Appendix J – Online Survey Results and Comments

Online Survey Results

An online survey was available between May 1 and June 23, 2023. The survey included several general questions for all respondents, followed by a customized series of questions specifically tailored to parents, students, teachers, and residents, respectively. The survey asked respondents to weigh in on the importance of providing safe walking and bicycling opportunities for students, as well as the most important factors related to school safety. Parents and students were also asked about their commuting patterns and the walking and bicycling conditions surrounding their school(s).

Detailed response summaries and individual comments from the survey are provided on the following pages.

Other Comments Received

In addition to the online survey and virtual open houses, the study team also hosted a project email address throughout the duration of the project. The team received three comments via email, provided below:

"I was listening to the presentation and heard that you suggested using rumble strips on one of the school zones. I am unsure if it's a possibility, but can you look into it for Jacks Valley Elementary? Numerous drivers go 45+ through that school zone often due to the previous speed zone through genoa and the increase right after the school zone. I don't see the flashing lights making much of a difference when I am there for drop offs and pickups." (comment received on September 15, 2023)

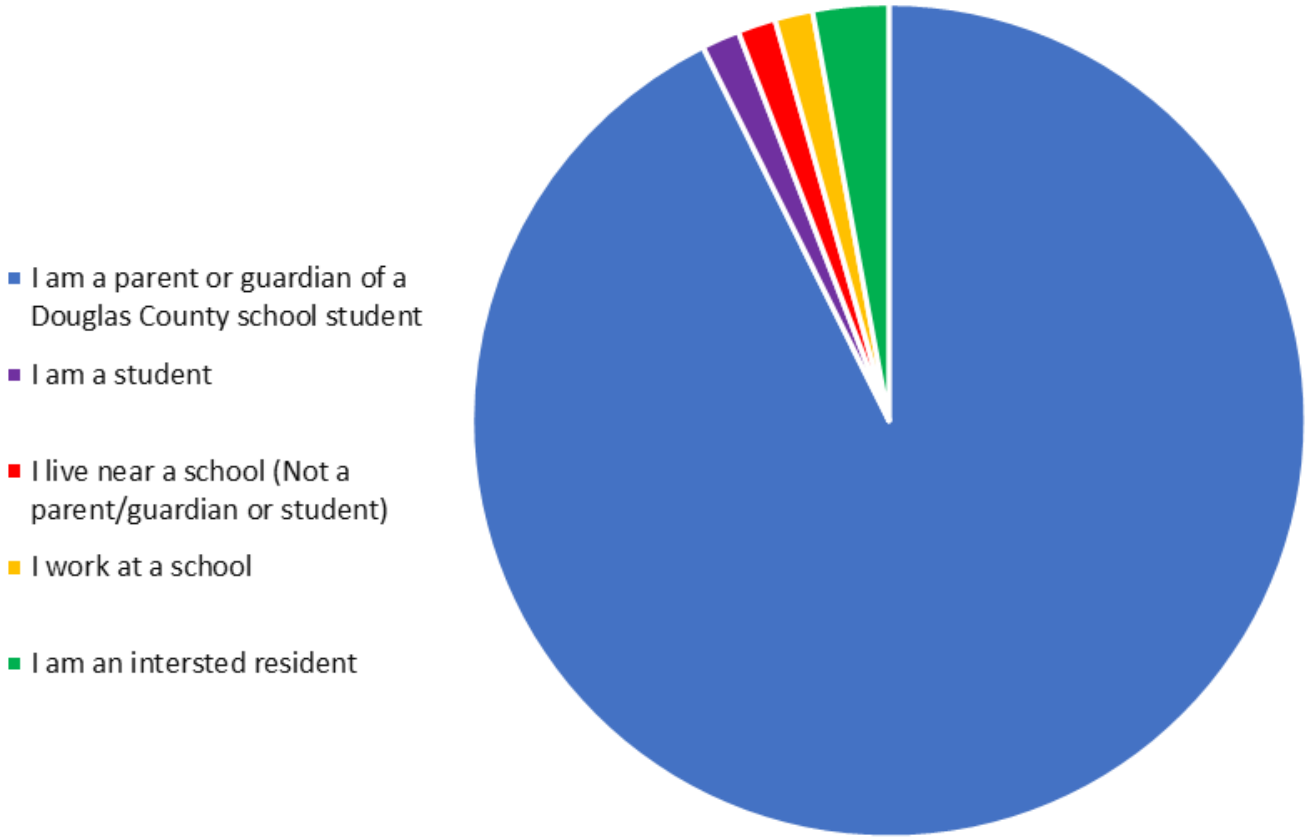
"Can we put in a sidewalk from Saratoga Springs Estates to Pinon Elementary? Currently, there are no sidewalks on Vicky and Stephanie. The road is narrow with no shoulder and makes it unsafe for students to walk or ride bikes to school. This would serve many students and provide an alternative way to get to school safely." (comment received on May 8, 2023)

"There are no sidewalks along Stephanie Rd heading towards PHES. Would love to have my kids bike or walk to school and they have but it would feel much safer if there was a sidewalk." (comment received on May 4, 2023)

Appendix J:
Douglas County
Safe Routes to School
Survey Results

5/3/23 – 6/23/23

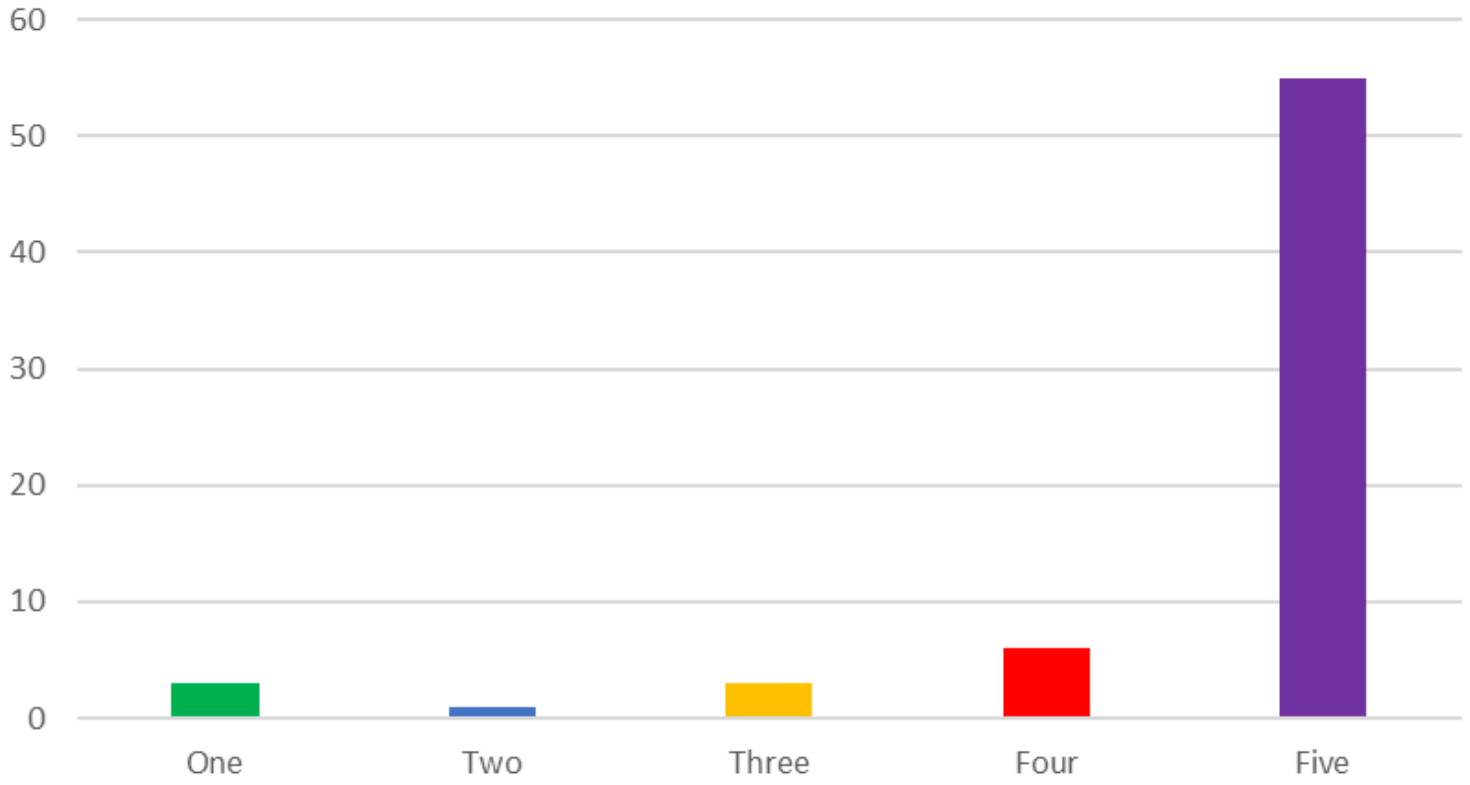
1. What is your relationship to Douglas County Public Schools?



Answer	Count	Percentage
I am a parent or guardian of a Douglas County school student	63	92.65%
I am a student	1	1.47%
I live near a school (Not a parent/guardian or student)	1	1.47%
I work at a school	1	1.47%
I am an interested resident	2	2.94%

2. How important is it to you that students are able to walk and bike safely to school?

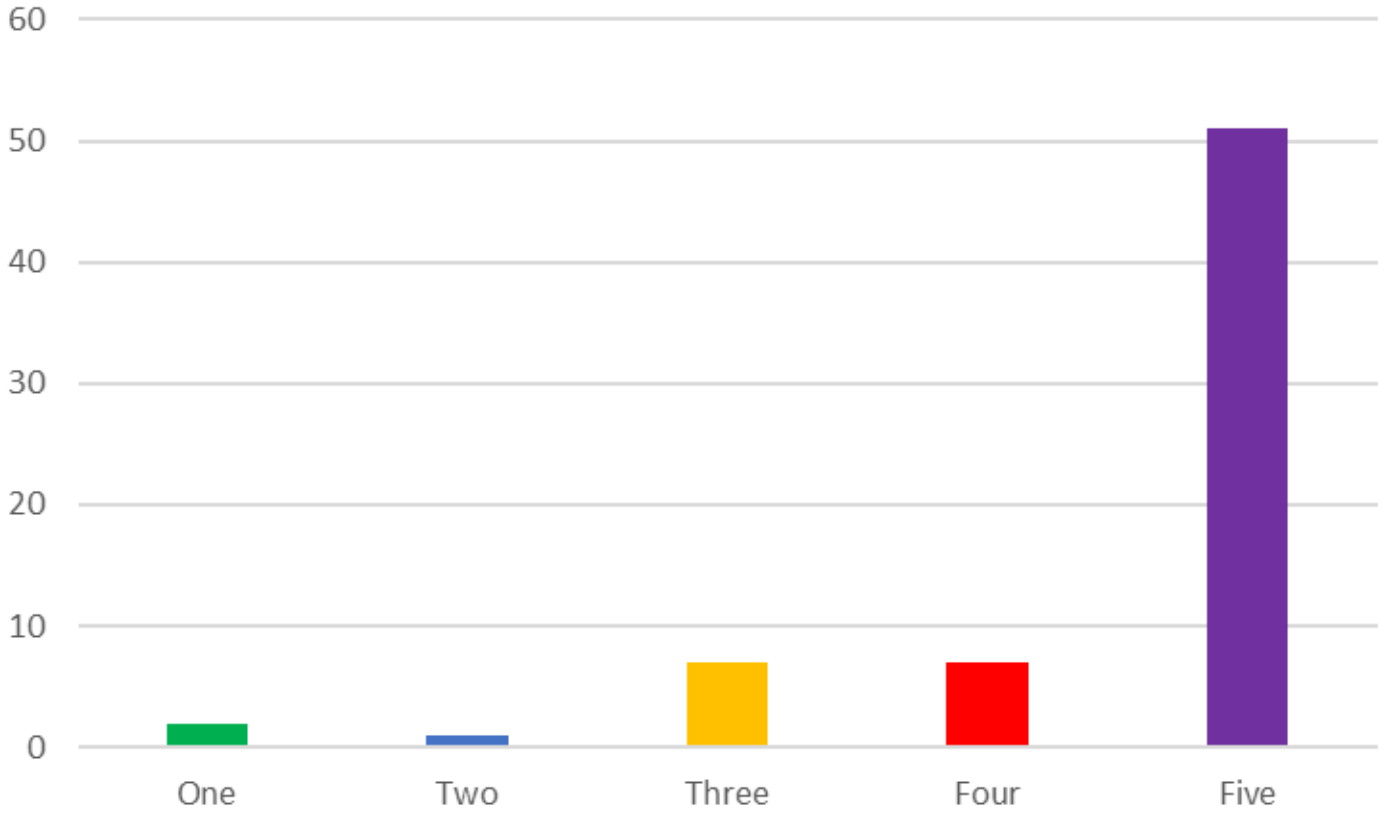
(On a scale of 1-5, with 1 being the lowest and 5 being the highest)



Answer	Count	Percentage
1	3	4.41%
2	1	1.47%
3	3	4.41%
4	6	8.82%
5	55	80.88%

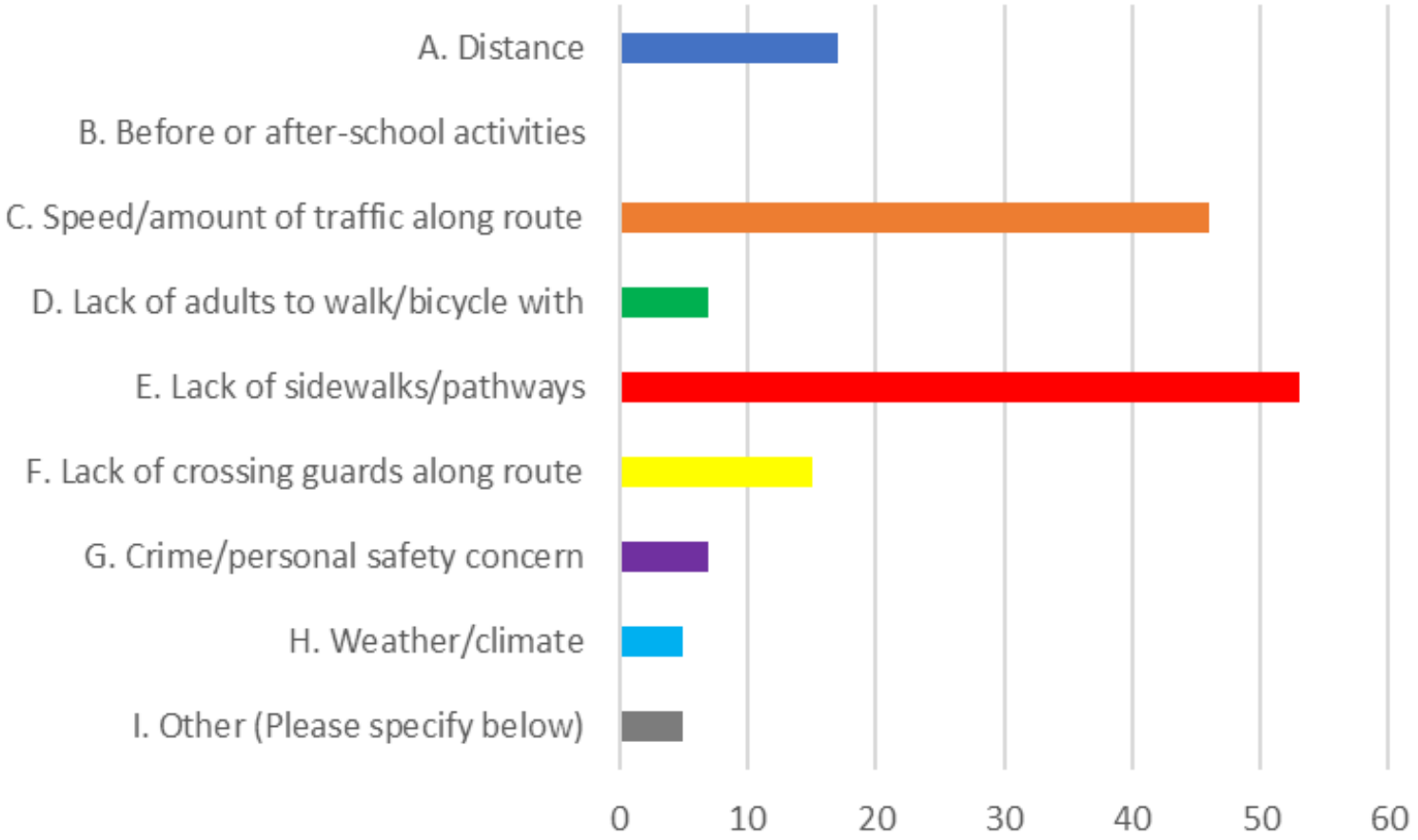
3. How important is it to you that public agencies invest in walking and biking facilities to improve access to schools?

(On a scale of 1-5, with 1 being the lowest and 5 being the highest)



Answer	Count	Percentage
1	2	2.94%
2	1	1.47%
3	7	10.29%
4	7	10.29%
5	51	75%

4. What do you feel is the most important safety concern for students walking or biking to school?

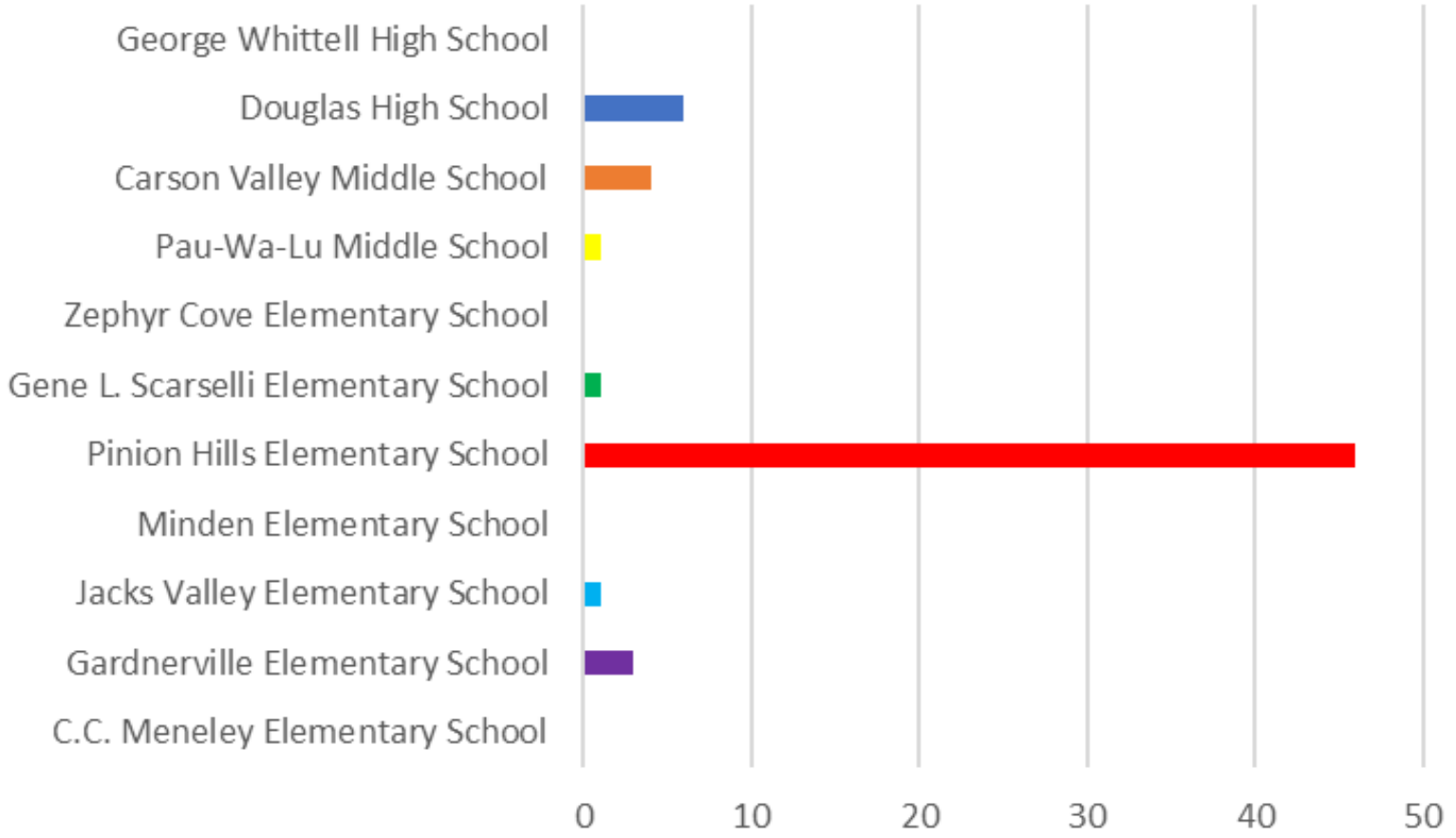


Answer	Count	Percentage
A. Distance	17	10.97%
B. Before or after-school activities	0	0%
C. Speed/amount of traffic along route	46	29.68%
D. Lack of adults to walk/bicycle with	7	4.52%
E. Lack of sidewalks/pathways	53	34.19%
F. Lack of crossing guards along route	15	9.68%
G. Crime/personal safety concern	7	4.52%
H. Weather/climate	5	3.23%
I. Other (Please specify below)	5	3.23%

5. What do you feel is the most important safety concern for students walking or biking to school? (Additional comments/concerns)

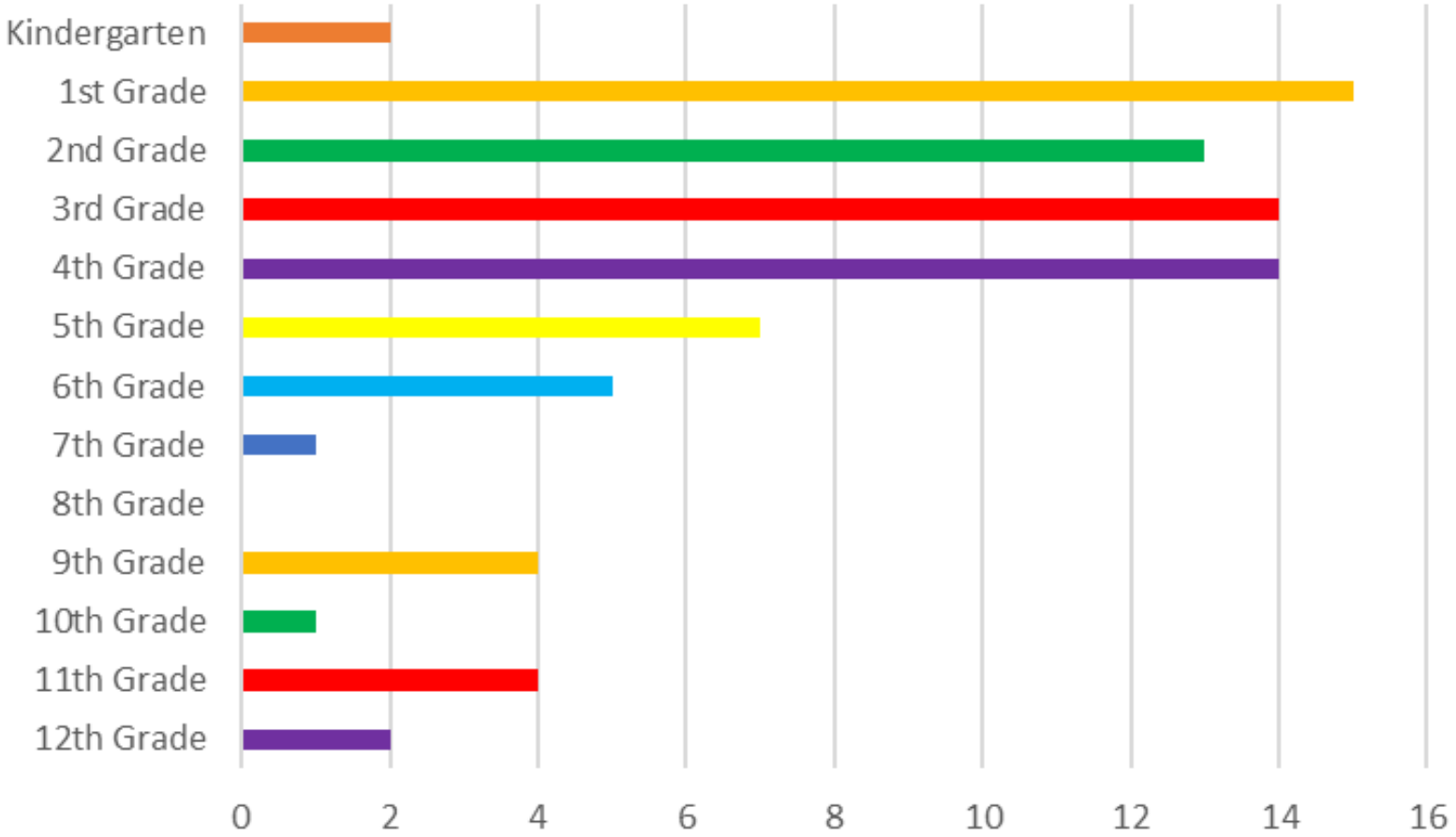
Other replies
Today 5-16-23 I witnessed a child fall off their bike to the right of the exit and fell half in road in front of a car. Luckily cars drive slow. Did t think too much about sidewalks or bike paths until I saw this kid fall off his bike today.
There is no safe path to ride or walk
Personal safety, traffic speed, distance, and lack of crossing guards.
No shoulder or bike path leaving the school, very narrow road with lots of traffic during drop off and pickup and no where to safely get off the road
Middle school and high school will be too far away.
Live in Indian Hills. Distance and 395 as only feasible route.
Lack of protected intersections at Stodick pkwy, Waterloo, and harvest for students from Arbor Gardens north to GES.
I allowed my son to ride his bike to school because there were sidewalks and volunteers/yard duty working at the crosswalks.
Crazy drivers that do not pay attention and always speed
Child does not like to ride up hill after school

6. Which school does your child attend?



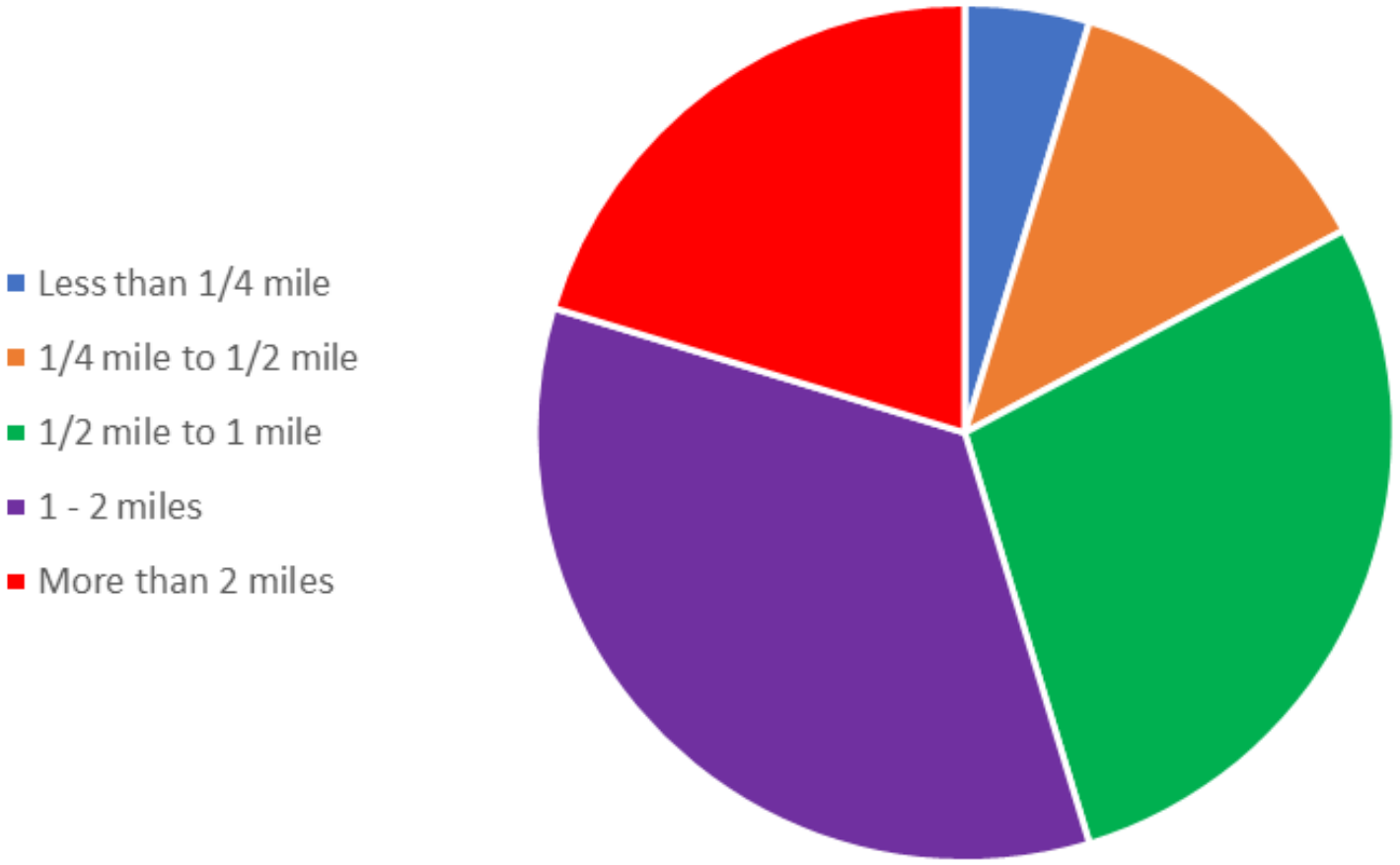
Answer	Count
George Whittell High School	0
Douglas High School	6
Carson Valley Middle School	4
Pau-Wa-Lu Middle School	1
Zephyr Cove Elementary School	0
Gene L. Scarselli Elementary School	1
Pinion Hills Elementary School	47
Minden Elementary School	0
Jacks Valley Elementary School	1
Gardnerville Elementary School	3
C.C. Meneley Elementary School	0

7. What is the grade of your child(ren)?



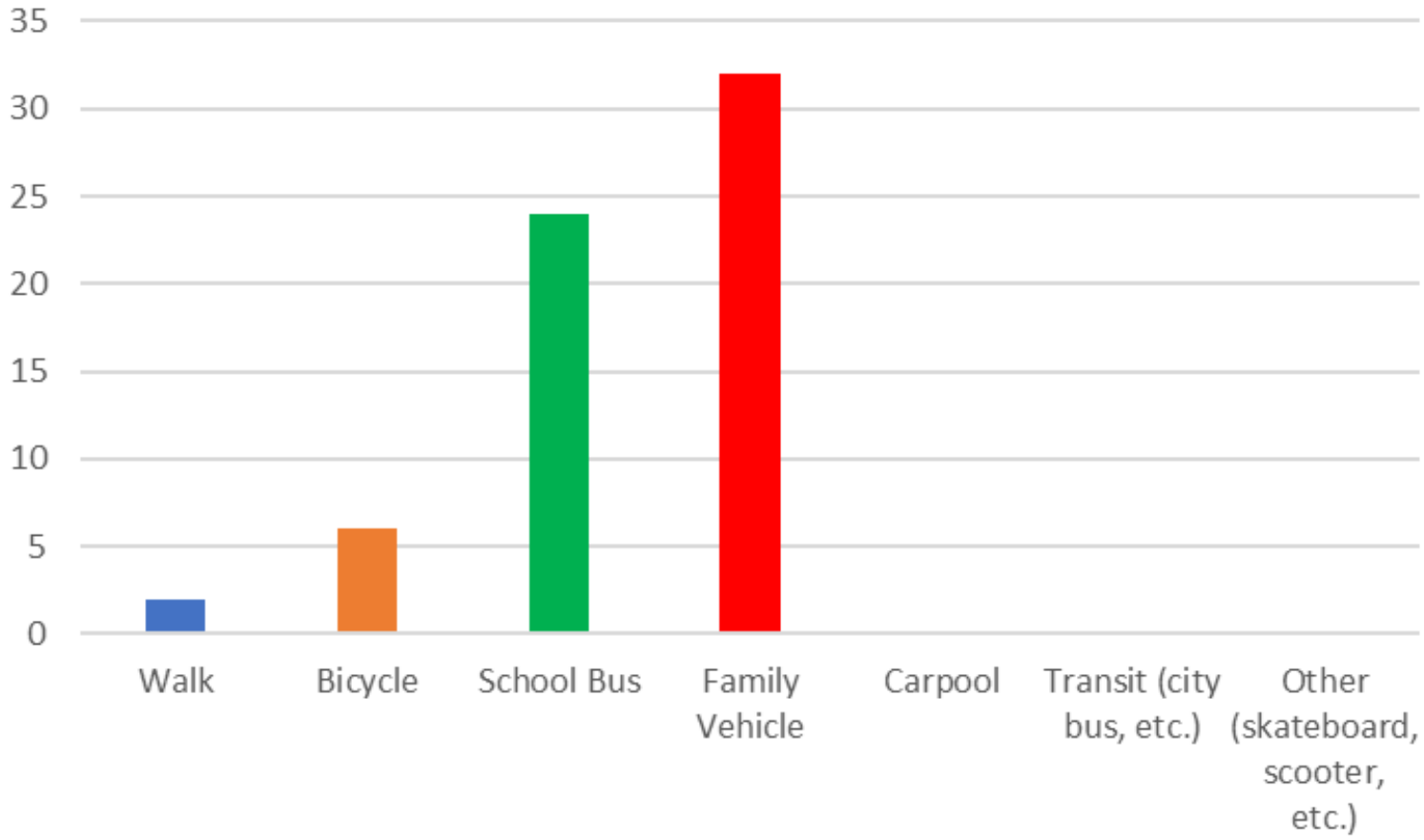
Answer	Count
Kindergarten	2
1st Grade	15
2nd Grade	13
3rd Grade	14
4th Grade	14
5th Grade	7
6th Grade	5
7th Grade	1
8th Grade	0
9th Grade	4
10th Grade	1
11th Grade	4
12th Grade	2

8. How far does your child live from school?



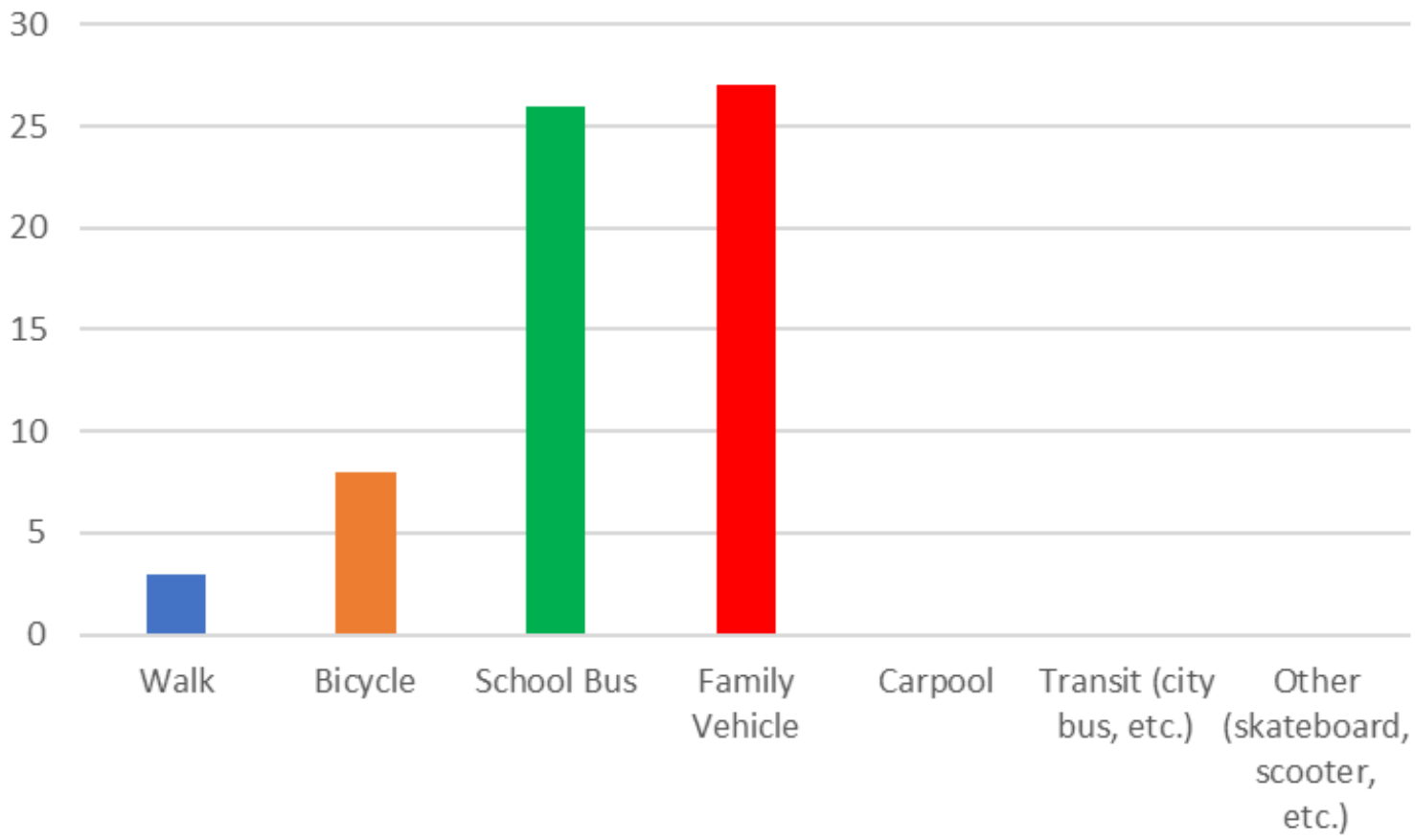
Answer	Count	Percentage
Less than ¼ mile	3	4.69%
¼ mile to ½ mile	8	12.50%
½ mile to 1 mile	18	28.13%
1 – 2 miles	22	34.38%
More than 2 miles	13	20.31%

9. On most days, how does your child arrive at school?



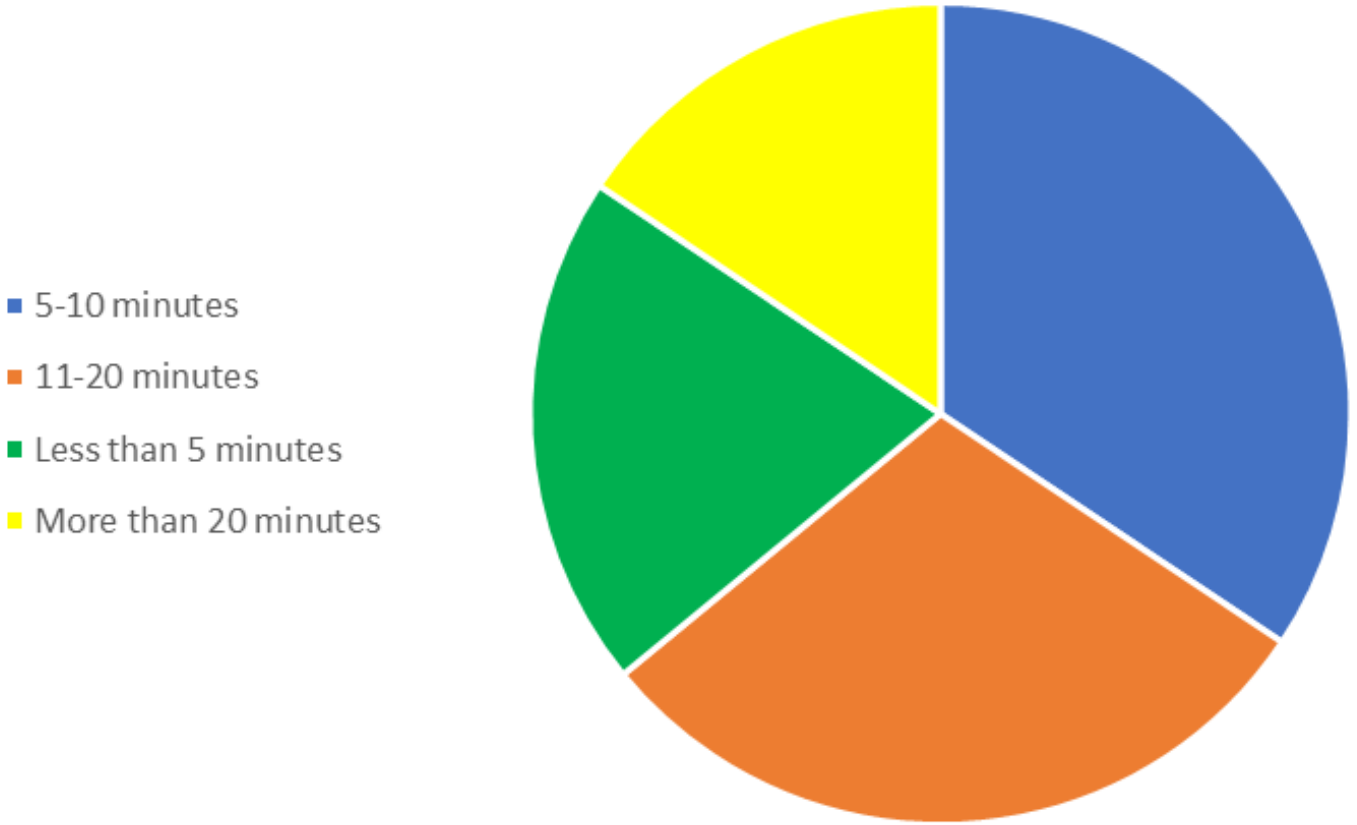
Answer	Count	Percentage
Walk	2	3.13%
Bicycle	6	9.38%
School Bus	24	37.50%
Family Vehicle	32	50%
Carpool	0	0%
Transit	0	0%
Other	0	0%

10. On most days, how does your child leave from school?



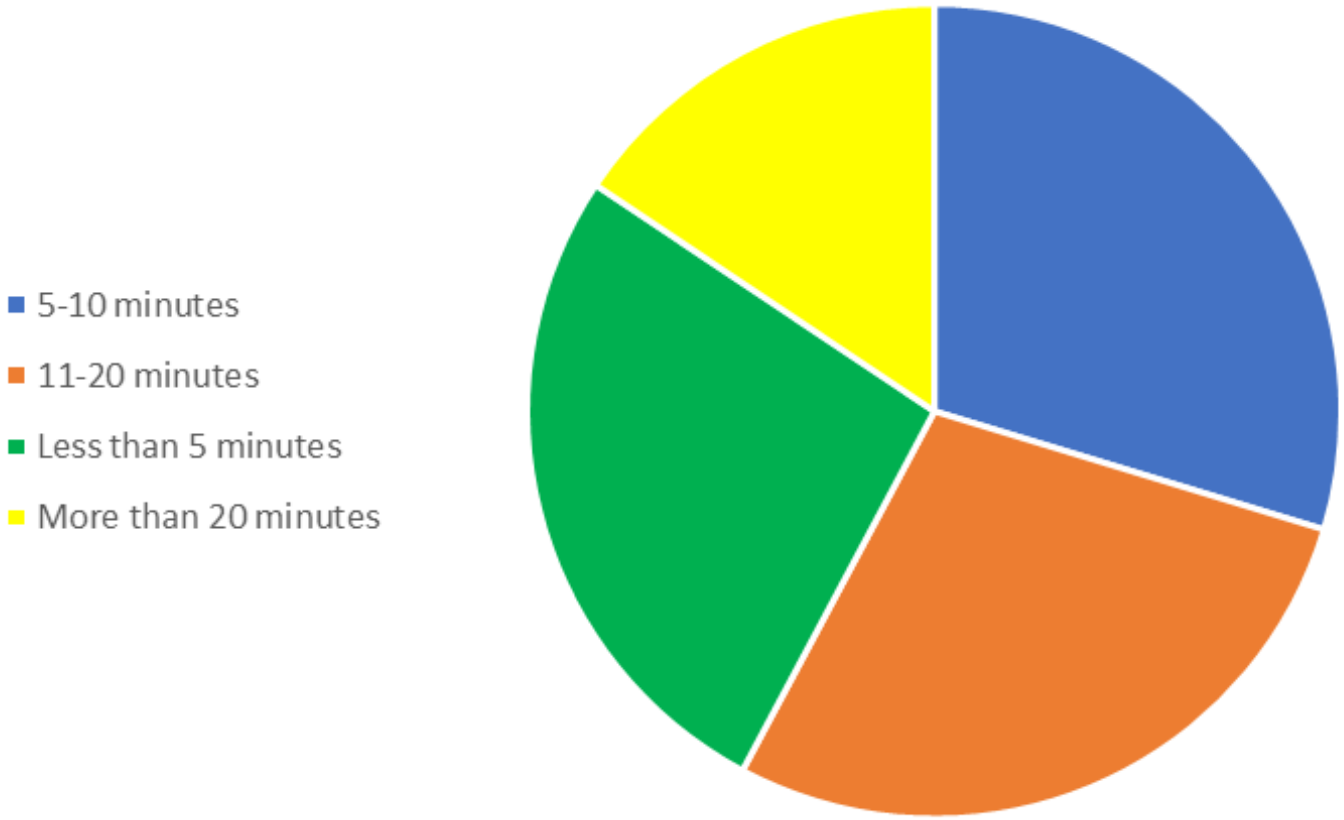
Answer	Count	Percentage
Walk	3	4.69%
Bicycle	8	12.50%
School Bus	26	40.63%
Family Vehicle	27	42.19%
Carpool	0	0%
Transit	0	0%
Other	0	0%

11. How long does it usually take your child to get to school?



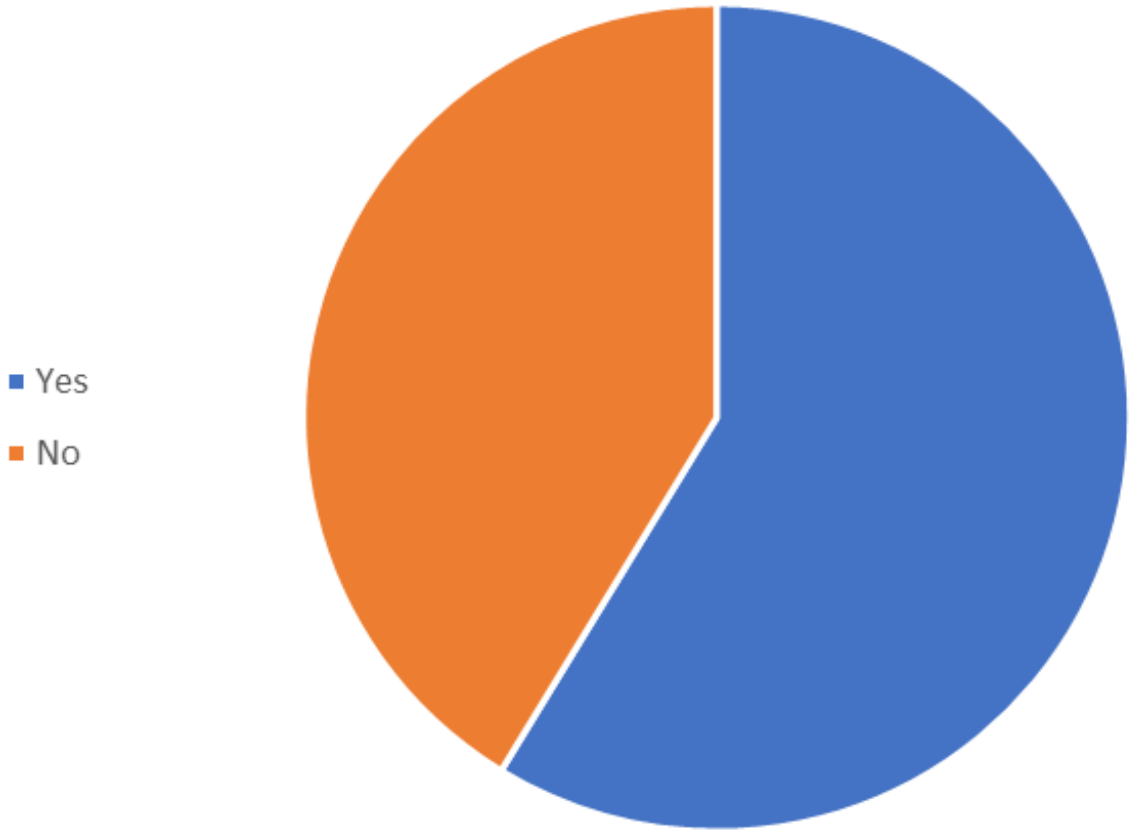
Answer	Count	Percentage
5 – 10 minutes	22	34.38%
11 – 20 minutes	19	29.69%
Less than 5 minutes	13	20.31%
More than 20 minutes	10	15.63%

12. How long does it usually take your child to get home from school?



Answer	Count	Percentage
5 – 10 minutes	19	29.69%
11 – 20 minutes	18	28.13%
Less than 5 minutes	17	26.56%
More than 20 minutes	10	15.63%

13. Has your child asked for permission to walk to/from school in the last year?



Answer	Count	Percentage
Yes	37	58.73%
No	26	41.27%

14. Feel free to share any additional comments or concerns:

Other replies
Would love to have a safe path for kids to ride bikes or walk to and from school in the Johnson lane area
With the current times I feel it is not safe for kids to walk or bicycle to school. It was safe in my day but times were different back than.
We would like to request a sidewalk to be put in from Saratoga Springs Santa Barbara to Pinion Hills Elementary School. There is no shoulder to walk or ride on safely to get to school in this area. Kids are not safe riding bikes or walking to school without a sidewalk. Please consider putting a sidewalk in to ensure our student safety to and from school. Thank you.
We live within a 1/2 mile of our kids' school, but do not feel confident allowing them to ride to school alone. Crossing Chichester Drive is our main concern as traffic crosses quickly and at times drivers are not paying attention (looking down, on phone, general distractions).
We live West of 395 so to bike to school at GES we cross at High School Street. The time of day for drop off and pick up for the elementary school the flashing school zone signs on 395 is not on making it very dangerous to cross 395. The 2nd issue the flashing crosswalk sign is always on at the crosswalk between Mission Street and Toler Ave leading drivers to a ignore subsequent flashing cross walks.
There needs to be safe street crossings for the kids, especially in the Ranchos
There are currently several students who walk to school at Piñon and I am always concerned for their safety as they walk, bike and run along Stephanie. I would love to see this remedied with bike paths.
The traffic issue is horrendous at DHS. Two entrance/exits is completely insufficient for the traffic volume. Furthermore, students must use a crosswalk which cannot accommodate the amount of students and vehicles coming and going, or they have to use a crosswalk in a busy traffic circle. They are crossing a highway, and they would be far safer if there was a pedestrian bridge, there are too many close calls. Commuters are stuck waiting for far too long.
Stephanie is a busy street. PHES parking lot has only one entrance which is very busy after school (Cars lined up out into Stephanie Way). Bike lane is very small. I'm just not confident those drivers are always paying attention to pedestrians/bicyclists (especially young children.
Stephanie has no sidewalks, traffic can get pretty heavy, and cars tend to speed. My kids would love to bike to school but it isn't really safe without sidewalks or a bike path.

14. Feel free to share any additional comments or concerns:

Other replies
SRTS seems too focused on transportation network immediately adjacent to school. Ped and bike improvement needs are greater in the 1/4 mile to 1 mile from schools. Maps show vehicle crash locations but not ped and bike collisions. Biggest improvement need for GES is separated and protected walk from Toler to Mission. Wide motel access and restaurant head in parking backing into sidewalk/guarded crossing is unacceptable during school hours.
SRTS are generally safe routes for everyone. Schools and the district should be engaged in transportation issues for non-motorists. Schools feel like a drive thru and school grounds don't allow public access have become barriers between neighborhoods rather than THE central place. I don't believe in discouraging use of public parks such as Heritage Park by closing restrooms, discriminating against kids. Long term CVMS and Town of Gardnerville need the equivalent of Courthouse street continuing to the Circle Dr access, Meneley alley.
Sidewalks or bike paths along Stephanie would add to safety and allow the community to safely access the school and park.
Sidewalks are desperately needed on Dresslerville Road.
Sidewalk or walking path would be amazing for our school.
Pinon is an ideal school for kids to ride their bikes to school. It is rural, nested into Johnson Lane, surrounded by 25 mph roads. However, there isn't a bike lane for the kiddos to safely commute to and from school. Currently, the kids that do ride bikes, do so in the middle of Stephanie. I have seen numerous close calls between kids on bikes and cars. Please consider a bike lane for students at Pinon. It would improve the safety for students and would likely reduce the car and bus traffic to and from the school. If there was a bike lane on Stephanie, we would drop off/pick up our kiddo on bikes.
Pinion elementary has no side walks along Stephanie rd. 1 crossing guard at the school. A path or sidewalk added would be great.
Our route to school goes up Stephanie. There aren't any sidewalks or shoulders for bike riding, and given the ages of our kids while they're at Pinon Hills, we'd drive them to school before letting them ride their bikes.
Next year he will be in middle school which is way to far. He will take the bus.
Need more sidewalks

14. Feel free to share any additional comments or concerns:

Other replies
My kids would bike to Pinion every day if there were safe, setback sidewalks on Stephanie Lane.
In this day and age, safe routes to and from school should be on top of the priority list. I do not feel it is safe for children and adults to walk on Stephanie. I would like to ask each BOD to walk individually on the shoulder lane of Stephanie from Vicky to Piñion Hills School at 7:30 a.m., Monday - Friday. That is all. Thank you for your time creating this survey for safer school routes.
I would love to be able to walk/bike with my children to school but there are no sidewalks or even shoulders on the roads. I've seen moms with strollers precariously walking on the edge of the road because there is no shoulder. We live in such a beautiful area and it would be so nice to be able to safely walk/bike with the kids to school but we need road shoulders at a minimum and preferably sidewalks. Also the drainage issues could be helped by sidewalks and gutters as well.
I would love a bike path to school. But first I would love for schools to get the proper funding so that they can stop fundraising. I feel like I'm constantly being asked to donate items to classrooms, attend a fundraiser at school, or send my child out to solicite money for the school. It's a backwards system that plays on the sweet faces of our babies and the heartstrings of the ones who love them. Pay the teachers what they deserve and give the schools the funding for a FREE education.
I understand that we are rural in the Johnson Lane community, but being able to install sidewalks along our major roadways (i.e. Stephanie and Johnson) would be great for not only our children, but the community as a whole! Especially if sidewalks were installed east of Vicky Lane going east and west. Thank you!
I think there should be maintained cross walks for children walking to/from school within a certain radius of the schools at the very least. I do not think we need to add sidewalks or bike lanes.
I have a friend who attends Pinion and their school has no safety measures in place for students if they do not ride the bus. I hope this will change so that the students will be able to participate in bike/walk to school programs.
I experience unsafe drivers every single day when I walk my children to and from school. Nobody pays attention to the speed not even in the school zone with the lights flashing. There is no real way to walk or even cross the street. After it rains the sides are completely washed out and muddy. On May 25th 2023 at 3:16 pm for school pick up a woman in a white Nissan Altima tried to purposely run me and my children off the road for crossing into the parking lot. She was speeding up to me as fast as she could indicating that she will hit us in the school zone, yelling and honking at us. I have an active police report filed against her. This is not safe for children. I hope there will be sidewalks build. And there needs to me more police presence.
I don't know if I'll let my kids bike to school. Maybe supervised but by the time they get to an age where I would be fine with it as if now, they'll be in middle school which is to far for them.

14. Feel free to share any additional comments or concerns:

Other replies
I do let my child ride his bike to school whenever he wants but I worry about the lack of adequate bike lanes. We have a bike lane painted on the road but it's approximately a foot wide and drivers who are constantly looking at their phones and not paying attention. A bike lane separated by an actual divider would be amazing.
Hello, The neighborhood surrounding Pinon Hills is completely lacking in sidewalks or bike lanes. The school is on a busy street with lots of auto traffic and there are no safe areas for walking or biking. We live about 1/2 mile from the school and yet I cannot allow my daughter to walk or bike to school because there is no safe access. If the county would install sidewalks and bikes lanes along Stephanie Lane and Vicky Lane, it would improve the neighborhood so much. This project could be done in conjunction with installing necessary drainage upgrades on those same roads. Not only would families be able to walk or bike to school, but they could also go to the county park, ball field and dog park. Sincerely, Erin Westerlund
Bike paths would not only help my children significantly but also benefit the community with safe routes for all Douglas county residents for recreation, access, and exercise. Connecting schools and parks is a great start! Knox excavation would be an awesome partner for a multiple use path along Stephanie way leading to a multiple use trail head on blm (for ohv and non motorized riders).
Bike paths along East Valkey and buckeye or toler would make biking from Johnson lane safer. My kids hate the bus and ask to bike, but East Valley isn’t safe. Or if we could extend Heybourne into a bike path from Airport Rd to Buckeye, it is much safer than East Valley.
Again witness a child fall off the jet bike and went half in raid due to no pathways
A walking and biking path around and to Pinon, would be benefit everyone wanting to utilize the dog park as well.
A bike path from Fuller to the parking lot of the school would be amazing. Fuller has some traffic but not too bad. I would feel comfortable biking along there and then taking a bike path into the school. There needs to be a way to get into the school on a bike without going on Stephanie.
There should be a bike lane along Santa Barbara to Vickey continuing up Stephanie to the school for the children who live in the Saratoga Springs subdivision.
A bike path from Santa Barbara to Vickie then to Stephanie up to Pinion Elementary needs to be provided. Currently there isn’t and safe route for kids walking or riding their bikes to Pinion Elementary.

Appendix K – Safety Policy Review

Purpose

This section provides an analysis of available Douglas County CAMPO plans, policies, and ordinances related to the development of a Safe Streets and Roads for All (SS4A) Implementation Grant application. The review details what should be endorsed as part of efforts toward a SS4A application to be compliant with the requirements listed in U.S. Department of Transportation's (USDOT) eligibility requirements, and identifies which should be modified, updated, or discontinued. [3,4]

The table attached to the end of this memorandum (Table 2) provides a summary of recommended strategies based on best practices from communities leading safety efforts around the country. The table links strategies identified in the policy analysis to best practices that will lead to a stronger grant application by Douglas County and CAMPO.

Background

The SS4A program is grounded in the Safe System Approach to road safety, which places an emphasis on safer roadway design to eliminate fatal and serious injury crashes. The Safe System Approach is composed of five elements: safe roads, safe vehicles, safe people, safe speeds, and post-crash care. The Safe System Approach acknowledges that humans make mistakes, and those mistakes should not result in serious injuries or fatalities. Vision Zero shares the common goal of eliminating traffic related fatal and serious injury crashes by a target year identified by the adopting agency. The Safe System Approach and Vision Zero recognize that traffic related deaths and serious injuries are preventable. A public commitment from a high-ranking official and/or governing body in a jurisdiction to eliminate fatal and serious injury crashes by a target date is required for the SS4A program.

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[3] U.S. Department of Transportation, "Safe Streets and Roads for All Self-Certification Eligibility Worksheet," https://www.transportation.gov/sites/dot.gov/files/2023-03/SS4A-Self-Certification-Eligibility-Worksheet-FY23.pdf

[4] The project team's analysis was based on a review of documents available on the County and MPO's websites. It is possible that not all relevant and applicable plans, policies and other documentation were reviewed. The project team welcomes additional documentation to inform this analysis and the formulation of strategies and actions in a future Safety Action Plan.

Douglas County and CAMPO currently have several plans under development, which are not included in this policy analysis as they are not substantially complete at this time. These plans include:

- CAMPO Vision Zero goal and Action Plan
- CAMPO Local Road Safety Plan (in collaboration with Nevada Department of Transportation)
- 2023-2028 Douglas County Strategic Plan
- 2023 Douglas County Comprehensive Trails Plan

Douglas County Adopted Plans, Policies, and Ordinances

Efforts toward an SS4A application should consider and build off strategies identified in the County's adopted and approved plans, policies, and ordinances including the following:

Douglas County Complete Street Policy Statement

Lays out the framework that all project proposals should improve safety for all road users; all new projects requiring County approval should be designed as Complete Streets; and Complete Streets solutions should be consistent with best practices. The statement includes exceptions to this framework and notes that the statement does not apply to Towns, State, and Tribal entities within Douglas County, but they are encouraged to adhere.[5]

FY18-22 Douglas County Strategic Plan

Provides a mission statement of working together with integrity and accountability, dedicated to providing essential and cost-effective public services fostering a safe, healthy, scenic, and vibrant community for the enjoyment of residents and visitors. Outlines strategic objectives related to financial stability; infrastructure; organizational sustainability; economic vitality; safe community; and natural resources, culture, and quality of life.[6]

Douglas County Master Plan

Lays the framework to properly plan for and mitigate the impact of growth in the area. Includes information related to transportation and safety and includes a goal to provide and maintain an integrated transportation system for the safe, efficient movement of people and goods throughout

[5] Douglas County, "Complete Street Policy Statement," 2016. https://cdnsm5-hosted.civiclive.com/UserFiles/Servers/Server_12493019/File/Public%20Works/Roads/Signed%20Complete%20Streets%20Policy%20Statement%20-%20Douglas%20County%20RTC.pdf

[6] Douglas County, "FY18-22 Strategic Plan," 2017. https://cdnsm5-hosted.civiclive.com/UserFiles/Servers/Server_12493019/File/Visitors/Board%20of%20County%20Commissioners/Group%20Photo%20of%20Commission/Strategic%20Plan/DouglasFY18-22StrategicPlanv12_FINAL_201707121216060076.pdf

Douglas County. Includes policies related to the prioritization of projects that improve safety (PF30). References the 2017 Douglas County Transportation Plan for more transportation strategies.[7]

Douglas County Transportation Plan

Provides overarching goals to provide and maintain an integrated transportation system for the safe, efficient movement of people and goods throughout Douglas County, and to provide appropriate transportation facilities to ensure a high quality of life for Douglas County residents. Includes the following Street and Highway Policies and Principles:

- Identify high crash locations and take appropriate actions to ensure continued public health and safety.
- Provide appropriate traffic control devices on new and existing transportation.
- Post appropriate speed limits based on current speed limit studies.
- Implement selected near-term traffic safety and traffic operations improvements from 2017 to 2020.
- Develop a "pedestrian-friendly" U.S. 395/Main Street corridor through Minden and Gardnerville.

Notes which recommended improvements qualify for the Nevada Department of Transportation (NDOT) Safety Improvement Program or District II maintenance projects. Provides background on the funding mechanism for the Complete Streets Program, related to the Policy Statement from 2016. The County is currently collecting funds for the program through the 2013 Nevada State Legislature funding mechanism through the Nevada Department of Motor Vehicles.[8]

5 Year Douglas County Transportation Work Plan

Outlines the projected short-term transportation needs of Douglas County from the current fiscal year through 2027/2028. The goal of the Plan is to provide a safe and efficient multi-modal transportation system that will facilitate vehicular, bicycle, pedestrian and transit modes within the constraints provided by existing funding sources. The Plan consists of seven programs, one of which is Safety Improvements, which consists of identifying locations with a high number of crashes and making low cost improvements such as new lighting, LED signing systems, increased speed limit signs, guardrail, and other safety mitigation measures.[9]

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[7] Douglas County, "Master Plan," 2020. https://cdnsm5-hosted.civiclive.com/UserFiles/Servers/Server_12493019/File/Community%20Development/Planning/2020%20Master%20Plan%20Text%20Update/final%20version%203-26-2021/Douglas%20County%202020%20MasterPlan_RS.pdf

[8] Douglas County, "Transportation Plan," 2017. https://www.douglascountynv.gov/common/pages/DisplayFile.aspx?itemId=12596444

[9] Douglas County, "5 Year Transportation Work Plan," 2023. https://cdnsm5-hosted.civiclive.com/UserFiles/Servers/Server_12493019/File/Public%20Works/Roads/FINAL_5_Year_Work_Plan_23-24.pdf

Douglas County Design Criteria and Improvement Standards

Provides certain minimum standards for the design, construction, repair, and alterations of streets, roadways, alleys, drainage, grading, sewers, and water supply facilities within Douglas County.[10]

Douglas County Code of Ordinances

The Complete Streets Policy Statement is not incorporated into the Code of Ordinances. The Code of Ordinances includes Title 10 Vehicles and Traffic. Ordinances under 10.16 Speed include:

- 25 MPH maximum in park and school zones.
- Restricted speed limits and zones established by the board of county commissioners.[11]

Douglas County Standards and Construction Details

Provides design standards for various street improvement details. The Arterial/Collector Street detail shows 12-14' lanes. The Local Road detail shows 12-16' lanes. Includes details for standard sidewalk, shared use path, notes for on-street bicycle facilities.[12]

Douglas County Bicycle Plan

Lays out the bicycle access, path design, and roadway design standards in the Douglas County Development Code and the Design Criteria and Improvement Standards Manual. Includes urban and rural bikeways, definitions, and pedestrian access standards. References Nevada's Zero Fatalities program, which adheres to the national Toward Zero Deaths initiative to eliminate fatal traffic crashes (see State and Federal Policies section). Outlines strategies to accommodate appropriate bicycling facilities on all roadways in Nevada open to bicycling and adopt additional design guidance and evaluation procedures for adding bicycle facilities. Includes information on different bicycle facilities. Includes a list of high priority bicycle improvement projects.[13]

CAMPO Adopted Plans, Policies, and Ordinances

Efforts toward an SS4A application should consider and build off strategies identified in CAMPO's adopted and approved plans, policies, and ordinances including the following:

[10] Douglas County, "Design Criteria and Improvement Standards," 2017. https://www.douglascountynv.gov/common/pages/DisplayFile.aspx?itemId=15388009
[11] Douglas County, "Code of Ordinances." https://library.municode.com/nv/douglas_county/codes/code_of_ordinances
[12] Douglas County, "Standards and Construction Details." https://www.douglascountynv.gov/government/departments/community_development/engineering_division/improvement_standards
[13] Douglas County, "Bicycle Plan," 2014. https://www.douglascountynv.gov/common/pages/DisplayFile.aspx?itemId=12596476

2050 CAMPO Regional Transportation Plan

Provides goals for the future of transportation in the CAMPO region, one of which is to increase safety of the transportation system for all users. Defines Complete Streets but does not reference a CAMPO commitment or policy. Includes future safety targets for the FHWA Highway Safety Improvement Program (HSIP) safety performance measures.

Includes safety performance measures from the FHWA HSIP and Safety Performance Management Measures Final Rules from 2016, including:

- Number of fatalities (5-year rolling average)
- Rate of fatalities per 100 million Vehicle Miles Traveled (VMT)
- Number of Serious Injuries (5-year rolling average)
- Rate of Serious Injuries per 100 million VMT
- Number of Non-motorized Fatalities and Non-motorized Serious Injuries (5-year rolling average)

Outlines how MPOs are required to establish targets for each of the performance measures annually. CAMPO coordinates target-setting with NDOT and can either support NDOT's statewide target or establish a target specific to the CAMPO area.[14]

CAMPO Complete Streets Performance Monitoring Program

Outlines the process of establishing baseline information on pedestrians and bicyclists on four corridors to meet CAMPO's Unified Planning Work Program for FY'17-18.[15]

CAMPO Transportation Network Monitoring Report

Lays out the requirements of the federal Infrastructure Investment and Jobs Act (IIJA) for MPOs to track and utilize certain performance measures and establish performance targets to inform decision-making for investments. CAMPO's regional transportation plan safety goal is to increase the safety of the transportation system for all users. The goals, objectives, and performance measures form the basis of CAMPO's planning framework that serve as the basis for project prioritization in CAMPO's Transportation Improvement Program.

Includes crash statistics through 2022, and safety performance measure targets for fatalities and serious injuries through 2023. Targets were increased for 2022 and 2023 after the 2021 and 2022 targets were exceeded. Targets for 2022 and 2023 are shown below.[16]

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[14] CAMPO, "2050 Regional Transportation Plan," 2021.
https://www.carson.org/home/showpublisheddocument/74094/637462257582430000
[15] CAMPO, "Complete Streets Performance Monitoring Program."
https://www.carson.org/home/showpublisheddocument/56038/636383039673930000
[16] CAMPO, "Transportation Network Monitoring Report," 2023.
https://www.carson.org/home/showpublisheddocument/87383

Crash Type	2022 Target	2023 Target
Fatalities	6.84	7.33
Serious Injuries	13.11	19.29
Fatalities and Serious Injuries, Non-Motorized	4.74	5.59

CAMPO Policies and Procedures

Includes policies intended to serve as flexible working guidelines to assist in the day-to-day operation of CAMPO and to assist the members of the governing body in administering the affairs of this special purpose organization. Policies approved by CAMPO are subordinate to Federal regulation, State law or City/County ordinance that may require specific approval process or action.[17]

State and Federal Policies

State and federal policies were reviewed with implications for work that aims to eliminate fatal and serious injury crashes, identifying potential sources of guidance, funding, and collaboration.[18]

State

Zero Fatalities Nevada

Introduced as a program of the Nevada Departments of Public Safety and Transportation in 2011. Emphasizes the humanity of traffic safety and how it affects all vulnerable road users with 13 target areas of focus: Bicyclists, Distracted Driving, Impairment, Intersection Safety, Lane Departure Safety, Micro-mobility, Motorcyclists, Occupant Protection, Older Drivers, Pedestrian Safety, Speed, Teen Drivers, and Work Zone Safety. Zero Fatalities Nevada hosts an annual Traffic Safety Summit, publishes the Nevada Strategic Highway Safety Plan and Action Plan, and has an Advisory Committee on Traffic Safety.[19]

2021-2025 Nevada Strategic Highway Safety Plan (SHSP)

Lays out a comprehensive statewide safety plan that identifies the greatest causes of fatalities and serious injuries on Nevada roadways and provides a coordinated framework for reducing the crashes that cause fatalities and serious injuries. Outlines steps to eliminate traffic-related fatalities and serious injuries by combining and sharing resources across disciplines and strategically targeting efforts to the areas of greatest need. Guiding principles in the plan include prioritizing safe speeds and implementing

[17] CAMPO, "Policies and Procedures." https://www.carson.org/home/showpublisheddocument/78289/637746479627600000

[18] These regional, state, and federal plans and policies are not specifically referenced in the Policy Analysis table, which focuses on plans and policies under the jurisdiction of Douglas County.

[19] Nevada Departments of Public Safety and Transportation, "Zero Fatalities Nevada." https://zerofatalitiesnv.com/

proven safety countermeasures. Key focus areas include safer roads and vulnerable road users. CAMPO signed a partner pledge as a committee member of Nevada's SHSP Execute Committee on Traffic Safety.[20]

2021-2025 Nevada SHSP Action Plan

Uses the most complete five years of crash data (2014-2018) and the evaluation of performance measures to set the action steps and targets for 2021.[21]

Nevada Traffic Safety Crash Facts

Provides the appropriate data to effectively guide strategies and actions for the SHSP, the Highway Safety Plan HSP for the Nevada Office of Traffic Safety OTS, the HSIP for the NDOT, and other traffic safety efforts within the state. Includes emphasis areas like impaired driving, intersection, lane departure, motorcycle, occupant protection, pedestrian, and young driver.[22]

Federal

At the federal level, Secretary Pete Buttigieg, USDOT Secretary of Transportation, committed to the vision of eliminating fatalities and serious injuries on the nation's roadways on January 27, 2022. The zero deaths vision is strengthened by the USDOT Safety Council's focus on developing a Safety System Approach both internally and among the public. FHWA, NHTSA, and FMCSA are working with the National Safety Council to lead a national Road to Zero coalition that also includes the Vision Zero Network, the Institute of Transportation Engineers (ITE), and several hundred national, state, and local organizations.[23] The USDOT and FHWA provide guidance to state DOTs and MPOs on how to incorporate the zero deaths vision into goal setting, performance tracking, and identification of proven safety countermeasures.[24]

Policy and Practice Gap Analysis

Reviewing Douglas County and CAMPO's plans and policies and identifying what needs to be strengthened, added, or eliminated is a critical step toward fulfilling the eligibility requirements for SS4A. Douglas County and CAMPO have made substantial efforts towards improving traffic safety by working across departments on a Safe Routes to School program in Douglas County, developing educational and encouragement programs like bike rodeos, securing grant funding, and by delivering

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[20] Nevada Departments of Public Safety and Transportation, "2021-2025 Strategic Highway Safety Plan," 2021. https://zerofatalitiesnv.com/app/uploads/2021/03/2021-2025_NV_SHSP.pdf

[21] Nevada Departments of Public Safety and Transportation, "2021-2025 Strategic Highway Safety Plan, Action Plan," 2021. https://zerofatalitiesnv.com/app/uploads/2023/03/NDOT-SHSP-Action-Plan_032723.pdf

[22] Nevada Departments of Public Safety and Transportation, "Traffic Safety Crash Facts," 2020. https://zerofatalitiesnv.com/app/uploads/2020/06/Nevada-Traffic-Safety-Crash-Facts.pdf

[23] U.S. Department of Transportation Federal Highway Administration, "Zero Deaths and Safe System." https://safety.fhwa.dot.gov/zerodeaths/.

[24] U.S. Department of Transportation Federal Highway Administration, "Safety Performance Management (Safety PM)." https://safety.fhwa.dot.gov/hsip/spm/.

street project improvements. However, there is much more to be done in order to reach the goal of zero traffic fatalities and serious injuries.

Table 1 recommends nine strategies distilled from communities leading safety efforts around the country. The recommended strategies are grouped into one or more distinct but interrelated strategy areas that align with the Zero Fatalities Nevada program. These are listed in the first column of the table to assist with identifying areas of focus for future planning efforts.

Table 6: Douglas County and CAMPO Recommended Strategies and Strategy Areas

Strategy Areas						Recommended Strategies
Planning	Design	Legislation	Operations	Education	Data	
x	x	x	x	x	x	Reduce Vehicle Speeds, Speed Limits, and Vehicle Miles Traveled
x					x	Prioritize Data-Driven Safety Improvements Using an Equitable Approach
		x		x		Create a Culture of Safety
				x	x	Track the County and/or CAMPO's Progress to Meeting Plan Goals and Implementing Projects
x	x			x		Integrate Vision Zero into the Capital Improvement Program's Development, Pilot Program Installation, Resurfacing Projects, and New Development
			x		x	Embed Equity into Enforcement Approaches
x			x	x		Prioritize Safety Around Schools
	x		x			Coordinate with First Responders to Address Safety Needs
			x			Reduce Safety Risks between Trucks and Other Roadway Users

For each of the recommended strategies, Table 2 evaluates Douglas County and CAMPO's plans and policies next to best practices and notable communities leading safety efforts around the country. This analysis reveals potential gaps and opportunities to build on existing practices and develop new ones that will enable Douglas County and CAMPO to reduce fatal and serious injury crashes.

The first column shows the recommended strategy. The second column lists best practices from policies, including examples from other jurisdictions. The third column includes relevant practices and policies from Douglas County and CAMPO, whether or not they are in line with best practices. The fourth column suggests gaps and areas and recommended updates.

Table 7. Douglas County and CAMPO Policy Analysis

Recommended Strategies	Notable Best Practices + Policies	Current Douglas County and CAMPO Practices + Policies	Gap Areas + Recommendations
Reduce Vehicle Speeds, Speed Limits, and Vehicle Miles Traveled	*It is not possible to reduce the number of traffic fatalities and serious injuries without reducing vehicle operating speeds. Design streets that encourage slower, context-appropriate speeds and second by enforcing speed limits. Enforcement must be done in a manner that doesn't result in racial profiling or disparate impacts to communities of color. Reduce vehicle miles traveled (VMT) to reduce exposure and increase overall safety.* • The City of Portland, OR worked with the state legislature and Oregon DOT to gain flexibility in speed reduction. As an alternative to the vehicle 85th percentile speed setting methodology, Portland created a Decision Matrix for staff that emphasizes risk reduction to vulnerable road users. The City has lowered speed limits across the city, implemented traffic calming features that provide separation between different types of road users, and installed speed cameras on high crash corridors. • An extensive case study in the City of Seattle, WA found that lowering speed limits and increasing sign density alone - absent any marketing campaigns, additional enforcement, retimed signal progressions, or engineering changes to the street geometry – resulted in lower speeds and fewer crashes. Based on this data, Seattle reduced the posted speed limit on nearly every arterial street to 25 MPH and reduced the speed limit by 5 MPH on many state routes running through the city. • The City of San Jose, CA explicitly identifies the alignment of Vision Zero goals with sustainability goals to reduce single occupancy vehicle mode share. • The City of Seattle, WA recognizes the connection between mode shift and Vision Zero and aims to shift an additional 30% of trips to zero-emissions modes (e.g., walking, biking, and transit) by 2030. • As part of its Vision Zero strategy, the City of San Francisco, CA has a goal of shifting 80% of its trips to "sustainable travel	• Zero Fatalities Nevada emphasizes the humanity of traffic safety and how it affects all vulnerable road users with 13 target areas of focus including Speed. Zero Fatalities Nevada published the Speed Management Action Plan in 2022.[25] • The 2021-2025 Nevada Strategic Highway Safety Plan (SHSP) includes safe speeds as a guiding principle. • Douglas County Code of Ordinances, Title 10, Section 10.16 addresses speed. There is a 25 MPH max. in parks and school zones. The board of county commissioners can establish speed limits and zones – the lowest of which is 15 MPH on Warrior Way (where Zephyr Cove Elementary School and George Whittell High School are located).	• Reevaluate current practices around setting design speed and consider the approaches laid out in NACTO's *City Limits* guide to holistically evaluate and set speed limits based on context and the safety of all road users. • Lower speed limits and implement traffic calming features that lower design speeds, starting with residential streets. Efforts should subsequently focus on high risk corridors identified in the LRSP and/or Vision Zero Action Plan crash analysis. Prioritize interventions that improve safety for vulnerable road users. • Continue tracking and supporting efforts at the state level to expand the use of automated traffic enforcement (see Embed Equity into Enforcement Approaches) and provide more control to municipalities over the setting of speed limits. • Develop standard plans for quick implementation of low-cost, low-speed road design. • Include VMT reduction as a foundational component of the Vision Zero strategy. • Develop strategies to increase the availability of safe bicycle parking. Invest in active transportation and transit networks to provide alternatives to driving. • Develop requirements for businesses and employers to provide bicycle parking in Commercial, Industrial, Community Facilities, and Multi-Family Residential land use areas.

[25] Zero Fatalities Nevada, "Nevada Speed Management Action Plan," 2022. https://zerofatalitiesnv.com/app/uploads/2023/02/Nevada-Speed-Management-Action-Plan.pdf

Recommended Strategies	Notable Best Practices + Policies	Current Douglas County and CAMPO Practices + Policies	Gap Areas + Recommendations
	choices" by 2030. It proposes road pricing (including parking pricing) measures aimed at improving safety conditions without disproportionately burdening low-income communities.		

Recommended Strategies	Notable Best Practices + Policies	Current Douglas County and CAMPO Practices + Policies	Gap Areas + Recommendations
Prioritize Data-Driven Safety Improvements Using an Equitable Approach	*Prioritize safety improvements using a data-driven process and a focus on equity. Use an anti-racist mobility justice and accessibility framework to prioritize transportation investments. Examine the equity implications of transit schedules, fares, housing affordability, and policing on mobility.* *Work with Police Departments to improve data collection methods around traffic crashes and unsafe driving behaviors. Pedestrian and bike volumes can help calculate exposure rates and inventories of street design features can assist with risk factor analysis.* • The cities of Denver, CO and Los Angeles, CA prioritize engineering projects within their high-injury networks. The City of Los Angeles established their high-injury network based on the area's level of risk, location within a "vulnerable community," and the measured risk to children or older adults. • King County Metro, in King County, WA, has put racial justice at the forefront of their Mobility Framework, meeting regularly with a Mobility Equity Cabinet to create a set of guiding principles aimed at better serving low-income communities and communities of color. • As part of the citywide Race and Social Justice Initiative, Seattle DOT created a Transportation Equity Workgroup with the goal of building a racially equitable and socially just transportation system that provides safe and affordable access to places and opportunities. • Oakland DOT has initiated a paving plan that prioritizes local streets in historically underserved neighborhoods, acknowledging the disparate burden of poor-condition streets have on low-income residents in terms of safety and car repairs. • The Los Angeles DOT Safe Routes to School Strategic Plan prioritizes investments partially based on the number of students at each school that are eligible for Free-Reduced Price Meals. • The City of New York's Police Department is enhancing their officers' training to include improved discussions on recording and preserving crash details and site evidence.	• Nevada Traffic Safety Crash Facts provides the appropriate data to effectively guide strategies and actions for the SHSP, the Highway Safety Plan (HSP) for the Nevada Office of Traffic Safety (OTS), the Highway Safety Improvement Program (HSIP) for the Nevada Department of Transportation (NDOT), and other traffic safety efforts within the state. Emphasis areas include impaired driving, intersection, lane departure, motorcycle, occupant protection, pedestrian, and young driver. The data can be used to evaluate what fatalities have occurred, where and when they occurred, and why the fatalities occurred to better identify proven safety countermeasures that are effective in reducing fatal and serious injury crashes. • The Douglas County Transportation Plan notes that appropriate speed limits should be posted based on current speed limit studies. The Transportation Capital Improvement Projects section focuses on vehicular level of service standards.	• Conduct a systemic safety analysis to make data-driven decisions around what safety treatments should be prioritized and where those treatments should be implemented first. Incorporate public health and equity considerations into the prioritization framework. • Prioritize equity in the planning and implementation of safety projects so as not to reinforce existing racial and socioeconomic disparities by concentrating investment in areas that are already better served by transportation infrastructure. • Consider more nuanced metrics to evaluate mobility and accessibility (i.e., sidewalk connectivity and ADA compliance, transit operating hours and frequency, and low-stress bicycle network connectivity). • Include the lived experiences of community members as relevant data for transportation planning and design projects. • Consider partnering with local transit providers to address mobility gaps and prioritizing low-income communities that lack other transportation options. • Develop signal timing policies that ensure all roadway users are considered and help facilitate a multimodal transportation system. • Build on the County and/or CAMPO's asset management system and/or roadway database to include data that would help to identify and refine risk factors through systematic safety analysis, including number of travel lanes and turn lanes, street width, traffic signal phasing, transit frequency and boarding/alighting counts, location of fixed objects (barriers, utility poles, etc.) and marked crosswalks and crosswalk enhancements. • Collect additional data on pedestrian and bicyclist volumes to better understand exposure and crash risk for those modes. • Make sure that datasets relating to transportation projects and street design features include installation dates to enable before/after study. • Enhance police officer training on accurate crash reporting and investigation, including the unique attributes required to accurately report the circumstances of crashes involving bicyclists, pedestrians, and other vulnerable road users.

Recommended Strategies	Notable Best Practices + Policies	Current Douglas County and CAMPO Practices + Policies	Gap Areas + Recommendations
	• When Los Angeles Police Department switched from paper Form 555 to digital devices for collecting collision data, Los Angeles DOT successfully had additional fields added, including "speeding-related" as a separate, so that they could more accurately determine contributing factors to crashes. • The City of Eugene, OR performs before and after crash data analysis on capital projects to monitor the success of safety improvements.		

Recommended Strategies	Notable Best Practices + Policies	Current Douglas County and CAMPO Practices + Policies	Gap Areas + Recommendations
Create a Culture of Safety	*Expand the focus of county- or CAMPO-hosted education campaigns and outreach events to include motorists' responsibilities for creating a culture of safety, along with bicyclists' and pedestrians' responsibilities.* • The City of Bellevue, WA, in partnership with the Bellevue School District and Washington DECA, implemented a "Tune In, Not Out" campaign to combat distracted driving. The campaign aimed at fostering a school culture in which students feel comfortable keeping each other accountable for safe driving behaviors. • Jersey City, NJ created partnerships with transit, rideshare, taxi and other services to provide transportation alternatives near commercial corridors and large events to help prevent impaired driving.	• Zero Fatalities Nevada emphasizes the humanity of traffic safety and how it affects all vulnerable road users. Zero Fatalities Nevada hosts an annual Traffic Safety Summit, publishes the Nevada Strategic Highway Safety Plan and Action Plan, and has an Advisory Committee on Traffic Safety. • CAMPO signed a partner pledge as a committee member of Nevada's SHSP Execute Committee on Traffic Safety, as part of the 2021-2025 SHSP. • CAMPO's 2050 Regional Transportation Plan includes a goal to increase safety of the transportation system for all users. • The mission statement in Douglas County's Strategic Plan mentions "fostering a safe, healthy, scenic, and vibrant community for the enjoyment of our residents and visitors."	• Work with media outlets and County/CAMPO staff to more accurately report traffic crashes to avoid victim-blaming and report crashes in the systemic context of the Safe System Approach. Traffic crashes should be referred to as "crashes" rather than "accidents" to align with the Federal Highway Administration's and the Safe System Approach. • Develop comprehensive engagement strategies that create personal connections to the Safe System Approach and/or Zero Fatalities Nevada. Also include messaging about stopping for pedestrians at all marked crosswalks and all intersections and giving bicycles at least 3 feet of space when passing. • Partner with youth organizations to create peer-to-peer anti-distraction messaging campaigns. • Create partnerships with mobility providers to provide transportation alternatives that help prevent impaired driving (i.e., safe ride home programs). • Work with Nevada Department of Motor Vehicles and Douglas County Public Schools to promote driver education that addresses safely sharing the rod with pedestrians and bicyclists.
Track the County and/or CAMPO's Progress to Meeting Plan Goals and Implementing Projects	*Provide regular updates on safety project implementation and planning efforts on the County and CAMPO safety webpages.* • In addition to providing information and links to the City's VZ adoption history and planning documents, San Francisco, CA designed their VZ website to include an interactive map that shows the City's progress in meeting its initial goals from its VZ Action Plan, and the projects' progress. • Seattle, WA is regularly updating its online crash records. Regular updates to the records allow for community members to track the VZ program's progress and remaining needs, which promotes accountability and builds support for continuing efforts. • The City of Tacoma, WA created an interactive data dashboard to transparently share progress on their	• Zero Fatalities Nevada has a publicly available data dashboard to track the state's progress toward zero traffic deaths. • The safety performance measures associated with CAMPO's 2050 Regional Transportation Plan are from the FHWA Highway Safety Improvement Program (HSIP) and Safety Performance Management Measures Final Rules from 2016. CAMPO's future targets show an increase in fatalities for all users, and an increase in serious injuries for non-motorized users. • CAMPO's Complete Streets Performance Monitoring Program tracks pedestrian and bicyclist volumes on four corridors to establish a baseline to meet CAMPO's Unified Planning Work Program for FY'17-18. • To meet the federal Infrastructure Investment and Jobs Act, which requires MPOs to track and utilize	• Create a goal to eliminate fatal and serious injury crashes by a target date, that is supported by a high-ranking official and/or governing body within a jurisdiction. The target date should be aspirational yet achievable. Yearly targets in related reports, like CAMPO's Transportation Network Monitoring Report, should reflect the larger goal. • Create a publicly available data dashboard to transparently track progress towards accomplishing safety actions and meeting key metrics. • Leverage the data from Zero Fatalities Nevada and use Zero Fatalities Nevada's dashboard as a reference.

Recommended Strategies	Notable Best Practices + Policies	Current Douglas County and CAMPO Practices + Policies	Gap Areas + Recommendations
	Vision Zero goal. The dashboard shows fatal and serious injury crashes.	certain performance measures and establish performance targets to inform decision-making for investments, CAMPO created a Transportation Network Monitoring Report. This report includes crash statistics in more recent years than what is included in the 2050 CAMPO Regional Transportation Plan. The target for fatalities and serious injuries was increased for 2023 and 2022 after the 2022 and 2021 targets were exceeded. Targets for the rolling average serious injury crashes increased from 13.8 in 2021 to 20 in 2022.	

Recommended Strategies	Notable Best Practices + Policies	Current Douglas County and CAMPO Practices + Policies	Gap Areas + Recommendations
Integrate Vision Zero into the Capital Improvement Program's Development, Pilot Program Installation, Resurfacing Projects, and New Development	*Communicate program funding needs and allocate funding through the Capital Improvement Program. Implement temporary installations using low-cost materials to test new designs and build support for changes. Evaluate and leverage resurfacing projects for implementing safety improvements. Update development standards and guidelines to align with safety initiatives and approaches.* • The City of Bellevue, WA included $2,500,000 in their 2021-27 Capital Investment Program for "data driven, rapid build road safety projects" along their High Injury Network. • Sacramento, CA outlines its VZ program's funding status and outlook through its Capital Improvement Program (CIP) plan. Sacramento considers the program's funding needs over a five-year period. Through the CIP document, the city clearly communicates to elected officials, staff, and the public how the VZ program will move towards its goals and how VZ projects will impact the operating budget. • The City of Seattle's 2nd Ave protected bike lane was first installed as a demonstration project. Over time modifications have been made based on observations and support for the facility has solidified leading to the installation of more permanent infrastructure. Many other cities are using demonstration projects to test new roadway configurations and treatments without the political pushback often experienced with major street projects. • The City of Boston, MA implements VZ projects during re-paving projects to leverage funding resources and to limit construction impacts on community members. • Seattle, WA updated its Right-of-Way Improvements Manual to provide guidance to private developers on best practices for ensuring safety in the right of way.	• Douglas County Regional Transportation Commission's statement on Complete Streets recognizes all project proposals should improve safety for all road users; all new projects requiring County approval should be designed as Complete Streets; complete streets solutions should be consistent with best practices. The statement includes exceptions for interstate freeways or other corridors where specific users are prohibited; when the cost of accommodation is excessively disproportionate, determined through cost-benefit analysis; for the documented absence of current and future need based on employment densities, traffic volumes, level of transit service; and maintenance projects like cleaning, sealing, spot repairs, patching. The statement applies to all Douglas County-funded projects and all privately funded projects or developments within Douglas County. The statement does not apply to Towns, State, and Tribal entities within Douglas County, but they are encouraged to adhere. • Douglas County's 5-Year Transportation Plan was developed to meet the projected short-term transportation needs of Douglas County from 2023 through 2027/2028. The goal of the 5-Year Plan is to provide a safe and efficient multi-modal transportation system that will facilitate vehicular, bicycle, pedestrian and transit modes within the constraints provided by existing funding sources. The 5-Year Plan consists of seven programs, one of which is Safety Improvements, which consists of identifying locations with a high number of crashes and making low cost improvements such as new lighting, LED signing systems, increased speed limit signs, guardrail, and other safety mitigation measures.	• Incorporate Douglas County Regional Transportation Commission's Complete Street Policy into an ordinance in order for it to be enforced and integrated into the Capital Improvement Program and new development standards. Exceptions to the policy should be clearly defined to maximize the number of projects that must adhere to Complete Streets. • Integrate Vision Zero safety projects into all stages of capital project planning and development. Review capital projects from all seven program categories to ensure that they are consistent with road safety best practices. • Prioritize funding for safety and access improvements on high crash corridors. • Create pilot programs to include traffic calming (i.e., chicanes and pinch points) and pedestrian facility improvements (i.e., curb extensions and walkways using paint, flex posts, planters, etc.). • Study outcomes for pilot installations, publish results as feasible, and install permanent street design changes based on successful installations as capital projects where appropriate. • Evaluate all resurfacing projects, planned maintenance activities (i.e., signal retiming), and other major projects (i.e., new traffic signals) for the potential implementation of safety improvements, particularly on the high-risk corridors. Leverage this work to implement improvements without requiring substantial additional funding. Minor work and emergency repairs may not be able to support recommended safety improvements. • Develop a policy to support pedestrian crossing improvements when curb ramps are reconstructed (i.e., curb bulbs). • Use the Safe System Approach and High Injury Network corridors as one criterion for prioritizing re-surfacing projects. • Explore Code of Ordinance revisions that would update Douglas County and/or CAMPO's transportation concurrency level of service standard to include safety performance and require contributions from new development to implement safety improvements along high-risk corridors.

	The updates included new street types that prioritize safety and quality for all users; updated pedestrian and bicycle design standards; and guidance on interim design treatments. The cities of Portland, OR and Los Angeles, CA are currently undergoing similar efforts.	• Douglas County's Design Criteria and Improvement Standards provides certain minimum standards for the design, construction, repair, and alterations of streets, roadways, alleys, drainage, grading, sewers, water supply facilities and all appurtenances thereto within Douglas County. • Douglas County's Standards and Construction Details include details for Arterial/Collector Streets and Local Roads. Arterial/Collector Streets shows 12-14' lanes and Local Road shows 12-16' lanes.	• Update the Douglas County Design Criteria and Improvement Standards to include new street types that prioritize the safety and comfort of all users and make all ages, all abilities facilities the default option for all local streets. • Explore Impact Fees for new development projects as a tool to support infrastructure improvements that are needed to address increased growth.

Recommended Strategies	Notable Best Practices + Policies	Current Douglas County and CAMPO Practices + Policies	Gap Areas + Recommendations
Embed Equity into Enforcement Approaches	*Recognize the current and historical impacts of traffic enforcement activities on communities of color.* • The City of Denver, CO seeks to not "exacerbate injustices of the past" by approaching areas of safety concerns with both engineering and enforcement tactics. Denver invests in deploying safety-focused engineering projects and installing warning signs ahead of automated speed enforcement cameras. • Jersey City, NJ advised all parking enforcement officers to focus their efforts on ticketing vehicles illegally parked in crosswalks, bike lanes, and in front of fire hydrants. • The Seattle Police Department deprioritized low-risk public safety violations and will no longer regard expired registration, missing front license plate, cracked windshields, items hanging from rearview mirrors, or bicycle helmet violations as primary reasons to make traffic stops. • The Portland Vision Zero Action Plan begins with a commitment that the plan "will not result in racial profiling". The plan does not include actions such as increased penalties or fines for traffic violations or DUI checkpoints, which lead to disproportionately negative outcomes for low-income communities and communities of color.	• Zero Fatalities Nevada is pursuing automated enforcement in school zones. • The Nevada Advisory Committee on Traffic Safety's 2023 Legislative/Policy Recommendations lists road safety cameras as a recommendation.	• Support Nevada Advisory Committee on Traffic Safety's 2023 Legislative/Policy Recommendations on Road Safety Cameras.[26] • Speed safety cameras should only be used on High Injury Network corridors, land uses with higher safety risk, or similar conditions where crashes could occur, until roadway design changes can be made to achieve the target speed. Design self-enforcing roadways to encouraged compliance and reduce the need for enforcement. • Fines should be scalable to income level and number of infractions (fines increase for each violation) with no late fees. Fines should be used as a tool to change behavior, not to generate revenue. Any revenue generated from speed safety camera programs should go directly into roadway design changes that improve safety on the corridor where a speeding-related crash risk exists. • Focus parking enforcement on violations that create safety issues, such as parking too close to an intersection and blocking sight lines, or parking in bicycle facilities.
Prioritize Safety Around Schools	*Work with school districts to take a comprehensive approach to create safer schools and routes to schools.* • The City of Seattle, WA developed a Safe Routes to School 5-Year Action Plan, which involved working closely with Seattle Public Schools and Cascade Bicycle Club to refine the pedestrian and bicycle safety curriculum and provide funding for a fleet of bicycles to be used in bicycle education efforts and to prioritize	• The Douglas County Safe Routes to School Plan lists priority safety improvements around the nine schools in the Valley, and some recommendations for the two Tahoe schools which couldn't be evaluated in depth due to snow conditions. • The Western Nevada Safe Routes to School (WNSRTS) program assists schools in Carson City, Douglas, Lyon and Storey counties to promote safe biking, walking	• Support goals, actions, and recommended improvement projects from Douglas County's SRTS Action Plan. • Track and support efforts at the state level to expand the use of automated traffic enforcement and provide more control to municipalities over the setting of speed limits using alternative FHWA-endorsed approaches to lower speed limits. Automated enforcement programs should directly fund safety improvements. Consider

[26] Zero Fatalities Nevada, "Legislative/Policy Recommendations on Road Safety Cameras," 2023. https://zerofatalitiesnv.com/app/uploads/2022/09/Road-Safety-Cameras-White-Paper.pdf

Recommended Strategies	Notable Best Practices + Policies	Current Douglas County and CAMPO Practices + Policies	Gap Areas + Recommendations
	safety improvements along roads near schools. The Action Plan and prioritization approach improves schools' ability to leverage Safe Routes to School funding, and to coordinate with the City on safety improvements. • The City of Eugene, OR joins local Safe Routes to School staff on school zone walk audits to identify barriers to safety and accessibility.	and rolling for students traveling to and from school. WNSRTS hosts engagement events and school assemblies.[27]	automated traffic enforcement near schools, especially when schools are located on high injury network corridors. • Ensure that projects near schools integrate active transportation and the Safe System Approach.

[27] Carson City, "The Western Nevada Safe Routes to School Program." https://www.carson.org/government/departments-g-z/public-works/transportation/western-nevada-safe-routes-to-school

Recommended Strategies	Notable Best Practices + Policies	Current Douglas County and CAMPO Practices + Policies	Gap Areas + Recommendations
Coordinate with First Responders to Address Safety Needs	*Include first-responders in project design and design guidance development.* • The City of Portland, OR engaged with the Portland Fire & Rescue teams during the development of flexible street design standards. • The City of Denver, CO included design considerations for the Denver Fire Department into the Multimodal Safety Toolbox. Denver will use the Toolbox when retrofitting streets to improve safety for all roadway users in a consistent manner.	• None identified	• Review and revise Fire and Emergency Medical Services call response procedures for East Fork Fire Protection District and Tahoe Douglas Fire Department to ensure appropriate response vehicle per call type. Consider smaller vehicles/apparatus where feasible. • Coordinate on design and operation modifications impacting designated emergency response routes. • Determine the level and types of traffic calming that would be acceptable on all roadway classifications and response routes.
Reduce Safety Risks between Trucks and Other Roadway Users	*Require safety training for large vehicle operators within the County and CAMPO's vehicle fleet and adopt new safety technologies.* • The City of Boston, MA developed a large vehicle safety training program, and a safety inspection protocol for its Public Works vehicles. The safety inspection protocol reviews the vehicle's side guards, blind spot awareness decals and mirrors, and camera installation. • The City and County of San Francisco, CA and the San Francisco Municipal Transportation Authority created a "Safe Streets Working Group" to address an increase in bicycle and pedestrian fatalities from collisions with large trucks. The group included stakeholders like FedEx, UPS, the California Trucking Association, and local bicycle and walking advocates. In addition to a pilot program for the installation of side guards, the group initiated a driver education policy focused on the safe operation of large vehicles in urban areas. • The Cities of Boston, MA; New York City, NY; Cambridge, MA; Seattle, WA; Washington D.C.; and Chicago, IL have adopted truck side guard requirements for large fleet vehicles.	• The Douglas County Valley Vision Plan (2013) includes a proposed truck route (Muller Parkway) that would bypass downtown Gardnerville and Minden to reduce conflict points between trucks and other roadway users. Muller Parkway would be a north-south alternative to US 395, on the east side.	• Evaluate the feasibility and safety benefits of Muller Parkway, as outlined in Douglas County's Valley Vision Plan. • Install side guards and crossover mirrors where applicable to all large fleet vehicles and require entities contracting with the County and/or CAMPO to have site guards on a certain proportion of their fleet over 10,000 lbs. Side guards, also known as "lateral protective devices", keep pedestrians, bicyclists, and motorcyclists from being run over by a large truck's rear wheels in a side-impact collision. • Collaborate with transit and truck operators to develop an educational course for fleet drivers that emphasizes safe operations around cyclists and pedestrians.

Appendix L – Design Toolbox

The following document provides example design standards for pedestrian, bicycle, and mixed-use facilities, taking into consideration the unique needs and characteristics of the various user types. The standards include specifications for width, clear space, surface type, maintenance considerations, crossings, and approximate costs, among other considerations.

Douglas County, NV

Safe Routes to School Infrastructure

DESIGN TOOLBOX

Table of Contents

Section I

Context

Introduction

This Design Toolbox has been developed to complement Douglas County's Safe Routes to School Master Plan and to assist the County in the selection and design of facilities. The designs featured in this Toolbox work to promote pedestrian and bicycle comfort, particularly among children. The chapter presents engineering design resources and approaches to implement bicycle and pedestrian enhancements.

What, Why, Where, When and How?

Future roadway planning, engineering, design and construction will continue to strive for a balanced transportation system that includes a seamless, accessible bicycle and pedestrian network and encourages bicycle and pedestrian travel wherever possible.

There are many reasons to integrate bicycle and pedestrian facilities into typical roadway development policy. The goal of a transportation system is to better meet the needs of people - whether in vehicles, bicyclists or pedestrians - and to provide access to goods, services, and activities.

Supporting active modes gives users important transportation choices, whether it is to make trips entirely by walking or cycling, or to access public transit. Often in urban or suburban areas, walking and cycling are the fastest and most efficient ways to perform short trips.

Convenient non-motorized travel provides many benefits, including reduced traffic congestion, user savings, road and parking facility savings, economic development, and a healthier environment.

Compatible design does more than help those who already walk or bicycle. It encourages greater use of non-motorized transportation and makes the street safer for everyone.

The design recommendations in this document are for use on Douglas County roadways. Projects must not only be planned for their physical aspects as facilities serving specific transportation objectives; they must also consider effects on the aesthetic, social, economic and environmental values, needs, constraints and opportunities in a larger community setting. This is commonly known as Context Sensitive Design, and should be employed when determining which standard is applicable in each scenario.

All walkway and bikeway design guidelines in this document meet or exceed the minimums set by the Americans with Disabilities Act.

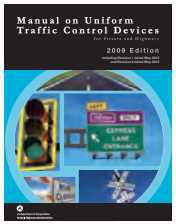
All traffic control devices, signs, pavement markings used and identified in this document must conform to the latest edition of the "Manual on Uniform Traffic Control Devices" (MUTCD).

Whenever possible and appropriate, the National Association of City Transportation Officials (NACTO)'s guidance is recommended where applicable.

Guidance Basis

The sections that follow serve as an inventory of pedestrian and bicycle design treatments and provide guidelines for their development. These treatments and design guidelines are important because they represent the tools for creating a pedestrian- and bicycle-friendly, accessible community. The guidelines are not, however, a substitute for a more thorough evaluation by a professional engineer prior to implementation of facility improvements. The following guidelines are incorporated in this Design Guide.

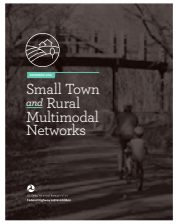
National Guidance



The Federal Highway Administration's **Manual on Uniform Traffic Control Devices (MUTCD)** *defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic.*

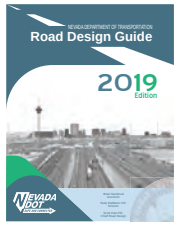
The National Association of City Transportation Officials' (NACTO) **Urban Bikeway Design Guide (2012)** *and* **Urban Street Design Guide (2013)** *are collections of nationally recognized street design standards, and offers guidance on the current state of the practice designs.*

Separated Bike Lane Planning and Design Guide (2015) *is the latest national guidance on the planning and design of separated bike lane facilities released by the Federal Highway Administration (FHWA). The resource documents best practices as demonstrated around the U.S., and offers ideas on future areas of research, evaluation and design flexibility.*



The Federal Highway Administration's **Small Town and Rural Multimodal Networks Report (2016)** *offers resources and ideas to help small towns and rural communities support safe, accessible, comfortable, and active travel for people of all ages and abilities. It connects existing guidance to rural practice and includes examples of peer communities.*

Nevada Guidance



The Nevada Department of Transportations's **Road Design Guide (2019)** *establishes uniform design criteria for Nevada roadways to supplement AASHTO's "A Policy on Geometric Design of Highways and Streets."*

Design Needs of Pedestrians

The MUTCD recommends a normal walking speed of 3.5 ft per second when calculating the pedestrian clearance interval at traffic signals. The walking speed can drop to 3 ft per second for areas with older populations and persons with mobility impairments. While the type and degree of mobility impairment varies greatly across the population, the transportation system should accommodate these users to the greatest reasonable extent.

Types of Pedestrians

Pedestrians have a variety of characteristics and the transportation network should accommodate a variety of needs, abilities, and possible impairments.

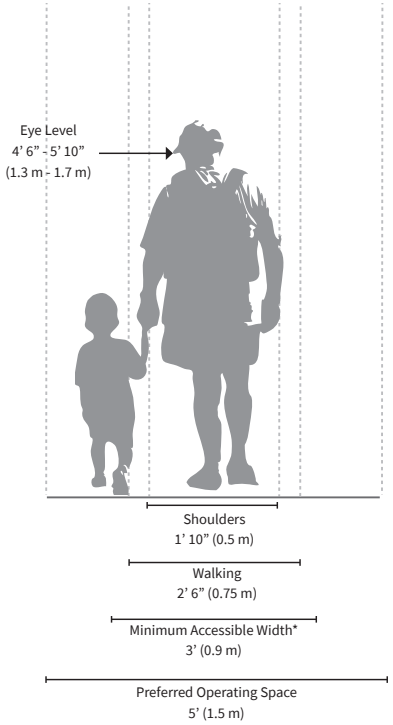
Age is one major factor that affects pedestrians' physical characteristics, walking speed, and environmental perception. Children have low eye height and walk at slower speeds than adults. They also perceive the environment differently at various stages of their cognitive development. Older adults walk more slowly and may require assistive devices for walking stability, sight, and hearing.

Disabled Pedestrian Design Considerations

The table below summarizes common physical and cognitive impairments, how they affect personal mobility, and recommendations for improved pedestrian-friendly design.

Disabled Pedestrian Design Considerations

Impairment	Effect on Mobility	Design Solution
Physical Impairment Necessitating Wheelchair and Scooter Use	Difficulty propelling over uneven or soft surfaces.	Firm, stable surfaces and structures, including ramps or beveled edges.
	Cross-slopes cause wheelchairs to veer downhill or tip sideways.	Cross-slopes of less than two percent.
	Require wider path of travel.	Sufficient width and maneuvering space.
Physical Impairment Necessitating Walking Aid Use	Difficulty negotiating steep grades and cross slopes; decreased stability and tripping hazard.	Cross-slopes of less than two percent. Smooth, non-slippery travel surface.
	Slower walking speed and reduced endurance; reduced ability to react.	Longer pedestrian signal cycles, shorter crossing distances, median refuges, and street furniture.
Hearing Impairment	Less able to detect oncoming hazards at locations with limited sight lines (e.g. driveways, angled intersections, channelized right turn lanes) and complex intersections.	Longer pedestrian signal cycles, clear sight distances, highly visible pedestrian signals and markings.
Vision Impairment	Limited perception of path ahead and obstacles; reliance on memory; reliance on non-visual indicators (e.g. sound and texture).	Accessible text (larger print and raised text), accessible pedestrian signals (APS), guide strips and detectable warning surfaces, safety barriers, and lighting.
Cognitive Impairment	Varies greatly. Can affect ability to perceive, recognize, understand, interpret, and respond to information.	Signs with pictures, universal symbols, and colors, rather than text.



**At point of contact*

Pedestrian Characteristics by Age

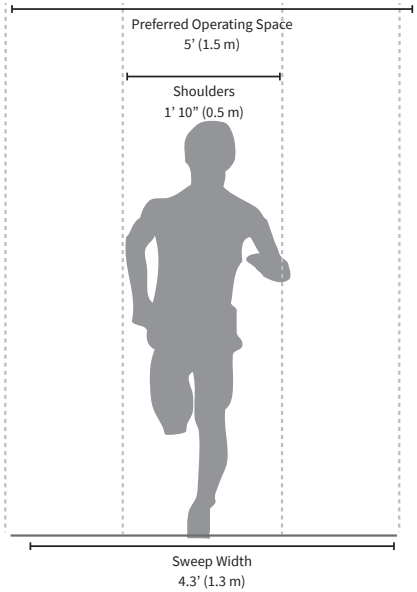
Age	Characteristics
0-4	Learning to walk
	Requires constant adult supervision
	Developing peripheral vision and depth perception
5-8	Increasing independence, but still requires supervision
	Poor depth perception
9-13	Susceptible to "darting out" in roadways
	Insufficient judgment
	Sense of invulnerability
14-18	Improved awareness of traffic environment
	Insufficient judgment
19-40	Active, aware of traffic environment
41-65	Slowing of reflexes
65+	Difficulty crossing street
	Vision loss
	Difficulty hearing vehicles approaching from behind

Source: AASHTO. Guide for the Planning, Design, and Operation of Pedestrian Facilities, Exhibit 2-1. 2004.

Design Needs of Runners

Running is an important recreation and fitness activity commonly performed on shared use paths. Many runners prefer softer surfaces (such as rubber, bare earth or crushed rock) to reduce impact. Runners can change their speed and direction frequently. If high volumes are expected, controlled interaction or separation of different types of users should be considered.

Runner Dimensions

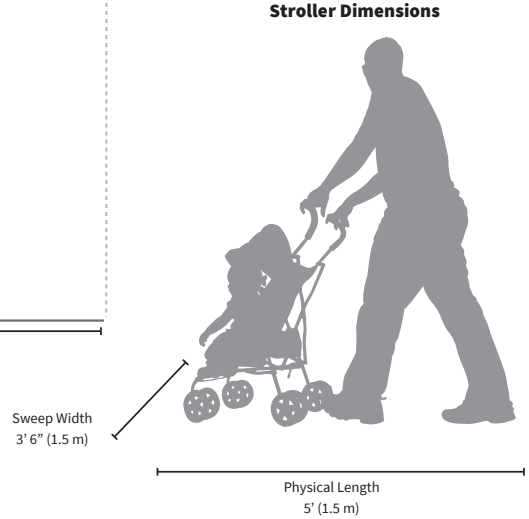


Design Needs of Strollers

Strollers are wheeled devices pushed by pedestrians to transport babies or small children. Stroller models vary greatly in their design and capacity. Some strollers are designed to accommodate a single child, others can carry 3 or more. Design needs of strollers depend on the wheel size, geometry and ability of the adult who is pushing the stroller.

Strollers commonly have small pivoting front wheels for easy maneuverability, but these wheels may limit their use on unpaved surfaces or rough pavement. Curb ramps are valuable to these users. Lateral overturning is one main safety concern for stroller users.

Stroller Dimensions



Design Needs of Wheelchair Users

As the American population ages, the age demographics in Carson City may also shift, and the number of people using mobility assistive devices (such as manual wheelchairs, powered wheelchairs) will increase.

Manual wheelchairs are self-propelled devices. Users propel themselves using push rims attached to the rear wheels. Braking is done through resisting wheel movement with the hands or arm. Alternatively, a second individual can control the wheelchair using handles attached to the back of the chair.

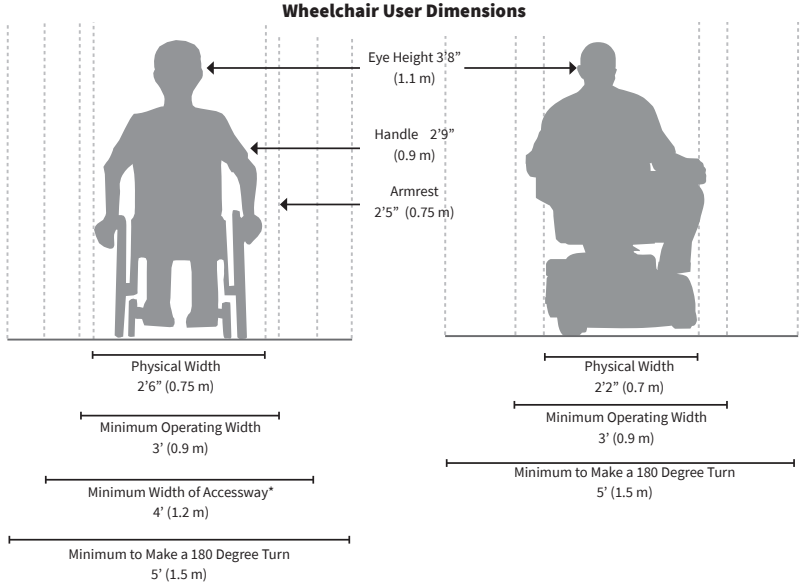
Power wheelchairs use battery power to move the wheelchair. The size and weight of power wheelchairs limit their ability to negotiate obstacles without a ramp. Various control units are available that enable users to control the wheelchair movement, based on their ability (e.g., joystick control, breath controlled, etc).

Maneuvering around a turn requires additional space for wheelchair devices. Providing adequate space for 180 degree turns at appropriate locations is an important element of accessible design.

Wheelchair User Design Considerations

Effect on Mobility	Design Solution
Difficulty propelling over uneven or soft surfaces.	Firm, stable surfaces and structures, including ramps or beveled edges.
Cross-slopes cause wheelchairs to veer downhill.	Cross-slopes of less than two percent.
Require wider path of travel.	Sufficient width and maneuvering space.

Wheelchair User Dimensions



**Provide 5' x 5' passing zone every 200' if travel way is at minimum width*

Design Needs of Bicyclists

The facility designer must have an understanding of how bicyclists operate and how their bicycle influences that operation. Bicyclists, by nature, are much more affected by poor facility design, construction and maintenance practices than motor vehicle drivers.

By understanding the unique characteristics and needs of bicyclists, a facility designer can provide quality facilities and minimize user risk

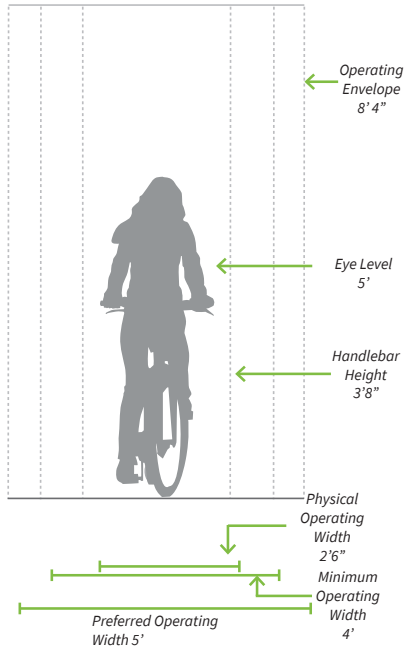
Bicycle as a Design Vehicle

Similar to motor vehicles, bicyclists and their bicycles exist in a variety of sizes and configurations. These variations occur in the types of vehicle (such as a conventional bicycle, a recumbent bicycle or a tricycle), and behavioral characteristics (such as the comfort level of the bicyclist). The design of a bikeway should consider reasonably expected bicycle types on the facility and utilize the appropriate dimensions.

The Bicycle Rider figure illustrates the operating space and physical dimensions of a typical adult bicyclist, which are the basis for typical facility design. Bicyclists require clear space to operate within a facility. This is why the minimum operating width is greater than the physical dimensions of the bicyclist. Bicyclists prefer five feet or more operating width, although four feet may be minimally acceptable.

In addition to the design dimensions of a typical bicycle, there are many other commonly used pedal-driven cycles and accessories to consider when planning and designing bicycle facilities. The most common types include tandem bicycles, recumbent bicycles, and trailer accessories.

Bicycle Rider - Typical Dimensions



Bicycle as Design Vehicle - Design Speed Expectations

BICYCLE TYPE	FEATURE	TYPICAL SPEED
Upright Adult Bicyclist	Paved level surfacing	8-12 mph*
	Crossing Intersections	10 mph
	Downhill	30 mph
	Uphill	5 -12 mph
Recumbent Bicyclist	Paved level surfacing	18 mph

** Typical speed for causal riders per AASHTO 2013.*

Section 2

Pedestrian Toolbox

Marked Crosswalks

A marked crosswalk signals to motorists that they must yield to pedestrians and encourages pedestrians to cross at designated locations. Installing crosswalks alone will not necessarily enhance the comfort level of crossings. At mid-block locations, crosswalks can be marked where there is a demand for crossing and there are no nearby marked crosswalks.

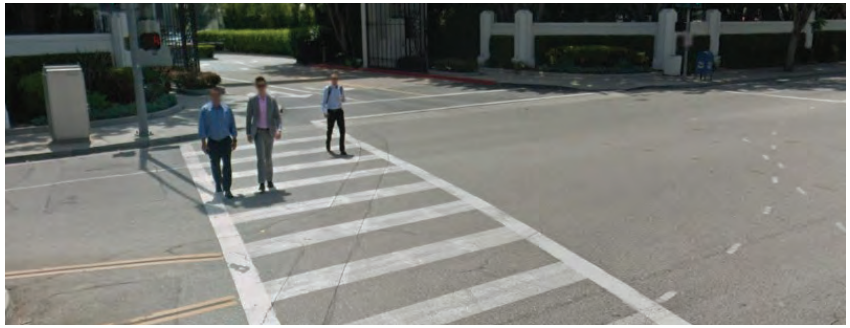
Typical Use

All crosswalks should be marked at signalized intersections. At unsignalized intersections, crosswalks may be marked under the following conditions:

- At a complex intersection, to orient pedestrians in finding their way across.
- At an offset intersection, to show pedestrians the shortest route across traffic with the least exposure to vehicular traffic and traffic conflicts.
- At an intersection with visibility constraints, to position pedestrians where they can best be seen by oncoming traffic.
- At an intersection within a school zone on a walking route.

Design Features

- The crosswalk should be located to align as closely as possible with the through pedestrian zone of the sidewalk corridor.
- Users should not have to leave the crosswalk or reorient themselves from the crosswalk when accessing the curb ramp onto the sidewalk.
- See page 18 for design guidelines for curb ramps.
- High- visibility ladder, zebra, and continental crosswalk markings are preferable to standard parallel or dashed pavement markings.
- To reinforce yielding to pedestrians and reduce vehicle incursion into the crosswalk, include an advanced stop bar in advance of the crosswalk.



Marked crosswalks include standard parallel pavement markings as well as high-visibility ladder markings. Source: Google Streetview

Further Considerations

Pedestrians are sensitive to out-of-direction travel, and reasonable accommodations should be made to make crossings both convenient at locations with adequate visibility.

Continental crosswalk markings should be used at crossings with high pedestrian use or where vulnerable pedestrians are expected, including: school crossings, across arterial streets for pedestrian-only signals, at mid-block crosswalks, and at intersections where there is expected high pedestrian use and the crossing is not controlled by signals or stop signs. High-visibility crosswalks are not appropriate for all locations. Other crosswalk marking patterns are provided for in the MUTCD.

Some cities prohibit omitting or removing a marked crosswalk at intersections in order to require a three-stage pedestrian crossing. Intersections with three-stage crossings lead to arduous and increased crossing distances, pedestrian frustration, encourages jaywalking, and exhibits modal bias favoring motor vehicle level-of-service over other modes. There are circumstances when only three crosswalks are utilized and typically occur at or near interchanges and freeway ramps.

Materials and Maintenance

Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority. Thermoplastic markings offer increased durability than conventional paint.[1]

Approximate Cost

Depending on the type of material used, width of the crossing and width of the roadway, approximate installation costs are $500 for a regular striped crosswalk, $1,000 for a ladder crosswalk, and $8,000 for a patterned concrete crosswalk. In addition, the cost of a curb ramp is about $5,000-$10,000 per ramp.

Due to various number of crosswalk styles in use, signing standards, color and aesthetics, other factors will affect the final cost.

Maintenance of markings should also be considered.

1 The appropriate marking material(s) should be determined on a project basis.

Raised Pedestrian Crossings

A raised crosswalk or intersection can eliminate grade changes from the pedestrian path and give pedestrians greater prominence as they cross the street. Raised crosswalks also functions as speed tables, and encourage motorists to slow down. As such, they should be used only in cases where a special emphasis on pedestrians is desired.

Raised crosswalks are typically implemented on low-speed streets, bike boulevards and other areas of very high pedestrian activity. They are often paired with other treatments such as curb extensions for greater traffic calming effect.

Typical Use

Like a speed hump/table, raised crosswalks have a traffic slowing effect which may be unsuitable on high-speed streets, roadways with sharp curves, designated transit or freight routes, and in locations that would reduce access for emergency responders. Use detectable warnings at the curb edges to alert vision-impaired pedestrians that they are entering the roadway.

Approaches to the raised crosswalk may be designed to be similar to speed humps/tables.

Design Features

- Use detectable warnings at the curb edges to alert vision-impaired pedestrians that they are entering the roadway.
- Approaches to the raised crosswalk may be designed to be similar to speed humps.
- Drainage improvements may be required depending on the grade of the roadway.
- Special paving materials can be used to increase conspicuity of the crossing, and alert drivers to the presence of pedestrians.

Raised pedestrian crossings help reduce vehicle speeds and give pedestrians greater prominence as they cross the street.

Further Considerations

- The noise of vehicles traveling over raised crosswalks may be of concern to nearby residents and businesses.
- Refer to Americans with Disabilities Act (ADA) and California Building Code (CBC) for additional requirements.

Materials and Maintenance

Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority. Ensure drainage used to channel stormwater past the raised intersection is kept free of debris, to prevent stormwater from backing up and pooling.

Approximate Cost

Raised crosswalks are approximately $2,000 to $15,000, depending on drainage conditions and material used.

Sidewalk Zones & Widths

Sidewalks are the most fundamental element of the walking network, as they provide an area for pedestrian travel separated from vehicle traffic. Providing adequate and accessible facilities can lead to increased numbers of people walking, improved accessibility, and the creation of social space.

Curbside Lane	Buffer Zone	Pedestrian Through Zone	Frontage Zone
The curbside lane can act as a flexible space to further buffer the sidewalk from moving traffic., and may be used for a bike lane. Curb extensions and bike corrals may occupy this space where appropriate. In the **edge zone** there should be a 6 inch wide curb.	The buffer zone, also called the furnishing or landscaping zone, buffers pedestrians from the adjacent roadway, and is also the area where elements such as street trees, signal poles, signs, and other street furniture are properly located.	The through zone is the area intended for pedestrian travel. This zone should be entirely free of permanent and temporary objects. Wide through zones are needed in downtown areas or where pedestrian flows are high.	The frontage zone allows pedestrians a comfortable "shy" distance from the building fronts. It provides opportunities for window shopping, to place signs, planters, or chairs.

Street Classification	Parking Lane/ Enhancement Zone	Buffer Zone	Pedestrian Through Zone	Frontage Zone*
Local Streets	Varies	4 - 6 ft	6 ft	N/A
Downtown and Pedestrian Priority Areas	Varies	4 - 6 ft	12 ft	2.5 - 10 ft
Arterials and Collectors	Varies	4 - 6 ft	6 - 8 ft	2.5 - 5 ft

**Indicates ideal frontage zone space. Actual frontage zone is contingent upon the City's development code and required set backs*

Typical Uses

- Wider sidewalks should be installed near schools, at transit stops, in downtown areas, or anywhere high concentrations of pedestrians exist.
- At transit stops, an 8 ft by 5 ft clear space is required for accessible passenger boarding/ alighting at the front door location per ADA requirements.
- Sidewalks should be continuous on both sides of urban commercial streets, and should be required in areas of moderate residential density (1-4 dwelling units per acre).
- When retrofitting gaps in the sidewalk network, locations near transit stops, schools, parks, public buildings, and other areas with high concentrations of pedestrians should be the highest priority.

Materials and Maintenance

Sidewalks are typically constructed out of concrete and are separated from the roadway by a curb or gutter and sometimes a landscaped boulevard. Less expensive walkways constructed of asphalt, crushed stone, or other stabilized surfaces may be appropriate. Ensure accessibility and properly maintain all surfaces regularly. Surfaces must be firm, stable, and slip resistant. Colored, patterned, or stamped concrete can add distinctive visual appeal.

Approximate Cost

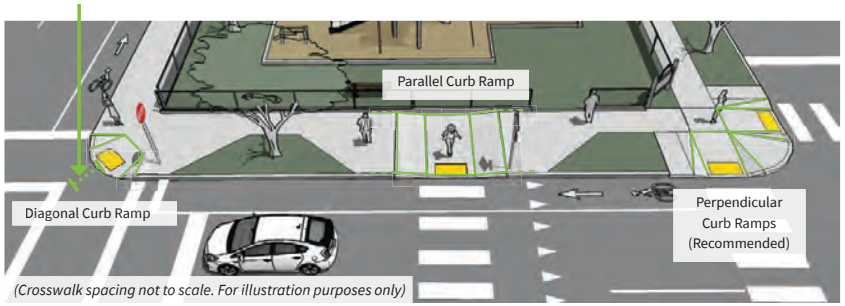
Cost of standard sidewalks range from about $25 per square foot for concrete sidewalk. This cost can increase with additional right-of-way acquisition or addition of landscaping, lighting or other aesthetic features. As an interim measure, an asphalt concrete path can be placed until such time that a standard sidewalk can be built. The cost of asphalt path can be less than half the cost of a standard sidewalk.

Curb Ramps

Curb ramps are the design elements that allow all users to make the transition from the street to the sidewalk. A sidewalk without a curb ramp can be useless to someone in a wheelchair, forcing them back to a driveway and out into the street for access. There are a number of factors to be considered in the design and placement of curb ramps.

Diagonal ramps shall include a clear space of at least 48" within the crosswalk for user maneuverability

Curb ramps shall be located so that they do not project into vehicular traffic lanes, parking spaces, or parking access aisles. Three configurations are illustrated below.



(Crosswalk spacing not to scale. For illustration purposes only)

Typical Use

- Curb ramps must be installed at all intersections and midblock locations where pedestrian crossings exist, as mandated by federal legislation (1973 Rehabilitation Act and ADA 1990). All newly constructed and altered roadway projects must include curb ramps. In addition, existing facilities must be upgraded to current standards when appropriate.
- The edge of an ADA compliant curb ramp shall be marked with a tactile warning device (also known as truncated domes) to alert people with visual impairments to changes in the pedestrian environment. Contrast between the raised tactile device and the surrounding infrastructure is important so that the change is readily evident to partially sighted pedestrians. These devices are most effective when adjacent to smooth pavement so the difference is easily detected.

Design Features

- The level landing at the top of a ramp shall be at least 4 feet long and at least the same width as the ramp itself. The slope of the ramp shall be compliant to current standards.
- If the ramp runs directly into a crosswalk, the landing at the bottom will be in the roadway.
- If the top landing is within the sidewalk or corner area where someone in a wheelchair may have to change direction, the landing must be a minimum of 4'-0" long (in the direction of the ramp run) and at least as wide as the ramp, although a width of 5'-0" is preferred.

Not recommended: diagonal curb ramp configuration. Source: Google Streetview

Recommended: Bulb-Out with bidirectional curb ramps for crossing in both directions. Source: Google Streetview

Further Considerations

Where feasible, separate directional curb ramps for each crosswalk at an intersection should be provided rather than having a single ramp at a corner for both crosswalks. Although diagonal curb ramps might save money, they orient pedestrians directly into the traffic zone, which can be challenging for wheelchair users and pedestrians with visual impairment. Diagonal curb ramp configurations are not recommended.

Curb return radii need to be considered when designing directional ramps. While curb ramps are needed for use on all types of streets, the highest priority locations are in downtown areas and on streets near transit stops, schools, parks, medical facilities, shopping areas.

Materials and Maintenance

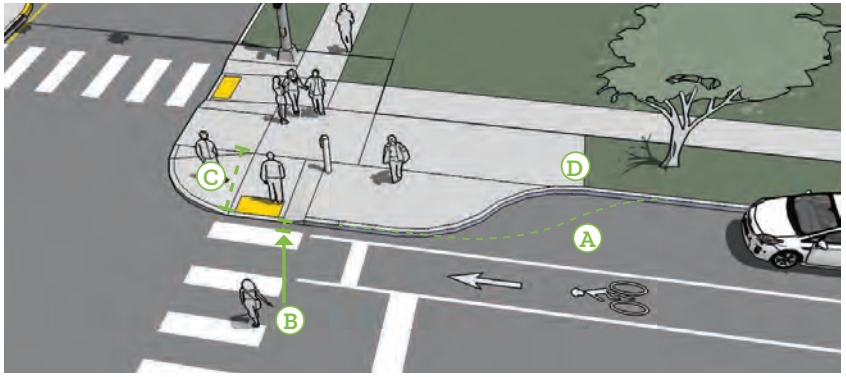
It is critical that the interface between a curb ramp and the street be maintained adequately. Asphalt street sections can develop potholes at the foot of the ramp, which can catch the front wheels of a wheelchair.

Approximate Cost

The cost is approximately $5,000-$10,000 per curb ramp depending on drainage and right-of-way.

Curb Extensions

Curb extensions minimize pedestrian exposure during crossing by shortening crossing distance and giving pedestrians a better chance to see and be seen before committing to crossing.



Typical Use

- Within parking lanes appropriate for any crosswalk where it is desirable to shorten the crossing distance and there is a parking lane adjacent to the curb.
- May be possible within non-travel areas on roadways with excess space.
- Particularly helpful at midblock crossing locations.
- Curb extensions should not impede bicycle travel in the absence of a bike lane.
- Curb extensions are often utilized as in-lane transit stops, allowing passengers to board and alight outside of the pedestrian through zone.

Materials and Maintenance

Planted curb extensions may be designed as a bioswale, a vegetated system for stormwater management. To maintain proper stormwater drainage, curb extensions can be constructed as refuge islands offset by a drainage channel or feature a covered trench drain.

Design Features

(A) For purposes of efficient street sweeping, the minimum radius for the reverse curves of the transition is 10 ft and the two radii should be balanced to be nearly equal.

(B) When a bike lane is present, the curb extensions should terminate one foot short of the parking lane to enhance bicyclist access.

(C) Reduces pedestrian crossing distance by 6-8 ft.

(D) Planted curb extensions may be designed as a bioswale for stormwater management.

Approximate Cost

The cost of a curb extension can range from $2,000 to $20,000 depending on the design and site condition, with the typical cost approximately $12,000. Green/vegetated curb extensions cost between $10,000 to $40,000.

Median Refuge Islands

Median refuge islands are located at the mid-point of a marked crossing and help improve pedestrian access by increasing pedestrian visibility and allowing pedestrians to cross one direction of traffic at a time. Refuge islands minimize pedestrian exposure at mid-block crossings by shortening the crossing distance and increasing the number of available gaps for crossing.

Typical Use

- Refuge islands an be applied on any roadway with a left turn center lane or median that is at least 6' wide. Islands are appropriate at signalized or unsignalized crosswalks.
- The refuge island must be accessible, preferably with an at-grade passage through the island rather than ramps and landings.
- The island should be at least 6' wide between travel lanes (to accommodate wheelchair users) and at least 20' long (40' minimum preferred).
- Provide double centerline marking, reflectors, and "KEEP RIGHT" signage (MUTCD R4-7a) in the island on streets with posted speeds above 25 mph.

Materials and Maintenance

Refuge islands may require frequent maintenance of road debris. Trees and plantings in a landscaped median must be maintained so as not to impair visibility, and should be no higher than 1 foot 6 inches.

Design Features

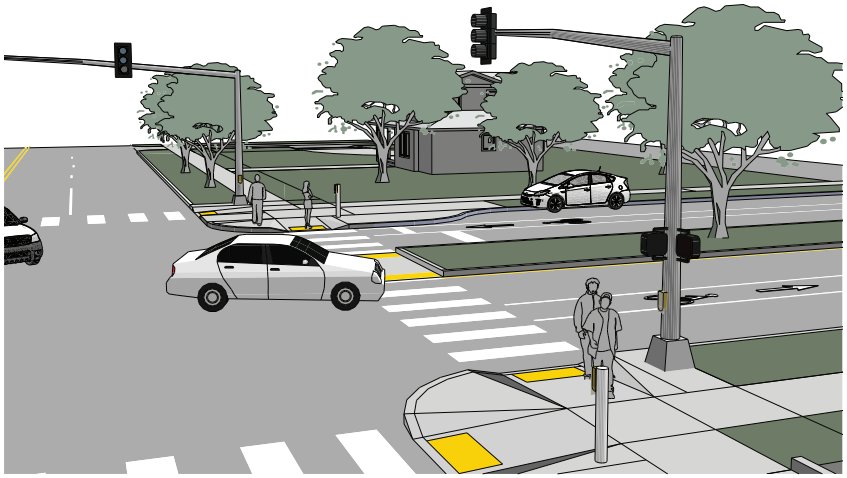
- Median refuge islands can be installed on roadways with existing medians or on multi-lane roadways where adequate space exists
- Median Refuge Islands should always be paired with crosswalks, and should include advance pedestrian warning signage when installed at uncontrolled crossings.
- On multi-lane roadways, consider configuration with active warning beacons for improved yielding compliance.

Approximate Cost

The approximate cost to install a median refuge island ranges from $500 to $1,100 per foot, or about $3,500 to $4,000, depending on the design, site conditions, landscaping, and whether the median can be added as a part of a larger street reconstruction project or utility upgrade.

Pedestrian Signalization Improvements

Pedestrian signal heads indicate to pedestrians when to cross at a signalized crosswalk. All traffic signals should be equipped with pedestrian signal indications except where pedestrian crossing is prohibited by signage. Pedestrian signals should be used at traffic signals wherever warranted, according to the MUTCD.



Typical Use

- Countdown pedestrian signals are particularly valuable for pedestrians, as they indicate whether a pedestrian has time to cross the street before the signal phase ends. Countdown signals should be used at all new and rehabilitated signalized intersections.
- Adequate pedestrian crossing time is a critical element of the walking environment at signalized intersections. The length of a signal phase with parallel pedestrian movements should provide sufficient time for a pedestrian to safely cross the adjacent street.
- There are several types of signal timing for pedestrian signals, including concurrent, exclusive, "Leading pedestrian interval" (LPI), and all-red interval. In general, shorter cycle lengths and extended walk intervals provide better service to pedestrians and encourage better signal compliance. For optimal pedestrian service, fixed-time signal operation usually works best.
- Leading Pedestrian Intervals (LPI) are used to reduce right turn and permissive left turn vehicle and pedestrian conflicts. The through pedestrian interval is initiated first, in advance of the concurrent through/right/permissive left turn interval. The LPI minimizes vehicle-pedestrian conflicts because it gives pedestrians a 3-10 second head start into the intersection, thereby making them more visible, and reducing crossing exposure time. Accessible Pedestrian Signals (APS) are recommended with an LPI.
- Automated pedestrian phases are preferred to passive or active detection, particularly in areas of high pedestrian activity.

A Pedestrian Island in large intersections helps shorten crossing distances. Source: Google Streetview

Design Features

- The MUTCD recommends that traffic signal timing assumes a pedestrian walking speed of 3.5 ft per second.[1]
- At crossings where older pedestrians or pedestrians with disabilities are expected, crossing speeds as low as 3 ft per second should be assumed. Special pedestrian phases can be used to provide greater visibility or more crossing time for pedestrians at certain intersections.
- Pedestrian pushbuttons may be installed at locations where pedestrians are expected intermittently. Otherwise, pedestrian signals should be automated with traffic signals. When used, pushbuttons should be well signed and within reach and operable from a flat surface for pedestrians in wheelchairs and with visual disabilities. They should be conveniently placed in the area where pedestrians wait to cross. Section 4E.09 within the MUTCD provides detailed guidance for the placement of pushbuttons to ensure accessibility.

Further Considerations

- When pushbuttons are used, they should be located so that someone in a wheelchair can reach the button from a level area of the sidewalk without deviating significantly from the natural line of travel into the crosswalk. Pushbuttons should be marked (for example, with arrows) so that it is clear which signal is affected.
- In areas with very heavy pedestrian traffic, consider an all-pedestrian signal phase to give pedestrians free passage in the intersection when all motor vehicle traffic movements are stopped.
- An exclusive pedestrian signal phase called a "Pedestrian Scramble" can be provided to reduce vehicle turning conflicts.

Materials and Maintenance

It is important to perform ongoing maintenance of traffic control equipment. Consider semi-annual inspections of controller and signal equipment, intersection hardware, and detectors.

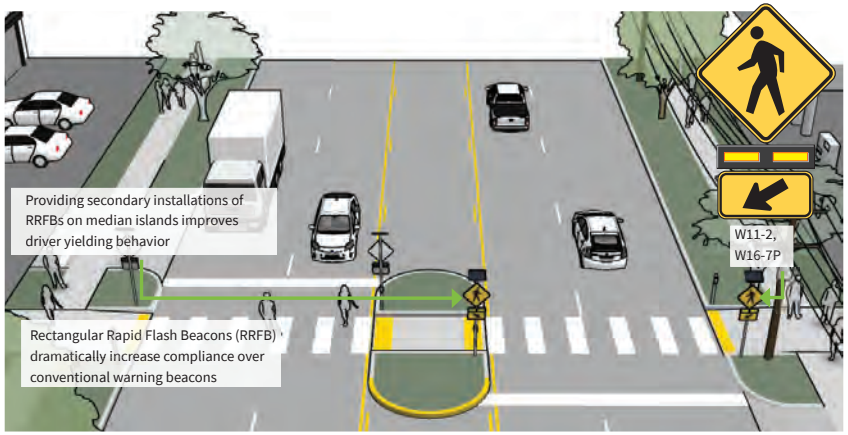
Approximate Cost

Adjusting signal timing is relatively inexpensive, as it requires only a few hours of staff time to accomplish. New signal equipment ranges from $20,000 to $140,000.

1 In Carson City, 3.5 ft per second is used for the Flashing Don't Walk (FDW) interval and 3.0 ft per second for the WALK interval.

Rectangular Rapid Flashing Beacons (RRFB)

Rectangular Rapid Flash Beacons (RRFB) are a type of active warning beacon used at unsignalized crossings. They are designed to increase motor vehicle yielding compliance on multi-lane or high-volume roadways. Guidance for marked/unsignalized crossings applies.



Typical Use

RRFBs are typically activated by pedestrians manually with a pushbutton, or can be actuated automatically with passive detection systems.

RRFBs shall not be used at crosswalks controlled by YIELD signs, STOP signs, or traffic control signals.

RRFBs shall initiate operation based on user actuation and shall cease operation at a predetermined time after the user actuation or, with passive detection, after the user clears the crosswalk.

Materials and Maintenance

RRFBs should be regularly maintained to ensure that all lights and detection hardware are functional.

Design Features

Guidance for marked/unsignalized crossings applies.

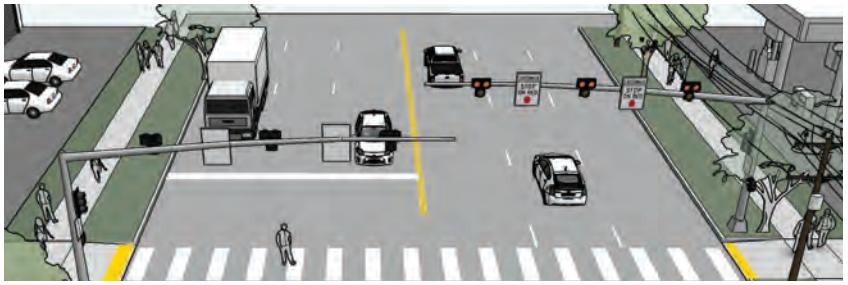
- A study of the effectiveness of going from a no-beacon arrangement to a two-beacon RRFB installation increased yielding from 18 percent to 81 percent. A four-beacon arrangement raised compliance to 88%. Additional studies of long term installations show little to no decrease in yielding behavior over time.
- See FHWA Interim Approval 21 (IA-21) for more information on device application standards.

Approximate Cost

RRFBs range in price from $5,000 to $20,000 for a solar powered unit depending on the location, width of the road and other factors.

Pedestrian Hybrid Beacon (PHB)

Hybrid beacons or High-Intensity Activated Crosswalk (HAWK) beacons are used to improve unsignalized intersections or midblock crossings of major streets. It consists of a signal head with two red lenses over a single yellow lens on the major street, and a pedestrian signal head for the crosswalk. The signal is only activated when a pedestrian and/or bicyclist is present, resulting in minimal delay for motor vehicle traffic.



Typical Use

PHBs are only used at marked mid-block crossings or unsignalized intersections. They are typically activated with a pedestrian pushbutton at each end. If a median refuge island is used at the crossing, another pedestrian pushbutton can be located on the island to create a two-stage crossing.

Design Features

- PHBs may be installed without meeting traffic signal control warrants if roadway speed and volumes are excessive for comfortable pedestrian crossings.
- If installed within a signal system, signal engineers should evaluate the need for the PHB to be coordinated with other signals.
- The MUTCD recommends but does not require that PHBs be installed at least 100 feet from side streets that are controlled by stop or yield signs. Many agencies have implemented successful projects at otherwise uncontrolled intersections.
- Parking and other sight obstructions should be prohibited for at least 100 feet in advance and at least 20 feet beyond the marked crosswalk to provide adequate sight distance.

Further Considerations

- PHBs may also be actuated by infrared, microwave, or video detectors.
- Each crossing, regardless of traffic speed or volume, requires additional review by a registered engineer to identify sight lines, potential impacts on traffic progression, timing with adjacent signals, capacity, and safety.
- The installation of PHBs should also include public education and enforcement campaigns to ensure proper use and compliance.

Materials and Maintenance

PHBs are subject to the same maintenance needs and requirements as standard traffic signals. Signing and striping need to be maintained to help users understand any unfamiliar traffic control.

Approximate Cost

PHBs are more expensive than other beacons, ranging in costs from $150,000 to $250,000, but are generally less expensive than full signals. PHBs may be side mounted in some contexts or solar powered to provide additional flexibility and costs closer to a RRFB installation.

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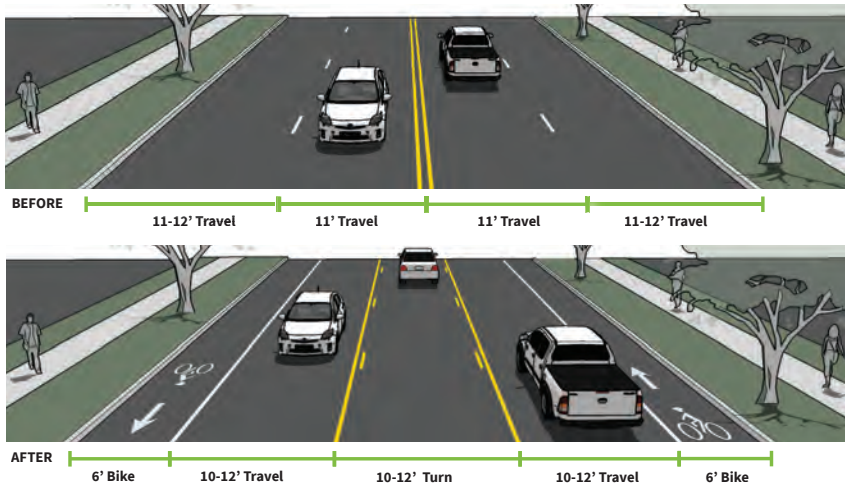
Section 3

Bicycle Toolbox

Lane Reconfigurations and Road Diets

Streets with excess roadway capacity or wider lanes often make excellent candidates for lane reconfigurations or road diet projects. The removal of a single travel lane will generally provide sufficient space for bike lanes on both sides of a street. Even if the width of the sidewalk does not increase, pedestrians benefit from the buffer that the new bike lanes create between the sidewalk and travel lanes. Although the actual roadway crossing distance has not been reduced, the addition of bike lanes reduces the number of vehicle travel lanes pedestrians must cross.



Typical Use

- Depending on a street's existing configuration, traffic operations, user needs, and comfort level, various lane reconfigurations may be appropriate.
- For instance, a four-lane street (with two travel lanes in each direction) could be modified to provide one travel lane in each direction, a center turn lane, and bike lanes.
- Prior to implementing this measure, a traffic analysis should identify potential impacts, including diversion to other parallel neighborhood streets. Road diets should also consider school, city bus, emergency service access, and other truck volumes.

Design Features

- Narrower lanes generally encourage slower vehicle speeds, higher comfort for people walking and biking.
- Vehicle lane width: Width depends on project. No narrowing may be needed if a lane is removed. Lanes along transit and freight routes may need a minimum of 11 feet to accommodate larger vehicles.
- Bicycle lane width: Standard bicycle lane width is 5-6 feet as measured from the face of the curb. A buffered bike lane requires an additional 2-3 feet.
- Number of Lanes: Generally, 3 lanes with a center turn lane can provide a capacity of 20,000 vehicles per day., with some examples carrying over 24,000 vehicles per day.

Before-and-after road reconfiguration on Duquesne Avenue in Culver City, CA. General Flow lanes were narrowed to make way for a bike lane while retaining parking.

Materials and Maintenance

Road configurations are often paired with the road repaving schedule to reduce costs. Use bicycle compatible drainage grates, and ensure they are flush with the pavement.

Approximate Cost

Adding striped shoulders can cost as little as $1,000 per mile if old paint does not need to be removed.

The cost for restriping a street to bike lanes or reducing the number of lanes to add on-street parking is approximately $11 per foot on street, depending on the number of lane lines to be removed.

The approximate cost for restriping a roadway as depicted can range from $10,000-$60,000 per mile.

Bike Boulevards

A Bike Boulevard is a low-speed, low-volume roadway that is designed to enhance comfort and convenience for people bicycling. It provides better conditions for bicycling while improving the neighborhood character and maintaining emergency vehicle access. Bike Boulevards are intended to serve as a low-stress bikeway network, providing direct, and convenient routes across Douglas County. Key elements of Bike Boulevards are unique signage and pavement markings, traffic calming and diversion features to maintain low vehicle volumes, and convenient major street crossings.

Typical Use

- Parallel with, and in close proximity to major thoroughfares (1/4 mile or less) on low-volume, low-speed streets.
- Follow a desire line for bicycle travel that is ideally long and relatively continuous (2-5 miles).
- Avoid alignments with excessive zigzag or circuitous routing. The bikeway should have less than 10% out of direction travel compared to shortest path of primary corridor.
- Local streets with traffic volumes of fewer than 3,000 vehicles per day and posted speed limits of 25 miles per hour. Utilize traffic calming to maintain or establish low volumes and discourage vehicle cut through / speeding.

Design Features

- Signs and pavement markings are the minimum treatments necessary to designate a street as a bike boulevard.
- Implement volume control treatments based on the context of the bike boulevard, using engineering judgment. While motor vehicle volumes should not exceed 3,000 vehicles per day, ideal conditions are 1,500 vehicles per day or less.
- Intersection crossings should be designed to enhance comfort and minimize delay for bicyclists of diverse skills and abilities

A Painted Intersection, planters, and curb extensions to reinforce that the street is intended for local, slow-speed use instead of cut-through vehicle traffic.

An example of an large pavement marking to reinforce that the street is a Bike Boulevard.

Further Considerations

- Bike Boulevards are established on streets that improve connectivity to key destinations and provide a direct, low-stress route for bicyclists, with low motorized traffic volumes and speeds, designated and designed to give bicycle travel priority over other modes.
- Bike Boulevard retrofits to local streets are typically located on streets without existing signalized accommodation at crossings of collector and arterial roadways. Without treatments for bicyclists, these intersections can become major barriers along the Bike Boulevard.
- Traffic calming can deter motorists from driving on a street. Anticipate and monitor vehicle volumes on adjacent streets to determine whether traffic calming results in inappropriate volumes. Traffic calming can be implemented on a trial basis.

Materials and Maintenance

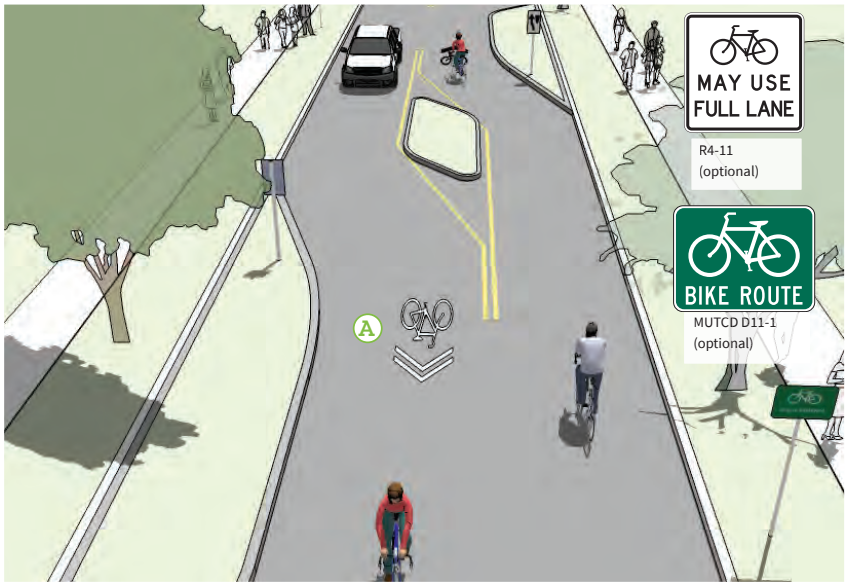
Bike Boulevards require few additional maintenance requirements to local roadways. Signage, signals, and other traffic calming elements should be inspected and maintained according to local standards.

Approximate Cost

Costs vary depending on the type of treatments proposed for the corridor. Simple treatments such as wayfinding signage and markings are most cost-effective, but more intensive treatments will have greater impact at lowering speeds and volumes, at higher cost. Costs can range from $5,000/mile on the simple end to $50,000/mile for significant horizontal deflection and diversion.

Shared Lane Markings

Shared Lane Marking (SLM) or "Sharrow" stencils are lane positioning stencils that can enhance shared roadways. The MUTCD approved pavement marking can serve a number of purposes, such as making motorists aware of the need to share the road with bicyclists, showing bicyclists the direction of travel, and, with proper placement, reminding bicyclists to bike further from parked cars to prevent collisions with drivers opening car doors.



Typical Use

- Shared Lane Markings are not appropriate on paved shoulders or in bike lanes, and should not be used on roadways that have a posted speed greater than 35 mph.
- Shared Lane Markings should be implemented in conjunction with BIKES MAY USE FULL LANE signs.

Design Features

Ⓐ Placement in the center of the travel lane is preferred in constrained conditions.

- Markings should be placed immediately after intersections and spaced at 250 foot intervals thereafter.
- The MUTCD recommends centering the marking a minimum of 11 feet from the curb face with on-street parking and a minimum of 4 feet from the curb with no parking. Larger offsets are frequently desirable.

Sharrows also serve as positional guidance and raise bicycle awareness where there is not space to accommodate a full-width bike lane. Center lane markings may or may not be necessary depending on travel lane widths. Narrower two way residential streets (less than 22 ft between parked cars) have a natural traffic calming effect without center turn lanes.

Further Considerations

- Consider modifications to signal timing to induce a bicycle-friendly travel speed for all users.
- Though not always possible, placing the markings outside of vehicle tire tracks will increase the life of the markings and the long-term cost of the treatment.
- A green thermoplastic background can be applied to further increase the visibility of the shared lane marking.

Materials and Maintenance

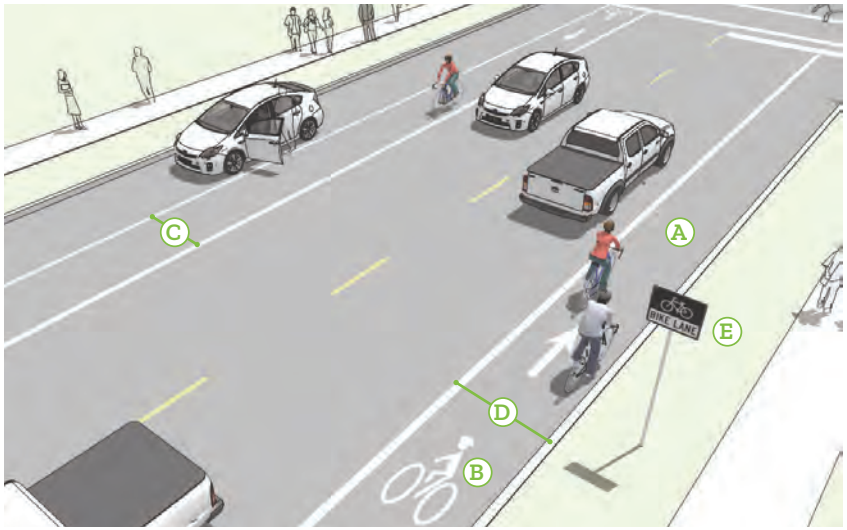
- Shared lane markings should be inspected annually and maintained accordingly, especially if located on roadways that feature high vehicle turning movements, or bus, or truck traffic. They can be placed in the center of the lane of travel to reduce wear from vehicles.

Approximate Cost

Sharrows typically cost $200 per each marking for a lane-mile cost of $4,200, assuming the MUTCD guidance of sharrow placement every 250 feet.

Bicycle Lanes

On-street bike lanes designate an exclusive space for bicyclists through the use of pavement markings and signs. The bike lane is located directly adjacent to motor vehicle travel lanes and is used in the same direction as motor vehicle traffic. Bike lanes are typically on the right side of the street, between the adjacent travel lane and curb, road edge or parking lane.



Typical Use

- Bike lanes may be used on any street with adequate space, but are most effective on streets with moderate traffic volumes ≤ 6,000 ADT (≤ 3,000 preferred).
- Bike lanes are most appropriate on streets with lower to moderate speeds ≤ 25 mph.
- Appropriate for skilled adult riders on most streets.
- May be appropriate for children when configured as 6+ ft wide lanes on lower-speed, lower-volume streets with one lane in each direction.

Design Features

(A) Mark inside line with 6" stripe. **(MUTCD 9C.04)** Mark 4" parking lane line or "Ts".

(B) Include a bicycle lane marking **(MUTCD Figure 9C-3)** at the beginning of blocks and at regular intervals along the route. **(MUTCD 9C.04)**

(C) 6 foot width preferred adjacent to on-street parking, (5 foot min.)

(D) 5–6 foot preferred adjacent to curb and gutter (4 foot min.) or 4 feet more than the gutter pan width.

(E) The R3-17 "Bike Lane" sign is optional, but recommended in most contexts.

Further Considerations

- On high speed streets (≥ 40 mph) the minimum bike lane should be 6 feet.
- It may be desirable to reduce the width of general purpose travel lanes in order to add or widen bicycle lanes.
- On multi-lane streets, the most appropriate bicycle facility to provide for user comfort may be buffered bicycle lanes or physically separated bicycle lanes.

Manhole Covers and Grates:

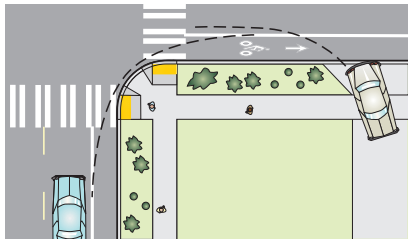
- Manhole surfaces should be manufactured with a shallow surface texture in the form of a tight, nonlinear pattern
- If manholes or other utility access boxes are to be located in bike lanes within 50 ft. of intersections or within 20 ft. of driveways or other bicycle access points, special manufactured permanent nonstick surfaces are required to ensure a controlled travel surface for cyclists breaking or turning.
- Manholes, drainage grates, or other obstacles should be set flush with the paved roadway. Roadway surface inconsistencies pose a threat to safe riding conditions for bicyclists. Construction of manholes, access panels or other drainage elements should be constructed with no variation in the surface. The maximum allowable tolerance in vertical roadway surface will be 1/4 of an inch.

Materials and Maintenance

Bike lane striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway.

Bike lanes should also be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

Bike lanes provided dedicated spaces for cyclists to ride on the street.



Place Bike Lane Symbols to Reduce Wear

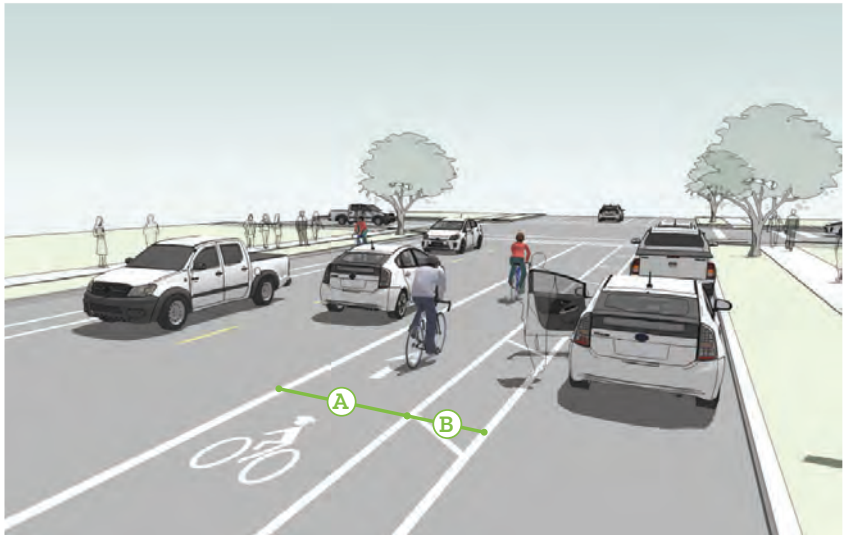
Bike lane word, symbol, and/or arrow markings ***(MUTCD Figure 9C-3)*** *shall be placed outside of the motor vehicle tread path in order to minimize wear from the motor vehicle path.* **(NACTO 2012)**

Approximate Cost

The cost for installing bicycle lanes varies and will depend on the implementation approach. Typical costs are $16,000 per mile for restriping using paint. More durable thermoplastic materials and the cost of repaving, or removing/replacing existing vehicle lane striping is not accounted for in this estimate. .

Buffered Bicycle Lanes

Buffered bike lanes are conventional bicycle lanes paired with a designated buffer space, separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane.



Typical Use

- Anywhere a conventional bike lane is being considered.
- While conventional bike lanes are most appropriate on streets with lower to moderate speeds (≤ 25 mph), buffered bike lanes are appropriate on streets with higher speeds (+25 mph) and high volumes or high truck volumes (up to 6,000 ADT).
- On streets with extra lanes or lane width.
- Appropriate for skilled adult riders on most streets.

Design Features

Ⓐ The minimum bicycle travel area (not including buffer) is 5 feet wide.

Ⓑ Buffers should be at least 2 feet wide. If buffer area is 4 feet or wider, white chevron or diagonal markings should be used.

- For clarity at driveways or minor street crossings, consider a dotted line.
- There is no standard for whether the buffer is configured on the parking side, the travel side, or a combination of both.

Buffered bike lanes should consider both vehicular traffic and parked cars.

The use of additional pavement markings delineates space between vehicles and cyclists.

Further Considerations

- Color may be used within the lane to discourage motorists from entering the buffered lane.
- A study of buffered bicycle lanes found that, in order to make the facilities successful, there needs to also be driver education, improved signage and proper pavement markings.[1]
- On multi-lane streets with high vehicles speeds, the most appropriate bicycle facility to provide for user comfort may be physically separated bike lanes.
- NCHRP Report #766 recommends, when space is limited, installing a buffer space between the parking lane and bicycle lane where on-street parking is permitted rather than between the bicycle lane and vehicle travel lane.[2]

Materials and Maintenance

Bike lane striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway.

Bike lanes should be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

Approximate Cost

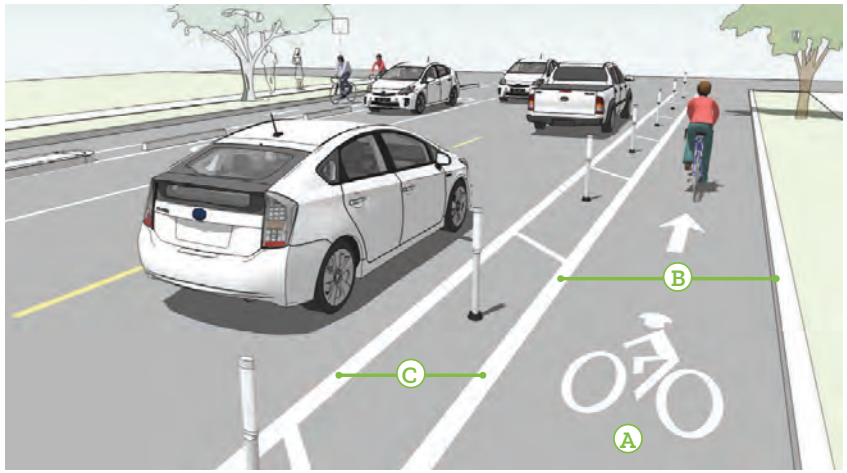
The cost for installing buffered bicycle lanes will depend on the implementation approach. Typical costs are $16,000 per mile for paint based restriping. More durable thermoplastic materials and the cost of repaving, or removing/replacing existing vehicle lane striping is not accounted for in this estimate.

1 Monsere, C.; McNeil, N.; and Dill, J., "Evaluation of Innovative Bicycle Facilities: SW Broadway Cycle Track and SW Stark/ Oak Street Buffered Bike Lanes. Final Report" (2011).Urban Studies and Planning Faculty Publications and Presentations.

2 National Cooperative Highway Research Program. Report #766: Recommended Bicycle Lane Widths for Various Roadway Characteristics.

One-Way Separated Bikeway

One-way separated bikeways, also known as protected bikeways or cycle tracks, are on-street bikeway facilities that are separated from vehicle traffic. Physical separation is provided by a barrier between the bikeway and the vehicular travel lane. These barriers can include flexible posts, bollards, parking, planter strips, extruded curbs, or on-street parking. Separated bikeways using these barrier elements typically share the same elevation as adjacent travel lanes, but the bikeway could also be raised above street level, either below or equivalent to sidewalk level.



Typical Use

- Along streets on which conventional bicycle lanes would cause many bicyclists to feel stress because of factors such as multiple lanes, high bicycle volumes, high motor traffic volumes (9,000-30,000 ADT), higher traffic speeds (25+ mph), high incidence of double parking, higher truck traffic (10% of total ADT) and high parking turnover.
- Along streets for which conflicts at intersections can be effectively mitigated using parking lane setbacks, bicycle markings through the intersection, and other signalized intersection treatments.

Design Features

(A) Pavement markings, symbols and/or arrow markings must be placed at the beginning of the separated bikeway and at intervals along the facility based on engineering judgment to define the bike direction. **(MUTCD 9C.04)**

(B) 7 foot width preferred in areas with high bicycle volumes or uphill sections to facilitate safe passing behavior (5 ft minimum).

(C) When placed adjacent to parking, the parking buffer should be 3 ft wide to allow for passenger loading and to prevent door collisions.

- When placed adjacent to a travel lane, one-way raised cycle tracks may be configured with a mountable curb to allow entry and exit from the bicycle lane for passing other bicyclists or to access vehicular turn lanes.

Parked cars serve as a barrier between bicyclists and the vehicle lane. Barriers could also include flexible posts, bollards, planters, or other design elements. Source: Bike East Bay

Further Considerations

- If the buffer area is 4 feet or wider, white chevron or diagonal markings should be used. Curbs may be used as a channeling device. Grade-separation provides an enhanced level of separation in addition to buffers and other barrier types.
- Where possible, physical barriers such as removable curbs should be oriented towards the inside edge of the buffer to provide as much extra width as possible for bicycle use.
- A retrofit separated bikeway has a relatively low implementation cost compared to road reconstruction by making use of existing pavement and drainage and using a parking lane as a barrier.
- Gutters, drainage outlets and utility covers should be designed and configured as not to impact bicycle travel.
- For clarity at major or minor street crossings, consider a dotted line for the buffer boundary where cars are expected to cross.
- Special consideration should be given at transit stops to manage bicycle and pedestrian interactions.

Materials and Maintenance

Bikeway striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

Bikeways should be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

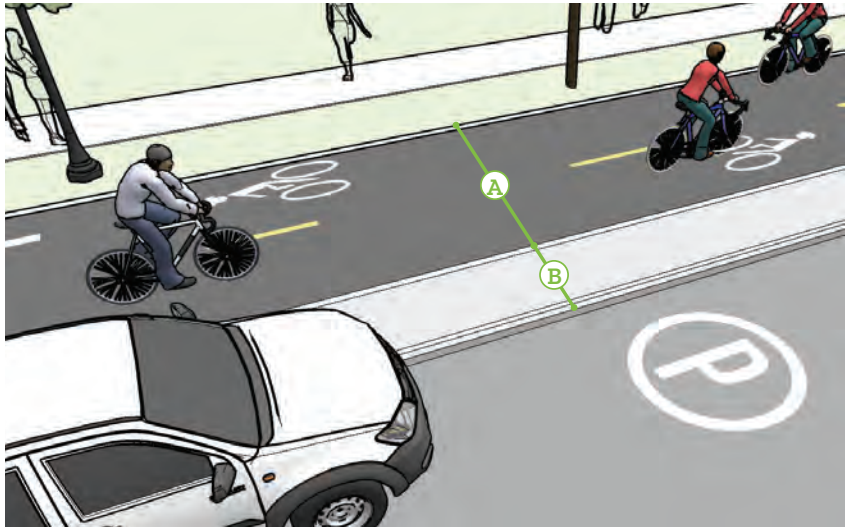
Access points along the facility should be provided for street sweeper vehicles to enter/exit the separated bikeway,

Approximate Cost

Separated bikeway construction costs can vary drastically depending on the type of separation used, the amount of new curb and gutter, stormwater mitigation, and crossing treatments. On the lower end of the scale, construction of a striped parking protected bikeway without delineators or other vertical elements can cost as little as $16,000 per mile.

Two-Way Separated Bikeway

Two-Way Separated Bikeways are bicycle facilities that allow bicycle movement in both directions on one side of the road. Two-way separated bikeways share some of the same design characteristics as one-way separated bikeways, but often require additional considerations at driveway and side-street crossings, and intersections with other bikeways.



Typical Use

- Works best on the left side of one-way streets.
- Streets with high motor vehicle volumes and/or speeds
- Streets with high bicycle volumes.
- Streets with a high incidence of wrong-way bicycle riding.
- Streets with few conflicts such as driveways or cross-streets on one side of the street.
- Streets that connect to shared use paths.

Design Features

(A) 12 foot operating width preferred (10 ft minimum) width for two-way facility.

- In constrained locations an 8 foot minimum operating width may be considered.

(B) Adjacent to on-street parking a 3 foot minimum width channelized buffer or island shall be provided to accommodate opening doors. **(NACTO, 2012**

- Additional signalization and signs may be necessary to manage conflicts.

Two-Way Separated Bikeway

A two-way facility can accommodate cyclists in two directions of travel.

Further Considerations

- A two-way separated bikeway on one way street should be located on the left side.
- A two-way separated bikeway may be configured at street level or as a raised separated bikeway with vertical separation from the adjacent travel lane.
- Two-way separated bikeways should ideally be placed along streets with long blocks and few driveways or mid-block access points for motor vehicles.

Materials and Maintenance

Bikeway striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

Bikeways should be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

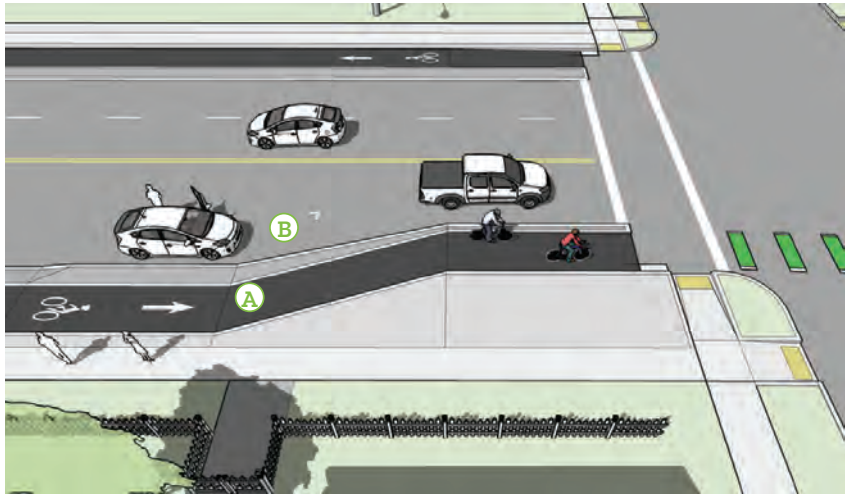
Access points along the facility should be provided for street sweeper vehicles to enter/exit the separated bikeway.

Approximate Cost

Separated bikeway construction costs can vary drastically depending on the type of separation used, the amount of new curb and gutter, stormwater mitigation, and crossing treatments. On the lower end of the scale, construction of a striped parking protected bikeway with delineators or other vertical elements can cost as little as $15,000-$30,000 per mile.

Bend-In

To increase the visibility of bicyclists for turning motorists, a “bend-in” intersection approach laterally shifts the separated bikeway immediately adjacent to the turning lane.



Typical Use

- Bikeways separated by a visually intensive buffer or on-street parking.
- Where it is desirable to create a curb extension at intersections to reduce pedestrian crossing distance.
- Where space is not available to bend-out the bikeway prior to the intersection.

Design Features

Ⓐ At least 20 ft prior to an intersection, provide between 20 – 40 ft of length to shift the bikeway closer to motor vehicle traffic.

Ⓑ Where the separated bikeway uses parked cars within the buffer zone, parking must be prohibited at the start of the transition.

- Place a “Turning Vehicles Yield to Bikes” sign (modified MUTCD R10-15) prior to the intersection.
- Optional - Provide a narrow buffer with vertical delineators between the travel and lane and bikeway to increase comfort for bicycle riders and slow driver turning speed.

Clear sight lines at intersections and driveways for people on bikes and people driving are an important aspect of this design.

The approach to an adjacent crossing intersection in Vancouver, BC.

Further Considerations

- The design creates an opportunity for a curb extension, to reduce pedestrian crossing distance. This curb extension can also create public space which can be used bike parking corrals, bikeshare stations, parklets, public art exhibits, and/or stormwater features such as bioswales.
- Can be paired with intersection crossing markings such as green colored pavement to raise awareness of conflict points.

Materials and Maintenance

Bikeway striping and markings will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

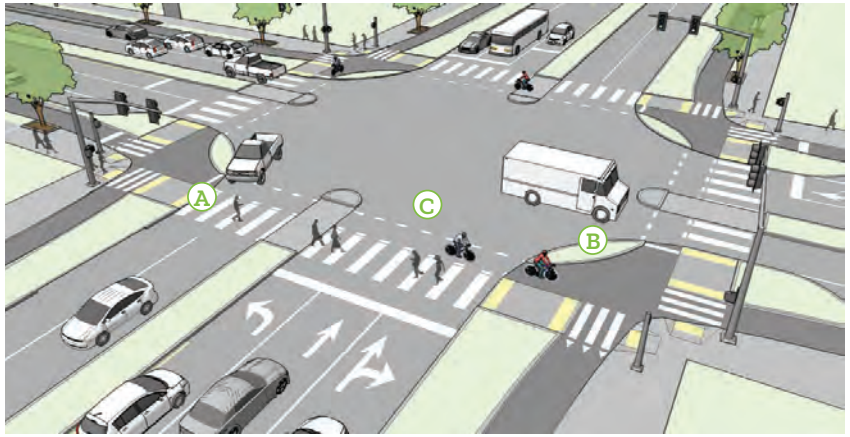
Bikeway should be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

Approximate Cost

The costs of the lateral shift or protected intersection elements vary depending on materials used and degree of implementation desired. Inexpensive materials can used, such as paint, concrete planters, and bollards.

Protected Intersection

A protected intersection, or "Bend Out" uses a collection of intersection design elements to maximize user comfort within the intersection and promote a high rate of motorists yielding to people bicycling. The design maintains a physical separation within the intersection to define the turning paths of motor vehicles, slow vehicle turning speed, and offer a comfortable place for people bicycling to wait at a red signal.



Typical Use

- Streets with separated bikeways protected by wide buffer or on-street parking.
- Where two separated bikeways intersect and two-stage left-turn movements can be provided for bicycle riders.
- Helps reduce conflicts between right-turning motorists and bicycle riders by reducing turning speeds and providing a forward stop bar for bicycles.
- Where it is desirable to create a curb extension at intersections to reduce pedestrian crossing distance.

Design Features

(A) Setback bicycle crossing of 19.5 feet allows for one passenger car to queue while yielding. Smaller setback distance is possible in slow-speed, space constrained conditions.

(B) Corner island with a 15-20 foot corner radius slows motor vehicle speeds. Larger radius designs may be possible when paired with a deeper setback or a protected signal phase, or small mountable aprons. Two-stage turning boxes are provided for queuing bicyclists adjacent to corner islands.

(C) Use intersection crossing markings.

Protected intersections feature a corner safety island and intersection crossing markings.

Protected intersections incorporate queuing areas for two-stage left turns.

Further Considerations

- Pedestrian crosswalks may need to be further set back from intersections in order to make room for two-stage turning queue boxes.
- Wayfinding and directional signage should be provided to help bicycle riders navigate through the intersection.
- Colored pavement may be used within the corner refuge area to clarify use by people bicycling and discourage use by people walking or driving.
- Intersection approaches with high volumes of right turning vehicles should provide a dedicated right turn only lane paired with a protected signal phase. Protected signal phasing may allow different design dimensions than are described here.

Materials and Maintenance

- Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.
- Bikeways should be maintained so that there are no pot holes, cracks, uneven surfaces or debris.
- Bikeways protected by concrete islands or other permanent physical separation, can be swept by street sweeper vehicles with narrow widths.

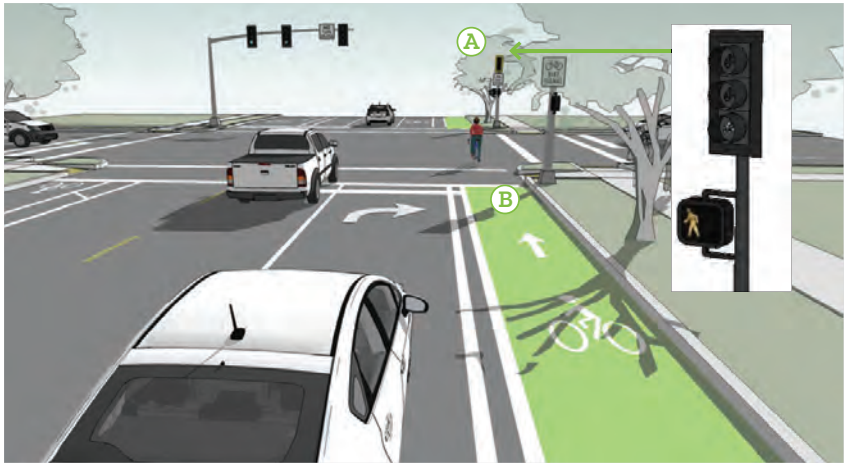
Approximate Cost

The cost of protected intersection elements vary depending on materials used and degree of implementation desired.

- Complete reconstruction costs comparable to a full intersection.
- Retrofit implementation may be possible at lower costs if existing curbs and drainage are maintained. Inexpensive materials can used, such as paint, concrete planters, and bollards.

Separated Bicycle Signal Phase

Separated bicycle lane crossings of signalized intersections can be accomplished through the use of a bicycle signal phase which reduces conflicts with motor vehicles by separating bicycle movements from any conflicting motor vehicle movements. Bicycle signals are traditional three lens signal heads with green, yellow and red bicycle stenciled lenses.



Typical Use

- Two-way protected bikeways where contraflow bicycle movement or increased conflict points warrant protected operation.
- Bicyclists moving on a green or yellow signal indication in a bicycle signal shall not be in conflict with any simultaneous motor vehicle movement at the signalized location
- Right (or left) turns on red should be prohibited in locations where such operation would conflict with a green bicycle signal indication.

Design Features

- (A) An additional “Bicycle Signal” sign should be installed below the bicycle signal head.
- (B) Designs for bicycles at signalized crossings should allow bicyclists to trigger signals via pushbutton, loop detectors, or other passive detection, to navigate the crossing.
- On bikeways, signal timing and actuation shall be reviewed and adjusted to consider the needs of bicyclists. **(MUTCD 9D.02)**

A bicycle signal head at a signalized crossing creates a protected phase for cyclists to safely navigate an intersection.

A bicycle detection system triggers a change in the traffic signal when a bicycle is detected.

Further Considerations

- A bicycle signal should be considered for use only when the volume/collision or volume/geometric warrants have been met.
- The Federal Highway Administration (FHWA) has approved bicycle signals for use, if they comply with requirements from Interim Approval 16 (I.A. 16). Bicycle Signals are not approved for use in conjunction with Pedestrian Hybrid Beacons.
- Bicyclists typically need more time to travel through an intersection than motor vehicles. Green light times should be determined using the bicycle crossing time for standing bicycles.
- Bicycle detection and actuation systems include user-activated buttons mounted on a pole, loop detectors that trigger a change in the traffic signal when a bicycle is detected and video detection cameras, that use digital image processing to detect a change in the image at a location.

Materials and Maintenance

Bicycle signal detection equipment should be inspected and maintained regularly, especially if detection relies on manual actuation. Pushbuttons and loop detectors will tend to have higher maintenance needs than other passive detection equipment.

Approximate Cost

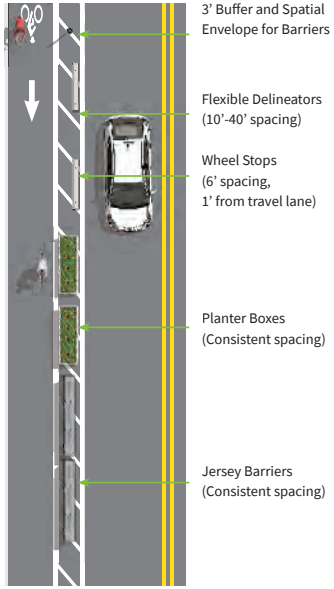
Bicycle signal heads have an average cost of $12,800.

Video detection camera system costs range from $15,000 to $25,000 per intersection.

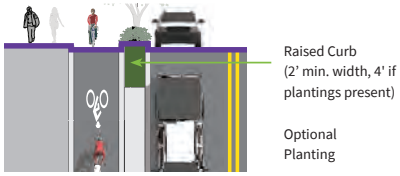
Separated Bikeway Barriers

Separated bikeways may use a variety of vertical elements to physically separate the bikeway from adjacent travel lanes. Barriers may be robust constructed elements such as curbs, or may be more interim in nature, such as flexible delineator posts.

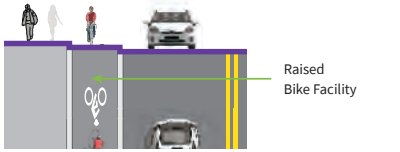
Barrier Separation



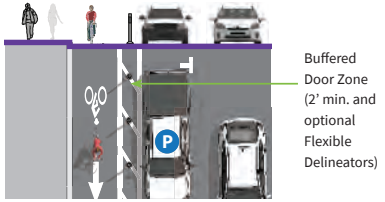
Media Separation



Grade Separation



Parking Separation



Typical Use

Appropriate barriers for retrofit projects:

- Parked Cars
- Flexible delineators
- Bollards
- Planters
- Parking stops

Appropriate barriers for reconstruction projects:

- Curb separation
- Medians
- Landscaped medians
- Raised protected bike lane with vertical or mountable curb
- Pedestrian Refuge Islands

Raised separated bikeways are bicycle facilities that are vertically separated from motor vehicle traffic.

Design Features

- Maximize effective operating space by placing curbs or delineator posts as far from the through bikeway space as practicable.
- Allow for adequate shy distance of 1 to 2 feet from vertical elements to maximize useful space.
- When next to parking allow for 3 feet of space in the buffer space to allow for opening doors and passenger unloading.
- The presences of landscaping in medians, planters and safety islands increases comfort for users and enhances the streetscape environment.

Further Considerations

- With new roadway construction, a raised separated bikeway can be less expensive to construct than a wide or buffered bicycle lane because of shallower trenching and sub base requirements.
- Parking should be prohibited within 30 feet of the intersection to improve visibility.

Materials and Maintenance

Separated bikeways protected by concrete islands or other permanent physical separation, can be swept by smaller street sweeper vehicles.

Access points along the facility should be provided for street sweeper vehicles to enter/exit the separated bikeway.

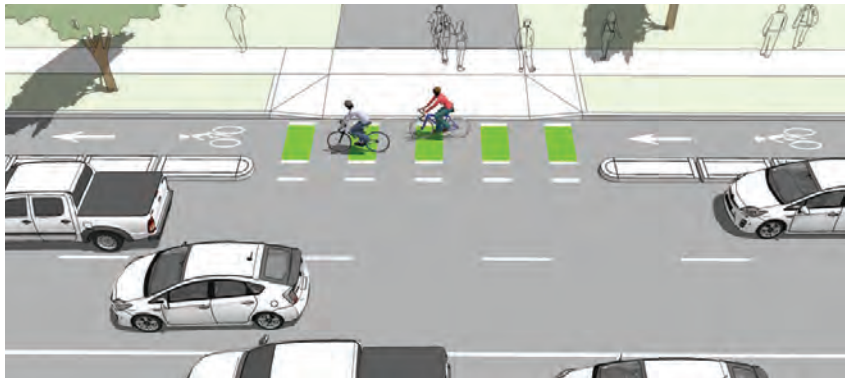
Approximate Cost

Separated bikeway barrier material costs can vary greatly, depending on the type of material, the scale, and whether it is part of a broader construction project.

Separated Bikeways at Driveways (and Minor Streets)

The added separation provided by separated bikeways creates additional considerations at intersections and driveways when compared to conventional bicycle lanes. Special design guidelines are necessary to preserve sightlines and denote potential conflict areas between modes, especially when motorists turning into or out of driveways may not be expecting bicycle travel opposite to the main flow of traffic.

At driveways and crossings of minor streets, bicyclists should not be expected to stop if the major street traffic does not stop.

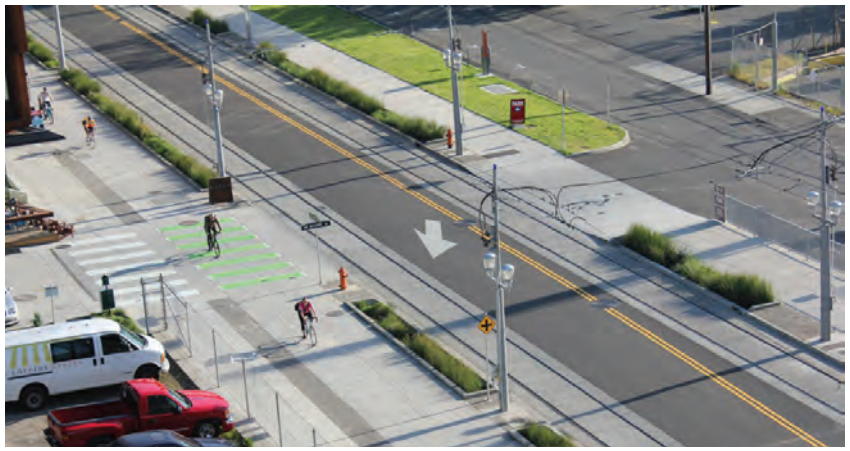


Typical Use

- Along streets with separated bikeway where there are intersections and driveways.
- Higher frequency driveways or crossings may require additional treatment such as conflict markings and signs.

Design Features

- Remove parking to allow for the appropriate clear sight distance before driveways or intersections to improve visibility. The desirable no-parking area is at least 30 feet from each side of the crossing.
- Use colored pavement markings and/or shared line markings through conflict areas at intersections.
- If a raised bikeway is used, the height of the lane should be maintained through the crossing, requiring automobiles to cross over.
- Motor vehicle traffic crossing the bikeway should be constrained or channelized to make turns at sharp angles to reduce travel speed prior to the crossing.
- Driveway crossings may be configured as raised crossings to slow turning cars and assert physical priority of travelling bicyclists.
- Motor vehicle stop bar on cross-streets and driveways is setback from the intersection to ensure that drivers slow down and scan for pedestrians and bicyclists before turning.



Intersection crossing markings can be used at high volume driveway and minor street crossings, as illustrated above.

Further Considerations

- Removing obstructions and providing clear sight distance at crossings increases visibility of bicyclists.
- Treatments designed to constrain and slow turning motor vehicle traffic will slow drivers to bicycle-compatible travel speeds prior to crossing the separated bikeway.

Materials and Maintenance

Green conflict striping and markings, will require higher maintenance where vehicles frequently traverse over them at driveways and minor intersection. Green conflict striping (if used) will also generally require higher maintenance due to vehicle wear.

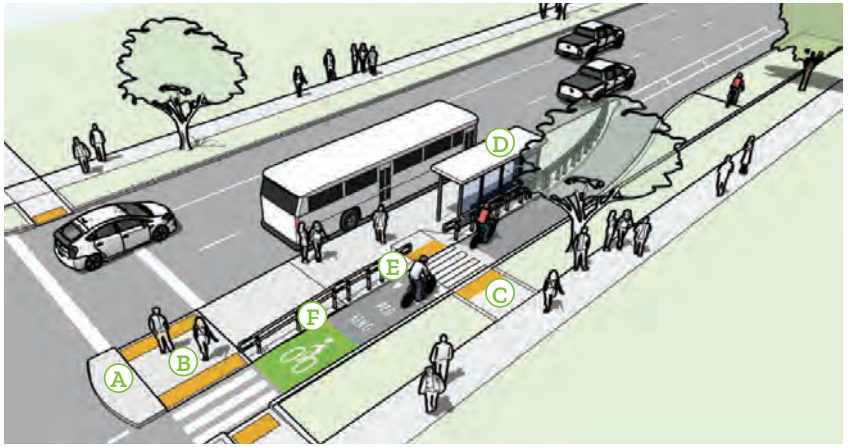
Approximate Cost

The cost for installing high visibility colored crossing markings will depend on the materials selected and implementation approach. Typical costs range from $1.20/sq. ft. installed for paint to $14/sq. ft. installed for thermoplastic. Colored pavement is more expensive than standard asphalt installation, costing 30-50% more than non-colored asphalt.

Separated Bikeways at Transit Side Boarding Islands

A transit side boarding island is a channelized lane for bicyclists designed to provide a path for bicyclists to pass stopped transit vehicles, and clarify interactions between pedestrians, bicyclists, and passengers, boarding and alighting.

This is particularly helpful on corridors with high volumes of transit vehicles and bicyclists, where "leapfrogging" may occur, and on separated bikeway corridors where maintaining physical separation is important to maintain user comfort.



Typical Use

- Routes where bike lanes or separated bikeways and transit operations overlap.
- Provides an in-lane stop for buses, reducing delay at stops.
- Median refuge also provides a shorter crossing for pedestrians at intersections

Design Features

(A) Pedestrian median refuge island (optional) shortens the crossing distance at intersections.

(B) Pedestrian ramp into crosswalks should be ADA compliant with detectable warning surfaces.

(C) Direct pedestrians to crossing locations to minimize conflicts between modes.

(D) High volume stops should have room for appropriately sized shelters and transit amenities.

(E) Pavement markings and signage should clarify expectations among users. The bikeway could also ramp up to sidewalk level at this crossing to reduce bicycle speeds and enhance ADA access to the stop.

(F) Pavement markings on the bikeway should define the bicycle path of travel to minimize intrusion by pedestrians, except at designated crossings.

A transit side boarding island clarifies user spaces and minimizes conflict between bicyclists. pedestrians, transit passengers, buses, and vehicles.

Further Considerations

- Transit island should be wide enough to accommodate mobility devices. An 8'x 5' accessible clear space is required at the front door per ADA requirements.
- Transit platforms should feature pedestrian scale lighting.
- Side boarding island will require detectable warning surfaces along full length of platform if greater than 6" high.

Materials and Maintenance

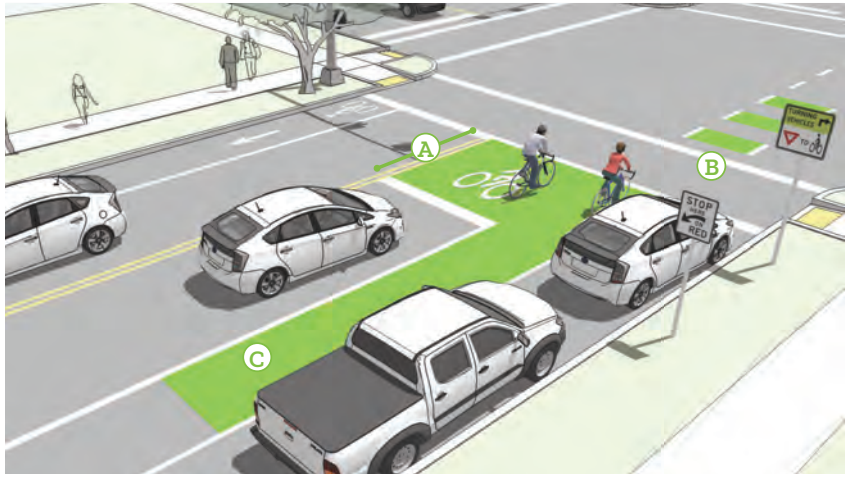
Similar to median refuge islands, side boarding islands may require frequent maintenance of road debris. If at street grade, the bikeway can be swept by street sweeper vehicles with narrow widths.

Approximate Cost

The approximate cost of a side boarding island is similar to median refuge islands ranging from $500 to $1,100 per foot, or about $3,500 to $4,000, depending on the design, and site conditions. This cost is exclusive of transit shelters and amenities, landscaping, and lighting.

Bicycle Box

A bicycle box is an experimental treatment, designed to provide bicyclists with a safe and visible space to get in front of queuing traffic during the red signal phase. Motor vehicles must queue behind the white stop line at the rear of the bike box. On a green signal, all bicyclists can quickly clear the intersection. This treatment received Interim Approval from the FHWA in 2016.



Typical Use

- At potential areas of conflict between bicyclists and turning vehicles, such as a right or left turn locations.
- At signalized intersections with high bicycle volumes.
- At signalized intersections with high vehicle volumes.
- Not to be used on downhill approaches to minimize the right hook threat potential during the extended green signal phase.

Design Features

(A) 14 foot minimum depth from back of crosswalk to motor vehicle stop bar. **(NACTO, 2012)**

(B) A "No Turn on Red" **(MUTCD R10-11)** sign shall be installed overhead to prevent vehicles from entering the Bike Box. A "Stop Here on Red" **(MUTCD R10-6)** sign should be post mounted at the stop line to reinforce observance of the stop line.

(C) A 50 foot ingress lane should be used to provide access to the box.

- Use of green colored pavement is recommended.

A bike box allows for cyclists to wait in front of queuing traffic, providing high visibility and a head start over motor vehicle traffic.

Further Considerations

- This treatment positions bicycles together and on a green signal, all bicyclists can quickly clear the intersection, minimizing conflict and delay to transit or other traffic.
- Pedestrian also benefit from bike boxes, as they experience reduced vehicle encroachment into the crosswalk.
- Bike boxes require permission from the FHWA to implement, and jurisdictions must receive approval prior to implementation. A State may request Interim Approval for all jurisdictions in that State.[1]
- Bike boxes should not be used to accommodate bicyclist turns at intersections that have substantial parallel green time as bicyclists cannot safely occupy the box when arriving on green.

Materials and Maintenance

Bike boxes are subject to high vehicle wear, especially turning passenger vehicles, buses, and heavy trucks. As a result, bike boxes with green coloring will require more frequent replacement over time. The life of the green coloring will depend on vehicle volumes and turning movements, but thermoplastic is generally a more durable material than paint.

Approximate Cost

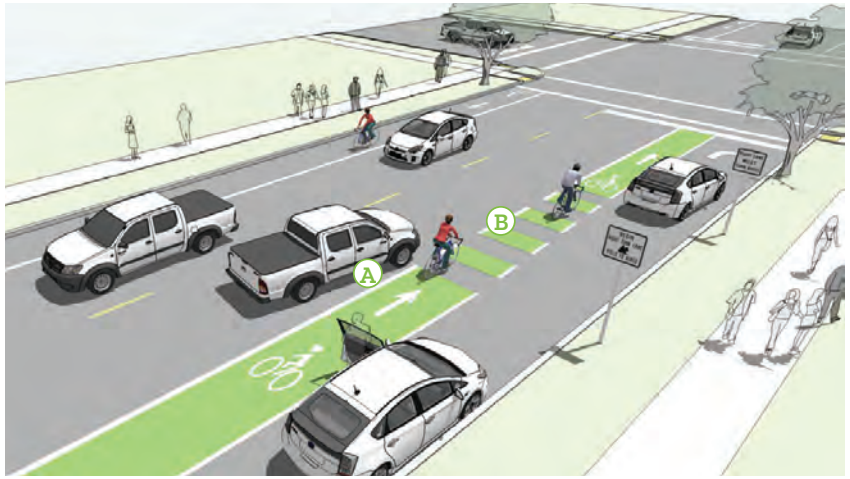
Costs will vary due to the type of paint or thermoplastic used and the size of the bike box, as well as whether the treatment is added at the same time as other road treatments.

Typical costs range from $1.20/sq. ft. installed for paint to $14/sq. ft. installed for thermoplastic.

1 *FHWA. Interim Approval for Optional Use of an Intersection Bicycle Box (IA-18). 2016.*

Colored Pavement Treatment

Colored pavement within a bicycle lane may be used to increase the visibility of the bicycle facility, raise awareness of the potential to encounter bicyclists, and reinforce priority of bicyclists in conflict areas.



Typical Use

- Within a weaving or conflict area to identify the potential for bicyclist and motorist interactions and assert bicyclist priority.
- Across intersections, driveways and Stop or Yield-controlled cross-streets.
- At bike boxes and two-stage turn boxes

Design Features

(A) Typical white bike lane striping (solid or dotted 6” stripe) is used to outline the green colored pavement.

(B) In weaving or turning conflict areas, preferred striping is dashed, to match the bicycle lane line extensions.

- The colored surface should be skid resistant and retro-reflective **(MUTCD 9C.02.02).**
- In exclusive use areas, such as bike boxes, color application should be solid green.

Green colored conflict striping indicates the path of travel of people on bicycles, and alerts people intending to turn across the bike lane to yield when bicyclists are present.

Further Considerations

- Green colored pavement shall be used in compliance with FHWA Interim Approval (FHWA IA-14.10).[1]
- While other colors have been used (red, blue, yellow), green is the recommended color in the US.
- The application of green colored pavement within bicycle lanes is an emerging practice. The guidance recommended here is based on best practices in cities around the county.

Materials and Maintenance

As intended, paint or thermoplastic are placed in locations that are trafficked by vehicles, and are subject to high vehicle wear. Colored pavement treatments will experience higher rates of wear at locations with higher turning vehicles, buses, and heavy trucks. At these locations, green coloring will require more frequent replacement over time.

The life of the green coloring will depend on vehicle volumes and turning movements, but thermoplastic is a more durable material than paint.

Approximate Cost

The cost for installing colored pavement markings will depend on the materials selected and implementation approach. Typical costs range from $1.20/sq. ft installed for paint to $14/sq. ft installed for thermoplastic. Colored pavement is more expensive than standard asphalt installation, costing 30-50 percent more than non-colored asphalt.

1 *FHWA. Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14). 2011.*

Short-Term Bicycle Parking

People need a safe, convenient place to secure their bicycle when they reach their destination. This may be short-term parking of 2 hours or less, or long-term parking for employees, students, residents, and commuters.

Information on short- and long-term bike parking has been informed by the Association of Pedestrian and Bicycle Professionals (APBP) Bicycle Parking Guide, which is updated frequently and is available online at www.apbp.org.

Application

Bike Racks

- Bike racks provide short-term bicycle parking and are meant to accommodate visitors, customers, and others expected to depart within two hours. It should be an approved standard rack, appropriate location and placement.

Bike Corrals

- On-street bike corrals (also known as on-street bicycle parking) consist of bicycle racks grouped together in a common area within the street traditionally used for automobile parking.
- Bicycle corrals are reserved exclusively for bicycle parking and provide a relatively inexpensive solution to providing high-volume bicycle parking. Bicycle corrals can be implemented by converting one or two on-street motor vehicle parking spaces into on-street bicycle parking.
- Each motor vehicle parking space can be replaced with approximately 6-10 bicycle parking spaces.

Design Features

Bike Racks

- When placed on sidewalks, 2 feet minimum from the curb face to avoid 'dooring.'
- 4 feet between racks to provide maneuvering room.
- Locate close to destinations; 50 feet maximum distance from main building entrance.
- Minimum clear distance of 6 feet should be provided between the bicycle rack and the property line.
- While bike racks could be installed perpendicular or parallel to the curb, it is important to ensure there is sufficient room for pedestrian traffic, even when a bike is locked to the rack.

Bike Corrals

- Bicyclists should have an entrance width from the roadway of 5-6 feet.
- Can be used with parallel or angled parking.
- Parking stalls adjacent to curb extensions are good candidates for bicycle corrals since the concrete extension serves as delimitation on one side.

Further Considerations

- Where the placement of racks on sidewalks is not possible (due to narrow sidewalk width, sidewalk obstructions, street trees, etc.), bicycle parking can be provided in the street where on-street vehicle parking is allowed in the form of on-street bicycle corrals.
- Some types of bicycle racks may meet design criteria, but are discouraged except in limited situations. This includes undulating "wave" racks, schoolyard racks, and spiral racks. These discouraged racks are illustrated on the following page.
- Bike racks should be made of thick stainless steel to reduce the chance of thieves cutting through the racks to take bicycles. Square tubing can provide further protection from cutting, as well.
- If a bike rack is installed as surface mount, countersink bolts or expansion bolts should be used to keep the rack in place. Covering the bolts with putty or epoxy can provide additional protection.

References

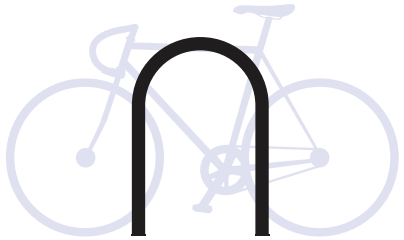
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- APBP. Bicycle Parking Guide 2015.

Inverted-U racks provide two points of contact.

Racks with square tubing, good spacing, and a concrete base likewise offer two points of contact.

Types of Bike Racks to Use

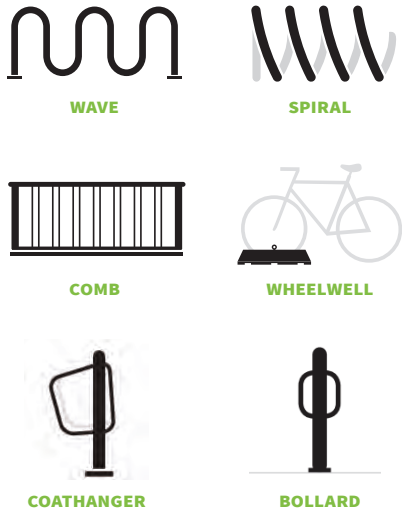
These racks provide two points of contact with the bicycle, accommodate varying styles of bike, allow for the frame of a bicycle and at least one wheel to be secured by most U-locks, and are intuitive to use.



Communities may consider purchasing branded U-racks for installation on sidewalks.

Types of Bike Racks to Avoid

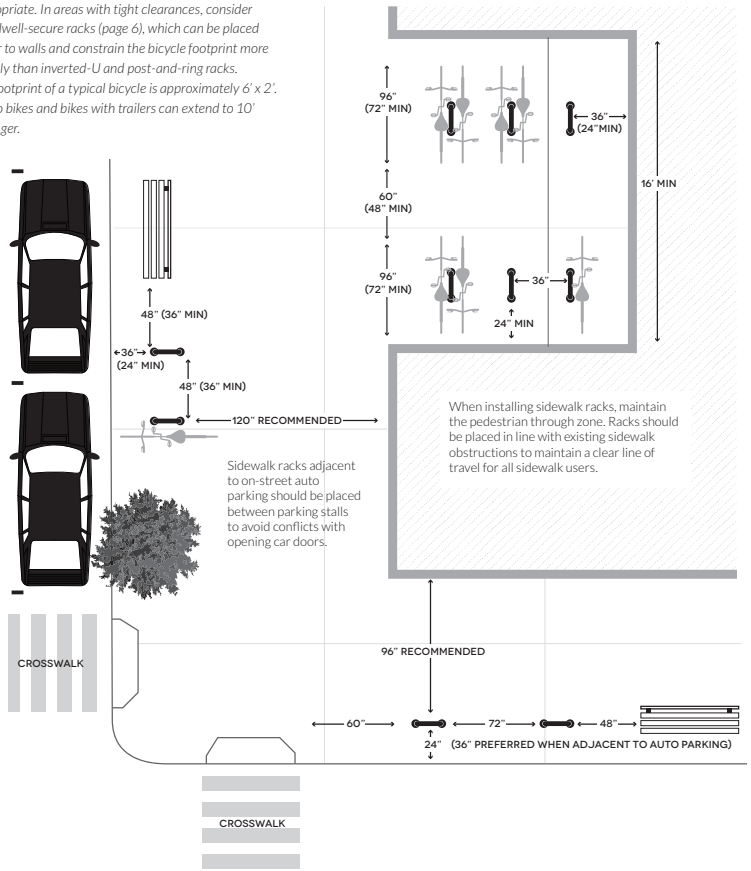
These racks do not provide support at two places on the bike, can damage the wheel, do not provide an opportunity for the user to lock the frame of their bicycle easily, and are not intuitive to use. Because of performance concerns, the APBP Essentials of Bike Parking Report recommends selecting other racks instead of these.



Graphics courtesy of Association of Pedestrian and Bicycle Professionals Essentials of Bike Parking report (2015).

Space Requirements

The following minimum spacing requirements apply to some common installations of fixtures like inverted-U or post-and-ring racks that park one bicycle roughly centered on each side of the rack. Recommended clearances are given first, with minimums in parentheses where appropriate. In areas with tight clearances, consider wheelwell-secure racks (page 6), which can be placed closer to walls and constrain the bicycle footprint more reliably than inverted-U and post-and-ring racks. The footprint of a typical bicycle is approximately 6' x 2'. Cargo bikes and bikes with trailers can extend to 10' or longer.



Long-Term Bicycle Parking

Users of long-term parking generally place high value on security and weather protection. Long-term parking is designed to meet the needs of employees, residents, public transit users, and others with similar needs.

Information on short and long term bike parking has been obtained from the APBP Bicycle Parking Guide, which is updated frequently and is available online at www.apbp.org.

Application

- At transit stops, bike lockers or a sheltered secure enclosure may be appropriate long term solutions.
- On public or private property where secure, long-term bike parking is desired.
- Near routine destinations, such as workplaces, universities, hospitals, etc.

Design Features

Bike Lockers

- Minimum dimensions: width (opening) 2.5 feet; height 4 feet; depth 6 feet.
- 4 foot side clearance and 6 foot end clearance. 7 foot minimum distance between facing lockers.

Secure Parking Area

- Closed-circuit television monitoring or on-site staff with secure access for users.
- Double high racks & cargo bike spaces.
- Bike repair station with bench and bike tube and maintenance item vending machine.
- Bike lock "hitching post" – allows people to leave bike locks.

Further Considerations

- As the APBP Bike Parking Guide notes, increasing density of bike racks in a long-term facility without careful attention to user needs can exclude users with less-common types of bicycles which may be essential due to age, ability, or bicycle type.
- To accommodate trailers and long bikes, a portion of the racks should be on the ground and should have an additional 36" of in-line clearance.

References

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- APBP. Bicycle Parking Guide 2015.

High Density Bike Racks

Racks may be used that increase bike parking density, like the ones below. While these types of racks provide more spaces, racks that require lifting should not be used exclusively. People with heavier bikes (i.e. cargo bikes) or people with disabilities or people who are simply small in stature may be unable to lift their bikes easily.

STAGGERED WHEELWELL-SECURE

VERTICAL

TWO-TIER

Bike Parking Rooms

Long term bike parking may be available in dedicated rooms in residential and commercial buildings. Bicycle parking can be accommodated in 15 square feet per space or less.

Bike lockers

Secured parking areas

Where should parking be located?

Well-located bike parking will be:

- Visible to the public.
- Near primary entrances/exits, as close to the entrance as the first motor vehicle parking spot not designated for people with disabilities when possible.
- Easily accessed without dismounting a bike.
- Clear of obstructions which might limit the circulation of users and their bikes.
- In areas that are well-lit.
- Installed on a hard, stable surface that is unaffected by weather.

How much parking should be provided?

APBP's Essentials of Bicycle Parking Recommendations

The Association of Pedestrian and Bicycle Professionals' (APBP) has published recommendations for bicycle parking locations and quantities. These guidelines and recommendations are based on industry best practices as well as APBP's Essentials of Bicycle Parking Recommendations, but can be adjusted to meet the context and needs of each community.

Recommendations for Bicycle Parking Locations and Quantities

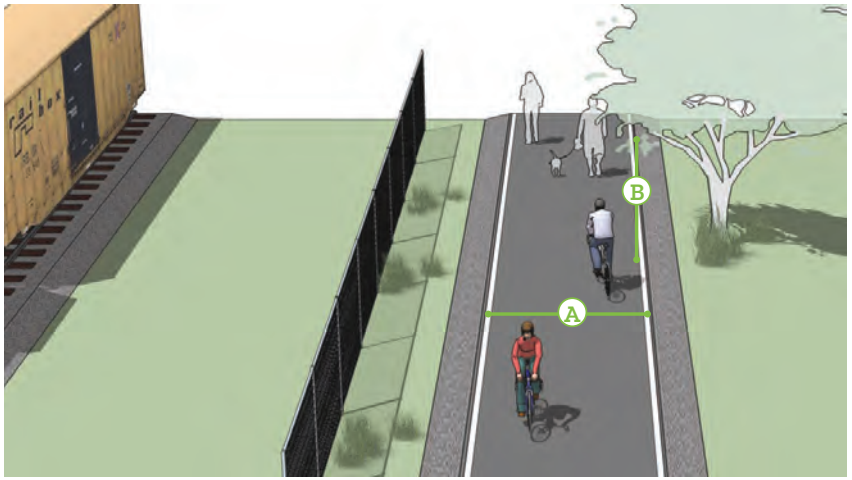
Land Use or Location	Physical Location	Quantity (Minimum)
Parks	Adjacent to restrooms, picnic areas, fields, and other attractions	8 bicycle parking spaces per acre
Schools	Near office and main entrance with good visibility	8 bicycle parking spaces per 40 students
Public Facilities (e.g., libraries, community centers)	Near main entrance with good visibility	8 bicycle parking spaces per location
Commercial, Retail, and Industrial Developments (over 10,000 square feet)	Near main entrance with good visibility	1 bicycle parking space per 15 employees or 8 bicycles per 10,000 square feet
Shopping Centers (over 10,000 square feet)	Near main entrance with good visibility	8 bicycle parking spaces per 10,000 square feet
Transit Stations	Near platform, security or ticket booth	1 bicycle parking space or locker per 30 automobile parking spaces
Multi-Family Residential	Near main entrance with good visibility	1 short-term bicycle parking space per 10 residential units and 1 long-term bicycle parking space per 2 residential units

Section 4

Mixed Use Toolbox

Shared Use Path

Shared use paths are off-street facilities that can provide a desirable transportation and recreation connection for users of all skill levels who prefer separation from traffic. They often provide low-stress connections to local and regional attractions that may be difficult, or not be possible on the street network.



Typical Use

- In abandoned rail corridors (commonly referred to as Rails-to-Trails or Rail-Trails.
- In active rail corridors, trails can be built adjacent to active railroads (referred to as Rails-with-Trails).
- In utility corridors, such as power line and sewer corridors.
- In waterway corridors, such as along canals, drainage ditches, rivers, and creeks.
- Along roadways.

Design Features

- (A) 8 ft is the minimum width (with 2' ft shoulders) allowed for a two-way bicycle path and is only recommended for low traffic situations.
- 10 ft is recommended in most situations and will be adequate for moderate to heavy use.
- 12 ft is recommended for heavy use situations with high concentrations of multiple users. A separate track (5' minimum) can be provided for pedestrian use.

Lateral Clearance

- A 2 ft or greater shoulder on both sides of the path should be provided. An additional ft of lateral clearance (total of 3') is required by the MUTCD for the installation of signage or other furnishings.
- If bollards are used at intersections and access points, they should be colored brightly and/or supplemented with reflective materials to be visible at night.

Overhead Clearance

(B) Clearance to overhead obstructions should be 8 ft minimum, with 10 ft recommended.

Striping

- When striping is required, use a 4 inch dashed yellow centerline stripe with 4 inch solid white edge lines.
- Solid centerlines can be provided on tight or blind corners, and on the approaches to roadway crossings.

Further Considerations

- The provision of a shared use path adjacent to a road is not a substitute for the provision of on-road accommodation such as paved shoulders or bike lanes, but may be considered in some locations in addition to on-road bicycle facilities.
- To reduce potential conflicts in some situations, it may be better to place one-way sidepaths on both sides of the street.
- The design of the trail should conform to Crime Prevention Through Environmental Design (CPTED) principles. CPTED is a framework that encourages intuitive visual cues to guide path users, increase the visibility of the corridor and adjacent landmarks and properties, careful design that indicates active use and upkeep, and manages conflicting uses, and regular maintenance to prevent improper or illegal uses.

Shared Use Paths offer pedestrians and bicyclists space to be active away from vehicle traffic. Source: Peter Stetson.

Materials and Maintenance

Shared use paths must be regularly maintained so that they are free of potholes, cracks, root lift, and debris. Signage and lighting should also be regularly maintained to ensure shared use path users feel comfortable, especially where visibility is limited.

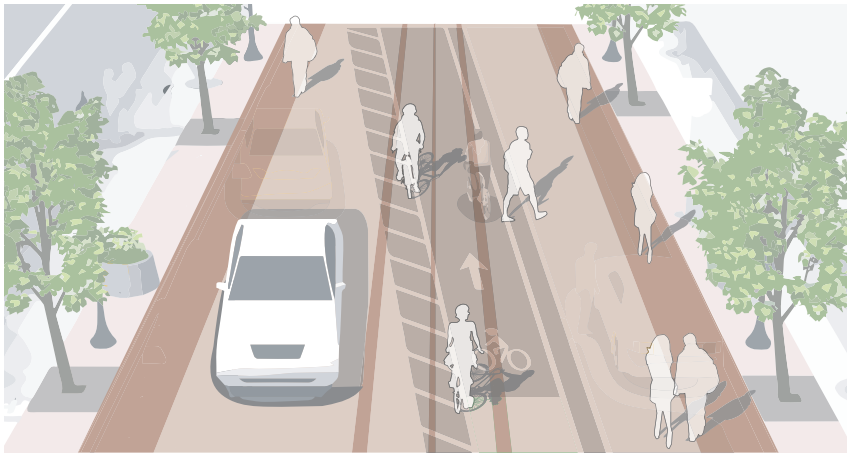
Adjacent landscaping should be regularly pruned, to allow adequate sightlines, daylight, and pedestrian-scale lighting, and so as not to obstruct the path of travel of trail users.

Approximate Cost

The cost of a shared use path can vary, but typical costs are between $65,000 per mile to $4 million per mile. These costs vary with materials, such as asphalt, concrete, boardwalk and other paving materials, lighting, and ROW acquisition.

Shared Street

A shared street is a street with no designated space for bicyclists, pedestrians or vehicles. Pedestrian and bicycle travel is prioritized, speeds are limited by the speed of pedestrians and bicyclists, and pavement materials, landscaping and amenities communicate that this is not a standard road. Vehicle volumes should be very low with only local vehicles (no through travel) using the street.



Typical Use

- Utilized in areas with high pedestrian activity that need to maintain limited access for vehicles and loading / unloading delivery trucks at designated hours.
- In commercial areas, a shared street environment should be considered in places where pedestrian activity is high and vehicle volumes are either low or discouraged.
- In residential areas, a shared street should be considered in places where sidewalks are limited, pedestrian activity and use of streets as public space is high, and vehicle volumes are low.

Design Features

- Vehicle use should be limited to destinations along the shared street (residences, parking garages, maintenance and emergency access vehicles).
- Vehicle speeds should be no more than 15 mph.
- The entrance to the shared street should be designed so that the shared street is clearly recognizable (through signage, surface material, amenities and landscaping).
- Landscaping should include canopy trees for shade and to enhance the bicycle and pedestrian environment, but should not restrict visibility.
- Amenities such as benches, cafe seating, and moveable landscaping elements should be included to communicate the prioritization of pedestrians and bicyclists, but should not restrict visibility.
- A clear width (void of vertical objects) should be provided to ensure emergency vehicle access.

Shared streets in active commercial areas become destinations themselves.

In residential areas, shared streets expand public space and create new places for people to play.

Additional References and Guidelines

FHWA, Achieving Multimodal Networks: Applying Design Flexibility & Reducing Conflicts, "Shared Streets". 2016.

Examples:

- Jack London Square, Oakland, CA
- Wall Street, Asheville, NC
- Bell Street Park, Seattle, WA
- Old Firehouse Alley, Fort Collins, CO
- Calle Guanajuato, Ashland, OR
- Winthrop Street, Cambridge, MA
- First Street North, Jacksonville Beach, FL

Materials and Maintenance

Pavement materials should be similar to that of a pedestrian pathway or plaza using concrete, colored concrete, paving stones or similar materials. Pavement materials and depths should be designed to accommodate vehicular travel, but should clearly signal to all roadway users that pedestrians have priority.

Approximate Cost

The cost of a shared street can vary depending on materials (such as asphalt, concrete, and other paving materials), lighting, landscaping, and ROW acquisition.

Sidepath Design

A sidepath is a bidirectional shared use path located immediately adjacent and parallel to a roadway. Sidepaths can offer a high-quality experience for users of all ages and abilities.

Typical Use

Sidepaths should be considered where one or more of the following conditions exist:

- The adjacent roadway has relatively high volume and/or high-speed motor vehicle traffic that might discourage many people bicycling from riding on the roadway to achieve the targeted low stress. Sidepaths do not preclude the installation or maintenance of existing bike lanes.
- Along corridors with few intersections with minor streets and driveways.
- To provide continuity between existing segments of shared use paths.
- For use near schools, neighborhoods, and mixed use commercial areas, where increased separation from motor vehicles is desired, and there are few roadway and driveway crossings.

Design Features

- Sidepaths shall be designed to meet transportation standards as defined by AASHTO, PROWAG, and MUTCD.
- Materials: Asphalt is the standard paving material for sidepaths.
- Minimum Width: Minimum width of a sidepath is 10'. Where user volumes are high, additional width, as well as parallel facilities such as bike lanes and sidewalk can provide needed space.
- Roadway Separation: The preferred minimum roadway separation width is 6.5 - 16.5' **(Schepers, 2011).** Absolute minimum separation width of 5' **(AASHTO Bike Guide 2012, p. 5-11).**
- Roadway Separation: Separation from roadway traffic is an essential design feature of sidepaths. Separation should increase as volumes and speed of adjacent roadway increase **(AASHTO Bike Guide 2012, p. 5-11).**

A sidepath provides a continuous path of travel along roadway corridors with few driveways or intersections. Depending on the anticipated volumes and context, the sidepath can be constructed in lieu of sidewalk and/or bike lanes. Oftentimes, anticipated volumes, mix of skills, or other factors such as route continuity will also be considered in the decision to also include bike lanes and sidewalks.

- Horizontal Clearance: A lateral clearance to landscaping, street furnishings and signs is required. MUTCD identifies minimum clearance. Signs and other street furniture should be placed outside of the minimum path width.
- Vertical Clearance: Standard clearance to overhead obstructions is 10'.
- Cross Slope and Running Slope: As sidepaths are typically located within public rights of way, their designs are governed by ADA guidelines.

Further Considerations

- Sight Lines: It is important to keep approaches to intersections and major driveways clear of obstructions due to parked vehicles, shrubs, and signs on public or private property.
- Corner radii at driveways and minor streets should be minimized to facilitate vehicle turning speeds of 10-15 mph.

Materials and Maintenance

Like shared use paths, Sidepaths must be regularly maintained so that they are free of potholes, cracks, root lift, and debris. Signage and lighting should also be regularly maintained to ensure sidepath users feel comfortable, especially in areas where visibility is limited.

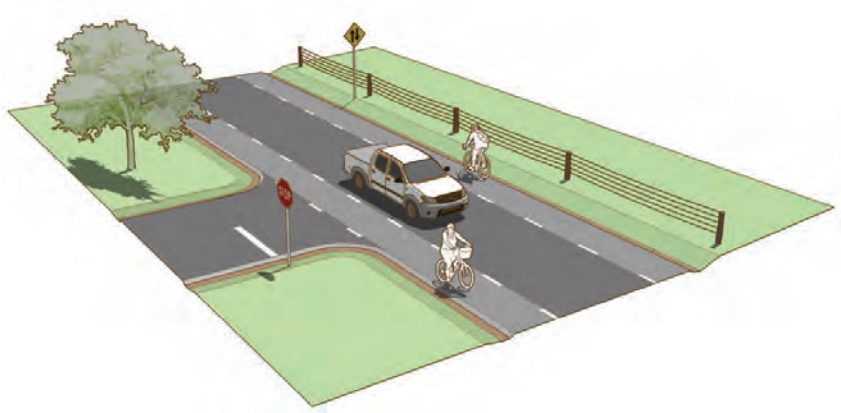
Adjacent landscaping should be regularly pruned, to allow adequate sightlines along the path and at minor street crossings and driveways, allow for daylight, and pedestrian-scale lighting, and so as not to obstruct the path of travel of trail users.

Approximate Cost

The cost of a sidepath can vary, but typical costs are similar to shared use paths between $90,000 per mile to $4 million per mile. These costs vary with materials, such as asphalt, concrete, boardwalk, and other paving materials, and ROW acquisition.

Advisory Shoulder

Roads with advisory shoulders accommodate low to moderate volumes of two-way motor vehicle traffic and provide a prioritized space for bicyclists with little or no widening of the paved roadway surface. An approved Request to Experiment is required to implement Advisory Shoulders, called "dashed bicycle lanes" in the FHWA experimentation process.



Typical Use

- Most appropriate on streets with low to moderate volumes and moderate speeds of motor vehicles.
- Roadways in built-up areas with constrained connections, bicycle and pedestrian demand, and limited available paved roadway space.
- Advisory shoulder designs work best on road segments without frequent stop or signal controlled intersections.

Design Features

- The preferred width of the advisory shoulder space is 6 ft. Absolute minimum width is 4 ft when no curb and gutter is present.
- Consider using contrasting paving materials between the advisory shoulder and center travel lane to differentiate the advisory shoulder from the center two-way travel lane in order to minimize unnecessary encroachment and reduce regular straddling of the advisory shoulder striping.
- Preferred two-way center travel lane width is 13.5–16 ft although may function with widths of 10–18 ft. **(Small and Rural Multimodal Networks Report, Table 2-2)**
- A broken lane line used to delineate the advisory shoulder should consist of 3 ft line segments and 6 ft gaps.
- Use signs to warn road users of the special characteristics of the street.

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.

Further Considerations

- Unlike a conventional shoulder, an advisory shoulder is a part of the traveled way, and it is expected that vehicles will regularly encounter meeting or passing situations where driving in the advisory shoulder is necessary and safe
- Advisory shoulders may function as an interim measure where plans include shoulder widening in the future.
- Where additional edge definition is desired, stripe a normal solid white edge line in addition to the broken advisory shoulder line.
- In general, do not mark a center line on the roadway. Short sections may be marked with center line pavement markings to separate opposing traffic flows at specific locations, such as around curves, over hills, on approaches to at-grade crossings, and at bridges.
- Strive to maintain the visual definition of the advisory shoulder through all driveways and street crossings, and provide a conventional shoulder at controlled intersections.
- Advisory shoulders as described here are not intended for use by pedestrians. When advisory shoulders are intended for use by pedestrians, they must meet accessibility guidelines.

Materials and Maintenance

Shoulder striping will require higher maintenance where vehicles frequently traverse over them at intersections, driveways, parking lanes, and along curved or constrained segments of roadway.

Advisory shoulders should also be maintained so that there are no pot holes, cracks, uneven surfaces or debris.

Approximate Cost

The cost for installing advisory shoulders will depend on the implementation approach. Typical costs are $6,000 per mile when used on a street with no markings.

For additional information, please contact:

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