Table of Contents

Chapter 7 : Design Alternatives and Safety

Goal 5: Develop and construct bicycle and pedestrian facilities to effectively balance the needs of all transportation users to promote travel choices, ensuring that bicyclist and pedestrian needs are prioritized in appropriate locations and with safety in mind.

To effectively implement a useable bike-ped network infrastructure must be designed in a manner that gives all users safe transportation options. The County's 2016 Bicycle-Pedestrian Master Plan Interest Survey (2016 Interest Survey) clearly shows there is a desire to see more bike-ped infrastructure. Designing rural roads to be more bike-friendly can be challenging. The best ways to apply bike-ped facilities may be examined through national and statewide trends; however, these trends often focus on urban areas. Rural and urban areas have design and safety challenges that differ. Based on the characteristics of rural crashes there are design options and safety measures that can be put in place to reduce collisions and harmful incidents. As new facilities are constructed and existing facilities are improved user safety conditions improve and user confidence increases. This chapter will examine safety concerns and crash data and offer best practice design alternatives to consider.

Safety and Collisions

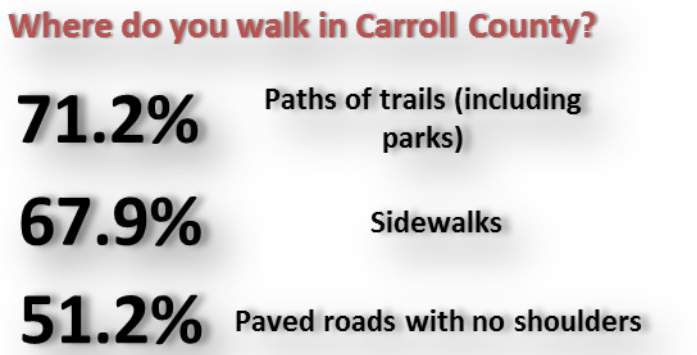
One of the main ways to encourage walking and biking would be to ensure all participants feel safe and secure. High motorist speeds and heavily congested areas can create unsafe conditions for bicyclists and pedestrians. A countywide bicycle and pedestrian network will be more efficient than a vehicle-focused network with the appropriate, safe infrastructure in place. The 2016 Interest Survey found that people are interested in walking and biking to destinations in Carroll County but do not feel safe due to a lack of infrastructure and traffic conditions. Some key responses are outlined in Table 7-1. It is important that the common causes of crashes be examined in order to determine potential countermeasures. It is also important to determine those problems unique to Carroll County and its rural environment. This includes analyzing collision data and gathering the input of those who are biking and walking in the County. A community-based approach is the best way to educate and ensure user safety concerns are addressed.

Safety Concerns from the Public

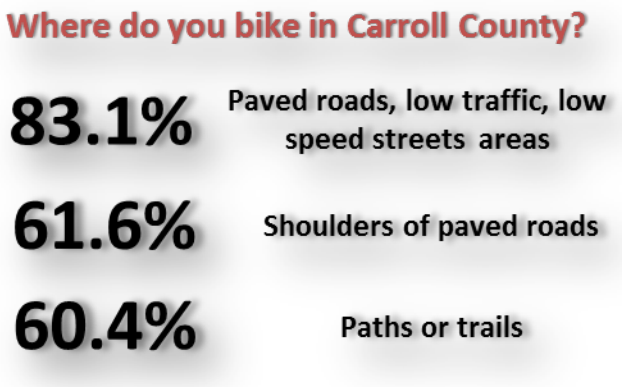
Maintaining a safe transportation network for drivers, bicyclists and pedestrians is a top concern of citizens. The proper, safe infrastructure needs to be put in place to accommodate those who bike and walk in the County. There needs to be education on bicycle and pedestrian law and safety. Citizens have expressed concerns about the disrespect between motorists, and bicyclists and pedestrians. The 2016 Interest Survey found top safety concerns include:

- More and improved infrastructure
- Respect from motorists
- Motorist education
- More signage
- More safe crossings

Table 7-1 shows what was determined from responses in the 2016 Interest Survey in terms of infrastructure, safety and other notable characteristics.



Crossing roads and intersections on bicycle and by foot is another extensive safety concern of citizens. Throughout the outreach process of this plan citizens have stated that they are fearful of biking and walking certain roads, and crossing roads and intersections. Citizens have also mentioned how cyclists can be treated by motorists including spitting on cyclists, speeding up when approaching cyclists, and yelling at cyclists. Pedestrians can experience similar behavior as vehicles are used to being the preeminent occupants of roadways.



If the people of Carroll County are not comfortable walking and biking because of a lack of safe infrastructure, then the appropriate actions should be examined to improve the walking and biking experience. This includes but is not limited to examining why crashes or collisions occur so that appropriate infrastructure and safety measures can be put in place.

2016 Interest Survey Responses

	Walking	Biking
Infrastructure	Survey participants are walking on the following Carroll County infrastructure: • Paths or trails (including parks) 71.2% • Sidewalks 67.9% • Paved roads with no shoulders 51.2% Participants would walk more if there were: • More walking trails or paths 85.3% • Improved sidewalks 52.6% • Improved pedestrian crossings, signals and signage 39.5% • Improved lighting and other security measures 31.5%	Survey participants are biking on the following Carroll County infrastructure: • Paved roads, low traffic, low speed streets 83.1% • Shoulders of paved roads 61.6% • Paths or trails (including parks) 60.4% Participants would bike more if there were: • Off-road paths 63.7% • Bike lanes 61.7% • Paved shoulders 50.4% • Improved wayfinding signage 37.9% • In addition to infrastructure, education for motorists (37.7%) was the next most requested improvement.
Safety	On a scale of one to five (five being the most important): • Rated as a four or five, motorists respecting pedestrians 69.2% • Rated as a four or five, safely and easily walking across roadways 64.6% What keeps you from walking in Carroll County more often? • I don't feel safe due to walking conditions/traffic 66.1%	On a scale of one to five (five being the most important): • Rated as a four or five, motorists' respect of cyclists 82.9% • Rated as a four or five, safe and easy road crossings 66.8% What keeps you from biking in Carroll County more often? • I don't feel safe due to road conditions/traffic 65.8%
Other	Some other notable characteristics are: • 70.3% walk at least a few times a week for leisure, fun, or exercise • Over two-thirds of respondents will walk up to two miles or more • Walking one- half miles or more is comfortable for 82.5%	Some other notable characteristics are: • 75.5% ride a bike but only 59.1% ride a bike within Carroll County (based on all respondents) • Nearly half of respondents ride their bike for leisure, fun or exercise at least once a week and nearly three-fourths ride their bikes at least once a month • Over two-thirds of respondents are comfortable biking between 30 and 120 minutes[i]

Table 7-1: 2016 Interest Survey Responses

Understanding Collisions

Bicyclists and Pedestrians are more vulnerable and may sustain major injuries in a collision compared to vehicular drivers. As the volume and speed of vehicles increase there is an increased need for bicycle facilities (Figure 7-1); similar is true for pedestrians. It is important to recognize that bicycles are vehicles by Maryland law[ii]. Therefore, cyclists have the right to be on the road but also have responsibilities similar to drivers. Most traffic laws are applicable to bicyclists. These factors play an important role in understanding how and why collisions occur. Failing to understand the laws and how to protect oneself, as it applies to pedestrians and bicyclists, could lead to increased roadway incidents, including collisions and fatalities.

FACT: Bike-Ped Crashes

Compared to urban areas, rural areas are more likely to:

- **Have higher bicycle and pedestrian fatality rates**
- **Have higher vehicle speeds**
- **Have crashes that occur at non-intersection locations**

FHWA. Factors Contributing to Pedestrian and Bicycle Crashes on Rural Highways. 2010. https://www.fhwa.dot.gov/publications/research/safety/10052/10052.pdf

While pedestrian and bicycle accidents are more common in urban areas, the likelihood of a fatality increases in rural areas[iii], according to the FHWA. The Federal Highway Administration (FHWA) published a 2010 summary report *Factors Contributing to Pedestrian and Bicycle Crashes on Rural Highways.* The report is based on the Highway Safety Information System (HSIS) data. The report includes these conclusions about rural vehicle-bicycle and vehicle-pedestrian crashes:

- Compared to urban areas rural crashes have:
  - Higher bicycle and pedestrian fatality rates
  - Higher reported vehicle speeds
  - Less roadway lighting
  - More incidents on unpaved shoulders
  - More incidents at non-intersection locations
- The top rural pedestrian crash type is walking along the roadway
- The top rural bicycle crash type is turning/merging into the path of the driver and drivers overtaking the bicyclist
- Rural crashes are more likely to occur at midblock, compared to urban crashes generally occurring at intersections
- Targeting funding to rural two-lane roads at specific segments offers the best return on safety improvements[iv]

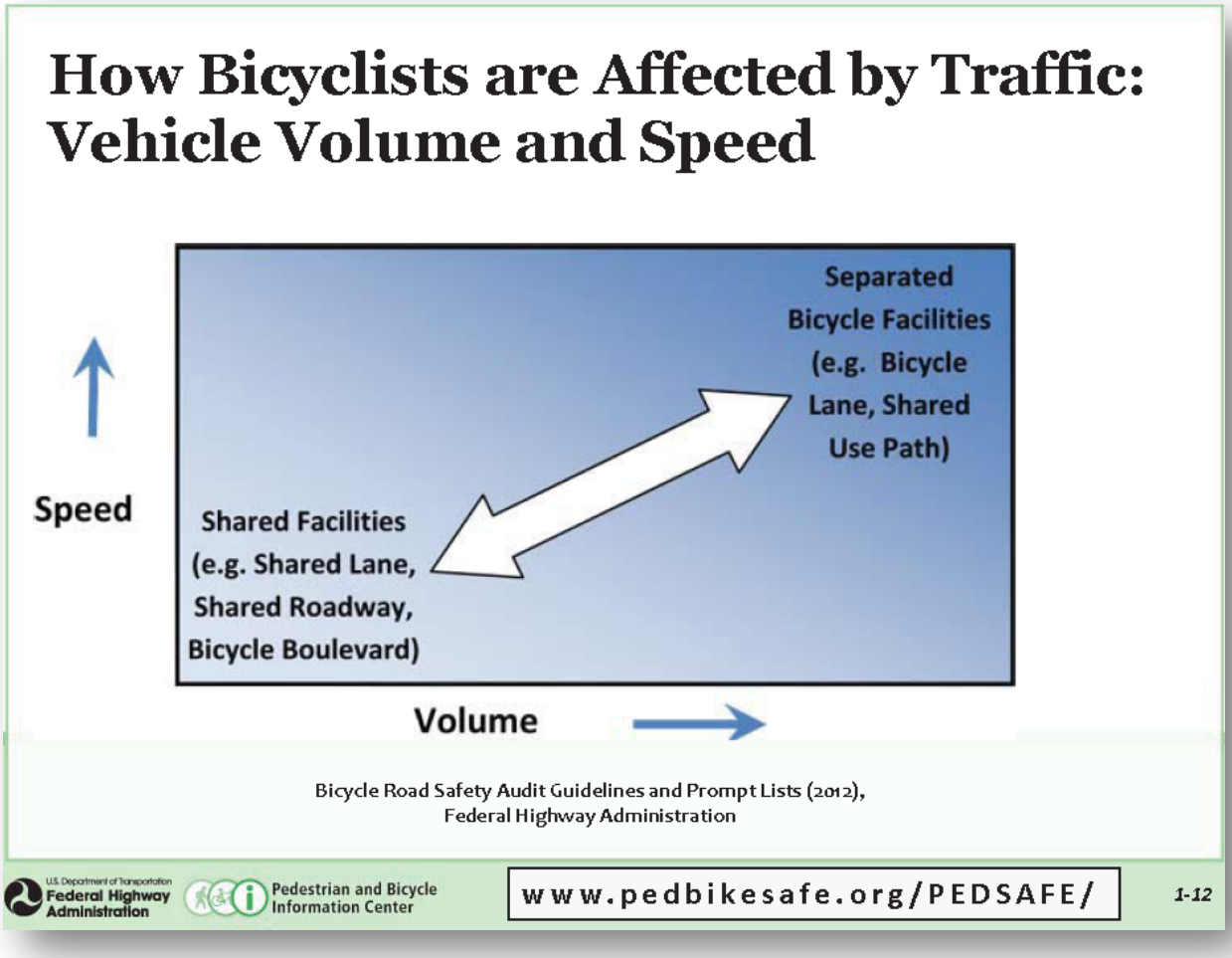


Figure 7-1: How Bicyclists Are Affected by Traffic: Vehicle Volume and Speed, Pedbikesafe.org

County Data

To better understand collisions in Carroll County, data was collected from the County and municipal law enforcement offices[v] and Carroll County Emergency Communications. The County sheriff/police data represents collisions that occurred between 2012 and 2015[1]. The Emergency Communications data represents responses to calls between 2016 and 2018. See the Appendix for more details on the data and methodology.

This data is only a sample size of all the County's potential crashes and does not represent a complete picture of collisions.[vi] It is important to note that only 36 percent of the sheriff/police reported collision records were from municipalities, denser areas. Yet, state and federal data support crashes occurring more frequently in higher density areas.

[1] Based on County Sheriff/Police Reports January 1, 2012 through August 7, 2015

Below are the main highlights of the sheriff/police data:

- 78 percent of all bike-ped collisions involved pedestrians
- 22 percent of all bike-ped collisions involved cyclists
- Age and Sex
    - Children (< 18) are more likely to be involved in a collision on a bicycle than as a pedestrian
    - Males are more likely to be involved in a pedestrian or bicycle collision than females
- Location
    - Nearly half of all collisions occurred along the roadway, on the shoulder or mid-road, Figure 7-3
- Injury, Fault, and Safety Practices
    - Over half of all collisions required the pedestrian/bicyclist to be transported from the scene to emergency services
    - While the driver is at fault most often, bicyclist are more likely to be at fault than pedestrians (as determined in the police/sheriff report)
    - Pedestrians are more likely to wear light colored or reflective clothing compared to bicyclists
    - Only 3 out of 17 night time collisions were known to have streetlights present
- Bicycle Collision Frequency (see Figure 7-2)
    - Peak collision months were the warmer months May through June and September
    - Peak collision days were Thursday and Friday
    - Peak collision time was around 6:00 PM
    - Peak collision days were Thursday and Friday
- Pedestrian Collision Frequency (see Figure 7-2)
    - Peak collision hours were between 6:00 AM to 9:00 AM, 3:00 PM, and 7:00PM to 10:00 PM.
    - Peak collision days for pedestrians were Friday, similar to the state of MD, but also Thursday
    - Peak collision months were April through September
    - 50 percent of pedestrian collisions occurred along the roadway (32 percent) or on the shoulder (18 percent) compared to 9 percent at intersections. This data compares to the FHWA data on rural crashes in that it showed many collisions occurring at non-intersection locations

There were various safety issues that were revealed in the County data. The data showed:

- Safety equipment and colors were not often used by pedestrians or bicyclists. However, pedestrians were more likely to wear light or reflective clothing compared to bicyclists (32 percent of all pedestrian collisions versus 23 percent of all bicyclists).
- At night, only 9 percent of both bicyclists and pedestrians wore the proper clothing.

- Only 1 out of 13 bicyclists were wearing a helmet when the collision occurred. Maryland law requires everyone under 16 to wear a helmet, yet there was no record of children wearing helmets.
- Pedestrians were more likely to walk in an unsafe direction – with the flow of traffic.
- Bicyclists were more likely to ride in a safe direction – with the flow of traffic.

The Emergency Communications bike-ped related calls received showed the following:

- 83.8 percent were about a pedestrian involved collision
- 16.2 percent were about a bicycle involved collision
- The top 3 Fire Districts that responded to calls were:
    - 44.8 percent – District 3 (Westminster Fire Engine & Hose Company)
    - 11.4 percent – District 12 (Sykesville Freedom District Fire Company)
    - 8.6 percent – District 1 (Mount Airy Volunteer Fire Department)
- These districts fall within the Central and Southern EMS Districts.

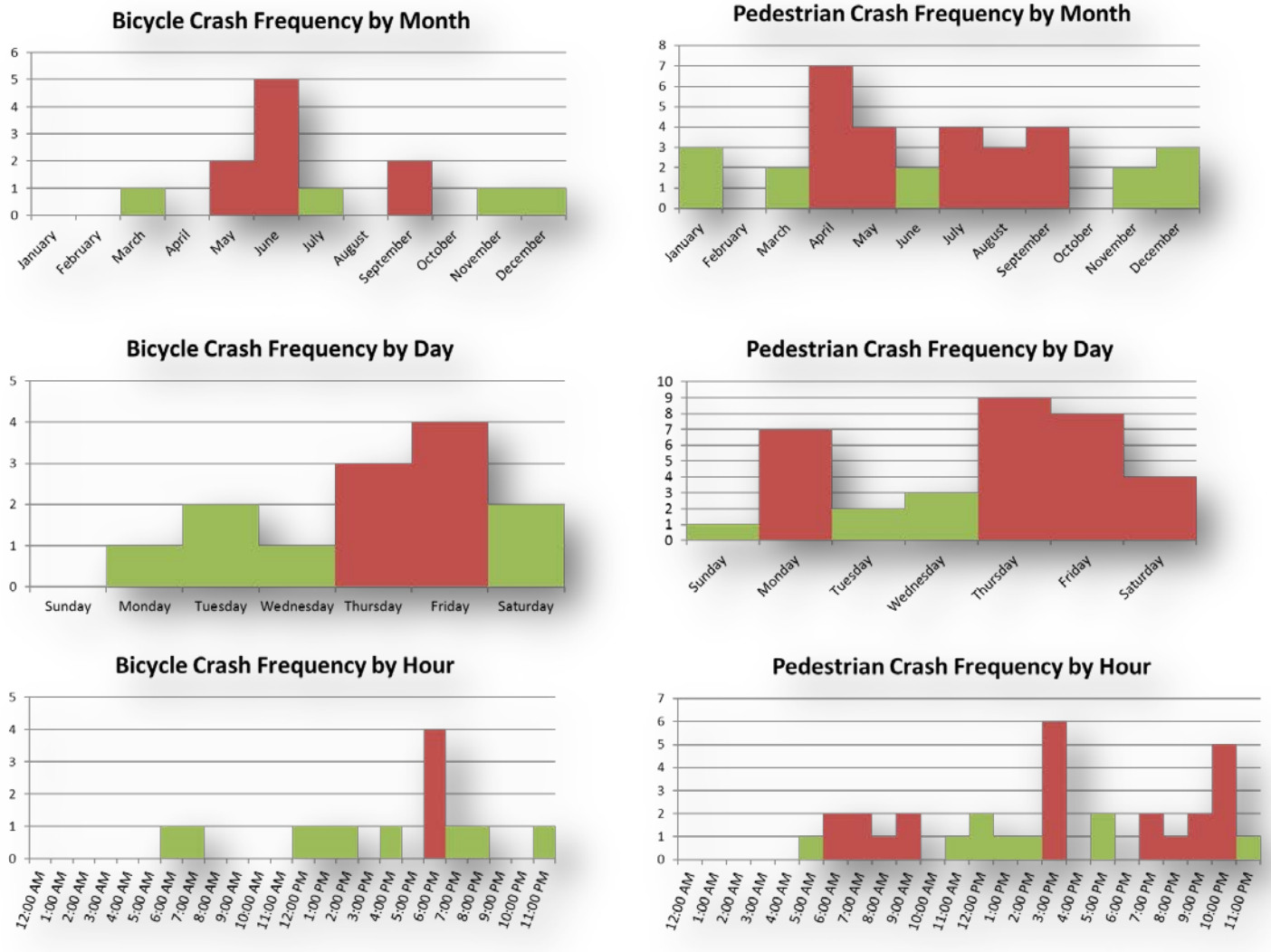


Figure 7-2: Carroll County Crash Frequency

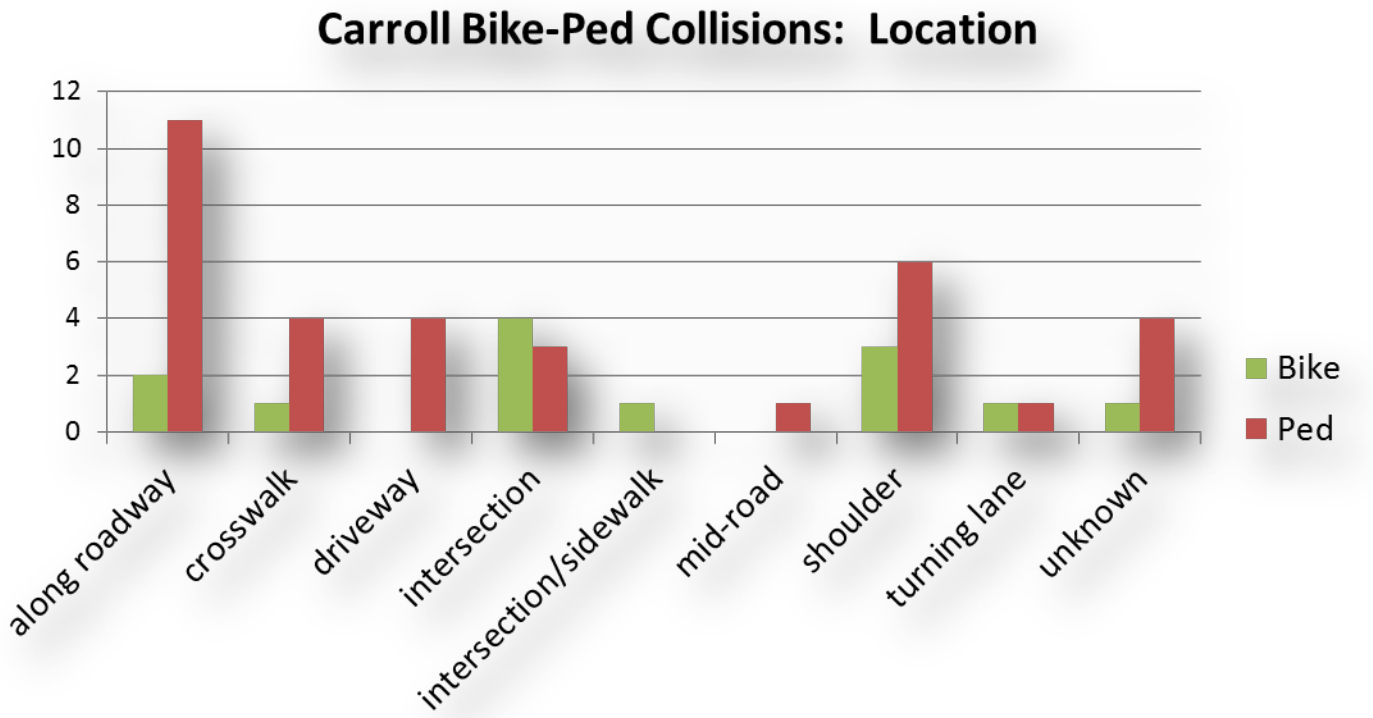


Figure 7-3: Carroll Bike-Ped Collisions: Location

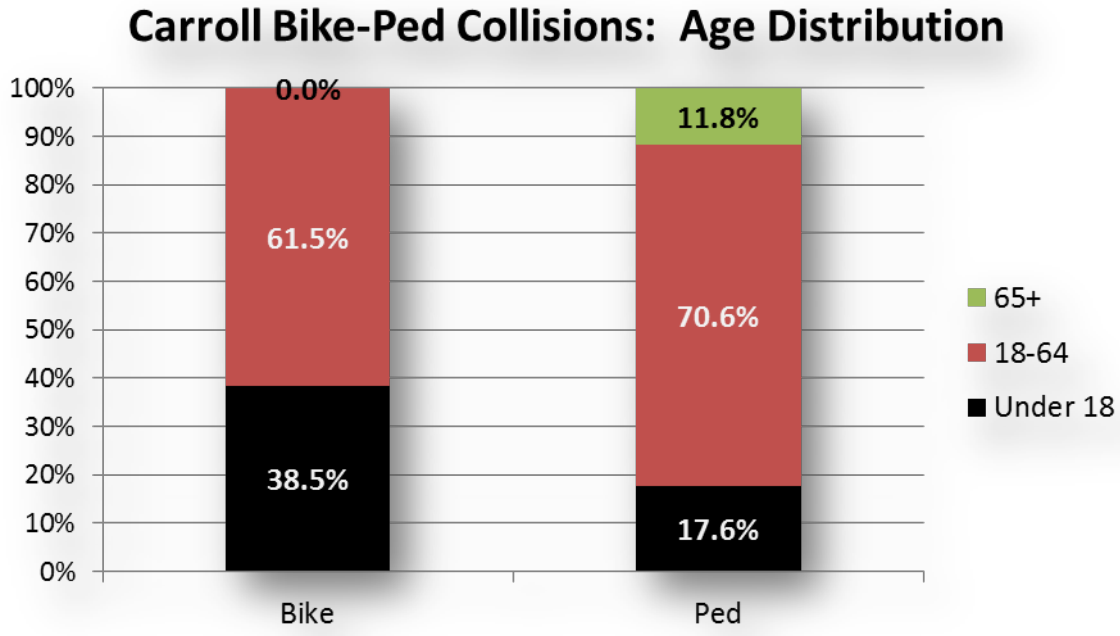


Figure 7-4: Carroll Bike-Ped Collisions: Age Distribution

State Data

In comparison to County data, the Motor Vehicle Association (MVA) found the following about bicycle/pedalcycle safety in Maryland:

- Between 2011 and 2015:
  - Crashes involving bicycles and pedalcycles have increased 20 percent, and 80 percent of those crashes resulted in death or injury
  - More than 60 percent of all bicycle/pedalcycle crashes occurred between May and October, with June to August having the highest number of injuries
- Between 2007–2011, on average:
  - 40 percent of all crashes and 35 percent of all fatal crashes involving a pedalcycle occurred between the hours of 4:00 PM and 8:00 PM
  - During those same years, on average, 52 percent of all pedalcycle involved crashes occurred between May and August. In these four warmer months, 49 percent of the crashes were fatal
  - The vast majority of all bicycle or other pedalcycle involved crashes and bicycle or other pedalcycle involved fatal crashes occurred in daylight; 77 percent and 71 percent respectively
  - More than 63 percent of all bicyclist crashes occur between the months of May to September
  - Bicyclist crashes overall are distributed fairly equally across the days of the week; however, Tuesday is the peak day for bicyclist fatalities, accounting for 30 percent of all riders killed
  - Young bicyclists are the most likely to be involved in a bicycle crash; more than 40 percent of bicycle crashes involve a person under the age of 18
  - Approximately 84 percent of all bicyclists involved in a crash, injured or killed while riding are male[vii]

Below are important facts from the MVA about pedestrian safety in Maryland:

- Between 2011 and 2015:
  - Pedestrian involved crashes in the state have increased, including those resulting in injuries or fatalities
  - Pedestrian crashes are 3 percent of the state's approximately 108,000 crashes but 19 percent of all fatalities
  - Pedestrian-involved crashes are highest during the fall season
  - Fatal pedestrian crashes increased between October and December
  - Nearly half of all pedestrian crashes occurred between 3:00 PM and 10:00 PM
  - Fatal pedestrian crashes are more likely to occur between 6:00 PM and midnight
  - Teens and young adults (age 34 and younger) are more likely the be the driver in a pedestrian crash
  - Pedestrians are more likely to be between the ages of 10 and 29 (37 percent), and 45 and 59 (30 percent)

- Males are more likely to be the pedestrian and driver in a pedestrian-vehicle crash

- Between 2006 and 2010, on average:
  - 36 percent were impaired by alcohol, drugs, or both
  - More than 70 percent of all pedestrians killed are male
  - 68 percent of pedestrians were on a road where there was no crosswalk
  - Police indicated on the crash report the pedestrian was at fault in 67 percent of the crashes
  - Pedestrian fatalities represent 19 percent of all traffic fatalities statewide
  - A crash involving a pedestrian is nearly six times as likely to produce a fatality as all traffic crashes statewide
  - Pedestrian crashes are similar in distribution across the months of the year, compared to all crashes statewide (slight increases in pedestrian crashes occur in the spring and late fall months)
  - There is an increase in pedestrian fatalities in the months of October through December, compared to all crashes statewide; during these times there is less daylight, but weather is still moderate enough to accommodate most pedestrians
  - Friday is the peak day for total pedestrian crashes, and Saturday is the peak day for crashes that result in a pedestrian fatality
  - Early evening hours of 3:00 PM to 8:00 PM are the peak hours for total pedestrian crashes, and early morning hours are overrepresented in fatal pedestrian crashes
  - Pedestrians aged 10 to 15 are overrepresented in total pedestrian crashes and pedestrian injury crashes; older pedestrians aged 45-54 years are overrepresented in fatal pedestrian crashes[viii]

Most of these federal and state statistics are consistent with what was found in the County. This means the sample data obtained from the Sheriff's office is a general indicator of the occurrence of crashes in Carroll County.

Additional County crash data was obtained through the State Police.[ix] This can be seen in Map 7-1 along with the County Sheriff/municipal crash data. The highlight of this data is shown in Table 7-2 and Table 7-3. These tables point out that the bulk of the Carroll County crashes are pedestrian involved, occur in the Westminster MGA, and occur on County roads.

State Police Vehicle Crash Data

State Police - County Total	134	100.0%
Pedestrian Crashes	109	81.3%
Pedalcycle Crashes	25	18.7%
County Growth Area Total	98	73.1%
County Total Outside Growth Area	36	26.9%
Crashes in Westminster MGA	60	44.8%
Baltimore Blvd (MD 140) in Westminster	*13*	*9.7%*
of MD 140 crashes within MGA	*13*	*21.7%*
Crashes in Freedom DGA	14	10.4%
Liberty Rd (MD 26)	*4*	*3.0%*

Table 7-2: State Police Vehicle Crash Data, 2015-2017

State Police Vehicle Crash Data - County vs State Roads

	County%	State%	Other%	Total
Pedestrian	35.1%	24.6%	21.6%	81.3%
Pedalcycle	9.0%	9.0%	0.7%	18.7%
Total	44.0%	33.6%	22.4%	**100.0%**

Table 7-3: State Police Vehicle Crash Data - County vs State Roads

Preventing Collisions

Some of the collision incidents listed in the previous section have the potential to be prevented with the appropriate countermeasures. Solutions must be found to eliminate the collision causing conditions and allow pedestrians and bicyclist to feel safer. However, the feeling of safety is not enough. Solutions include a combination of engineering, education, and enforcement policies and strategies. The creation of a design guide will supplement this plan and allow addressing specific engineering challenges at specific locations when designing bicycle and pedestrian facilities. In this section of the plan a more general overview of collision prevention will be addressed.

The findings of the County collision data show there is a need to educate bicyclists and pedestrians about safe practices. Both groups must be educated differently as the factors that contribute to bicycle crashes are not the same as those factors that contribute to pedestrian crashes. Therefore, the solutions are not the same.

The FHWA report, *Factors Contributing to Pedestrian and Bicycle Crashes on Rural Highways,* noted "effective and feasible countermeasures" from BIKESAFE and PEDSAFE (United State Department of Transportation, US DOT). These findings have been displayed in Table 7-4. As mentioned, 51.2 percent of 2016 Interest Survey respondents are walking on paved roads with no shoulders. This is common to rural roads because when no paths or sidewalks are available

the road is the best location to enjoy walking. This is a safety challenge as rural crashes are more often occur at midblock.

There are recommended safe practices that pedestrians and bicyclist may take to protect themselves. The National Center for Safe Routes to School (SRTS) states, "When one must walk on the road because the area lacks pedestrian facilities such as a sidewalk, one is advised to walk on the left-side, facing traffic, as this presents opportunities to establish eye-contact with approaching motorists and make quick judgments to protect oneself."[x] The Pedestrian and Bicycle Information Center recommends wearing or carrying items at night that would make one noticeable to drivers.[xi] This includes light colored clothing, reflectors, or lights. According to the Maryland Highway Safety Office's Bicycle Safety Program bicyclists fare best when they act like vehicles and are treated as vehicular drivers. Therefore, they should move in the same lane direction as cars, obeying signals and signs, and yielding to traffic when appropriate.

Common Crash Types and Countermeasures[xii]

	Crash type	Solutions
Pedestrian:	**Pedestrians walking along the roadway**	Add sidewalks (targeted) Add paved shoulders Add roadway lighting (targeted)
	Pedestrians failing to yield midblock	Educate pedestrians
	Pedestrians darting/dashing midblock	Improve signage (targeted) Educate pedestrians Utilize traffic-calming measures (targeted)
	Disabled vehicle-related[xiii]	Educate drivers
	Pedestrians failing to yield at the intersection	Educate pedestrians Install pedestrian signal (targeted) Improve roadway lighting (targeted)
	Pedestrians crossing the expressway	Improve roadway lighting (targeted) Install fence or barrier (targeted)
Bicycle:	**Bicyclists turning/merging into the path of the driver midblock**	Provide marked pavement space for bicyclists (locations with suitable pavement width) Add paved shoulder
	Drivers overtaking midblock	Provide marked pavement space for bicyclists (locations with suitable pavement width) Improve roadway lighting (targeted)
	Bicyclists failing to yield midblock	Reduce lane width to minimize crossing distance and slow vehicles (targeted)
	Bicyclists failing to yield at the intersection	Improve sight distance. Improve school zones

Table 7-4: Common Crash Types and Countermeasures, Federal Highway Administration[xiv]

The Maryland Strategic Highway Safety Plan (SHSP) is a statewide, coordinated, comprehensive, traffic safety plan that provides the framework for reducing highway fatalities and serious injuries on all public streets and highways. It establishes overall goals and objectives as well as objectives and strategies within each of six key emphasis areas: Aggressive Driving, Distracted Driving, Highway Infrastructure, Impaired Driving, Occupant Protection, and Pedestrians & Bicyclists. The current document covers the years 2016 through 2020.

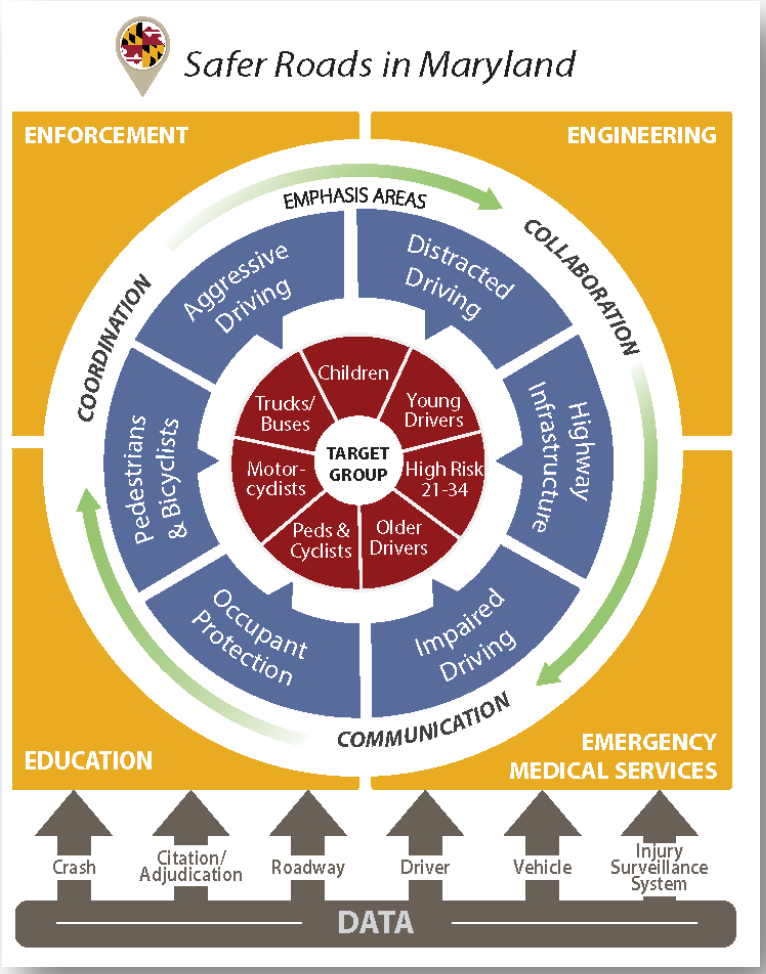


Figure 7-5: Diagram of Safer Roads in Maryland; from Maryland Strategic Highway Safety Plan 2016-2020

The fourth Emphasis Area of the 2016-2020 SHSP is:

> *"Create and improve pedestrian and bicycle safety culture in Maryland including the promotion and implementation of legislation and training of professionals and stakeholders about best safety practices. This includes the development of a training program for law enforcement on best practices in pedestrian and bicycle enforcement as well as the creation and passing of legislation for Complete Streets policies for the state."*

The recommendations and strategies suggested in this document should be used in Carroll County's Strategic Highway Safety Plan (Carroll SHSP), which is in progress. The Maryland Highway Safety Office (MHSO) offers jurisdictions technical assistance with developing a safety plan. The state also has grants available to assist with the implementation of these plans. Funding and grants are discussed more in Chapter 8: Implementation. MHSO has access to grants and funding that have benefited other Carroll County programs such as the Children's Advocacy Center, Carroll County Health Department, the Bureau of Aging and Disabilities, and County and municipal law enforcement agencies[xv].

There is an opportunity to partner with existing campaigns and utilize existing resources to improve safety education and prevent bicycle-pedestrian incidents and collisions. One example is the *Street Smart* campaign, through the Maryland Highway Safety Office's (MHSO) Pedestrian and Bicycle Safety Program. The *Street Smart* campaign is a program partnership within Maryland, DC, and Virginia. The campaign "works to protect vulnerable road users by raising awareness about pedestrian and bicycle safety" through various media outlets and outreach events. "It is meant to complement, not replace, the efforts of state and local governments."[xvi] Another example is MDOT's *Toward Zero Deaths* program. The program was established with the goal of moving toward the elimination of all roadway fatalities.

Safe Routes for Children

Children are a different type of pedestrian and bicyclist. They are smaller and do not have the full understanding and perception of road rules and dangers as do adults. Children tend to:

- React slowly
- Have a narrow field of vision
- Have challenges judging the speed and distance of approaching vehicles
- Find it difficult to focus on more than one thing at a time
- Find it difficult to determine the direction of auditory input[xvii]

The County Collision data previously shown finds that children (< age 18) are more likely to be involved in bicycle crashes compared to adults or seniors. Therefore, when traveling to destinations, such as school, child safety should receive focused attention.

Carroll County School System's Transportation Policy is to provide transportation to all elementary school students. Those middle and high school students who are one mile or more from their district school will also be provided transportation. Also, any children within a one mile radius could be required to walk to a given bus stop. This policy is not measured for persons living on unimproved roads or for special needs students. All eligible students shall be provided transportation to attend the school within their district[xviii]. There should be consideration for additional safety initiatives that are specifically dedicated to child safety when walking and biking going to school, going to the bus stop, or crossing the road to board a bus.

These initiatives would focus on a one mile radius around middle and high schools. Any initiative would include safety considerations when entering and existing the school bus.

There are some parents who may choose to let their children walk or bike to school. Some of the comments from this plan's outreach efforts found that this is a desire among parents, especially if gaps in sidewalk infrastructure are filled. Survey data[xix] collected from some of the parents of Robert Moton Elementary School (RMES) for the SRTS sidewalk project found that:

- The vast majority of the respondents identified distance (85 percent), traffic (speed - 78 percent and volume - 74 percent), and infrastructure as having an effect on why their children do not walk or bike to school
- Infrastructure – safety of intersections and crossings (63 percent) and a lack of sidewalks or paths (56 percent) – was top ranked as the issue affecting respondents' decision to not have their children walk or bike to school
- Over one-third of all respondents lived within one mile of RMES

Parent Comments

"We live very close to my children's elementary school (Robert Moton) and my car would not start one morning very recently. We decided to walk to school and the entire time I kept thinking 'we could do this every day if there was a sidewalk!'"

"We live on the other side of 97 which is a very busy road. I highly doubt my children will ever be able to walk/bike to elementary school"…."they possibly could walk to [Westminster High School] since it is a much quicker walk/bike...IF the intersection of Hook Rd and Crest Lane were made safer as well as Hook and 97."

SRTS. Parent Survey Report for Robert Moton Elementary School. October 2016

In addition to these results, when respondents chose to leave an additional comment, next to distance, the top concerns were infrastructure and safety.

With the appropriate infrastructure in place there is the opportunity to create and utilize additional initiatives to promote safe walking and biking to school. The Walking School Bus is a program through National Safe Routes to School (NSRTS). A walking school bus is "a group of children walking to school with one or more adults."[xx] Guidance that helps form partnerships among neighbors and iron out safety concerns and other logistics can be found on the site WalkingSchoolBus.org.[xxi] Another existing program is Safe Kids Worldwide. It is a global nonprofit organization that addresses child safety from a comprehensive standpoint. Its focal areas include kid safety while biking and walking. The Carroll County Health Department currently partners with them.

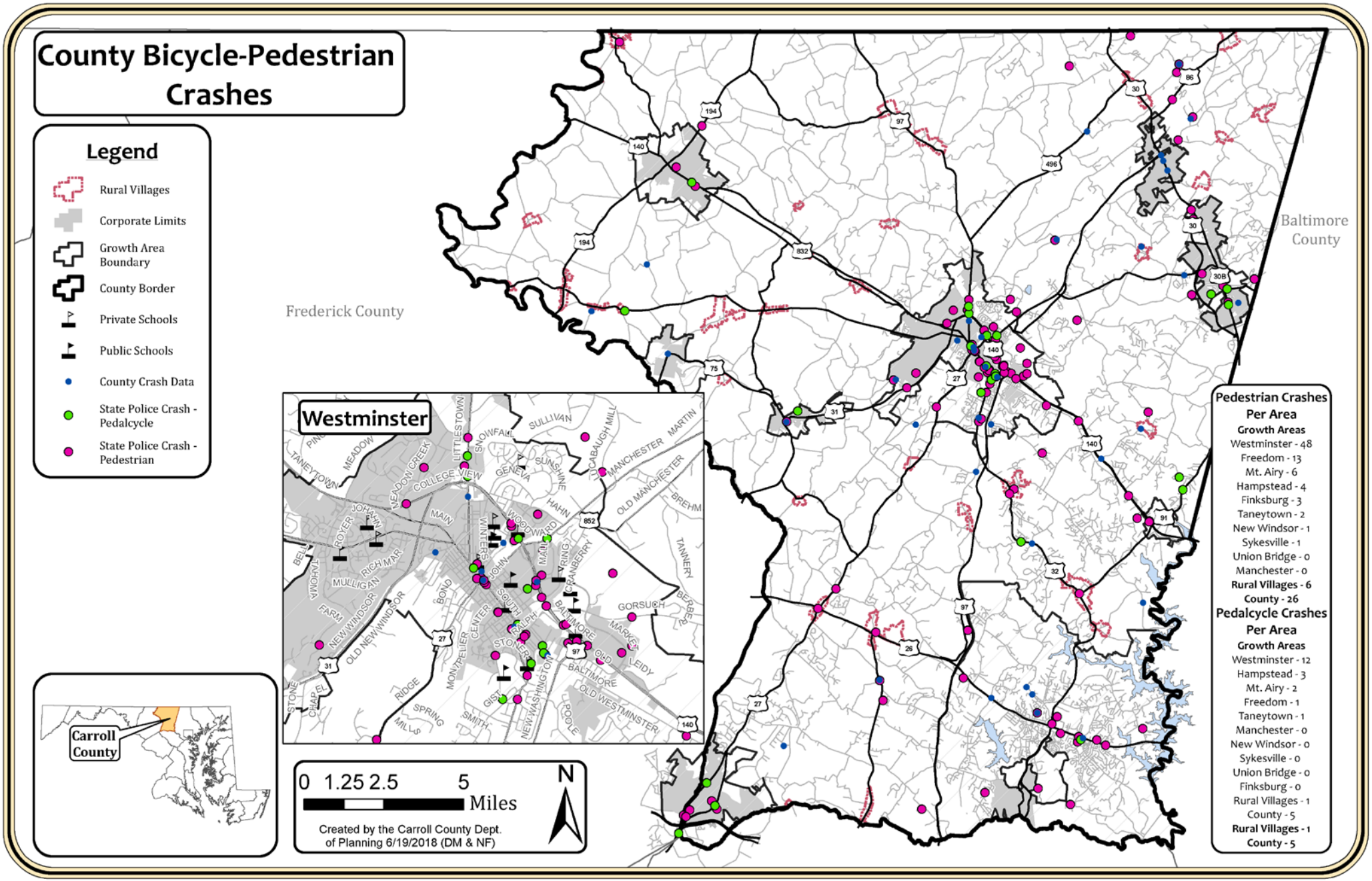
Creating Bicycle Trains are a way to encourage safe biking to school in groups. A Bicycle Train is similar to a Walking School Bus but is more involved. A Bicycle Train differs from a Walking

School Bus in that it is more suited for older elementary children, requires safety gear, and requires more adult supervision[xxii].

Some key takeaways to consider when planning for pedestrian facilities that promote child safety while walking are:

- What to wear when walking so that children are visible from the street
- The importance of being alert when walking and not focused on any electronic device
- The importance of promoting safety gear such as helmets and bright/reflective clothing
- Helping children to understand traffic signals and signs
- Adults/Parents practicing the walking or biking route with children[xxiii]
- The benefits of a Walking School Bus or Bicycle Train

A reduction in collisions may be accomplished by understanding why and how they occurred, putting appropriate safety and education measures in place, and by proper design, but also by public education. There are several education programs already in place that can be expanded and brought into a unified County partnership that addresses bicycle and pedestrian safety for all of the Carroll County's transportation system users.



Map 7-1: County Collisions 2012-2015 and State Police Vehicle Crash data 2015 to 2017

Design Best Practices

There is a great opportunity to improve bicycle and pedestrian infrastructure and accommodations in Carroll County. Relevant safety considerations in design would encourage more walking and biking to destinations. As mentioned, addressing bike-ped development in rural areas differs from urban areas. The County's rural roads are limited in the ability to support certain types of bike-ped facilities. Most of the County's roads are 20-feet or less, do not have paved shoulders and are limited in right-of-way dedication. This limits the types of infrastructure that can be added and requires more creative solutions. For example, a road diet or lane diet (a narrowing of the roadway for other uses) may not be feasible, according to MD MUTCD lane width standards[xxiv], on a road that is only 20-feet wide.

When traveling along state highways, there are serious concerns for safety from both public officials and citizens. These roads often carry high volumes of traffic at high speeds. However, state highways happen to be the quickest and most direct linkages around the County. In addition, many County destinations are across state highways, including Main Streets, retail shopping centers, and grocery stores. Therefore, state highways are barriers to biking and walking in Carroll County.

The following bicycle and pedestrian infrastructure diagrams and information are solely for the discussion of best practices in bicycle and pedestrian infrastructure and are NOT complete solutions. To determine what is and is not appropriate each individual project must go through the appropriate development process and be reviewed against County, municipal, and state regulations. The examples and information shown are from various sources that should be consulted for complete understanding and legal compliance. These sources include:

- **Maryland Manual on Uniform Traffic Control Devices** (MD MUTCD), 2011 Edition
    - The purpose of this guide is to define "the standards used by road managers…to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public travel." It is in compliance with the Federal Highway Administration (FHWA) Manual on Uniform Traffic Control Devices.
- **SHA Bicycle Policy & Design Guidelines** (SHA BP&DG), Revised January 2015
    - The purpose of this guide is to provide transportation planners and engineers guidance for accommodations that improve bicycling in Maryland. It is consistent with the recommendations in the American Association of State Highway Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities*. The Carroll County agencies follow AASHTO guidelines.

- **NACTO Urban Bikeway Design Guide** (NACTO Guide), April 2011 Edition
    - The purpose of the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide is to provide cities with state-of-the-practice solutions that can help create complete streets that are safe and enjoyable for bicyclists.
- **Small Town and Rural Multimodal Networks (STRMNG)**, December 2016
    - The purpose of this FHWA guide is to "provide a resource and idea book to help small towns and rural communities support safe, accessible, comfortable, and active travel for people of all ages and abilities."[xxv]
- **Small Town and Rural Design Guide: Facilities for Walking and Biking** (Alta Small Town Guide)
    - This is an "online design resource and idea book, intended to help small towns and rural communities support safe, comfortable, and active travel for people of all ages and abilities."[xxvi] The guide, created by Alta Planning + Design, references a subset of the FHWA Small Town and Rural Multimodal Networks document

When going through the engineering and design process, it should also be considered what best applies to rural settings. To guide the bike-ped development process, a design manual that addresses Carroll County bike-ped infrastructure would need to be created. This document could supplement the County's Design Manual for Roads and Storm Drains, be included, or be separate.

In addition to general design, equal access to public spaces should be considered in design and use. This plan does not address ADA compliance in depth but recommends the inclusion of bicycle and pedestrian accommodations in the County ADA Self-Evaluation and ADA Transition Plan. A self-evaluation is a public entity's assessment of its current policies and practices. An ADA Self-Evaluation "identifies and corrects those policies and practices that are inconsistent with title II's requirements."[xxvii] An ADA Transition Plan is a public entity's plan to remove the barriers to structural modifications in order to achieve program accessibility.[xxviii] Carroll County DPW is in the process of drafting the ADA Self-Evaluation and it is near completion. The ADA Transition Plan will be initiated in the future. ADA compliance upgrades are continuously being made and will continue as CIP money is made available annually. The locations of these projects can be viewed in the maps titled ADA Compliance of Curb Ramps and Sidewalk. A County manual, recommended above, for bike-ped design guidelines should also incorporate ADA compliance standards. The purpose would be to address barriers to accessing bike-ped transportation facilities. Further, these accommodations should be considered in a Countywide Complete Streets Policy.

Bicycle Infrastructure

Bikeway

Bikeway – a generic term for any road, street, path, or way that in some manner is specifically designated for bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes [xxix]

Bikeways may include shared roadways, bicycle lanes, buffer-separate lanes, barrier-separated lanes, bike lanes, bicycle path, shared-use path, or a cycle track (one way). Bike routes are not a "bikeway type" [xxx] (rather, they are indicated by signage).

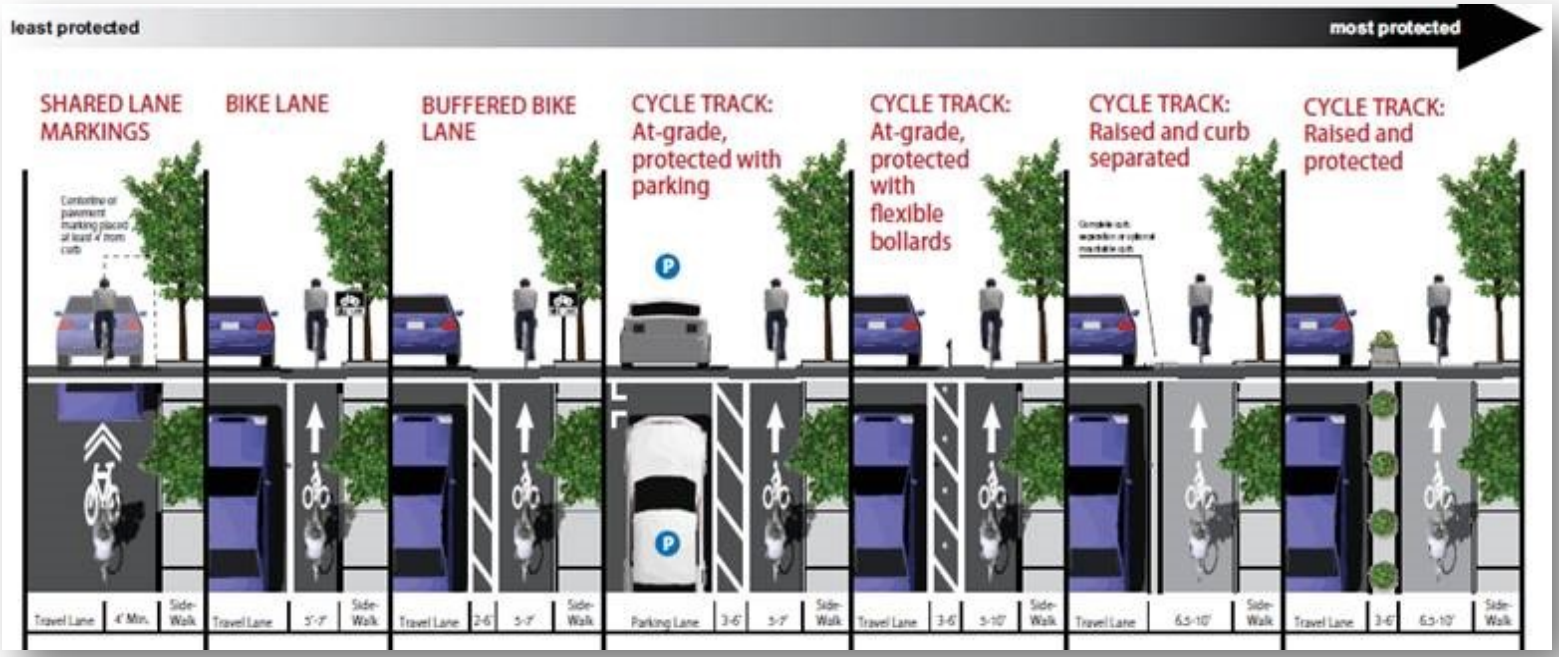


Figure 7-6: Various Examples of Bikeways based on Degree of Protective Infrastructure, from www.bikewalkdunwoody.org

Advisory Shoulder

Advisory Shoulders – also known as a "dashed bicycle lane", "advisory shoulders create usable shoulders for bicyclists on a roadway that is otherwise too narrow to accommodate one. The shoulder is delineated by pavement marking and optional pavement color. Motorists may only enter the shoulder when no bicyclists are present and must overtake these users with caution due to potential oncoming traffic. "[xxxi]

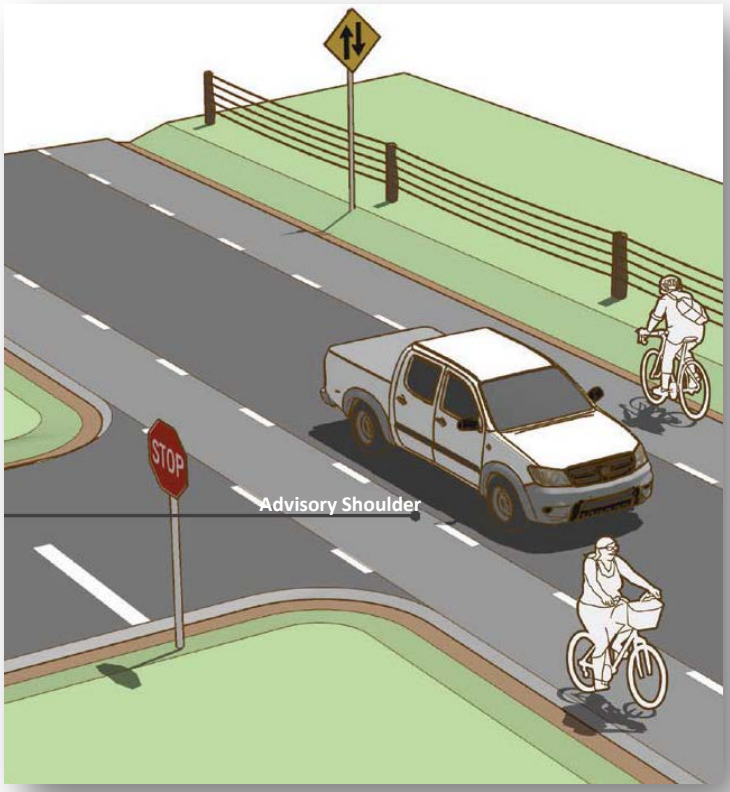


Figure 7-7: Advisory Shoulder from STRMNG p. 2-17

Advantages of Advisory Shoulders

Advisory Shoulders can:
• Provide a delineated but nonexclusive space available for biking on a roadway otherwise too narrow for dedicated shoulders • Possibly reduce some types of crashes due to reduced motor vehicle travel speeds • Minimize potential impacts to visual or natural resources through efficient use of existing space • Function well within a rural and small town traffic and land use context • Increase predictability and clarifies desired lateral positioning between people bicycling or walking and people driving in a narrow roadway • May function as an interim measure where plans include shoulder widening in the future • Reduce paved surface environmental requirements

Table 7-5: Advantages of Advisory Shoulders

Best Practices for Advisory Shoulders[xxxii]

Practical Locations:	When Not Practical:	Consider:
• Low speed roads • Low to medium traffic volume roads • Rural roads	• High speed roads • High vehicle volume roads	• Using contrasting materials to visually differentiate the shoulder from the roadway and discourage unnecessary encroachment • An approval from FHWA for a "Request to Experiment" is required as detailed in Section 1A.10 of the MUTCD

Table 7-6: Best Practices for Advisory Shoulders

Bicycle Lane

Bicycle Lane – a portion of a roadway that has been designated for preferential or exclusive use by bicyclists by pavement markings and, if used, signs [xxxiii]

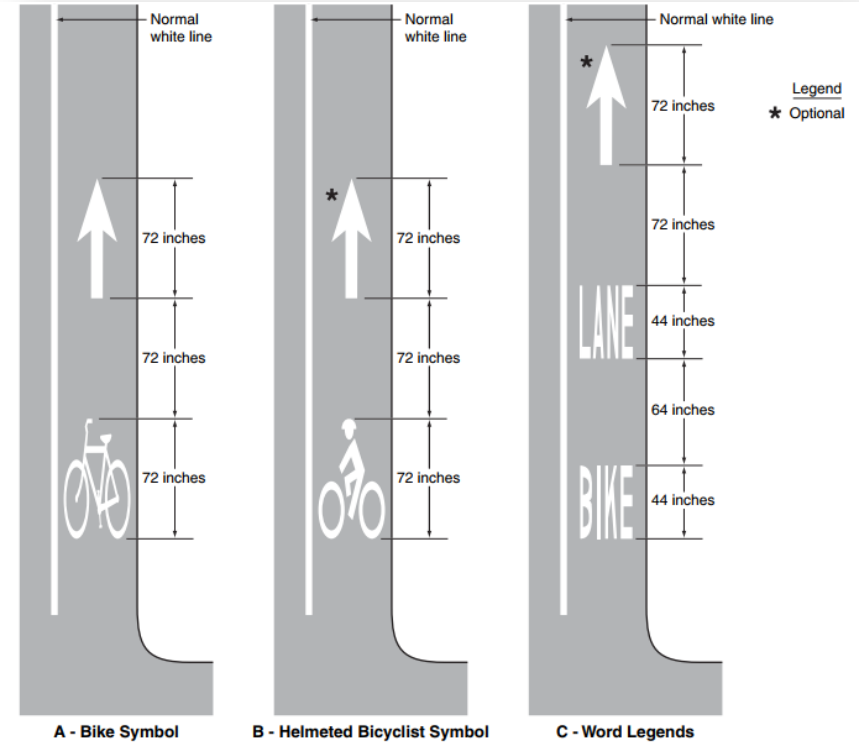


Figure 7-8: Examples of Bike Lanes, MD MUTCD p. 939

Advantages of Bicycle Lanes

Bicycle lanes over paved shoulder and wide outside lanes (design):	Bicycle Lanes can:
• Provide dedicated space for bicyclists • Reduce wrong way bicycle riding • Encourage increased bicycle use • Increase motorist awareness of bicyclists • Encourage bicyclists to ride farther away from parked vehicles • Reduce motorist lane changes when passing bicyclists • Provide visual guidance to bicyclists navigating intersections [xxxiv]	• "Increase bicyclist comfort and confidence on busy streets • Create separation between bicyclists and automobiles • Increase the predictability of bicyclist and motorist positioning and interaction • Increases total capacities of streets carrying mixed bicycle and motor vehicle traffic • Visually reminds motorists of bicyclists' right to the street" [xxxv]

Table 7-7: Advantages of Bicycle Lanes

Best Practices for Bicycle Lanes[xxxvi]

Practical Locations:	When Not Practical:	Consider:
• On roads with wide shoulders • On roads with motor vehicle average daily traffic (ADT) greater than or equal to 3,000 • On roads with a posted speed greater than or equal to 25 mph • On fairly straight two lane roads	• If the speed limit is greater than 35 mph consider treatments that provide greater separation between bicycle and motor traffic, such as buffered bike lanes, and cycle tracks • On roads with high traffic volume, regular truck traffic, and/or high parking turnover	• Shoulder width • Speed of traffic • Average traffic volume • Size of vehicles • Proximity of parked vehicles

Table 7-8: Best Practices for Bicycle Lanes

Buffer-Separated Lane

Buffer-Separated Lane – "a preferential lane or other special purpose lane that is separated from the adjacent general-purpose lane(s) by a pattern of standard longitudinal pavement markings that is wider than a normal or wide lane line marking. The buffer area might include rumble strips, textured pavement, or channelizing devices such as tubular markers or traversable curbs, but does not include a physical barrier."[xxxvii]

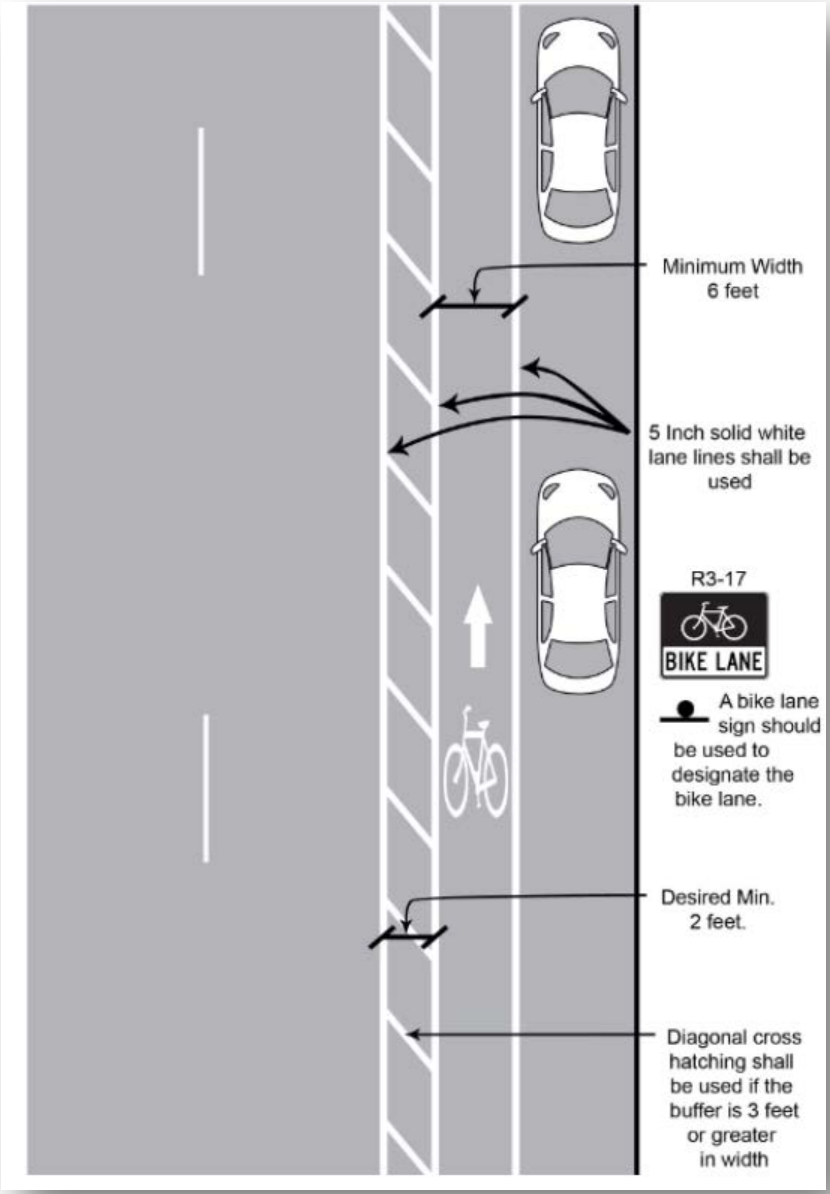


Figure 7-9: SHA Bicycle Policy & Design Guidelines, section 10.4

Advantages of Buffer-Separated Lanes

Buffer-Separated Lanes over Bicycle lanes (design):	Buffer-Separated Lanes can:
• "Provides greater shy distance between motor vehicles and bicyclists • Provides space for bicyclists to pass another bicyclist without encroaching into the adjacent motor vehicle travel lane • Encourages bicyclists to ride outside of the door zone when buffer is between parked cars and bike lane • Provides a greater space for bicycling without making the bike lane appear so wide that it might be mistaken for a travel lane or a parking lane"[xxxviii]	• Appeal to a wider cross-section of bicycle users • Encourage bicycling by contributing to the perception of safety among users of the bicycle network

Table 7-9: Advantages of Buffer-Separated Lanes

Best Practices for Buffer-Separated Lanes[xxxix]

Practical Locations:	Consider:
• On roads where a standard bike lane is being considered • On roads with high travel speeds • On roads with high travel volumes • On roads with high amounts of truck traffic • On roads with extra lanes or extra lane width	• Shoulder width • Speed of traffic • Average traffic volume • Size of vehicles • Road width • Parked cars buffer • Maintenance challenges

Table 7-10: Best Practices for Buffer-Separated Lanes

Barrier-Separated Lane

Barrier-Separated Lane — a preferential lane or other special purpose lane that is separated from the adjacent general-purpose lane(s) by a physical barrier.[xl] "Barriers can be constructed in a number of different ways, from different material and with different heights, depending upon the desired level of physical and visual separation."[xli] Common protected bike lane barriers include: jersey walls, parked cars, oblong low bumps, planters, delineated posts, raised curbs, bollards, vertical posts, fencing with gates, large rocks or boulders, and tree trunks.

- **Bicycle Path** – any travelway designed and designated by signing or signing and marking for bicycle use, located within its own right-of-way or in a shared right-of-way, and physically separated from motor vehicle traffic by berm, shoulder, curb, or other similar device [xlii]
- **Cycle Track** – an exclusive bicycle facility that is physically separated from motorized vehicle traffic and pedestrians. A cycle track combines the user experience of a separated path with the on-street infrastructure of a bicycle lane[xliii]
- **Shared-Use Path** – a bikeway outside the traveled way and physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent alignment. Shared-use paths are also used by pedestrians (including skaters, users of manual and motorized wheelchairs, and joggers) and other authorized motorized and non-motorized users [xliv]

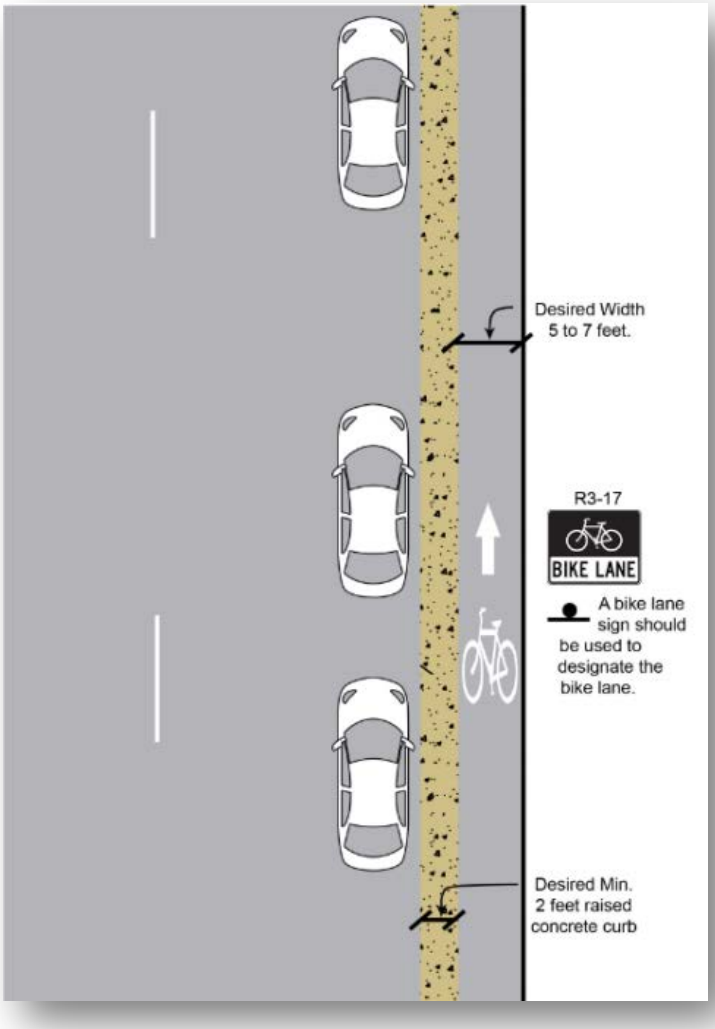


Figure 7-10: Barrier-Separated Bike Lane, SHA BP&DG section 10.2

Advantages of Barrier-Separated Lanes

Barrier-Separated Lanes over Buffer-Separated Lanes (design):	Buffer-Separated Lanes can:
• "Provides a more comfortable experience on high-speed and high-volume roadways than on-road shoulders • Separated bike lanes offer bicyclists a similar riding experience to side paths but with fewer operational and safety concerns over bidirectional side path facilities • Offers an increased level of service over side paths in areas with high volumes of pedestrians, when paired with sidewalks. • Increases the degree of connectivity over a side path, when configured as a one-way directional facility on both sides of the street"[xlv]	• Appeal to a wider cross-section of bicycle users • Encourage bicycling by contributing to the perception of safety among users of the bicycle network • Reduces the incidence of sidewalk riding and potential user conflicts

Table 7-11: Advantages of Barrier-Separated Lanes

Best Practices for Barrier-Separated Lanes[xlvi]

Practical Locations:	When Not Practical:	Consider:
• On roads where a buffer lane is being considered • Roads with high volumes of high speed motor vehicles • Roads with high volume of heavy vehicles (a concrete barrier is best) • On roads with extra lanes or extra lane width[xlvii]	• Barriers should not be used when not needed because they tend to collect trash and debris, and are difficult to maintain	• Shoulder width • Speed of traffic • Average traffic volume • Size of vehicles • Road width • Maintenance challenges • A concrete barrier is preferred in both of the following situations: high volume and high speed vehicles/high volume of heavy vehicles (regardless of speed)

Table 7-12: Best Practices for Barrier-Separated Lanes

Bicycle-Other

Bike-Share

Bike-Share – an innovative transportation program, ideal for short distance point-to-point trips providing users the ability to pick up a bicycle at any self-serve bike-station and return it to any other bike station located within the system's service area.[xlviii] A bike-share can also be dock less. The purpose is to encourage the use of alternative transportation.

Figure 7-11: McCycles Bikeshare at McDaniel College in Westminster

Best Practices for Bike-Share

Practical Locations:	When Not Practical:	Consider:
• Outside of business & shopping centers, employment campuses, schools and universities • Population dense areas with quick trip needs	• Low density areas	• Maps placed at bikeshare stations to inform riders of where stations are located • A bikeshare app • The availability of helmets and locks • Well-lit and populated areas

Table 7-13: Best Practices for Bike-Share

Bike Rack – a stationary fixture frame where a bicycle can be securely attached

Figure 7-12: Bike Rack adjacent to 7606 Main St in Sykesville, from Sykesville Main Street

Figure 7-13: Bike Rack outside County Administration Building in Westminster

Best Practices for Bike Racks

Practical Locations:	When Not Practical:	Consider:
• Outside of businesses (retail and restaurants), employment campuses, schools and universities, parks, and medical centers	• Low density areas	• Frequented destinations

Table 7-14: Best Practices for Bike Racks

Median Refuge Island (Bicycle)

Median Refuge Islands – "are protected space placed in the center of the street to facilitate bicycle and pedestrian crossings. On two-way streets, crossings are facilitated by splitting movements into two stages separated by the direction of approaching vehicle traffic." [xlix]

Figure 7-14: Median Refuge Islands, NACTO pp. 166, 167

Advantages of Bicycle Median Refuge Islands[l]

Median Refuge Islands can:	When used with a Protected Cycle Track, Raised Medians:
• Allow bicyclists to more comfortably cross streets • Provide a protected space for bicyclists to wait for an acceptable gap in traffic • On two-way streets allows bicyclists to take advantage of gaps in one direction of traffic at a time • Reduce the overall crossing length and exposure to vehicle traffic for a bicyclist or pedestrian • Decrease the amount of delay that a bicyclist will experience to cross a street • Calm traffic on a street by physically narrowing the roadway and potentially restricts motor vehicle left turn movements • Established and reinforces bicycle priority on bicycle boulevards by restricting vehicle through movements	• Can be installed at each side of the block to give structure to the floating parking lane • Can provide pedestrians with a place to pause before crossing a protected cycle track • That extend into the intersection can also provide a shelter for a bicyclist making a two-stage turn across traffic

Table 7-15: Advantages of Bicycle Median Refuge Islands

Best Practices for Bicycle Median Refuge Islands

Practical Locations:	When Not Practical:	Consider:
• On streets with protected cycle tracks • For bicycle facility crossings of higher volume or multi-lane streets • Where a bikeway crosses a moderate to high volume or high speed street • Along streets with few acceptable gaps to cross both directions of traffic • Where it is desirable to restrict vehicle through movements, a median can double as a diverter to prevent cut through traffic on a bicycle route	• On one-way or single lane roads, with low vehicle volume and speed	• Number of vehicle lanes • Speed of traffic • Average bicycle volume • Maintenance challenges

Table 7-16: Best Practices for Bicycle Median Refuge Islands

Two-Stage Turn Queue Boxes – "offer bicyclists a safe way make left turns at multi-lane signalized intersections from a right side cycle track or bike lane, or right turns from a left side cycle track or bike lane"[li], also referred to as a hook turn, box turn, or Copenhagen left.

Figure 7-15: Two-Stage Turn Queue Boxes, NACTO pp. 150, 142

Advantages of Two-Stage Turn Queue Boxes[lii]

Two-Stage Turn Queue Boxes can:	Other:
• Improve bicyclist ability to safely and comfortably make left turns • Provide a formal queuing space for bicyclists making a two-stage turn • Reduce turning conflicts between bicyclists and motor vehicles • Prevent conflicts arising from bicyclists queuing in a bike lane or crosswalk	• This infrastructure will likely result in a higher average wait time for bicyclists at the signal, as they will need to receive two separate green signals to complete the crossing • The queuing area is often colored to further define the bicycle space

Table 7-17: Advantages of Two-Stage Turn Queue Boxes

Best Practices for Two-Stage Turn Queue Boxes[liii]

Practical Locations:	When Not Practical:	Consider:
• Along bike lanes and cycle tracks • At signalized intersections • Along multi-lane roadways • Along roadways with high traffic speeds and/or traffic volumes • Where a significant number of bicyclists turn left from a right side facility • Where bicyclists need to navigate safely across streetcar tracks	• When right turns on red is permitted	• Number of vehicle lanes • Speed of traffic • Average vehicle volume • Maintenance challenges

Table 7-18: Best Practices for Two-Stage Turn Queue Boxes

'Bicycle pavement markings through intersections indicate the intended path of bicyclists through an intersection or across a driveway or ramp.'[liv]

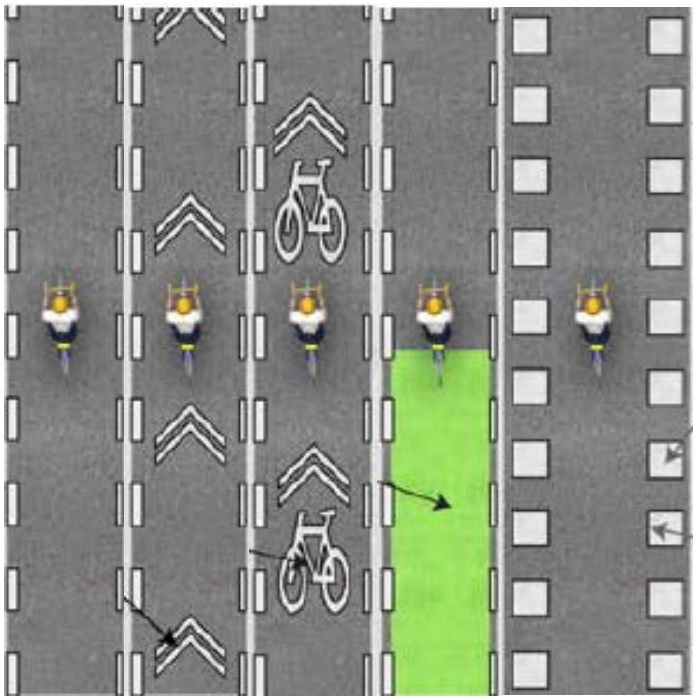


Figure 7-16: Intersection Crossing Markings, NACTO pp. 125-129

Figure 7-17: Intersection Crossing Markings, NACTO p. 137

Advantages of Intersection Crossing Markings[lv]

Intersection Crossing Markings can:	
• Raise awareness for both bicyclists and motorists to potential conflict areas • Reinforce that through bicyclists have priority over turning vehicles or vehicles entering the roadway (from driveways or cross streets) • Guide bicyclists through the intersection in a straight and direct path, reducing the likelihood of bicyclists veering right when entering the intersection and then back to the left at the far side	• Reduce bicyclist stress by delineating the bicycling zone • Make bicycle movements more predictable • Increase the visibility of bicyclists • Reduce conflicts between bicyclists and turning motorists • Promote multi-modal nature of the corridor

Table 7-19: Advantages of Intersection Crossing Markings:

Best Practices for Intersection Crossing Markings[lvi]

Practical Locations:	When Not Practical:	Consider:
• Across signalized intersections, particularly through wide or complex intersections where the bicycle path may be unclear • Along roadways with bike lanes or cycle tracks • Across driveways and Stop or Yield controlled cross-streets • Where typical vehicle movements frequently encroach into bicycle space, such as across ramp-style exits and entries where the prevailing speed of ramp traffic at the conflict point is low enough that motorist yielding behavior can be expected	• May not be applicable for crossings in which bicycles are expected to yield priority, such as when the street with the bicycle route has Stop or Yield control at an intersection	• Number of vehicle lanes • Complexity of intersection • Maintenance challenges

Table 7-20: Best Practices for Intersection Crossing Markings

Pedestrian Infrastructure

Crossings

Crosswalk – that part of a roadway that is distinctly indicated for pedestrian crossing by lines or other markings.[lvii]

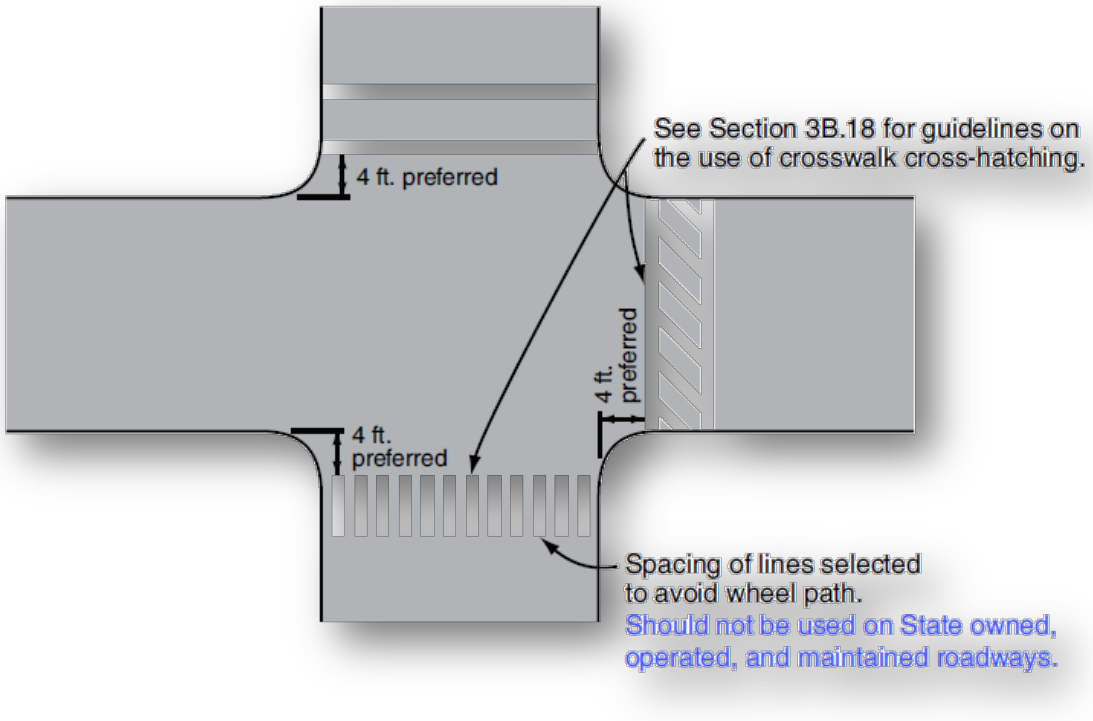


Figure 7-18: Crosswalk, MD MUTCD p. 487

Advantages of Crosswalks

Crosswalks can:
• Appropriately placed infrastructure will encourage pedestrians to follow the law

Table 7-21: Advantages of Barrier-Separated Lanes

Best Practices for Crosswalks

Practical Locations:	Consider:
• Where two or more roadways of any type meet or join, and sidewalks are present • Anywhere there is heavy pedestrian/foot traffic	• Road Width • Number of vehicle lanes • Maintenance challenges • Utilizing the block pattern which has the highest level of visibility

Table 7-22: Best Practices for Crosswalks

Pedestrian Lane

Pedestrian Lane – Pedestrian lanes provide interim or temporary pedestrian accommodation on roadways lacking sidewalks. They are not intended to be an alternative to sidewalks and often will fill short gaps between other higher quality facilities.[lviii]

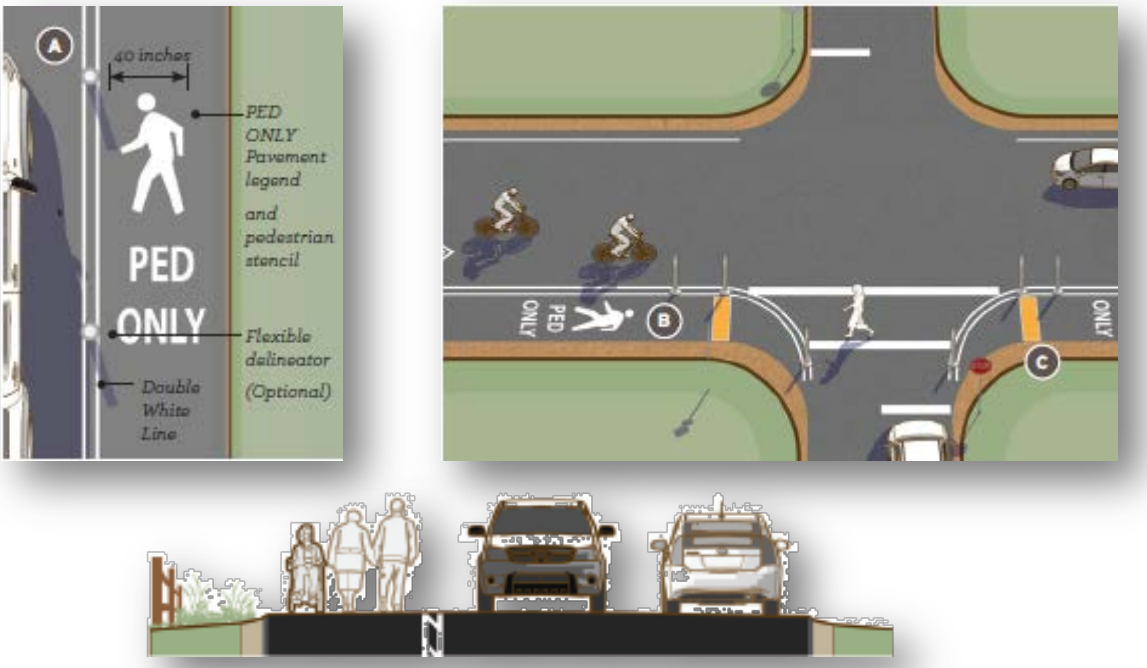


Figure 7-19: Pedestrian Lane, STRMNG 5-7, 5-8

Advantages of Pedestrian Lanes[lix]

Pedestrian Lanes can:	Pedestrian ONLY:
• Fill gaps between important destinations in a community • Increase detectability by people with vision disabilities	• Pedestrian lanes are designated space on the roadway for exclusive use of pedestrians • Use a PED ONLY marking to designate exclusive pedestrian use of lane • A buffer should be added for additional comfort

Table 7-23: Advantages of Pedestrian Lanes

Best Practices for Pedestrian Lanes[lx]

Practical Locations:	When Not Practical:	Consider:
• Road with low to moderate speeds and volumes • On one or both sides of the road	• Pedestrian lanes are an interim facility, and a full sidewalk construction should be planned for future implementation	• Speed of traffic • Average traffic volume • Maintenance challenges

Table 7-24: Best Practices for Pedestrian Lanes

Median Refuge Island (Pedestrian)

Median Refuge Islands – are protected space placed in the center of the street to facilitate bicycle and pedestrian crossings. On two-way streets, crossings are facilitated by splitting movements into two stages separated by the direction of approaching vehicle traffic. [lxi]

Figure 7-20: Median Refuge Islands (pedestrian), NACTO p. 164

Advantages of Pedestrian Median Refuge Islands[lxii]

Pedestrian Median Refuge Islands can:	
• Allow pedestrians to more comfortably cross streets • Provide a protected space for pedestrians to wait for an acceptable gap in traffic	• Reduce the overall crossing length and exposure to vehicle traffic for a pedestrian • Provide a protected space for pedestrians to wait for an acceptable gap in traffic

Table 7-25: Advantages of Pedestrian Median Refuge Islands

Best Practices for Pedestrian Median Refuge Islands[lxiii]

Practical Locations:	When Not Practical:	Consider:
• Along streets with high pedestrian volumes • Along streets with few acceptable gaps to cross both directions of traffic • At signalized or unsignalized intersections	• On one-way or single lane roads, with low vehicle volume and speed	• Number of vehicle lanes • Speed of traffic • Average pedestrian volume • Maintenance challenges

Table 7-26: Best Practices for Pedestrian Median Refuge Islands

Sidewalks

Sidewalk – That part of a highway that is intended for use by pedestrians; and that is between the lateral curb lines or, in the absence of curbs, the lateral boundary lines of a roadway and the adjacent property lines.[lxiv] Sidewalks provide dedicated space intended for use by pedestrians that is safe, comfortable, and accessible to all. Sidewalks are physically separated from the roadway by a curb or unpaved buffer space.[lxv]

A crosswalk at an intersection is defined as the extension of the sidewalk across the intersection.[lxvi]

Advantages of Sidewalks[lxvii]

Sidewalks Can:
• Provide a dedicated place within the public right-of-way for pedestrians to safely travel and reduces pedestrian collisions in rural areas • Reduce "walking along roadway" crashes • Notably increase levels of walking in areas with high traffic speeds and/or volumes

Table 7-27: Advantages of Sidewalks

Best Practices for Sidewalks[lxviii]

Practical Locations:	Consider:
• Anywhere where the roadway network has high traffic volumes or speeds • Areas with a mix of land uses • Along roads where there is heavy foot traffic	• The amount of available dedicated right-of-way • That it may notably increase levels of walking in areas with high traffic speeds and/or volumes • That sidewalks require a moderate-width roadside environment to provide for separation and sidewalk area outside of the adjacent roadway

Table 7-28: Best Practices for Sidewalks

Shared Infrastructure

Shared-Use Path and Sidepath

Shared-Use Path – "a bikeway outside the traveled way and physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent alignment. Shared-use paths are also used by pedestrians (including skaters, users of manual and motorized wheelchairs, and joggers) and other authorized motorized and non-motorized users."[lxix]

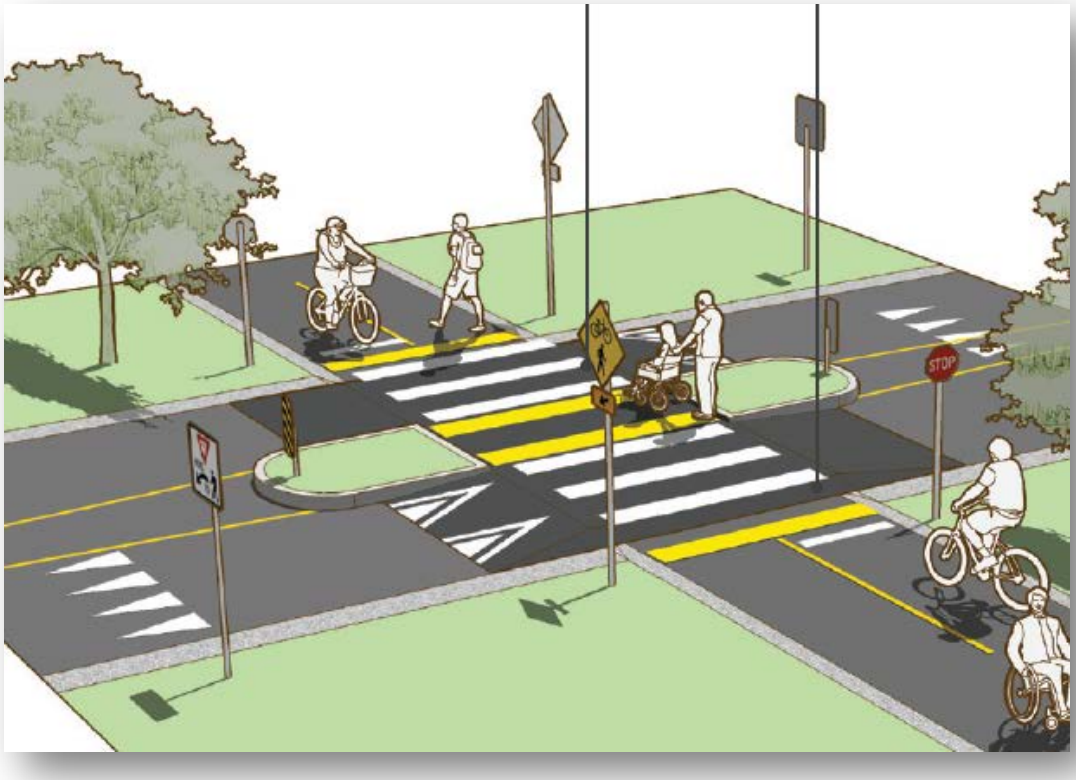


Figure 7-21: Shared-Use Path, from STRMNG p. 4-10

Advantages of Shared-Use Paths[lxx]

Shared-Use Paths Can:
• Provide a dedicated facility for users of all ages and abilities • Provide, in some cases, access to areas that are otherwise served only by limited-access roadways • Support tourism through convenient access to natural areas or as an enjoyable recreational opportunity itself • Provide nonmotorized transportation access to natural and recreational areas • Allows for bidirectional travel • Display a distinctly rural character when combined with vegetation to separate the path from the roadway

Table 7-29: Advantages of Shared-Use Paths

Best Practices for Shared-Use Paths [lxxi]

Practical Locations:	Consider:
• Where there are few conflicts with motorized vehicles (e.g. parks, along rivers, in greenbelts or utility corridors) • Adjacent to roadways	• Shared use paths should be wide enough for a comfortable two way crossing between pedestrians, bicyclists and other non-motorized traffic • Trail etiquette signs to manage multiple user types • Increasing the width of the path based on a high concentration of users • Crosswalk and crossing signage to slow traffic where the path intersects the road

Table 7-30: Best Practices for Shared-Use Paths

Signage

Designated Bicycle Route

Designated Bicycle Route – a system of bikeways designated by the jurisdiction having authority with appropriate directional and informational route signs, with or without specific bicycle route numbers. [lxxii]

The purpose of Designated Bicycle Routes is to inform bicyclists of bicycle route direction changes and to confirm route direction, distance and destination, MD MUTCD. The intent of a bicycle route is to guide bicyclists along the most favorable alignment between two or more points of interest. [lxxiii]

Shared Roadway/Shared Lane—"a roadway that is officially designated and marked as a bicycle route, but which is open to motor vehicle travel and upon which no bicycle lane is designated" [lxxiv], see Figure 7-22.

Sharrow - shared lane markings [lxxv], see Figure 7-23.

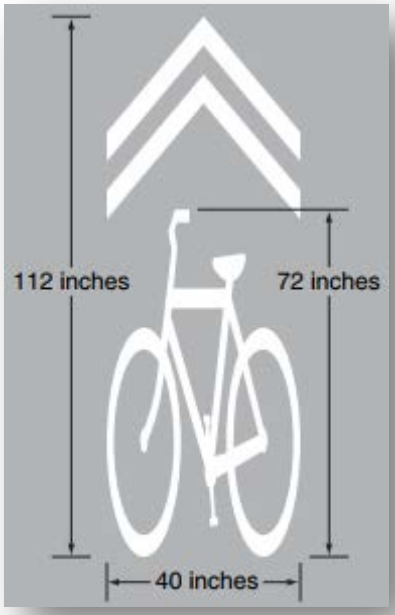


Figure 7-22: Shared Lane Marking from MD MUTCD page 948

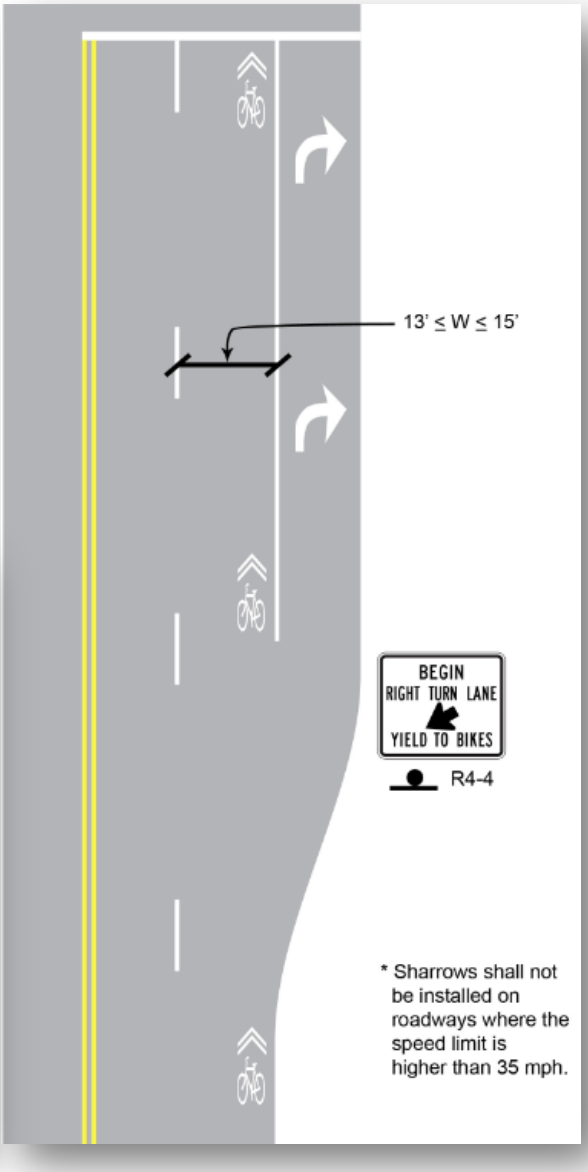


Figure 7-23: Shared Lane/Sharrow Markings, SHA BP&DG section 3.3

Best Practices for Shared Roads and Designated Routes [lxxvi]

Practical Locations:	Consider:
• Roads where there is low motor vehicle volume and speed • Sharrows can be used on roads where a bicycle lane is not necessarily needed	• The importance of signage and/or marking located along shared roadways so that both motorists and bicyclists know to keep an eye out for one another • Designated bicycle route markings/signs are vital to keeping bicyclists safe on the shared roadways. These signs/markings are present to inform both drivers and bicyclists to be aware of others traveling on the travelway

Table 7-31: Best Practices for Designated Routes and Shared Roads

Bike Lane Signs

The following are signs that are important for communicating about bicycle infrastructure. These are not just for cyclists, but also motorists. When used appropriately, signs can aid in reducing roadway incidents between bicycles and vehicles.

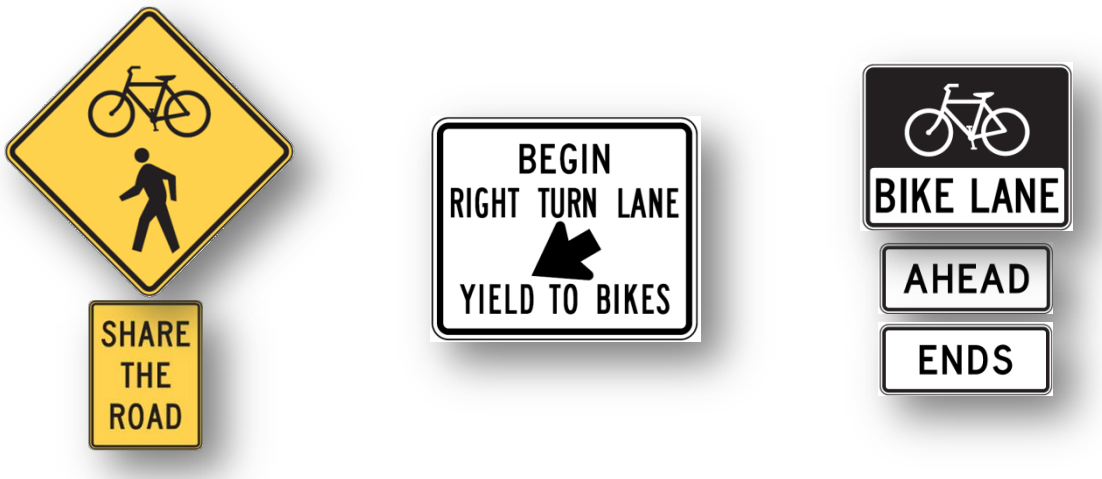


Figure 7-24: Bike Lane Signs, MD MUTCD

Pedestrian Signs

The purpose of pedestrian signage is to provide safety, guidance and awareness to pedestrians, and all other modes of transportation. Signage can be located along sidewalks, shared-use-paths and pedestrian lanes, and at intersections and road crossings. These signs may be aluminum or digitized, or the signage may be markings along the route. For complete guidance on pedestrian signage and appropriate usage refer to the MD MUTCD.

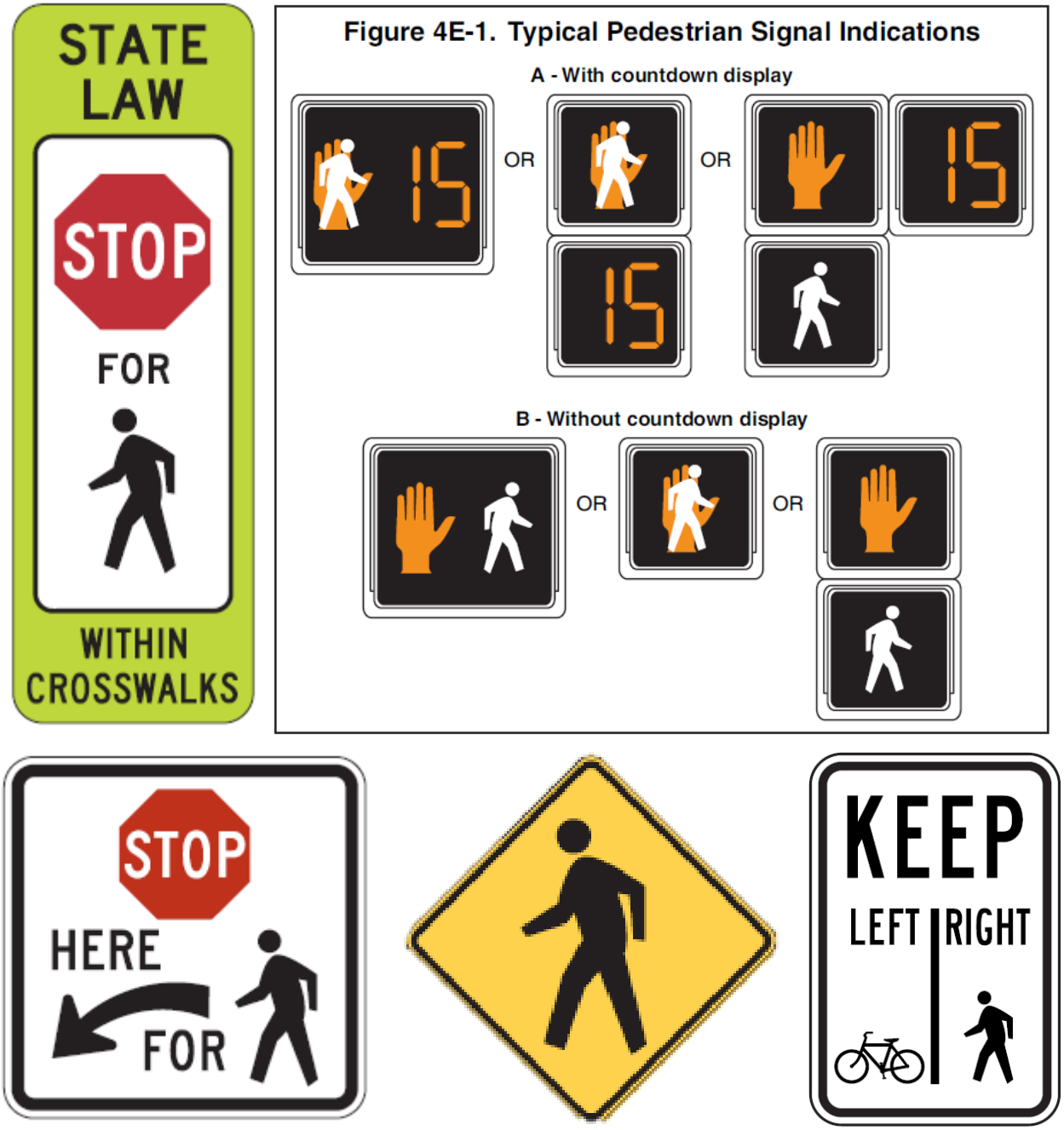


Figure 7-25: Pedestrian Signs, MD MUTCD

Other Traffic Calming Ideas

Traffic Calming - "Physical and other measures used on a [road] to reduce the dominance and speed of motor vehicles."[lxxvii] By calming vehicle speeds the roads become safer and more conducive to walking and bicycling. The idea is to create "a kind of equilibrium among all of the uses of a street, so no one mode can dominate at the expense of another."[lxxviii]

Creative Placemaking is "an evolving field of practice that intentionally leverages the power of the arts, culture and creativity to serve a community's interest while driving a broader agenda for change, growth and transformation in a way that also builds character and quality of place." Creative Placemaking can be utilized in the application of traffic calming.

The following are examples of low cost traffic calming and creative placemaking that can be considered in rural areas. Road paint, art, and signage can be used to manipulate driver perception and mark a community; as a result, traffic slows down. As mentioned, all projects must go through the appropriate processes of County or municipal approval for development.

Figure 7-28: A portion of the BoulevART 2012 Project, Highland Park, NY, Michael Tomb; www.nar.realtor

Figure 7-26: Changing driver perception, from Pollextime.com

Figure 7-27: Community Gateway Signage, www.ctre.iastate.edu

Figure 7-29: Pavement Markings, www.ctre.iastate.edu

Pavement Markings Considerations[lxxix]

Advantages to Consider:	Disadvantages to Consider:
• Low cost • Low impact to emergency vehicles • Low impact to drainage	• Less effective at reducing speeds in the winter due to visibility • Maintenance is higher as a result of snow plowing

Table 7-32: Pavement Markings Considerations

Design for Children – School Connections

Public Schools are principle destinations for education, recreation and other activities. Their primary use results in high child traffic. Good design practices in and around these areas will assist in keeping kids safe while they are biking and walking. Additional infrastructure design consideration should be given at and near school bus stops to support children walking to and from and getting on and off the school bus.

Best Practices for School Connections [lxxx]

Essential components:	Consider:
• As much separation as possible between children and motor vehicles • Exclusive pedestrian use facilities • Sidewalks are preferred over shoulders • Separate facilities are preferred near higher speed and higher volume streets • Clearly define facilities for walking and biking • Install controlled crossings near school • Include wayfinding signage all through the school campus	• Designing satellite drop-off locations for children to walk a safe distance to the bus stop • Creating a bike-ped network around schools connecting neighborhoods • Siting new schools near walking and biking infrastructure that does not require crossing major highways or roads

Table 7-33: Best Practices for School Connections

Recommendations

Consider the following recommendations to improve safety and design of bicycle and pedestrian facilities in the County:

- Safety
  - Continue with the creation of a County Strategic Highway Safety Plan, incorporating the strategies and recommendations in this plan and the 2016 - 2020 Maryland Strategic Highway Safety Plan. The County SHSP should include a Safety Awareness Campaign that targets driver awareness of bicyclists and pedestrians and safety education and encourage the appropriate safety practices when biking and walking
  - Continue to work with Carroll County Emergency Communications to obtain data on bicycle and pedestrian related crashes
  - Work with the Carroll County Health Department to expand the Safe Kids Program targeting child safety while biking and walking
  - Utilize existing state safety resources and programs such as MHSO technical assistance, *Street Smart* campaign, and the Toward Zero Deaths program
  - Create public-private partnerships to provide free safety gear to families with children, fixed-income households, low-income households, and seniors
  - Create public-private partnerships to provide street lights
  - Create a way to gather input from users identifying hazards or facility repair needs (e.g. a crowdsourcing app)
  - Include safety guidelines as a part of a countywide Complete Streets policy
  - Partner with existing County, state, national and global programs, such as Safe Kids, to promote safe walking and biking for children
  - Partner with the school system to promote safe walking and biking to and from schools within a one mile radius, as is consistent with the Carroll County Public Schools Transportation Policy
- Design
  - Utilize best practices for safe crossings of state highways to destinations frequented by cyclists and pedestrians
  - Utilize best practices for bike-ped infrastructure along high speed roads (45+)
  - Incorporate bicycle and pedestrian accommodations into the County ADA Self-Evaluation and/or ADA Transition Plan
  - Update the *Design Manual for Roads and Storm Drains* and any other County transportation or road policy to include bike-ped accommodations or create a bicycle and pedestrian focused design manual; incorporate ADA compliance standards
  - Encourage best practices in the development of all bicycle and pedestrian infrastructure
  - Include design guidelines as a part of a countywide Complete Streets policy
  - Utilize best practices when designing for walking and biking to and from schools and school bus stops within a one mile radius of middle and high schools

Citations

[i] According to Google Maps, approximately 5 to 20 miles at 10 mph (varies based on cyclist ability and terrain)
[ii] § 11-104. Bicycle
http://www.remlinedigital.com/M5144%20MDOT%20Bicycle%20and%20Pedestrian%20Master%20Plan/links/bike_ped_plan/Appendix%20A%202014-01-07.pdf
[iii] Injury and deaths on the transportation system are statistically higher in small towns. 2006 data shows that "23 percent of the US population lived in rural areas, yet 56 percent of all traffic facilities occurred in rural area." https://www.smartgrowthamerica.org/app/legacy/documents/cs/factsheets/cs-rural.pdf
[iv] FHWA. *Factors Contributing to Pedestrian and Bicycle Crashes on Rural Highways*. 2010.
https://www.fhwa.dot.gov/publications/research/safety/10052/10052.pdf
The Highway Safety Information System (HSIS) is a multi-State safety database that contains crash, roadway inventory, and traffic volume data for a select group of States. The current participating States—California, Illinois, Maine, Minnesota, North Carolina, Ohio, and Washington—were selected based on the quality of their data, the range of data available, and their ability to merge the data from the various files. The HSIS is used by FHWA staff, contractors, university researchers, and others to study current highway safety issues, direct research efforts, and evaluate the effectiveness of accident countermeasures.
[v] County Sheriff and the police reports of Hampstead, Manchester, and Westminster, data from January 2012 to August 2015
[vi] Pedestrian and Bicycle Information Center. http://www.pedbikeinfo.org/planning/tools_crashdata.cfm
[vii] Motor Vehicle Administration. Bicycle Safety. http://www.mva.maryland.gov/safety/mhso/program-bicycle-safety.htm
[viii] Motor Vehicle Administration. Pedestrian Safety. http://www.mva.maryland.gov/safety/mhso/program-pedestrian-safety.htm
[ix] The original County collision data discussed was obtained through the County Sheriff's Office and municipal police offices between January 2012 and August 2015. This data was calculated at the beginning of the bike-ped planning process. Some data was manually mapped in ArcGIS for analysis. In 2015, the State Police began releasing quarterly vehicle crash data that became available through the state's open data portal. This data covers January 2015 to December 2017 and was analyzed through GIS mapping. This data will be used to examine bike-ped and vehicle collisions in the future. More is available in the Appendix. State Police Maryland Statewide Vehicle Crashes from
https://data.maryland.gov/browse?category=Public%20Safety&anonymous=true&q=vehicle%20crashes&sortBy=relevance
[x] National Center for Safe Routes to School. *When walking on the road, do you walk against or with traffic?*
http://www.saferoutesinfo.org/program-tools/when-walking-road-do-you-walk-against-or-traffic
[xi] Pedestrian and Bicycle Information Center. http://www.pedbikeinfo.org/community/tips.cfm
[xii] Federal Highway Administration. Summary Report: Factors Contributing to Pedestrian and Bicycle Crashes on Rural Highways. June 2010. http://www.fhwa.dot.gov/publications/research/safety/10052/index.cfm
[xiii] Disabled vehicle related – relates to when a crash occurs due to a disabled vehicle (e.g., A driver is considered a pedestrian when exiting the car. If the car then hits the driver it is considered a pedestrian crash.)
[xiv] Federal Highway Administration. Summary Report: Factors Contributing to Pedestrian and Bicycle Crashes on Rural Highways. June 2010. http://www.fhwa.dot.gov/publications/research/safety/10052/index.cfm
[xv] MHSO. 2016 Annual Report. P. 13. http://www.mva.maryland.gov/safety/mhso/MHSO_AR_2016_final2.pdf. Accessed April 13, 2018.
[xvi] Street Smart. About. http://www.bestreetsmart.net/about/
[xvii] Federal Highway Administration. *Small Town and Rural Multimodal Networks*. December 2016. P. 5-9. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/. Accessed May 11, 2018.

[xviii] Carroll County Public Schools Transportation Department. 2017- 2018 Transportation Handbook for Parents and Students. P. 7. https://www.carrollk12.org/admin/transportation/Documents/PARENT%20STUDENT%20HANDBOOK%202017-2018.pdf

[xix] Standard data is collected from SRTS projects before and after the project is completed to examine how the project affected biking and walking to school. RMES data collected October 2016. http://saferoutesdata.org/

[xx] http://www.walkingschoolbus.org/WalkingSchoolBus_pdf.pdf

[xxi] http://www.walkingschoolbus.org/resources.html

[xxii] SRTS. Bicycle Train. http://guide.saferoutesinfo.org/walking_school_bus/bicycle_trains.cfm

[xxiii] https://issuu.com/safekids/docs/wheels_safety_study_2017/17

[xxiv] MD MUTCD. P. 737, 758, 798, 832

[xxv] Federal Highway Administration. *Small Town and Rural Multimodal Networks*. December 2016. P. 1-4

[xxvi] http://ruraldesignguide.com/ Accessed April 4. 2018.

[xxvii] ADA National Network. What is a self-evaluation? https://adata.org/faq/what-self-evaluation

[xxviii] The Americans with Disabilities Act. Title II Technical Assistance Manual (II-8.3000 Transition plan) https://www.ada.gov/taman2.html#II-8.3000

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[xxxi] STRMNG. Advisory Shoulder. Pp. 2-17 – 2-24

[xxxii] STRMNG. Pp. 2-17 to 2-24. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/fhwahep17024_lg.pdf

[xxxiii] MD MUTCD. Section 1A.13. P. 14

[xxxiv] SHA. Bicycle Policy & Design Guidelines (SHA BP&DG), P. 2.1

[xxxv] NACTO. Conventional Bike Lane Benefits. April 2011. p. 5

[xxxvi] NACTO p. 5

[xxxvii] MD MUTCD Section 1 A.13, p. 14

[xxxviii] NACTO p. 19

[xxxix] NACTO p. 19

[xl] MD MUTCD Section 1 A.13, p. 14

[xli] SHA BPDG 8.2

[xlii] MD Annotated Code §21-101

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[xlvi] SHA BPDG 8.3

[xlvii] NACTO p. 19

[xlviii] Pedestrian and Bicycle Information Center. Bike Sharing. http://www.pedbikeinfo.org/programs/promote_bikeshare.cfm. Accessed April 4, 2018.

[xlix] NACTO p. 154

[l] NACTO p. 155

[li] NACTO p. 141

[lii] NACTO p. 142

[liii] NACTO p. 142, 146)

[liv] NACTO p. 122

[lv] NACTO p. 123

[lvi] NACTO p. 124

[lvii] MD Annotated Code §21-101
[lviii] Small Town and Rural Multimodal Networks Guide(STRMNG), p. 5-7 and 5-8
[lix] STRMNG pp. 5-7 to 5-8
[lx] STRMNG pp. 5-7 to 5-8
[lxi] NACTO p. 154
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[lxiii] NACTO p. 155
[lxiv] MD Annotated Code §21-101
[lxv] STRMNG p 4-19
[lxvi] STRMNG p 4-22
[lxvii] STRMNG Pp. 4-20 to 4-22
[lxviii] STRMNG Pp. 4-20 to 4-22
[lxix] MD MUTCD, Section 1A.13 p.23
[lxx] STRMNG p. 4-3 – 4-16
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