.[17,18]
- As required by MCA 61-8-607(1), bicycles must be equipped with a lamp on the front emitting a white light visible from a distance of at least 500 feet to the front. A bicyclist may use a lamp with equal intensity and visibility on the cyclists helmet in lieu of a lamp affixed to the bicycle. Bicyclists must also be equipped with a rear facing lamp emitting a red light visible from a distance of at least 500 feet to the rear or a red reflector visible from a distance of at least 500 feet. Side lights or reflective materials should also be used in addition to front and rear bicycle lamps to ensure the bicyclist is seen from all angles. Most bicycle lamps have the option to run in either a steady or flashing mode. Montana does not address flashing lights on bicycles, however other states and countries have various regulations regarding the use of flashing lights. Flashing patterns can distract other road users and skew other road users' perception of speed.
- As required by MCA 61-8-607(2), bicycles must be equipped with brakes allowing the bike to stop within 25 feet from a speed of 10 mph on dry, level, clean pavement.

Resources

- *Countermeasures That Work*[3] discusses bicyclist safety in many regards and offers different strategies depending on population and location.

Source: torwaiphoto/Adobe Stock

Source: yarohorkAdobe Stock

Source: Lev KaravanovAdobe Stock

Safe Roads

4.2.3. Safe Roads

The following strategies are intended to enhance the safety of the roadway environment for VRUs. These strategies include improvements to enhance pedestrian and bicycle accommodations on roadways, at intersections, and at mid-block crossings.

REDUCE CROSSING DISTANCES

High-speed, multi-lane roadways are barriers to VRUs. The distance required to cross a street and the length of time that an individual is exposed to traffic correlate to the risk of collision. Strategic designs can minimize and eliminate travel lanes and shoulders to provide more space for pedestrians and bicyclists and reduce the distance needed to cross a roadway. Reduced crossing distances can be achieved by reducing the number of vehicular travel lanes in favor of bicycle travel lanes or through installation of curb extensions, refuge islands, or roundabouts. While these improvements help reduce VRU exposure to traffic and improve the visibility of VRUs by motorists, they also have the added benefit of creating a street environment that encourages motorists to drive more slowly and with increased caution.

Observed Trends

- **18%** of severe pedestrian-related crashes (41) and **9%** of severe bicycle-related crashes (7) involved the non-motorist crossing more than two traffic lanes.
  - **60%** of those crashes (29) occurred at an intersection or marked crosswalk; **40%** (19) occurred at midblock locations.
- **43%** of severe pedestrian-related crashes (43) occurred at locations without pedestrian facilities.

Partners

- Local Governments and MDT can evaluate high-use locations and install appropriate treatments to reduce crossing distances for non-motorists.

Source: RPA

E's of Safety

Engineering

Example Actions and Efforts

- Roadway reconfiguration
- Curb bulbouts/extensions
- Pedestrian refuge islands
- Roundabouts

REDUCE CROSSING DISTANCES

CHSP Connection

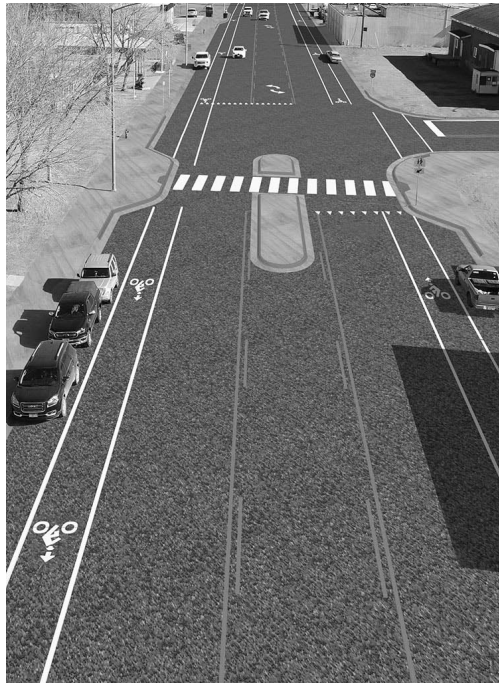
- The Roadway Departure and Intersection-related Crashes Emphasis Area includes a strategy to design intersections to mitigate user conflicts and reduce crashes, including consideration of implementing roundabouts and other VRU safety improvements.

Additional Considerations

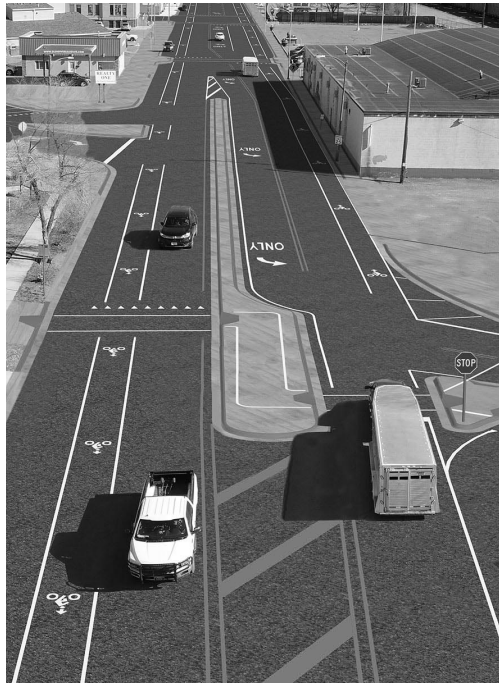
- This strategy may be more appropriate in urban settings with curb and gutter considerations.
- Extending curb lines to reduce pedestrian crossing distances can impact the function of bicycle and transit facilities. Bicycle cutouts or other treatments can ensure that extended pedestrian facilities preserve bicycle mobility.
- Pedestrian refuge islands should be considered for roadways with four or more lanes, speed limits of 35 mph or greater, and/or traffic volumes of 9,000 or greater. Refuge islands may also be appropriate for pedestrian crossings on 2-lane or 3-lane roads, especially where the street is wide and/or where vehicle speed or volumes are moderate to high.[19]
- The selection of an appropriate treatment to reduce crossing distances may require additional engineering studies.

Resources

- Medians and pedestrian refuge islands are proven safety countermeasures for application in urban and suburban areas to improve pedestrian safety by allowing pedestrians to cross one direction of traffic at a time.[20]
- Install raised medians with or without marked crosswalks at uncontrolled intersections has been shown to reduce vehicle-pedestrian crashes by approximately 31%.[21]
- FHWA's *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations* provides guidance to transportation agencies, including best practices for each step involved in selecting the best countermeasures at uncontrolled pedestrian crossing locations.[19]



Source: MDT/HDR



Source: MDT/HDR

INCREASE CROSSWALK VISIBILITY AND ACCESSIBILITY

Pedestrians' physical and cognitive abilities, including agility, balance, coordination, endurance, hearing, problem solving, strength, vision, and walking/rolling speed, can vary greatly. Sidewalks and crossings must be designed to accommodate all these differences and allow all users to cross streets safely. Particular consideration should be given to individuals with disabilities who have limited travel choices and typically rely most on the pedestrian environment.[22] Drivers from all travel lanes must be able to detect a crosswalk with adequate time to see if a pedestrian is crossing or waiting to cross, slow down, and safely stop. An effective pedestrian crossing may include a strategic layout of signs, visual and audible signals, beacons, pavement markings, medians or pedestrian islands, raised crosswalks, accessible curb ramps, and other elements.

Every crossing is different, and the most appropriate treatment will vary based on the road environment. MDT provides guidance for the application of treatments based on various design elements including crossing location, the number of travel lanes, roadway speeds, and AADTs. Possible treatments range from pavement markings and signage to roadway enhancements, and beacons or pedestrian signals.[23] MDT design standards also specify that transportation infrastructure must provide accessible curb ramps with ADA-compliant landings and a sufficient crosswalk width allowing two wheelchair users to pass without having to be in the roadway.[24]

Observed Trends

- **15%** of severe VRU crashes (47) involved a non-motorist crossing at a location without traffic controls (including mid-block and residential/commercial driveway crossings and approaches).
- None of the severe VRU crashes occurred at unsignalized crossings with high-visibility measures (pedestrian beacons or other advanced signaling) already in place.

E's of Safety

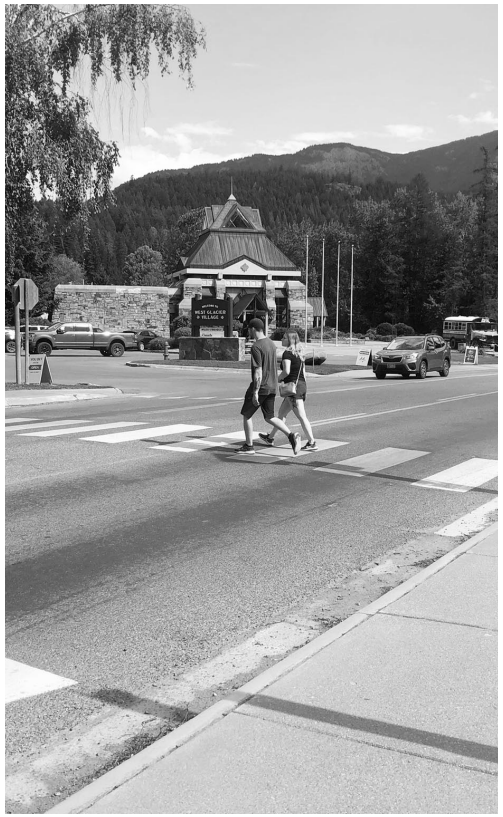
Engineering

Example Actions and Efforts

- Accessible curb ramps
- High-visibility pavement markings
- Rectangular Rapid Flashing Beacons (RRFBs)
- Pedestrian Hybrid Beacon (PHB)/High-intensity Activated crossWalKs (HAWKs)
- Intelligent Transportation Systems (ITS)

Partners

- Local Governments and MDT can identify high priority pedestrian crossing locations, conduct crossing studies, and install the most appropriate high-visibility treatments for each crossing.



Source: RPA

Source: MDT

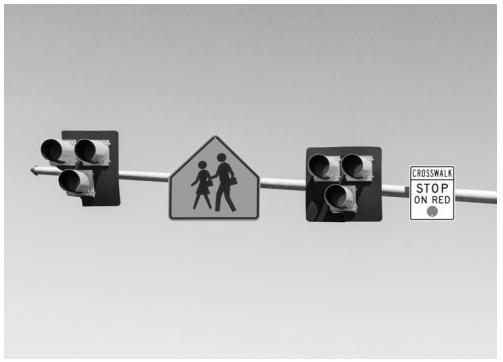
INCREASE CROSSWALK VISIBILITY AND ACCESSIBILITY

CHSP Connection

- Designing intersections to mitigate user conflicts and reduce crashes, including VRU-specific safety improvements, is included in the Roadway Departure and Intersection-related Crashes Emphasis Area.

Additional Considerations

- A crossing study may be required to select the most appropriate treatment given the specific context of the crossing location.
- Areas lacking ADA adaptations should be prioritized for updates.
- Pedestrian volume and user type should be considered for the implementation of high-visibility crosswalk measures.
- Advanced yield and stop signs should be considered in conjunction with high visibility devices.



Source: MichaelVi/Adobe Stock

Source: MDT

Resources

- Installing a PHB or HAWK at pedestrian crossings has been shown to yield a 24-45% reduction in vehicle-pedestrian crashes depending on the crash type and severity being addressed.[25]
- High-visibility crosswalks, improved lighting, and enhanced signing and pavement markings are all proven safety countermeasures to help make VRUs more visible to drivers at crossing locations.[26]
- PHBs are a proven safety countermeasure designed to help pedestrians safely cross higher-speed roadways at midblock crossings and uncontrolled intersections.[27]
- RRFBs are a proven safety countermeasure for enhancing pedestrian conspicuity and increasing driver awareness at uncontrolled, marked crosswalks.[28]

ENHANCE SIGNALIZED CROSSINGS

Signalized crossings are generally considered to give pedestrians the highest level of safety at intersection crossings. Despite this, many signalized crossings fail to give users adequate crossing time or meet ADA accessibility standards. The *Manual on Uniform Traffic Control Devices* (MUTCD) specifies that signals must provide a minimum of 4 seconds for users to cross a roadway if pedestrian volumes are low and 7 seconds if pedestrian volumes are moderate.[29] However, the MUTCD also specifies that the pedestrian clearance time should be sufficient to allow a pedestrian walking at a speed of 3.5 feet per second to travel to the far side of the traveled way or to a median of sufficient width for pedestrians to wait. If the average minimum width of arterial roadways in Montana is 30 feet,[30] and children move at an average speed of 4 feet/second,[31] a child could not cross an average arterial in the minimum allotted signal timing. Therefore, pedestrian intervals should be individually calculated to match the pedestrian volumes and characteristics of the intersection rather than using the optional minimums defined in the MUTCD.

In general, elderly and disabled populations also cross at slower speeds and require more time to navigate roadway crossings. In 2020, people 65 years old and above accounted for 17% of the national population with an disproportionate mortality rate of 20% at intersection crossings.[32] ADA requirements include accessible pedestrian signals and push buttons, curb ramps, and information for individuals with visual impairments at signalized crossings. MDT's 2021 *ADA Transition Plan* Update noted that accessible pedestrian signals with audible cues, such as announcing the street name and notifying a pedestrian when it is safe to cross, are valuable to individuals with visual and other impairments.[33]

Observed Trends

- **12%** of severe VRU crashes (36) occurred at signalized intersections. The presence of pedestrian signals at the intersections varied.
- Several severe VRU crashes involved a pedestrian being hit while in a crosswalk when the 'Walk' signal was illuminated.

E's of Safety:

Engineering

Example Actions and Efforts

- Accessible curb ramps
- High-visibility pavement markings
- Pedestrian push buttons, audible/visual cues
- Leading Pedestrian Intervals (LPIs)
- Increased pedestrian walk phase

Partners

- Local Governments and MDT can identify high priority signalized pedestrian crossing locations, conduct crossing studies, and install the most appropriate treatments for each crossing.

Source: Michael O'Keene/Adobe Stock

Source: Inscope/Adobe Stock

ENHANCE SIGNALIZED CROSSINGS

CHSP Connection

- Designing intersections to mitigate user conflicts and reduce crashes, including signalization and VRU safety improvements, is included in the Roadway Departure and Intersection-related Crashes Emphasis Area.

Additional Considerations

- Enhanced VRU treatments are typically more effective at intersections with high turning vehicle volumes.[34]
- An understanding of the surrounding population, including concentrations of children, elderly, or disabled individuals, is necessary to ensure treatments are accessible and targeted for users of all ages and abilities.
- Transportation agencies should refer to the MUTCD (Section 4E.06) for guidance on pedestrian signal timing and to ensure that pedestrian signals are accessible for all users.[29]
- A 24-hour capacity framework (e.g., 16-hour efficiency and 16-hour excess lane width) instead of peak-hour analyses can help jurisdictions weigh the trade-offs of building vehicular capacity for the peak hour compared to the off-peak consequences (particularly for VRUs) of overbuilt intersections/roadways in urban areas.

Resources

- LPIs are a proven safety countermeasure that allow pedestrians to establish their presence in the crosswalk before vehicles have priority to turn right or left.[35]
- Modifying an intersection's signal phasing by implementing an LPI has been shown to reduce vehicle-pedestrian crashes by 9-46% depending on site-specific conditions and traffic volumes.[36]
- Installing pedestrian countdown signals at signalized intersections has been shown to reduce vehicular crashes by 4-9%. The crash reduction potential specifically for vehicle-pedestrian crashes is unknown.[37]
- FHWA's *Improving Intersections for Pedestrians and Bicyclists Informational Guide and Fact Sheets* provides an easy-to-use guide for selecting countermeasures to install at various intersection design types.[38,39]
- The Transportation Research Board National Cooperative Highway Research Program's *Research Report 926: Guidance to Improve Pedestrian and Bicyclist Safety at Intersections* provides a succinct process for selecting intersection designs and operational treatments that provide safety benefits for pedestrians and bicyclists and offer the most appropriate situation for their application.[40]

Source: MDT

Source: RPA

Source: elvis901/Adobe Stock

INCREASE ROADWAY VISIBILITY

Visual acuity, the ability to discern details from a distance, and contrast sensitivity, the ability to detect differences in luminance and determine an object from its background, are the two largest factors in a motorist's perception of visual information. Several design strategies can be implemented on the roadway to increase motorist's visual acuity and contrast sensitivity including the use of high-visibility pavement markings and street lighting. Properly designed roadway lighting allows road users to quickly assess roadway conditions and creates a safer environment within the roadway.[41]

High-visibility crosswalk patterns, such as bar pair, continental, and ladder patterns, are visible to both the driver and pedestrian from farther away compared to traditional transverse line crosswalks. FHWA recommends considering this design element at midblock and uncontrolled crossings to increase driver awareness of the crossing. Signage and pavement markings can be placed in advance of crosswalks to indicate where a driver should stop or yield to pedestrians.

Obstacles such as parked cars, vegetation, and snow piles can block a motorist's view of the roadway and of VRUs. Daylighting is a practice used by many agencies in which parking spots closest to an intersection are removed to increase pedestrian visibility. Regular roadside maintenance can also help prevent the obstruction of the motorist's view in areas heavily used by VRUs. The horizontal and vertical curvature of the roadway itself can also impede sight distances. Crossings and accompanying signage should be carefully placed in these areas to ensure motorists and VRUs have enough time to detect and react to conflicts.

Observed Trends

- **38%** of severe pedestrian-involved crashes (86) occurred at night in areas with no street lighting.
- **12%** of severe bicyclist-involved crashes (9) occurred at night in areas with no street lighting.
- **16%** of all VRU crashes (235) occurred at night in areas where street lighting was present.

E's of Safety:

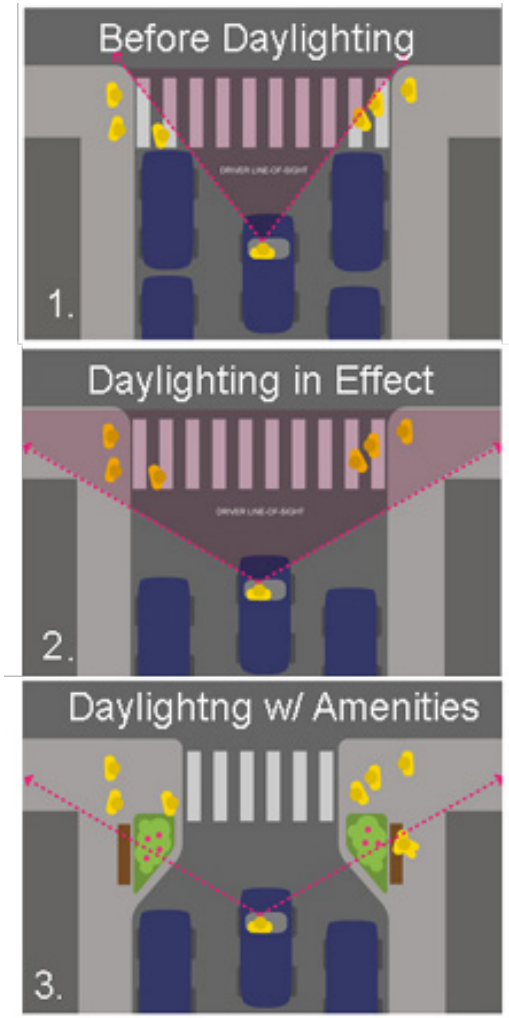
Engineering

Example Actions and Efforts

- Street lighting
- High-visibility pavement markings
- Signage
- Vegetation management
- Daylighting intersections
- Snow removal management

Partners

- When designing new roadways or installing improvements, Local Governments and MDT should consider various countermeasures to help increase the visibility of the roadway to motorists and VRUs. Transportation agencies and local road maintenance and public works departments can ensure vegetation management and snow removal are regularly performed.



Source: Myrtle Avenue Brooklyn Partnership

INCREASE ROADWAY VISIBILITY

CHSP Connection

- Designing roadways and intersections to mitigate user conflicts and reduce crashes, including lighting and VRU safety improvements, is included in the Roadway Departure and Intersection-related Crashes Emphasis Area.

Additional Considerations

- The maintenance of visibility measures must be considered.
- New technologies like adaptive LED fixtures, horizontal illuminance, Prisma street lighting, and solar lighting systems are available to help reduce the long-term costs of lighting.[42,43]

Resources

- Providing intersection illumination has been shown to reduce fatal vehicle-pedestrian crashes by 78-82% and other injury crashes by 42-59%.[44]
- Lighting is a proven safety countermeasure for application in urban and suburban areas to improve roadway visibility for motorists and non-motorists.[45]
- NHTSA's *Advancing Pedestrian and Bicyclist Safety: A Primer for Highway Safety Professionals* outlines a comprehensive approach to improving safety for bicyclists and pedestrians and offers a summary of the most frequently used engineering, enforcement, and education safety measures. The resource identifies how certain treatments may be placed in relation to other treatments, such as the coordinated installation of a pedestrian refuge island and lighting.[46]
- FHWA provides the handbooks *Street Lighting for Pedestrian Safety*, *Lighting Handbook*, and *Pedestrian Lighting Primer* with a review of existing documents and experiments conducted surrounding lighting, and detail recommendations regarding lighting for pedestrian safety.[47,48,49]

Source: wundermann/Adobe Stock

Source: Yulia/Adobe Stock

ENHANCE ON-ROAD BICYCLE FACILITIES

Many local jurisdictions have created and implemented area-specific plans for bicycle facilities within their jurisdictions. Outside of cities, Montana contains many expansive, rural areas that make the implementation of separated bicycle and pedestrian facilities infeasible due to cost effectiveness and difficulty to maintain. On-road facilities can be a feasible alternative to accommodate bicyclists within existing roadway facilities. In rural areas, widened shoulders can provide safe space for bicyclists outside of the vehicle travel lanes. On these roadways, shoulder rumble strips should be placed in a manner that allows enough space for cyclists to travel without deterrence.[50] In urban areas, bicycle lanes and sharrows (or pavement marking symbols designating travel lanes shared by cyclists and motor vehicles) can be implemented to create bicycle corridors and encourage bicycle travel through specific low-speed, low-volume corridors. MDT specifies that bicycle lanes must be a minimum of 5 feet wide and recommends paved shoulders to be 4 feet wide if no bicycle lane is offered.[51] Maintenance of on-road bicycle facilities is important to maximize use and safety. Removal of snow, gravel, leaves, trash, and debris should be regularly scheduled to maintain proper road conditions for bicyclists.

Observed Trends

- **54%** of severe bicyclist crashes (41) occurred on roadways with shoulders 4 feet or less, potentially indicating the bicyclist did not have adequate room to ride outside of the travel lane. Of these crashes, **49%** (20) occurred on roads with speeds of 30 mph or less and **20%** (8) occurred on roads with speeds of 50 mph or more.
- **20%** of severe bicycle crashes (15) occurred on rural two-lane highways with no or narrow (4 feet or less) shoulders.

E's of Safety

Engineering

Example Actions and Efforts

- Bike lanes
- Sharrows, bike route signage
- Widened shoulders
- Appropriately placed shoulder rumble strips
- Maintenance of facilities (i.e., street sweeping, snow removal, vegetation management, etc.)

Partners

- Local Governments and MDT should consider on-street bicycle facilities in existing design projects to increase connectivity and accessibility of bicycle facilities, and ongoing maintenance of bicycle facilities including mowing, sweeping and snow removal.

Source: MDT

Source: jStock/Adobe Stock

ENHANCE ON-ROAD BICYCLE FACILITIES

CHSP Connection

- The Roadway Departure and Intersection-related Crashes Emphasis Area includes the following strategies related to on-road bicycle facilities:
  - Designing roadways to mitigate user conflicts, including shoulder rumble strips and VRU safety improvements.
  - Share the Road education

Additional Considerations

- Consider widening shoulders or including bicycle lanes when expanding roadways to better accommodate bicycle travel.
- Solutions may be more appropriate where separated facilities are not feasible or warranted based on user needs and demographics. On-street facilities typically serve more confident bicyclists, including commuters. This user group is typically willing to tolerate higher levels of traffic stress to complete trips to destinations in order to avoid any out-of-direction travel.
- Adjacent travel speeds and traffic volumes, network connectivity, and continuity of facilities through intersections should be considered when implementing on-street bike facilities.
- According to the National Association of City Transportation Officials, "[sharrows are] not a facility type and should not be considered a substitute for bike lanes, cycle tracks, or other separation treatments where these types of facilities are otherwise warranted or space permits," however, they might be appropriate on lower speed, lower volume streets.[52]
- Take into account route connectivity to bus stops and transit stations when planning and constructing new facilities.
- In Montana, motorists are prohibited from traveling or parking in bicycle lanes (MCA 61-8-328).
- Maintenance of non-motorized facilities is key to ensuring year-round usage and access.
- It may be appropriate to prioritize investments in low-income areas with lower vehicle ownership rates where the use of bicycles as a primary mode of transportation is higher.

Resources

- In 2022, MDT published *Bicycling the Big Sky*, which maps rumble strips, shoulder widths, grades, rest areas, parking areas, and traffic volumes on Montana highways as well as equipment and medical services and daytime/overnight stopping locations to aid long-distance touring bicyclists with route planning.[53]
- FHWA's *Bicycle Safety Guide and Countermeasure Selection System* provides guidance for installation of bicycle lanes.[54]
- Installing bicycle lanes in urban areas while reducing lane and shoulder widths has been shown to reduce all crashes by 26-49% depending on the number of lanes.[55]
- Installing bicycle boulevards on two-way streets with incorporated signage, pavement markings, and special bike connections has been shown to reduce vehicle-bicycle crashes by 63%.[56]
- FHWA provides guidance on rumble strip application to balance the safety effects for motorists and bicyclists.[57]
- FHWA's *Bicycle Safety Guide* and *Countermeasure Selection System* provides guidance on implementation of wide curb lanes, which allow the lane to be better shared with motorists and bicyclists.[58]
- FHWA's *Bikeway Selection Guide* provides guidance for selecting the most appropriate bicycle facility types given user demographics and contextual considerations.[59]

Source: Ian/Adobe Stock

ENHANCE OFF-ROAD VRU FACILITIES

The use of active modes of transportation has been steadily increasing throughout many of Montana's communities.[60] Additionally, micromobility modes such as electric scooters, skateboards, and segways are becoming more common in some areas in Montana. These forms of personal transportation offer an alternative to vehicle trips and often rely on shared infrastructure. Areas that are buffered from vehicular traffic by vertical or lateral distances, parked cars, trees, or other barriers are inviting to these alternative forms of transportation. Constructing and maintaining dedicated, separated facilities, such as sidewalks or shared-use paths, for these modes can help enhance the comfort and convenience of walking, rolling, or bicycling for daily transportation purposes. The availability of off-road VRU facilities helps increase public health and safety, economic development, tourism, and recreation. Individuals who are intimidated by or feel unsafe using on-road VRU facilities may be more likely to use off-road VRU facilities.[61]

Observed Trends

- **61%** of severe bicycle crashes (46) occurred in locations without dedicated bicycle facilities.
- **43%** of severe pedestrian crashes (98) occurred in locations without dedicated pedestrian facilities.

E's of Safety

Engineering

Example Actions and Efforts

- Separated bike lanes
- Shared use paths
- Sidewalks with curb ramps
- Boulevards, raised curbs, planters, or concrete barriers between travel lanes and VRU facilities
- Overpasses, underpasses, pedestrian bridges
- Maintenance of facilities (i.e., street sweeping, snow removal, vegetation removal, etc.)

Partners

- Local Governments and MDT can consider the inclusion of off-street bicycle and pedestrian facilities in existing design projects and seek opportunities to provide these facilities where appropriate to help increase connectivity and accessibility of existing bicycle and pedestrian networks. Local governments can also encourage or require inclusion of off-road facilities as part of development in their communities.

Source: JW_PNW/Adobe Stock

Source: RPA

ENHANCE OFF-ROAD VRU FACILITIES

CHSP Connection

- Designing roadways to mitigate user conflicts, including separating users, is included in the Roadway Departure and Intersection-related Crashes Emphasis Area.

Additional Considerations

- Solutions may be more appropriate where separated facilities are feasible to install and maintain and where high non-motorized usage or the presence of specific demographic groups such as children, elderly, or disabled users warrants physical separation from motor vehicles.
- Maintenance of non-motorized facilities is key to ensuring year-round usage and access. These facilities may require specific equipment to perform necessary maintenance and can be difficult to build and maintain in long stretches. Maintenance agreements with local governments or service groups can help distribute responsibilities.
- Connectivity priorities should be considered when siting off-road VRU facilities, including connecting low-income areas to supportive resources and essential services, completing first-mile/last-mile connections to bus stops and transit stations, promoting access to outdoor attractions, and developing routes to downtowns and other economic generators.

Source: GCapture/Adobe Stock

Resources

- FHWA's *Evaluation of Safety, Design, and Operation of Shared-Use Paths* report provides a methodology for calculating the level of service for paths given the user mix and safety treatments.[62]
- FHWA's *Bicycle Safety Guide and Countermeasure Selection System* provides guidance for installation of separated shared use paths and discusses treatments to help reduce conflicts and crashes on these paths. Separated bike lanes are also included as a potential countermeasure.[63,64,65]

Source: Carolyn Franks/Adobe Stock

DESIGNATE NON-MOTORIZED CORRIDORS

Non-motorized corridors are low-volume, low-speed routes that prioritize multimodal modes of transportation. The routes typically help link neighborhoods, business districts, schools, and parks. To enhance safety for non-motorists, these corridors typically provide designated bicycle and pedestrian facilities, such as bike lanes, sharrows, sidewalks, and crosswalks, and are accompanied by enhanced wayfinding to help non-motorists identify the best routes to their destinations. Non-motorist activity can be further prioritized by fully or partially restricting vehicle access and generally directing vehicles to main thoroughfares. The application of these corridors is not appropriate in all locations, and context-sensitive designs should be considered.

In Montana, Missoula has mapped a city-wide network of neighborhood low-speed greenways that builds upon existing infrastructure and identifies priority areas to invest in non-motorized corridors.[66] On one summer Sunday per year, the city also shuts down a one-mile route in the downtown area to motorized vehicles to encourage all ages and all abilities to be active and build support for non-motorized transportation.[67]

The Billings MPO has prioritized walking and biking through a Safe Routes to School program which aims to improve walking, biking, and rolling conditions for elementary school students across Billings. Through the program, the MPO has developed non-motorized route maps for all 22 public elementary schools in the City and developed a list of prioritized projects to improve conditions for students. The program aims to make it safer for students to use active modes of transportation to get to school and encourage more walking, biking, and rolling where safety is not a barrier.[68]

The City of Billings and City of Missoula have both adopted complete streets policies, which were developed to ensure that users of all ages, abilities, and modes can travel safely and conveniently on all city roadways. Complete streets improve access and safety for those who cannot or choose not to drive motor vehicles, including those who walk, bike, roll, or use public transit.[69,70]

E's of Safety:

Education

Engineering

Example Actions and Efforts

- Low-volume/low-speed walking/rolling/bicycle routes
- Connected facilities – businesses, neighborhoods, parks, and schools
- Signage, striping
- Educational and wayfinding materials
- Maintenance of facilities (i.e., street sweeping, snow removal, vegetation management, etc.)

Partners

- Local Governments can evaluate their non-motorized networks and identify low-volume, low-speed routes to designate or prioritize for non-motorized transportation, implementing dedicated facilities and wayfinding as appropriate.
- MDT can consider opportunities to prioritize non-motorized travel and help enhance connectivity of local non-motorized corridors across MDT highways.

Source: Billings MPO

Source: David Erickson/The Missoulian

DESIGNATE NON-MOTORIZED CORRIDORS

Observed Trends

- About **38%** of all VRU crashes (564) occurred on roadways with 10,000 or more vehicles per day. About 33% of severe injury crashes (100) occurred on these higher volume roadways.
- **92%** of all VRU crashes (1,359) occurred on roadways with posted speed limits of less than 50 mph.

CHSP Connection

- Designing roadways to mitigate user conflicts, including signing, striping, and VRU improvements, is included in the Roadway Departure and Intersection-related Crashes Emphasis Area

Additional Considerations

- Within urban areas, low-volume, low-speed routes can be prioritized for walking, rolling, and biking.
- Roadway networks should be carefully evaluated for opportunities to prioritize non-motorized activity. Some improvements could be detrimental to traffic flow and should be considered. Context-sensitive designs that incorporate the needs of all users, rather than prioritizing one mode over another, may be more appropriate in some cases.
- Multiple studies show that the presence of bikeways, particularly low-volume, low-speed, connected bikeways, positively correlates with increased bicycling. This in turn results in improvements in bicyclists' overall safety due to a phenomenon known as "safety in numbers."[58]

Resources

- *Missoula in Motion* provides an example of where non-motorized corridors are already being implemented in Montana.[71]
- MDT's *Context Sensitive Solutions* webpage provides design and planning resources for context solutions.[72]

Source: RPA

Source: RPA

Source: wavebreak3/Adobe Stock

Safe Speeds

4.2.4. Safe Speeds

The following strategies are intended to promote safer roadway speeds through roadways design, speed limits, education, and enforcement.

REVIEW POSTED SPEED LIMITS

Speed and crash severity are inextricably linked. Crashes are more likely to result in serious or fatal injuries when vehicles are traveling at higher speeds. Motorists drive at the speed they feel comfortable, taking the weather condition, surrounding environment, and complexity of the roadway into account. Pedestrians and bicyclists travel much slower than motorists and do not have the components of a vehicle body to protect themselves on the roadway. Therefore, non-motorists are heavily reliant on the diligence of drivers to travel at appropriate speeds.

MDT makes speed limit decisions based on the use of context-sensitive solutions that apply collaborative, interdisciplinary approaches to balance the interests of local stakeholders with the needs of the transportation facility to appropriately fit the roadway setting.[73] Speed studies are typically set according to the 85th percentile travel speed, or the speed at which 85% of people drive at or below during ideal conditions. The 85th percentile speed is considered the maximum safe speed for a given location.[73] Since drivers are primarily influenced by roadway conditions, lowering speed limits alone is unlikely to change speed patterns without changes to roadway features or context.

Observed Trends

- **8%** of all VRU crashes (115) occurred on roadways with posted speed limits above 50 mph. Of those crashes, **53%** (61) were severe.
- **83%** of VRU crashes (998) in urban areas occurred on roadways with posted speed limits between 25 and 35 mph.
- Although it may appear from these statistics that more crashes occur on lower speed roadways than higher speed roadways, this data may also indicate that pedestrians and bicyclists are more likely to be present on lower speed roadways.

E's of Safety

Enforcement

Engineering

Example Actions and Efforts

- Speed studies
- Variable speed limit trailers
- Special speed zones (schools, high-use areas, work zones)
- Jurisdiction-wide speed limits (e.g., unless otherwise posted, the city speed limit shall be 25 mph)

Partners

- Law Enforcement at local and state levels can support and promote speed enforcement patrols.
- Local Governments can work with local safety partners to identify roadways that may require lower speed limits, request speed studies as necessary, and consider implementing jurisdiction-wide speed limits.
- MDT can continue to conduct speed studies and consider roadway contexts when determining the appropriate safe speed for a roadway.
- School Districts can work with parent groups, local business leaders, local community/government leaders, law enforcement, and local public works departments to promote and educate about the importance of safer speeds in school zones.

Source: Digidreamgrafix/Adobe Stock

REVIEW POSTED SPEED LIMITS

CHSP Connection

- Reducing and mitigating speed-related crashes is included in the Roadway Departure and Intersection-related Crashes Emphasis Area.

Additional Considerations

- Speed limits that are inconsistent with driver expectations can have a negative effect. Applying consistent speed limits across jurisdictions can help develop good driving habits and improve VRU safety.
- The Transportation Commission reviews all requests for changing posted speed limits.
- Speed limits on MDT routes are set based upon 85th percentile travel speeds. There is a specific speed study nomination and investigation process that MDT follows when evaluating roadway speed limits.[73]
- Some states and local jurisdictions have found that setting speed limits based on 85th percentile speeds can be detrimental to VRU safety and have moved towards implementing consistently lower speeds on residential roadways to improve VRU safety.[74]
- Speed reduction strategies may be more applicable and effective in urban, developed areas compared to rural, undeveloped highways.
- Particularly for urban areas, it may be safer to design streets using a target speed, or the speed the designer/jurisdiction intends for drivers to travel, as opposed to using the conventional highway design approach of setting design speed based on operating speed.

Resources

- FHWA offers provisions for applications and considerations of appropriate speed limits for all road users.[75]
- FHWA indicates that setting consistent jurisdiction-wide speed limits is a noteworthy speed management practice to improve safety for VRUs.[74]
- *Countermeasures That Work*[3] discusses speed reduction and enforcement countermeasures to address pedestrian safety.

Source: ansyvan/Adobe Stock

Source: Rix Pix/Adobe Stock

REDUCE VEHICULAR TRAVEL SPEEDS

Although speed limits may be appropriately set for a roadway's context, drivers sometimes choose to travel above posted speed limits. When it is not appropriate to lower a roadway's speed limit, other engineering countermeasures, typically referred to as traffic calming measures, may be implemented to help alter driver behavior and create safer conditions for all users, including VRUs.[76] These strategies may include horizontal and vertical displacements (chicanes or speed bumps), traffic control devices (roundabouts, traffic circles, ITS), road narrowing measures (curb extensions or medians), and other visual friction (landscaping, art, parklets). These strategies are intended to alter the roadway environment to change the driver's perception of the roadway and encourage slower speeds.

Observed Trends

- Crash records indicate that **4%** of drivers (64) involved in VRU crashes were traveling above posted speeds or driving too fast for conditions.

E's of Safety

Enforcement

Engineering

Example Actions and Efforts

- Traffic calming
  - Speed bumps/humps/speed tables/raised crosswalks
  - Visual friction (paint, art, vegetation, objects)
  - Narrowed roadways/curb extensions
  - Roundabouts/traffic circles
  - Horizontal roadway shifts (chicanes)
  - ITS/dynamic speed feedback signage
- Speed enforcement

Partners

- Business Districts can implement traffic calming measures in commercial districts where non-motorists are prevalent, and work with other agencies to enforce safer speeds in business districts.
- Law Enforcement officers can patrol corridors and issue citations when speeding is observed.
- Local Governments and MDT can consider and implement traffic calming measures when developing and implementing projects.
- School Districts can implement traffic calming measures on school pedestrian/bicycle routes, and work with local community parent groups, business owners, school resource officers, and other local community governments to promote, support, and develop community-wide safety campaigns.

REDUCE VEHICULAR TRAVEL SPEEDS

CHSP Connection

- Reducing and mitigating speed-related crashes is included in the Roadway Departure and Intersection-related Crashes Emphasis Area.

Additional Considerations

- Speed reduction strategies may be more effective in urban areas and must be balanced with visibility issues.
- Traffic calming measures can be implemented at an intersection, street, neighborhood, or area-wide level.
- Speed reduction strategies should be thoughtfully implemented to address the context and observed behavior and to consider potential spillover effects such as traffic diverting to nearby streets. Such strategies may be best approached at a neighborhood scale to proactively address spillover effects. In some cases, prior to permanently implementing a traffic calming measure, it may be useful to introduce a temporary measure using paint, cones, and other low-cost material to evaluate effectiveness.[77]
- Seasonal maintenance and replacement should be considered to ensure pavement markings are visible to drivers and VRUs.

Resources

- *Countermeasures That Work*[3] discusses a variety of methods to manage speeds and address speeding behavior.
- Installing raised pedestrian crossings has been shown to reduce vehicle-pedestrian crashes by 46%.[78]
- FHWA's *Bicycle Safety Guide and Countermeasure Selection System* provides guidance for installation of roundabouts to accommodate pedestrian and bicycle traffic.[79]
- The USDOT provides guidance on traffic calming measures to slow vehicle speeds and provides related information concerning the benefits to public health.[80]
- FHWA's *Traffic Calming ePrimer* presents a thorough review of current traffic calming practices, considerations for appropriate application, and research on the effects on mobility and safety for passenger vehicles, emergency response, public transit, waste collection vehicles, and pedestrians and bicyclists.[81]

Source: Tada Images/Adobe Stock

Source: RPA

Post-Crash Care

4.2.5. Post-Crash Care

The following strategies are intended to help improve post-crash care, protect emergency responders from being involved in secondary collisions, and enhance data and reporting to support future crash response, treatment, and transport.

IMPROVE POST-CRASH CARE FOR INJURED VRUs

Pedestrians and bicyclists who are involved in a collision with a motorized vehicle have little to no protective barrier to withstand the impact of a collision, putting them at greater risk of experiencing severe injuries. EMS response, characterized by post-crash timing, at-scene and in-transit care, and transport to appropriately staffed and equipped facilities, plays a critical role in improving road safety. EMS response goals often reference the "golden hour" as a benchmark for the rapid transport of trauma victims to a treatment facility. The distance (in time and miles) from a trauma center and access to the right facility—one with the required mix of staff and equipment—are vital to the survivability of severely injured VRUs.[82] Currently there is one Level 1 trauma center in Billings, three Level 2 trauma centers (Billings, Missoula, and Great Falls), three Level 3 trauma centers (Bozeman, Butte and Kalispell). There are also 49 critical access hospital (CAH)-designated facilities across rural parts of the state.

Observed Trends

- **33%** of all VRU crashes (485) occurred within a 25-mile radius of a CAH and **84%** of those crashes (407) resulted in some level of VRU injury.
- **7%** of all VRU crashes (103) occurred outside of an urban area and outside a 25-mile radius of a CAH. Of these, **87%** (90) resulted in some level of VRU injury.
- Crash records indicate **64%** of all non-motorists involved in crashes (888) were transported to a medical facility.

Partners

- DPHHS can continue to support and provide bystander training as well as injury prevention and care strategies for EMS providers and trauma center staff.
- EMS Responders can follow medical best practices and work with other safety partners to improve incident response and transport times.
- Law Enforcement can promote and support emergency dispatch training and help manage traffic at crash scenes to expedite emergency response.
- Local Governments and MDT can promote and support emergency dispatch training, improve roadway networks to enhance emergency response times, and support policy development and Legislative action.

E's of Safety

Education | Enforcement | EMS

Example Actions and Efforts

- Bystander training and education
- Dispatch training
- Post-crash arrival/transport and continued EMS/trauma care
- On-scene and hospital/clinic care
- Database enhancements
- Policy development and Legislative action

Source: Mr Doomits/Adobe Stock

IMPROVE POST-CRASH CARE FOR INJURED VRUs

CHSP Connection

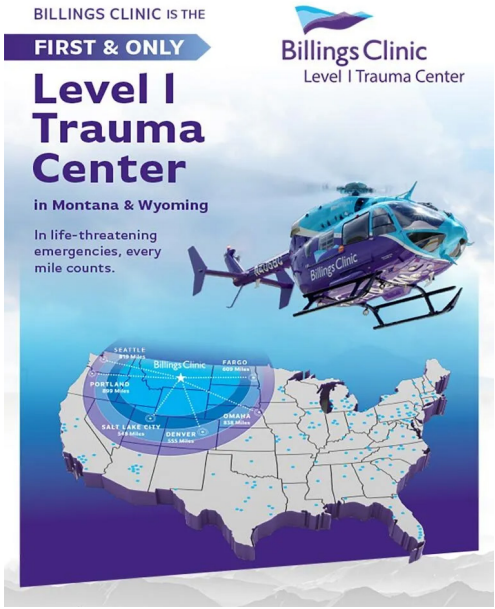
- Emergency Response - Post-Crash Care is an Emphasis Area in the CHSP with strategies and opportunities focused on reducing the potential of emergency responders being involved in a secondary crash while on the scene of a motor vehicle crash. Emergency responders include roadway and maintenance staff, highway workers, local and state law enforcement, emergency medical responders, fire and rescue response teams, and tow operators.

Additional Considerations

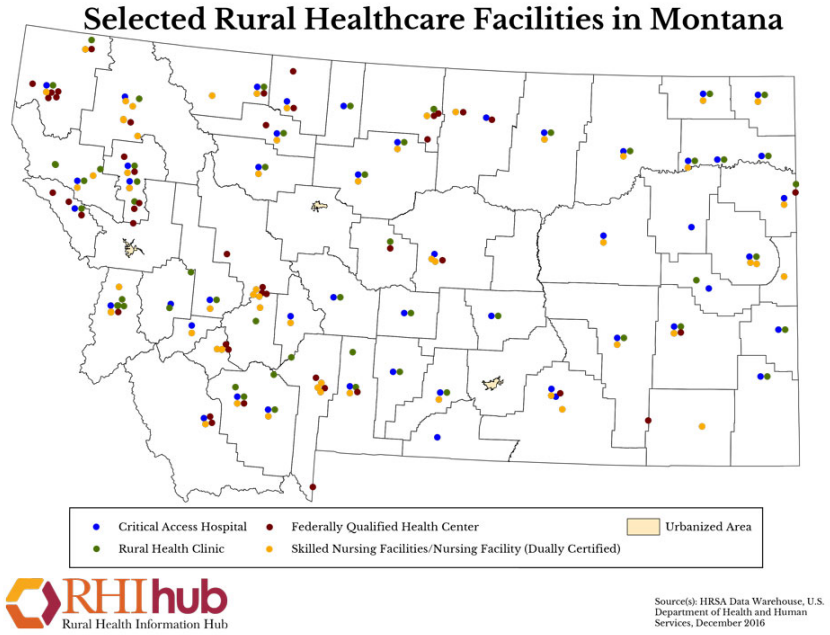
- Crash records do not provide data related to timeliness or adequacy of post-crash care for injured VRUs.
- All EMS responders follow best management practices that allow them to serve patients to the best of their ability.
- The location of emergency responders and proximity to care facilities are critical to ensuring prompt care. In rural parts of the state, CAH may not be able to provide the level of care needed to treat a severely injured VRU. High volumes of crashes can also strain smaller EMS facilities/providers, decreasing their ability to ensure prompt emergency response times and care.

Resources

- *Prehospital Care for Road Traffic Casualties* demonstrates best practices for medical professionals responding to crashes.[83]



Source: Billings Clinic



Source: Rural Health Information Hub

ENHANCE EMERGENCY RESPONDER SAFETY

According to the AAA Foundation for Traffic Safety, two emergency workers are killed every month in the US and 60% of workers experience a near-miss incident while working.[84] Emergency responders include law enforcement, EMS, fire and rescue, highway workers, tow truck operators, and crash investigators. Per MCA 61-8-3012, a highway worker is an employee of the department of transportation, local authority, utility company, or private contractor. When any of these emergency responders arrive at a crash site, they should assess the scene's safety to determine if it is safe to proceed to the scene and what safety equipment is required. Crash sites are highly dynamic environments and should be continually assessed. To prevent further injury or loss of life, it is important to minimize the risk of injuries to emergency personnel and bystanders at a crash site. The National Traffic Incident Management (TIM) training course teaches emergency responders how to safely and quickly clear traffic incidents, meet the needs of those injured, ensure the safety of responders and road users, and prevent secondary crashes.

To reduce the risk of secondary crashes, emergency responders should approach the scene carefully, use appropriate personal protective equipment (PPE), deploy high visibility signage and equipment to warn oncoming traffic, park in a manner that prevents emergency vehicles from being pushed into the scene in case of secondary impact, and always be aware of their surroundings.[85] Impaired, drowsy, or distracted drivers may not react to emergency lighting and other warning devices so redundant measures that give drivers plenty of time to react and respond are important. The American Association on State Highway and Transportation Officials assumes drivers have a perception reaction time of 1.5 seconds, which means a motorist traveling at 70 mph would take about 50 yards to process warnings placed on the roadway.[86] These same principles apply to crash scenes, work zones, and other interactions such as issuing citations or assisting a disabled vehicle. Anecdotal evidence from MDT indicates that most work zone and emergency worker crashes are due to distracted driving.

Observed Trends

- **0.3%** of VRU crashes (5) occurred in work zone locations.
- **1.3%** of severe VRU crashes (4) involved Work Zone or Emergency Workers. In these instances, the injured VRU was a construction or emergency worker.

E's of Safety

Education | Enforcement | EMS

Example Actions and Efforts

- ITS – portable, dynamic signage
- Construction cones, reflective striping, signage
- Reflective strips/clothing/PPE
- TIM training
- Educational campaigns
- Enforcement

Partners

- City/County Public Health/Injury Prevention Specialists can promote safety training of emergency responders; create safety awareness within communities by partnering with local businesses and emergency responders to create media campaigns; and support PPE use by emergency responders.
- Emergency Responders are responsible and continue to implement best practices, including use of PPE and warning signage to ensure visibility and enhance awareness of those on-scene. TIM training supports and promotes proper implementation of crash scene safety practices and can help improve personal safety.
- Individuals are responsible for being aware of their surroundings, focusing on driving, and obeying traffic laws including slowing down, moving over, and following traffic signaling and signage.
- Law Enforcement can educate and promote awareness of the Slow Down & Move Over Law.
- Local Governments can work with local public works and maintenance departments to coordinate educational campaigns and TIM training to enhance on-scene emergency response processes and procedures; and support the use of PPE and signage to enhance visibility of on-scene emergency responders.
- MDT can support and promote coordinated TIM training with district staff and local emergency responders; encourage use of on-scene reflective PPE; and share safety campaigns to create safety awareness among the traveling public.

ENHANCE EMERGENCY RESPONDER SAFETY

CHSP Connection

- Tracking emergency response worker-involved crashes is included in the Emergency Response - Post-Crash Care Emphasis Area.

Additional Considerations

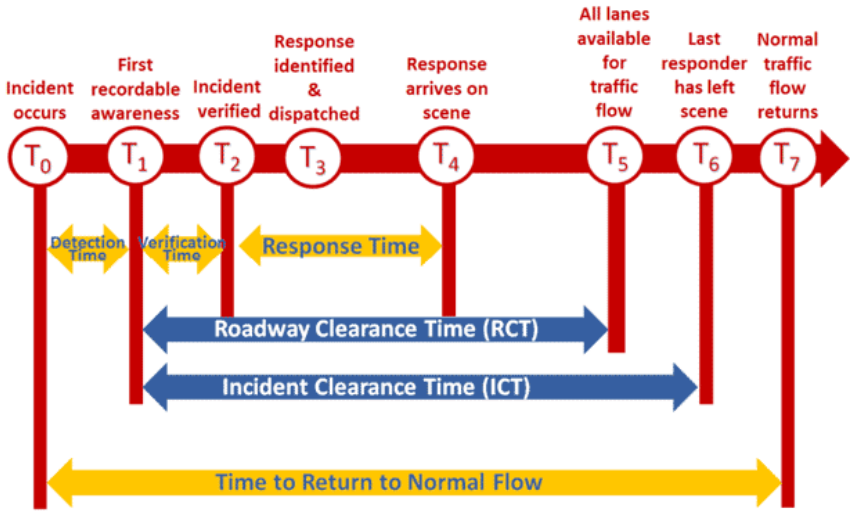
- None of the crash reports indicate whether proper visibility and awareness measures were in effect in work-zone or emergency-response related crashes. However, it is standard operating procedure for responders to put on PPE when responding to a roadway traffic incident.
- In addition to risks from motor vehicles in transport, it is standard operating procedure for emergency responders to protect themselves from other hazards such as fuel, oil, and other fluid spills, fires, or downed power lines.

Source: GregDPhotos/Adobe Stock

Resources

- Responder Safety's guidance on *Traffic Incident Management* provides cooperative policy and planning measures to ensure response teams reach roadway incidents in a timely manner.[87]
- Responder Safety's guidance on the *National Unified Goal for Traffic Incident Management* outlines resources and guidelines for local and public safety agencies to adopt unified, multi-disciplinary policies, procedures, and practices to improve the management of traffic incidents.[88]
- FHWA's *Traffic Incident Management* focuses on five action tracks to achieve efficient incident and emergency response.[89]
- The World Road Association *Road Network Operations Guide* provides a module on work zones which provides measures to minimize worker exposure to traffic.[90]
- *Emergency Vehicle and Roadway Operations Safety* provides "alive on arrival" tips for emergency vehicle operations as well as social media outreach materials for the "slow down, move over" campaign.[91]
- *The Responder Safety Learning Network* provides free, on-demand training opportunities for first responders covering advance warning, high visibility, traffic control, and other emergency roadway operations.[92]
- MDT's *Work Zone Safety & Mobility Toolbox* provides a variety of resources to increase safety for department employees, construction workers and the public through work zones.[93]
- *Arrive Alive* promotes road safety and shares various informational materials, including important measures for emergency responders to take when securing a crash scene.[94]
- The *National TIM Responder Safety Training* course teaches emergency responders how to safely and quickly clear traffic incidents.[95]

Source: Move Over Montana



Source: FHWA[96]

IMPROVE DATA COLLECTION AND REPORTING STRATEGY

MDT uses crash data to understand and improve roadway safety across the state. The crash records database contains a compilation of reports from MHP and local officers. The records are then cross referenced with MDT's roadway database to understand associated roadway factors for each crash. MDT continually reviews data for accuracy and completeness, though there are inherent inconsistencies and inaccuracies due to differences in agency reporting and general underreporting. Nationwide, VRU crashes are especially underreported. An international study estimated that 44% of severe and 76% of minor pedestrian injury crashes were not captured in police reports, and that injured pedestrians may seek medical treatment without reporting the crash.[97] Another international study found that 63% of severe bicycle crashes were not reported to the police.[15]

Enhancing and improving reporting practices can ensure consistent, complete, and accurate data collection including road user behavior and infrastructure factors in roadway crashes, which can help with identification of both site-specific and systematic safety improvements. In support of this effort, MDT's Traffic Records Coordinating Committee (TRCC) continually works to "improve the timeliness, accuracy, completeness, uniformity, integration, and accessibility of crash data and systems to address safety issues in Montana [in support of the CHSP]."[98]

It is also beneficial to share data across agencies and organizations, including EMS and hospitals, to develop a holistic understanding of the safety landscape and to improve accuracy. For example, understanding crash volumes can help EMS providers ensure they have enough capacity to adequately respond to crashes, and understanding response capacity can help with TIM. Furthermore, connecting crash records to hospital records can help ensure the accuracy of crash severity. For example, a person who appeared to sustain only minor injuries on-site may have sustained a head injury that later developed into severe or lasting consequences, which may not be discovered until treatment at a care facility.

Observed Trends

- Various inconsistencies and incomplete records were observed in the crash data review conducted for the VRU SA.
- Safety partners who participated in the development of the VRU SA expressed interest and desire in sharing data to improve safety management in Montana.

E's of Safety

Education | Enforcement | EMS

Example Actions and Efforts

- Officer web-based crash reporting training
- Crash records management
- Crash, injury, and traffic citation data integration
- Interagency coordination
- Legislative action requiring crash reporting training for all law enforcement

Partners

- DPHHS can improve EMS provider data collection efforts and assist with interagency data integration efforts.
- EMS Responders can assist with data integration and interagency coordination.
- Hospitals/Healthcare Facilities can assist with data integration and interagency coordination.
- Law Enforcement can improve crash reporting with continued mandatory, cyclical training to be consistent with state crash reporting to secure accurate and complete data, including VRUs involved in motor vehicle crashes, safety equipment used, VRU visibility, direction of travel, and proper positioning.
- MDT and safety partners within the Department of Justice can continue to work together to conduct qualitative reviews to improve data accuracy, completeness, uniformity, and integration with other traffic, injury, licensing, and judicial databases.
- State Agencies can discuss program data needs and requirements of traffic-related databases to determine limitations and viable opportunities to coordinate and integrate data.

Source: MDT

IMPROVE DATA COLLECTION AND REPORTING STRATEGY

CHSP Connection

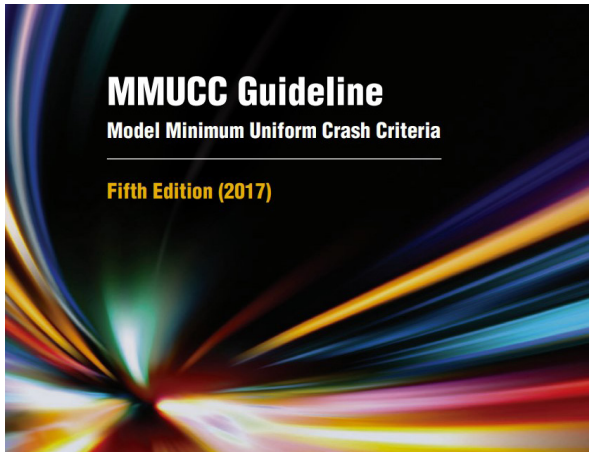
- A key element in all CHSP emphasis areas is to improve the accuracy, completeness, integration, timeliness, uniformity, collection, and accessibility of data used in traffic safety analysis.

Additional Considerations

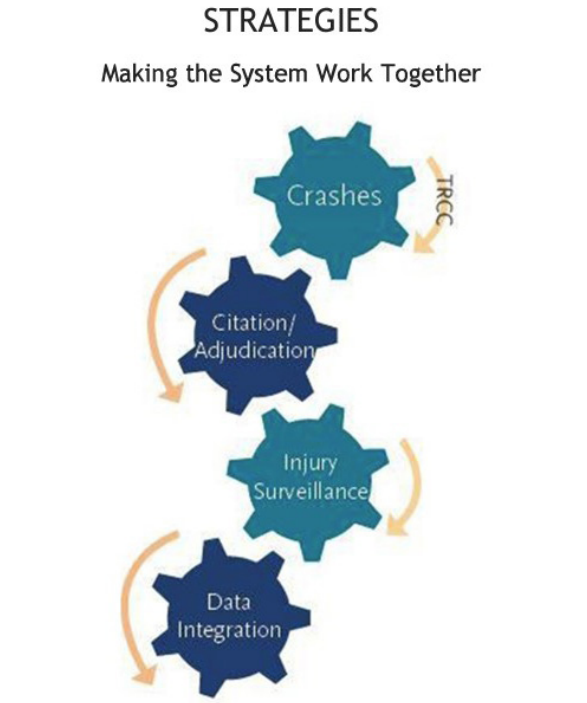
- There may be legal concerns or implications that prevent or reduce the ability to share data across agencies, including but not limited to the sharing of sensitive or confidential personal information.
- Currently, MHP officers must participate in intensive crash reporting training whereas officers in local police departments are only required to complete a brief half-day training. The lack of training, volume of staff turnover, and manual reporting methods can contribute to inaccurate or incomplete data.

Resources

- MDT's *Traffic Records Strategic Plan* serves as the guiding document for the TRCC as it works to improve the state's safety data.[98]
- NHTSA's *Crash Data Improvement Program Guide* provides an overview of crash data quality and guidance on how to measure and improve quality in terms of the six data quality characteristics - timeliness, accuracy, completeness, uniformity, integration, and accessibility. It also provides guidance for States on how to map crash reports to the MMUCC.[99]



Source: NHTSA



Source: MDT Traffic Records Strategic Plan

4.3 STRATEGY SUMMARY

Seventeen (17) individual strategies were identified to improve VRU safety in Montana using the SSA. The strategies target ways to improve the safety of road users, vehicles, roadway infrastructure, travel speeds, and post-crash care in support of reducing risks to VRUs and improving the accessibility of walking, biking, and rolling as transportation modes.

Strategies outlined in the Montana VRU SA are intended to represent the most effective types of actions for improving VRU safety in Montana based on a review of reported factors contributing to VRU-involved crashes. These strategies are intended to serve as a toolbox reference to assist in the future project identification, development, and implementation. **Table 4.1** lists individual strategies, relation to the E's of Safety, partners, and example actions and efforts.

Table 4.1: Summary of Strategies

	Strategy	E's of Safety	Partners	Example Actions/Efforts
Safe Road Users	**Reduce Driver and Non-Motorist Impairment**	Education, Enforcement, EMS	Behavioral Health/Substance Abuse/Prevention Specialists, Bicycle Clubs, EMS Responders/Medical Providers, Individuals, Law Enforcement, Local Governments, MDT, Walking and Disability Groups	• Focused alternative transportation communication campaigns • Partnerships with behavioral health, substance abuse, and prevention specialists • Penalties for impaired driving and biking
Safe Road Users	**Reduce Driver and Non-Motorist Distraction**	Education, Enforcement	City/County Public Health/Injury Prevention Specialists, Individuals, Law Enforcement, Local Governments, MDT, School Districts	• Education campaigns focused on safety awareness (e.g., avoidance of texting, headphones, ear buds) • Distracted driving/biking/rolling/walking laws • Penalties for distracted driving/biking/rolling/walking

Safe Road Users	**Increase Pedestrian Visibility**	Education, Enforcement	City/County Public Health/Injury Prevention Specialists, Individuals, Law Enforcement, Local Governments, MDT, School Districts, Walking and Disability Groups	• Education campaigns & incentives
				  • Light/white/bright clothing
				  • Reflective gear and personal lighting (flashlights, headlamps)
				  • Safety awareness (e.g., avoidance of texting, headphones, ear buds)
				  • Rules of the road
				• Walking buses, crossing guards

Safe Road Users	**Increase Bicyclist Visibility and Function**	Education, Enforcement	Bicycle Clubs and Bike Shops, City/County Public Health/Injury Prevention Specialists, Homeless Shelters/Pre-Release Centers, Individuals, Law Enforcement, Local Governments, MDT, School Districts	• Education campaigns & incentives
				  • Light/white/bright clothing
				  • Reflective gear and personal lighting (flashlights, headlamps)
				  • Safety awareness (e.g., avoidance of texting, headphones, ear buds)
				  • Rules of the road
				• Helmet laws

Safe Vehicles	**Enhance Bicycle Visibility and Protection**	Education	Bicycle Clubs and Bike Shops, City/County Public Health/Injury Prevention Specialists, Individuals, Local Businesses/Community Groups, Local Governments, MDT, School Districts	• Education campaigns & incentives
				  • Bicycle lamps/reflectors
				  • Functioning brakes
				  • Regular bicycle maintenance
				• Tool kits

Safe Roads	**Reduce Crossing Distances**	Engineering	Local Governments, MDT	• Roadway reconfiguration • Curb bulbouts/extensions • Pedestrian refuge islands • Roundabouts

Table 4.1: Summary of Strategies

	Strategy	E's of Safety	Partners	Example Actions/Efforts
Safe Roads	**Increase Crosswalk Visibility and Accessibility**	Engineering	Local Governments, MDT	• Accessible curb ramps • High-visibility pavement markings • RRFBs • PHBs/HAWKs • ITS
Safe Roads	**Enhance Signalized Crossings**	Engineering	Local Governments, MDT	• Accessible curb ramps • High-visibility pavement markings • Pedestrian push buttons, audible/visual cues • LPI • Increased pedestrian walk phase
Safe Roads	**Increase Roadway Visibility**	Engineering	Local Governments, MDT	• Street lighting • High-visibility pavement markings • Signage • Daylighting intersections • Maintenance of facilities (i.e., street sweeping, snow removal, vegetation management, etc.)
Safe Roads	**Enhance On-Road Bicycle Facilities**	Engineering	Local Governments, MDT	• Bike lanes • Sharrows, bike route signage • Widened shoulders • Appropriately placed shoulder rumble strips • Maintenance of facilities (i.e., street sweeping, snow removal, vegetation management, etc.)
Safe Roads	**Enhance Off-Road VRU Facilities**	Engineering	Local Governments, MDT	• Separated bike lanes • Shared-use paths • Sidewalks with curb ramps • Boulevards, raised curbs, planters, concrete barriers between travel lanes and VRU facilities • Overpasses, underpasses, pedestrian bridges • Maintenance of facilities (i.e., street sweeping, snow removal, vegetation management, etc.)
Safe Roads	**Designate Non-Motorized Corridors**	Education, Engineering	Local Governments, MDT	• Low-volume/low-speed walking/rolling/bicycle routes • Connected facilities – businesses, neighborhoods, schools, parks • Signage, striping • Educational and wayfinding materials • Maintenance of facilities (i.e., street sweeping, snow removal, vegetation management, etc.)
Safe Speeds	**Review Posted Speed Limits**	Enforcement, Engineering	Law Enforcement, Local Governments, MDT, School Districts	• Speed studies • Variable speed limit trailers • Special speed zones (schools, high-use areas, work zones) • Jurisdiction-wide speed limits

Table 4.1: Summary of Strategies

	Strategy	E's of Safety	Partners	Example Actions/Efforts

Safe Speeds	**Reduce Vehicular Travel Speeds**	Enforcement, Engineering	Business Districts, Law Enforcement, Local Governments, MDT, School Districts	• Traffic calming
				  • Speed bumps/humps/speed tables/raised crosswalks
				  • Visual friction (paint, art, vegetation, objects)
				  • Narrowed roadways/curb extensions
				  • Roundabouts/traffic circles
				  • Horizontal roadway shifts (chicanes)
				  • ITS/dynamic speed feedback signage
				• Speed enforcement

Post-Crash Care	**Improve Post-Crash Care for Injured VRUs**	Education, Enforcement, EMS	DPHHS, EMS Responders, Law Enforcement, Local Governments, MDT	• Bystander training and education • Dispatch training • Post-crash arrival/transport and continued EMS/trauma care • On scene and hospital/clinic care • Database enhancements • Policy development and Legislative action
	Enhance Emergency Responder Safety	Education, Enforcement, EMS	City/County Public Health/Injury Prevention Specialists, Emergency Responders, Individuals, Law Enforcement, Local Governments, MDT	• ITS – portable, dynamic signage • Construction cones, reflective striping, signage • Reflective strips/clothing/PPE • TIM training • Educational campaigns • Enforcement
	Improve Data Collection and Reporting Strategy	Education, Enforcement, EMS	DPHHS, EMS Responders, Hospitals/Healthcare Facilities, Law Enforcement, MDT, State Agencies	• Officer web-based crash reporting training • Crash records management • Crash, injury, and traffic citation data integration • Interagency coordination • Legislative action requiring crash reporting training for all law enforcement

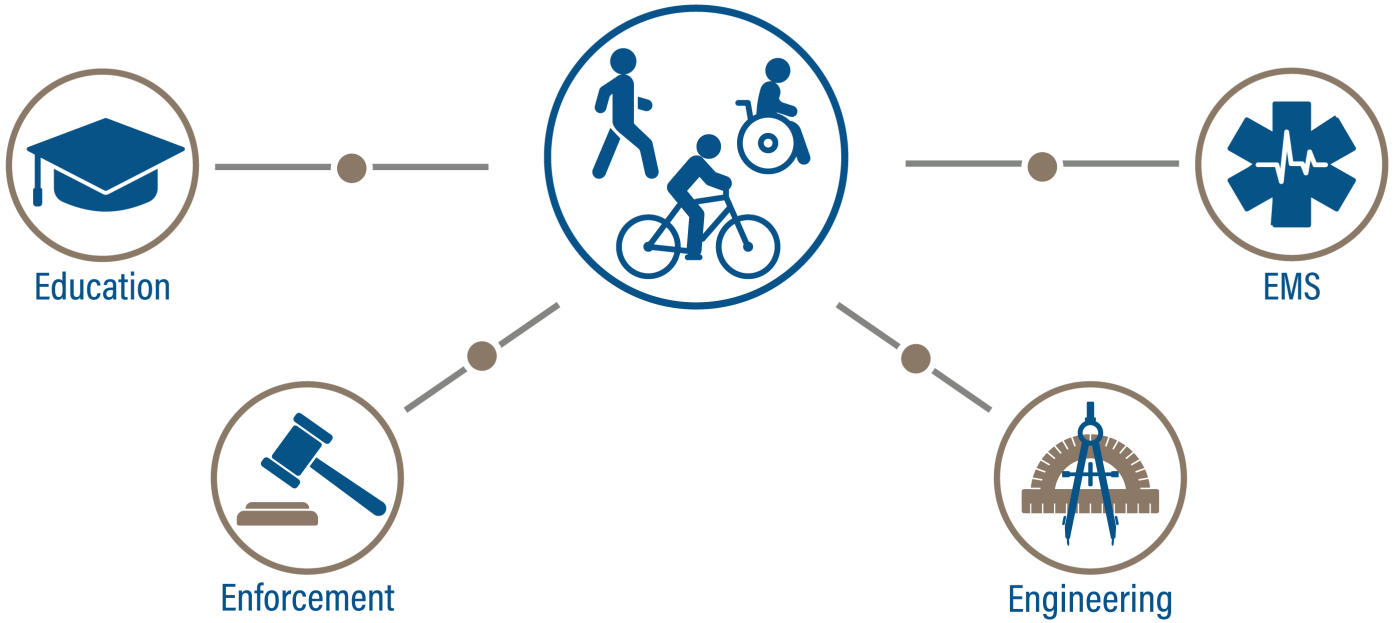
5.0. IMPLEMENTATION AND NEXT STEPS

5.0. IMPLEMENTATION AND NEXT STEPS

MDT is committed to supporting federal goals to reducing safety risks to VRUs in Montana. In collaboration with local governments, MPOs, Tribal agencies, and other safety partners across the state, MDT will use the Montana VRU SA as a guide when considering, nominating, and implementing projects to ensure VRUs are fully and equitably considered in transportation investment decisions. The projects and strategies detailed in the VRU SA can be implemented through a combination of federal, state, local, Tribal, and private funding sources. Some of the example projects may be fundable with apportioned HSIP funds, Transportation Alternatives set-aside funds, or one of the many other US DOT funding programs[100] supporting pedestrian and bicycle projects.

In accordance with federal regulations, the Montana VRU SA will be included as an addendum to the current CHSP. The VRU SA will be updated with subsequent updates of the CHSP which occur on a five-year rolling basis. Future updates will summarize continuing efforts to gather and analyze VRU crash data, refine the crash analysis and identification of high-risk areas, and document progress made toward reducing VRU safety risks in Montana.

MDT will continue to facilitate ongoing meetings with a multidisciplinary AC group affiliated with CHSP implementation to oversee progress, provide a forum for inter-agency coordination, identify barriers and challenges, evaluate program effectiveness, and provide guidance in relation to future program direction. Effective implementation of the VRU SA will require broad engagement and support from the 4 E's of safety with partners across the state of Montana. Shared funding, resources, personnel; involvement from partner agencies and subject matter experts of the 4 E's of Safety; and Legislative action will be needed to effectively address the safety needs of Montana's most vulnerable road users in working toward the goal of eliminating death and serious injury on Montana's roadways.



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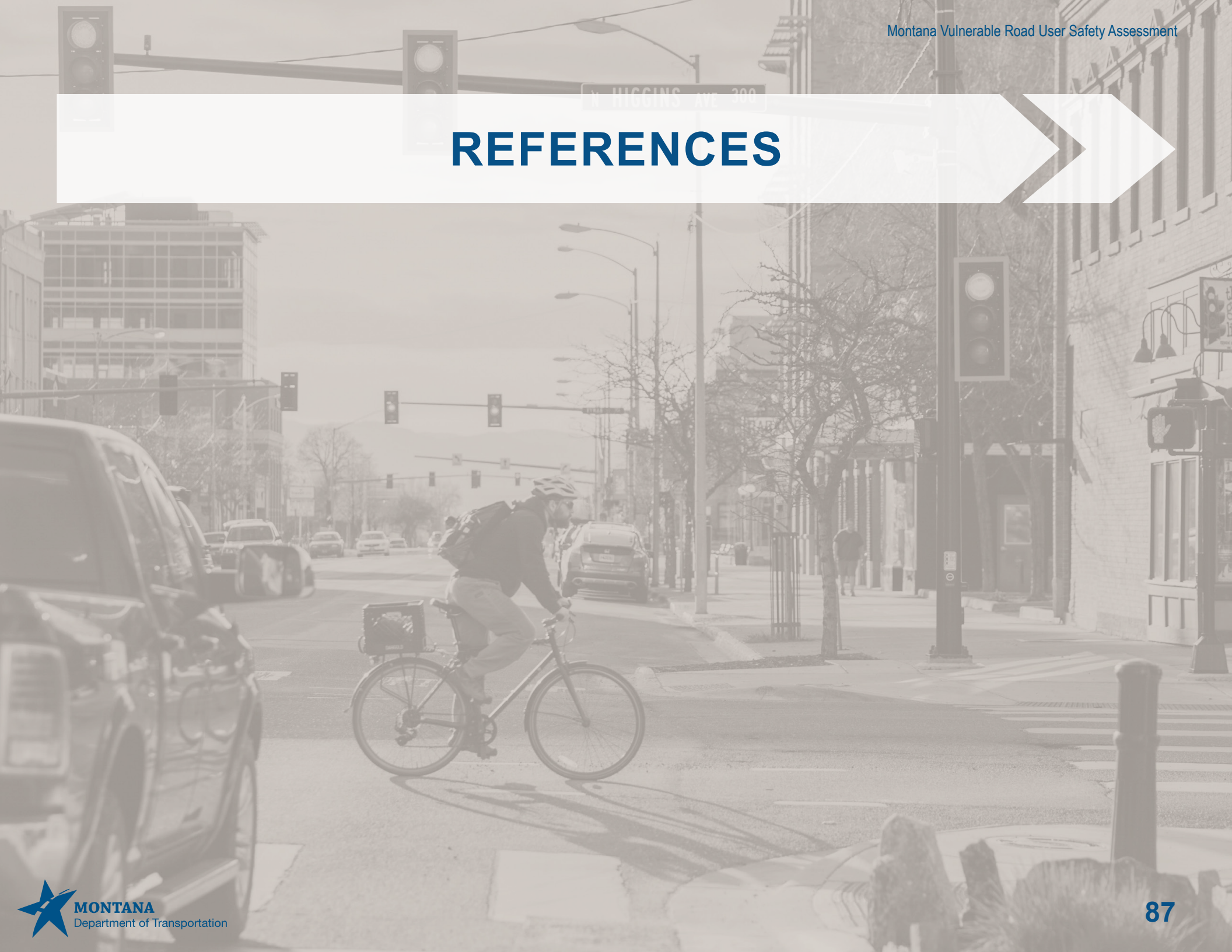

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APPENDIX A

REVIEW OF PREVIOUS EFFORTS

Appendix A – Review of Previous Efforts

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Tables

1.0. MDT PLANS AND POLICIES

The Montana Department of Transportation (MDT) has conducted a variety of planning exercises and prepared numerous statewide plans and technical documents detailing transportation programs and policies in Montana. The following efforts directly support the Vulnerable Road User Safety Assessment (VRU SA) development process.

1.1. TranPlanMT (2017)

TranPlanMT is Montana's statewide long-range transportation plan that sets overarching statewide policy goals and priorities for MDT's multimodal transportation system. The plan outlines existing and projected conditions related to transportation assets, users, context, and management. The assets and users volumes discuss infrastructure and user characteristics associated with non-motorized transportation in recognition of the full range of transportation modes, choices, and user needs associated with Montana's transportation system.

How is this plan relevant to the VRU SA?

- *TranPlanMT* documents safety performance, infrastructure condition, user characteristics, and administration of the transportation system, which all affect safety conditions for vulnerable road users.
- The plan addresses a federal planning factor to increase the safety of the transportation system for motorized and non-motorized users and documents a safety performance measure for the number of non-motorized fatalities and non-motorized serious injuries in support of national performance goals. These components directly support safety for vulnerable road users.
- The following *TranPlanMT* goal areas and statewide strategies directly support the VRU SA development process and intended outcomes.

Table 1.1: TranPlanMT Goals and Strategies

Topic Area	Strategy	Relationship to VRU SA
Safety **Goal**: *Improve safety for all transportation users to achieve Vision Zero: zero fatalities and zero serious injuries.*	**S1:** Maintain infrastructure condition to provide safe conditions for the traveling public. **S3:** Target safety improvement projects to address crash pattern locations. **S4:** Incorporate technology advancements in project development to improve safety. **S5:** Leverage relationships with education, enforcement, emergency medical services, and engineering partners to foster a culture of safety on Montana roadways. **S6:** Reduce unsafe driving behavior through targeted focus on transportation safety emphasis areas identified in Montana's Comprehensive Highway Safety Plan. **S7:** Enhance crash data integration and analysis to support decision making and data-driven problem identification.	Safety is an overarching goal and is applied in nearly every MDT decision-making process for all projects and programs. All of MDT's efforts to achieve the vision of zero fatalities and zero serious injuries support the VRU SA process and desired outcomes.

Topic Area	Strategy	Relationship to VRU SA
Accessibility and Connectivity **Goal**: *Preserve access to the transportation network and connectivity between modes.*	**AC1**: Improve pedestrian, public transportation, and other MDT-owned facilities to ensure accessibility to individuals with disabilities.	The Accessibility and Connectivity goal and strategies are focused on improved design, connectivity, accessibility, and maintenance of MDT-owned pedestrian, bicycle, and public transportation facilities, with special focus on disabled and other disadvantaged populations. By providing connected, dedicated non-motorized facilities, these strategies can help reduce conflicts between vehicles and vulnerable road users.
	AC3: Implement a consistent approach for investment, design, connectivity, and maintenance of pedestrian and bicycle facilities.	
	AC4: Identify and consider accessibility and connectivity needs on improvement projects.	
	AC6: Maximize efficiency of transportation options available to disadvantaged populations.	
Business Operations and Management **Goal**: *Provide efficient, cost-effective management and operation to accelerate transportation project delivery and ensure system reliability.*	**BOM5**: Invest at the appropriate level to achieve performance targets given available funding.	This goal and associated strategies outline the Department's commitment to cost-effective, efficient management and operation of the transportation system to serve all users by complying with appropriate regulations and maximizing investments to meet goals. These commitments support development of the VRU SA, which is required under federal law and funded through federal dollars.
	BOM6: Employ proactive management strategies to ensure compliance with rules and regulations, identify risk to MDT and the transportation network, and facilitate equitable participation in MDT programs and services.	

1.2. Comprehensive Highway Safety Plan (2020) & Highway Safety Improvement Program (HSIP)

The *Comprehensive Highway Safety Plan* (CHSP) is a data-driven, multi-year comprehensive plan that establishes statewide safety targets, objectives, and key emphasis areas and includes the four E's of highway safety – engineering, education, enforcement, and emergency medical services (EMS). The CHSP provides a framework to engage residents and traffic safety advocates across Montana and enable coordination of safety programs and partners to work together to cooperatively address safety issues, align goals, and leverage resources to meet the vision of zero fatalities and zero serious life-changing injuries on Montana's public roads.

The CHSP summarizes crash data to identify the top traffic safety problems in the State so that targeted approaches can be undertaken to save lives. The data-driven plan considers the safety needs of all roadway users, establishes statewide goals and objectives, defines key emphasis areas and strategies with the greatest potential to reduce fatalities and serious injuries, focuses resources on areas of greatest need, and adopts performance-based targets coordinated with other State safety programs.

The CHSP applies a Safe Systems Approach by focusing on improving the culture of traffic safety where death on the roadway is not tolerable. Recognizing that saving lives and reducing life-changing serious injuries on Montana roadways is a shared responsibility, the plan emphasizes proactively preventing deaths and serious injuries by making good choices and safe travel a daily part of life, as well as strategies focused on safe roads.

The Highway Safety Improvement Program (HSIP) supports the CHSP goal to ensure all highway users arrive safely at their destination by providing funding for infrastructure-related highway safety improvements. Projects funded through the program include signing, striping, delineation, guardrail installation, slope flattening, intersection improvements, roadway realignment, and other safety improvements.

How is this plan relevant to the VRU SA?

- The CHSP documents extensive data analysis conducted to determine crash characteristics represented in crash data to aid in identifying emphasis areas. Analysis of crash characteristics included infrastructure (e.g., intersections, roadway departure), populations (e.g., older or younger drivers), behaviors (e.g., restraint use, impaired driving, distracted driving), or modes/vehicles (e.g., motorcyclist, pedestrians, bicyclists, large trucks).
- One of the four emphasis areas identified in the plan is *Roadway Departure and Intersection-related Crashes*. The plan notes that intersections present the highest potential for conflict between vehicles, bicycles, and pedestrians, with approximately 12% of intersection-related fatality and serious injury crashes involving pedestrians or bicyclists during the 2010-2019 period.
- The plan notes that safe roads include clear zones or "forgiving roadsides," where objects are relocated away from the road, or roadside appurtenances are designed to mitigate severity when roadway departures do occur. In an urban setting, separation can be used to create safer roadsides, protecting vulnerable users when run-off-road crashes occur.
- The CHSP notes the federal special rule related to drivers and pedestrians over the age of 65, with specific strategies required to address any increases in these crash types. The plan indicates the number of Montana crashes involving older drivers and pedestrians has decreased since a high in 2015.
- The CHSP identifies several strategies specifically targeting non-motorized safety as follows:
    - *Strategy 3: Reduce roadway departure and intersection crashes through traffic safety education:*
        - S3.7 Continue to provide and enhance traffic safety information for bicyclists and pedestrians and other non-motorized transportation system users.
    - *Strategy 4: Reduce and mitigate intersection crashes through data-driven problem identification and the use of best practices:*
        - S4.1 Continue to Implement the Railway-Highway Crossings Program, with projects at all public crossings including roadways, bicycle, and pedestrian paths eligible for program funds.
- As one of five required federal performance measures, the plan identifies a Non-Motorized Fatality and Serious Injury Target of 61.9 for 2023 based on an annual reduction of 1.

1.3. Statewide Transportation Improvement Program (2022)

The *Statewide Transportation Improvement Program* (STIP) is a federally required publication outlining funding obligations over a five-year period. This program is developed through coordinated efforts of MDT, state and federal agencies, local and tribal governments, metropolitan planning organizations, public agencies, transportation providers, citizens, and other interested parties.

The STIP identifies improvements to preserve, renovate, and improve Montana's transportation system. Although the projects and dates in the STIP are official MDT objectives, the execution of this program is contingent on a number of factors, including federal and state funding availability, right-of-way acquisition, utility relocations, environmental review, surveying, and design. Complications with one or more of these factors may delay a project.

The Transportation Improvement Programs (TIPs) from the Billings, Great Falls and Missoula metropolitan areas are incorporated into the STIP by reference. TIPs contain information about current and future transportation projects and are developed by Metropolitan Planning

Organizations (MPOs) in cooperation with area transit providers and state and local governments as part of a continuing, cooperative, and comprehensive transportation planning process.

How is this plan relevant to the VRU SA?

- As part of its system performance overview of performance objectives, the STIP outlines Montana's interim highway safety goal, with fatalities and serious injuries reduced through the year 2030.
- The STIP summarizes the Highway Safety Improvement Program (HSIP), which targets locations with crash trends as well as systemic improvements at the network level. Listed safety projects are developed by MDT and the MPOs and funded through the HSIP and other sources. HSIP funds over fiscal years 2022-2026 is estimated at approximately $248 million.
- The STIP also outlines projects funded through the Transportation Alternatives (TA) program, including facilities and safe routes for pedestrians, bicyclists, and other non-motorized users. Listed projects are developed by MDT and local agencies.

1.4. Highway Safety Plan and Annual Report (2022/2023)

The *Highway Safety Plan* is developed in support of the National Highway Traffic Safety Administration (NHTSA) program. It summarizes Montana's highway safety program and outlines countermeasure strategies to meet defined performance targets. Plan components include a description of the highway safety planning process and problem identification, a performance plan with data-driven, quantifiable highway safety performance measures, countermeasure strategies to guide program implementation and project selection, and a performance report on meeting previous performance targets.

How is this plan relevant to the VRU SA?

- Two of the NHTSA Core Performance Measures are pedestrian fatalities and bicycle fatalities. The plan reports these numbers for individual plan years (2016-2020), on a 5-year moving average basis, and identifies 2023 and 2025 target goal numbers for each category.
- The 2022 Annual Report notes pedestrian fatalities are being addressed in the Roadway Departure and Intersection-related Crashes Emphasis Area with infrastructure and signage safety countermeasures, which includes the strategy to "Continue to provide and enhance traffic safety information for bicyclist and pedestrians and other non-motorized transportation system users."

1.5. Montana Pedestrian and Bicycle Plan (2019)

The 2019 *Montana Pedestrian and Bicycle Plan* is the first statewide effort to address the needs of non-motorized users across the state. The plan is primarily aimed at providing consistency across MDT for considering pedestrian and bicycle modes on state owned and maintained facilities but is also intended as a resource by other agencies working to fulfill the needs of pedestrians and bicyclists in Montana.

How is this plan relevant to the VRU SA?

- The plan outlines the state of walking and bicycling in Montana, including a section focused on historic and current safety conditions for non-motorists. The plan reports the number of fatalities and serious injuries during the 2008-2017 period, as well as contributing factors for these crashes.
- The plan identifies a set of recommended strategies to achieve the following goals in support of non-motorized safety.

Table 1.2: Montana Pedestrian and Bicycle Plan Goals and Strategies

Goal	Strategy	Relationship to VRU SA
Goal 1: Reduce pedestrian and bicyclist fatalities and serious injuries in support of Vision Zero.	Strategy 1A: Improve safety at intersections through applicable design standards and new technologies.	The plan's goal and associated strategies to improve safety for pedestrians and bicyclists directly align with the VRU SA effort. These strategies form a starting point for more detailed consideration and development in the VRU SA.
	Strategy 1B: Periodically review and update design guidance for pedestrian and bicycle facilities.	
	Strategy 1C: Improve safety on rural roadways through widened shoulders.	
	Strategy 1D: Collaborate across jurisdictions to support changes to traffic laws aimed at improving the safety and predictability of walking and bicycling.	
	Strategy 1E: Develop and implement non-motorized crossing treatment guidelines.	
	Strategy 1F: Analyze pedestrian and bicycle crashes and contributing factors to identify potential safety improvements.	
Goal 2: Educate, encourage, and promote safe and responsible travel practices of motorists, pedestrians, and bicyclists.	Strategy 2A: Explore cost-effective mechanisms to improve the quality of data on pedestrian and bicycle activity and travel behavior	Improving predictability in travel modes and traveler behaviors and practices can enhance safety for all users, including pedestrians, bicyclists, and other non-motorists.
	Strategy 2B: Improve and increase safety education and encouragement programs for pedestrians, bicyclists, and motorists.	
	Strategy 2C: Provide ongoing training programs for transportation engineers and planners focused on pedestrian and bicyclist needs and accommodations.	
Goal 3: Preserve and maintain the pedestrian and bicycle transportation system.	Strategy 3A: Develop a consistent approach for preservation and maintenance of pedestrian and bicycle facilities.	Maintaining the condition of pedestrian and bicycle facilities can encourage greater use of dedicated facilities, resulting in separation of modes and reduction of conflicts between vehicles and vulnerable road users.
	Strategy 3B: Explore innovative viable funding alternatives for maintenance of pedestrian and bicycle facilities.	
Goal 4: Improve mobility and accessibility for all.	Strategy 4A: Improve accessibility and mobility using current design guidance and modern technology when building, upgrading, and retrofitting pedestrian and bicycle facilities.	Employing modern technology and the most current design for pedestrian and bicycle facilities supports the safety of non-motorized users, with specific focus on safe access to schools and disadvantaged areas in direct alignment with the VRU SA.
	Strategy 4B: Provide safe access to schools and areas with significant senior, minority, and low-income populations.	
Goal 5: Support walking and bicycling as important transportation modes for access to destinations,	Strategy 5A: Improve community health and economic vitality by promoting walking and bicycling.	Investments in non-motorized modes and support of walking and bicycling will ultimately improve safety conditions for
	Strategy 5B: Explore innovative viable funding alternatives for pedestrian and bicycle transportation.	

Goal	Strategy	Relationship to VRU SA
economic vitality, and health.	Strategy 5C: Support access to recreational, historic, cultural, downtown, and scenic destinations for improved tourism and economic vitality.	these users, with the added benefit of promoting transportation equity.
	Strategy 5D: Evaluate criteria that ensures safety and meeting relevant guidelines for bicycle route identification.	
	Strategy 5E: Improve administrative efficiency, consistency, and coordination for pedestrian and bicycle transportation.	

1.6. ADA Transition Plan (2021)

The MDT *Americans with Disabilities Act (ADA) Transition Plan* directs the department's efforts to provide an accessible transportation system within the state of Montana. The purpose of the plan is to provide guidance for removal of barriers to enable equitable access to MDT's programs, facilities, and services for transportation users of all abilities. The plan provides an overview of MDT's external ADA program, outlines MDT's mission and ADA policy, and identifies methods to assist MDT in complying with ADA regulations.

How is this plan relevant to the VRU SA?

- The following ADA program methods specifically support the VRU SA development process by improving accessibility and safety for disabled individuals as part of non-motorized trips. Additional methods outlined in the plan broadly support non-motorized accessibility for disabled individuals.

Table 1.3: ADA Transition Plan Methods

Topic Area	Method		Relationship to VRU SA
Administration	**Method 2:** Conduct outreach with transportation officials.		Partner agency and stakeholder coordination is important to understand needs and identify safety barriers impacting non-motorized users. The VRU SA development process offers an opportunity to continue building these relationships.
	Method 3: Coordinate with representatives of the disability community		
Rights of Way	**ADA Inventory**	**Method 11:** Maintain an inventory of existing ADA features.	Understanding the existing location and condition of ADA features and considering safety performance when addressing barriers is critical to enhancing safety for vulnerable road users.
		Method 14: Identify projects using risk-based assessment of demand and compliance scoring, in combination with safety performance, proximity to programmed projects, local planning, and public feedback.	
	Design and Construction	**Method 23:** Design ADA improvement in accordance with applicable MDT design standards and federal regulations.	Development of the VRU SA in consideration of all users will aid MDT in broadly complying with federal regulations.
	Operations & Maintenance	**Method 28:** Identify ADA issues during regular maintenance duties.	Routine maintenance and winter maintenance of ADA facilities are important to ensure safe access for non-motorized users throughout the year.
		Method 29: Conduct winter maintenance, coordinate with local jurisdictions, and enforce maintenance agreements.	

2.0. COMMUNITY TRANSPORTATION SAFETY PLANS

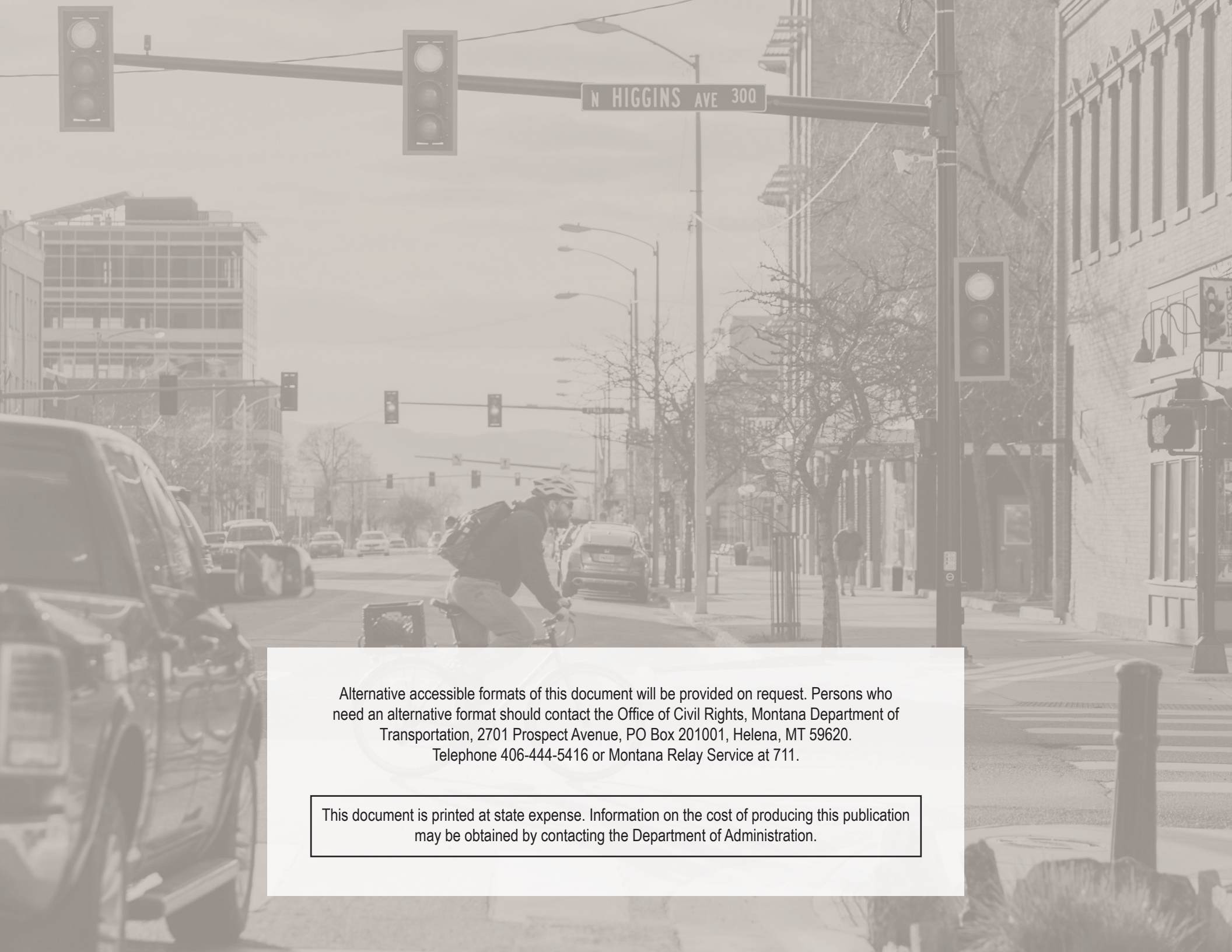
Community Transportation Safety Plans (CTSPs) are local plans focused on reducing roadway fatalities and serious injuries in specific geographic areas within the state. CTSPs generally follow the same methodology as Montana's CHSP using a data-driven approach to identify safety issues, determine areas in need of increased focus, and outline strategies to reduce roadway fatalities and serious injuries.

How are these plans relevant to the VRU SA?

The following CTSPs specifically address VRU safety issues.

- The **Billings CTSP (2022)** identified pedestrian-involved and bicyclist-involved as correlating factors for fatalities and serious injuries. The plan identified NHTSA *Countermeasures That Work* for these types of crashes including crosswalk visibility enhancements, bicycle lanes, rectangular rapid flashing beacons, leading pedestrian interval, medians and pedestrian refuge islands in urban and suburban areas, pedestrian hybrid beacons, road diets (roadway reconfiguration), and walkways.
- The **Missoula CTSP (2019)** noted through public outreach activities that Missoula residents believe pedestrian-involved crashes are among the most important areas of focus to decrease the number of fatal and severe crashes in the Missoula area. The plan documented an analysis of crash data for non-motorized users and identified **non-motorized users as one of three emphasis areas**. Strategies addressing this emphasis area included: 1) Improve non-motorist safety through design best practices and new technologies, 2) Provide education opportunities for pedestrians, bicyclists, and motorists about safe and lawful behavior and interactions, and 3) Support enforcement of pedestrian and bicycle traffic laws and policies.
- The **Bozeman CTSP (2013)** identified **bicycle and pedestrian crashes as one of three top areas of focus** to reduce fatal and incapacitating injuries in Bozeman. Strategies included: 1) Increase bicycle and pedestrian infrastructure in Bozeman, including bicycle lanes, sidewalks, signage and pavement markings, 2) Reduce impaired bicycling and walking, 3) Increase reporting of bicycle and pedestrian crashes, 4) Conduct public education about safe operating procedure between bicyclists and pedestrians and vehicles, 5) Increase enforcement of safe behaviors by both drivers around bicyclists and pedestrians and by bicyclists and pedestrians as they enter into the transportation mix.
- Based on crash data analysis and community input, the **Greater Helena Area CTSP (2013)** identified **bicycle and pedestrian-involved crashes as one of three top areas of focus**. Strategies included: 1) Continue to promote, enhance, and maintain bicycle and pedestrian safety as part of Greater Helena Area infrastructure, on local roadways, 2) Continue and enhance enforcement of safe behaviors by drivers around bicyclists and pedestrians and by bicyclists and pedestrians as they enter into the transportation mix, and 3) Continue to promote and enhance public education about safe bicycling and walking practices and safe operating procedures between bicyclists and pedestrians and vehicles.
- The **Butte-Silver-Bow CTSP (2012)** noted that roadways should include safety features such as infrastructure for pedestrians and bicycles, including pedestrian crosswalks. As part of its Intersection Safety emphasis area, the plan identified an action step to conduct communications on key driving issues, including the requirement to yield to pedestrians in crosswalks and ensuring drivers know how to share the road with bicyclists.

- The **Hamilton CTSP (2011)** identified **vulnerable users** (including pedestrians and bicyclists) **as one of three emphasis areas** through public and stakeholder outreach and data analysis. The plan catalogued existing strategies addressing vulnerable users, including bicycle/pedestrian outreach at safety fairs, through a seasonal bicycle officer, and driver's education. As a new strategy, the plan identified development of the *Hamilton Area Transportation Plan*, including an assessment of potential non-motorized facilities in the Hamilton area, and development of a non-motorized transportation plan identifying non-motorized projects, costs, design guidelines, and implementation steps.
- The **Shelby-Toole County CTSP (2011)** noted that roadways should be designed to include safety features including infrastructure for pedestrians and bicycles and rumble strips to alert drivers leaving the travel lane. During the analysis period, the number of pedestrian- and bicycle-involved crashes in the Shelby-Toole County study area were low compared to other crash types. However, the emphasis areas of inattentive driving and impaired driving can indirectly influence vulnerable road user safety as these factors can contribute to non-motorized crashes.



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