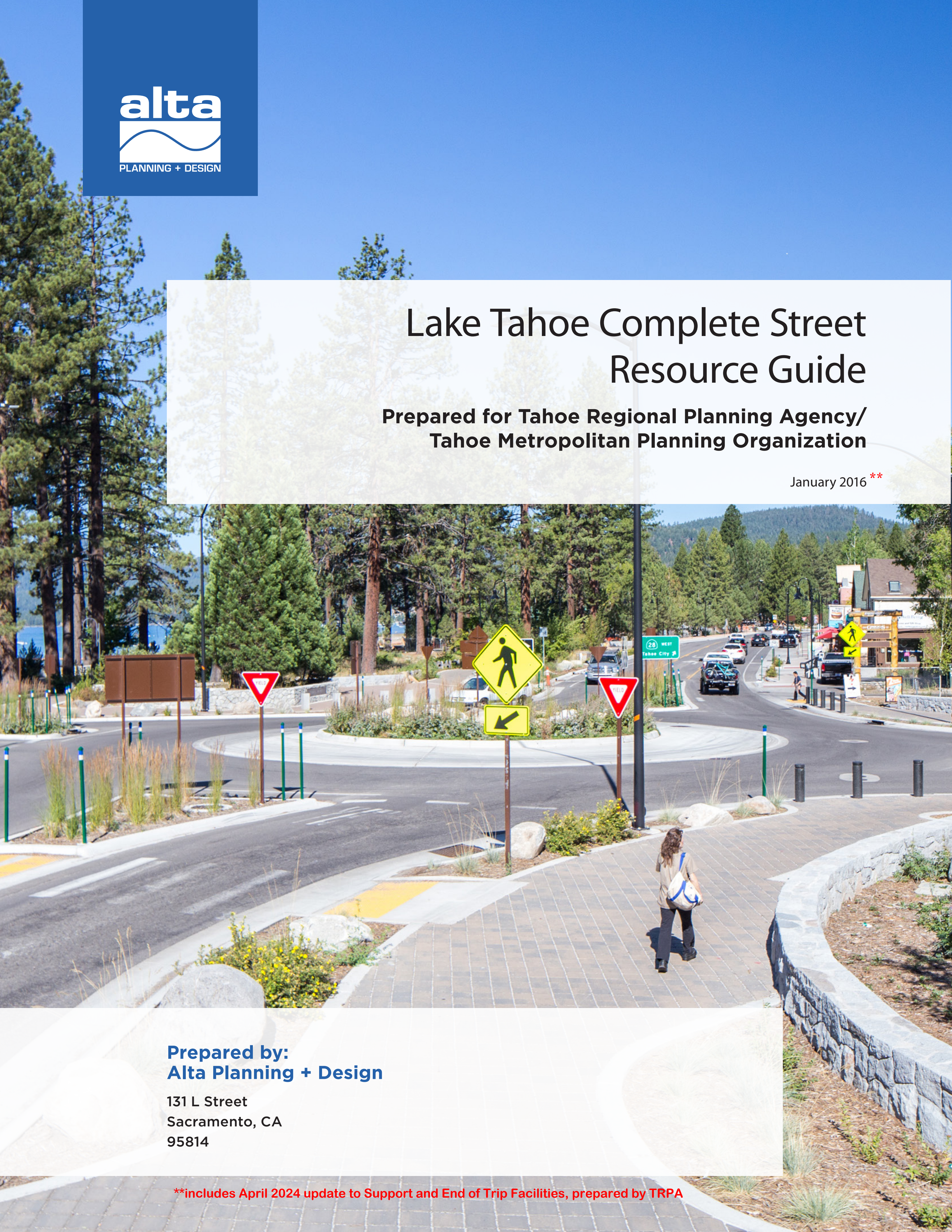
Appendix A

Lake Tahoe Complete Streets Resource Guide

Support and End of Trip Facilities updated for 2024 Plan Update



Lake Tahoe Complete Street Resource Guide

Prepared for Tahoe Regional Planning Agency/ Tahoe Metropolitan Planning Organization

January 2016 **

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**includes April 2024 update to Support and End of Trip Facilities, prepared by TRPA

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FOREWORD:

COMPLETE STREETS WORKSHOP

RECAP, NEXT STEPS & ACTIONS

Transporting Tahoe Transportation: A Workshop on Completing Our Streets.

OVERVIEW

TRPA/TMPO hosted a Complete Streets Workshop on Wednesday, November 18 and Thursday, November 19, 2015 for local, regional and state agency partners. Alta Planning + Design's Joe Gilpin, National Association of City Transportation Officials Certified, and Bryan Jones, PE, AICP, facilitated the workshop. Many agencies in the area, such as Truckee, Kings Beach, Tahoe City, and Carson City, are already applying complete street techniques to their projects to improve mobility and safety for all users. Key examples are the King's Beach roundabouts and Truckee's many projects including roundabouts, paid parking, trail system, and creative funding mechanisms and partnerships for maintenance. In addition, Caltrans and FHWA highlighted their efforts to encourage engineering judgment, design flexibility, and complete street funding opportunities.

More than 60 people attended the workshop, representing the following agencies:

- California Department of Transportation
- Nevada Department of Transportation
- Washoe County
- El Dorado County
- Douglas County
- Placer County
- Town of Truckee
- City of South Lake Tahoe
- California Highway Patrol
- Tahoe City Public Utility District
- California Tahoe Conservancy
- Federal Highway Administration
- TRPA/TMPO

Through brainstorm sessions, presentations, and expert panel discussions, Day 1 focused on exploring a variety of topics including:

- What makes the Tahoe Region unique and special to its residents and visitors
- Identifying Tahoe's transportation system customers and the challenges the Region faces serving them
- Redefining the challenges agency staff must solve
- Broadening the use of tools, resources, and solutions
- Debunking policy, funding, and engineering misconceptions to empower and enable complete street implementation
- Identifying agency-specific policies and commitments to designing and building complete street infrastructure
- Networking with regional partners to create new relationships, synergy and partnerships to better serve the Region.

Day 1 also included three guest presenters:

1. A keynote presentation by Dan Wilkins, the Public Works Director for the Town of Truckee. Dan highlighted Truckee's successes with trails, paid parking, roundabouts, and funding opportunities.
2. A roundabout and design flexibility presentation by Hilary Isebrands, a Federal Highway Administration (FHWA) Safety Engineer specializing in roundabouts and road safety audits.
3. A presentation on intersection control evaluation by Jerry Champa, Traffic Safety Liaison, for Caltrans.

The expert panel discussions involved agencies from all levels of government and included the audience in a question and answer period. The panel provided a localized discussion on challenges, opportunities, and commitments. Panel participants are listed on the right.

Day 2 began with a robust discussion about the key takeaways from day 1, followed by group design exercises of five local Tahoe roadway challenges. Participants split into three groups, with a mix of agency staff and expertise. These exercises gave participants an opportunity to apply newly learned tools in an intense and collaborative design process. Armed with data and local knowledge, groups proposed options for improving mobility, and safety for all users.

Expert Panel Participants

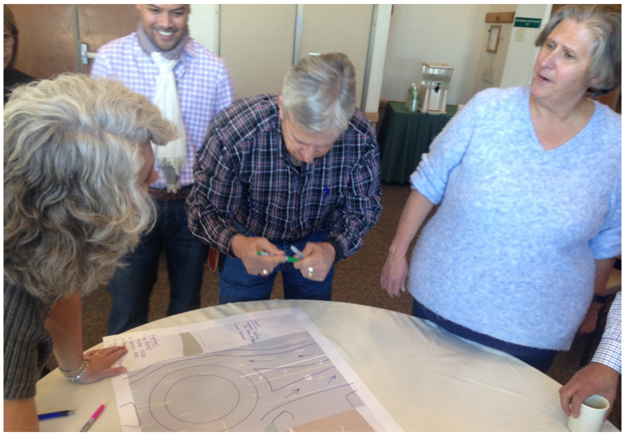
Planning, Design & Funding

Name	Organization	Position
Sondra Rosenberg	NDOT	Assistant Director Planning
Robert Peterson	Caltrans HQ	Chief, Office of HSIP
Chris Engleman	Caltrans HQ	CA MUTCD / CTCDC
David Cohen	FHWA California Division	Traffic Safety Specialist
Jerry Champa	Caltrans HQ	Traffic Safety & Ops Liaison Engineer
Dan Wilkins	Town of Truckee	Public Works Director

Implementation & Maintenance

Name	Organization	Position
Hilary Isebrands	FHWA Resource Center	Safety Engineer
Dan Wilkins	Town of Truckee	Public Works Director
Brian Stewart	Placer County Public Works	Design & Construction Engineer
Rod Murphy	Caltrans	District 3 Project Manager
Thor Dyson	NDOT	District 2 Engineer
Jerry Champa	Caltrans HQ	Traffic Safety & Ops Liaison Engineer
Tom Hallenbeck	Caltrans HQ	Traffic Safety Division Chief

Brainstorming Session on Day 1



Participants Create and Share Their Design Solutions on Day 2

Top Concerns

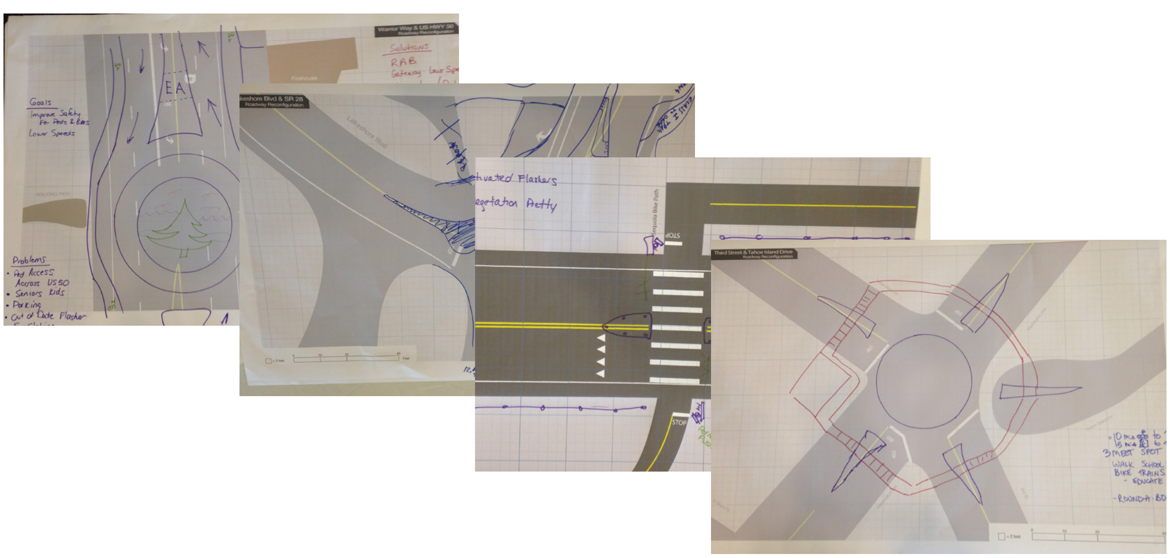
Alta Planning + Design led a brainstorm discussion at the beginning of the day to help identify local concerns about implementing complete streets projects. The main concerns included:

- The difficulty of designing projects for peak season and off peak season demands and needs. How can you design for both?
- Generating public support for project design, maintenance and funding.
- The conservation of natural resources.
- Support for design flexibility among agency leaders.
- The challenge of designing projects for snow removal and storage.

Who Are Tahoe's Customers?

The next brainstorm identified customers the Region serves or needs to serve with our transportation system. The list was long and diverse.

- Local residents and businesses
- Tourists (local, national, and international)
- People that walk, bike, drive, and use transit
- Emergency responders
- Special events
- Maintenance crews
- Regular and seasonal workforce
- People of different socio-economic backgrounds
- Freight and goods movement
- People seeking parking and access to destinations such as casinos, ski resorts, trail heads, and beaches.



Example Designs

The Biggest Barrier

Project Design & Liability

Presentations, panel sessions, design exercises, and peer to peer conversations all touched on this issue. Resources regarding design flexibility include:

- FHWA supports design flexibility through its 2013 memo, "Bicycle and Pedestrian Facility Design Flexibility." In that memo, FHWA refers planners and engineers to guides published by the American Association of State Highway and Transportation Officials, the National Association of City Transportation Officials, and the Institute of Transportation Engineers. FHWA also published the "Revision of Thirteen Controlling Criteria for Design" in 2015 which promotes design flexibility and clarifies FHWA's standards.
- Deputy Directive 64-R2, signed in October 2008 and renewed in 2014, directs Caltrans to implement complete streets.

  "The Department provides for the needs of travelers of all ages and abilities in all planning, programming, design, construction, operations, and maintenance activities and products on the State Highway System."
- The 2014 Caltrans memo, "Design Flexibility in Multi-Modal Design," provides for flexibility in design through experimental project processes. The memo identifies design documents such as the National Association of City Transportation Officials' "Urban Street Design Guide," "Urban Bikeway Design Guide," and the Institute of Transportation Engineers' "Designing Urban Walkable Thoroughfares" as important resources when considering designs that accommodate all users.

Local Issues and Solutions

Local issues and solutions were identified to support staff in taking advantage of the design flexibility offered by these federal and state government agencies.

Supported Documented Innovative Design

Many staff and elected officials are deterred from opportunistic innovation by perceived limitations. Staff and elected officials can rely too heavily on common standards, existing knowledge, or historic project experience. It is easy to be overly reactive to initial public perception, rather than letting a project gain support over time as the public becomes more familiar. There is a perceived high risk in trying something new, combined with a fear of costly failure both financially to the agency and in personal employment.

Generate Strong Leadership & Local Champions

Support and encourage agency staff to pursue new designs that better accommodate all users. Strong leadership can exist at the staff and elected official level. Leaders create a clear vision, and encourage staff to utilize new tools, resources, and techniques by creating an environment that supports experimentation and innovation to improve projects. Leaders should also increase the reward for successful project implementation that is adaptive, flexible and improves over time. Champions are those who are the first to implement new tools, resources, and techniques.

Activate Public Support for Projects & Funding Initiatives

Public support encourages continued innovative project implementation. Many projects that prioritize all roadway users require a change in roadway design, maintenance operations, and user behavior. Leaders can identify opportunities to bring additional support to agency staff through frequent training and by offering public education opportunities to the Region. Education should focus on increasing awareness about what other recreational tourism destinations and mountain communities do to publicly and financially support complete street implementation and maintenance. Interim projects, a phased project approach, and including maintenance staff during project design are other ways to gain public support and reduce increased maintenance costs.

Key Takeaways

Complete Street Policies & Vision Already Exist at Lake Tahoe

The Tahoe Region has a clear complete streets vision. TRPA/TMPO's Regional Plan and local agency general and area plans contain policy language that clearly defines a complete street policy and supports complete streets by

Panel Discussion

planning for creating walkable, bikeable communities. The following are some of the current policies that support complete streets in the Region.

TRPA/TMPO Active Transportation Plan:

Policy 1.1: Transportation projects will accommodate the needs of all travelers by designing and operating roads to provide for safe, comfortable, and efficient travel for roadways users of all ages and abilities such as pedestrians, bicyclists, transit riders, motorists, commercial vehicles, and emergency vehicles.

City of South Lake Tahoe General Plan:

Policy TC-1.8: Complete Streets Design: The City shall seek to develop or upgrade all State Highways, arterials, and collectors as Complete Streets that accommodate all travel modes.

Douglas County General Plan:

Policy 7-2A.3 Through the design process, ensure that collector and arterial road rights-of-way are wide enough to accommodate all identified street users and functions. These may include vehicles, transit, pedestrians, bike lanes, off-street shared use trails, landscaping and roundabouts. Traffic calming features should be included to improve safety and increase pedestrian and bicyclist safety.

Policy 7-2C.2 Design neighborhood streets to calm traffic and discourage traffic volumes in excess of adopted standards using methods such as shorter street lengths.

Policy 7-4B.4 Ensure new and existing developments promote connectivity through road and off-street path design to reduce trip lengths, provide multiple alternative travel routes between community uses and destinations, and provide alternatives to automobile use.

El Dorado County – Meyer's Area Plan

Page 3-3: Transportation and Circulation Goal: Redevelop the transportation system within the community plan area to reduce reliance on the private automobile, improve circulation and provide opportunities to experience Meyers as a pedestrian or cyclist.

Placer County General Plan:

Policy 3.D.9. Consider Complete Streets infrastructure and design features in street design and construction to create safe and inviting environments for all users consistent with the land uses to be served.

Policy 3.26. Placer County will incorporate Complete Streets principles into its Transportation and Circulation Element, Bikeways Master Plan, Regional Bikeway Plan, Community Plans, and other plans, manuals, rules, regulations and programs as appropriate, and will establish performance standards with measurable outcomes.

Design Flexibility & Engineering Judgment is Encouraged

FHWA and Caltrans have documented their encouragement of design flexibility and the use of engineering judgment. This protects engineers from liability as design decisions are documented with real world examples. We must remember that bike lanes are not the only tool. We need to explore many potential solutions and consider how each project is contextual and serves different users.

High Speed Kills on Roadways

High speed roadways are dangerous barriers to pedestrians and bicyclists and is the number one contributor to the feeling of safety. High speed only works on open highways with low traffic volumes. Highways routed though communities should not feel like highways and should not be designed primarily to accommodate peak traffic demand. Designing mostly for peak demand creates excess width and capacity and encourages speeding as a natural and consistent behavior for drivers during typical off-peak traffic periods. During peak times, there can be travel surges between traffic signals which also creates safety concerns and increases likelihood of vulnerable user collisions. Cars move through an urban corridor at a safer and more consistent flow at lower speeds.

Low Speed Kills when Delivering Projects

It often takes much longer to design and approve a project than it does to build the project. Agencies can use pilot and demonstration projects to more quickly build roadway improvements, test new solutions, and build public support. Also, agencies should utilize maintenance projects, such as roadway resurfacing to temporarily adjust the roadway. Changes should be monitored over time, adjusting for improvements and creating permanent solutions. Snow removal operations which degrade roadway stripping offer significant annual opportunities to repurpose roadways in the spring and summer.

Matching the Community's Character: Tahoe's Population is Variable

Agencies often focus on "how" and "what," but vision is created by asking "why." While Tahoe is home for many, it is also a major tourism destination. To maintain Tahoe's competitiveness while improving the environment, it is critical to provide a transportation system that is consistent with the area's scale and sense of place. Complete streets create an opportunity to better manage the peak season and off season demand by providing choices in mobility.

Maintenance Should Be Part of the Design & Engineering Process

Understanding resource and equipment limitations is important in project design. These discussions are also an opportunity to reprioritize resources and equipment and evaluate the performance metrics used to measure their success.

Reducing Capacity is OK When You Create Safe Transportation Choices

We have built our transportation system to accommodate motor vehicles and as a result our system forces people to drive. By offering people convenient, safe, and enjoyable walking and biking opportunities to reach desired destinations we can reduce vehicle use and dependence.

Lifecycle Cost Decision Making

Project decisions should consider more than initial construction costs. Annual and long term maintenance costs can vary significantly. Sometimes, projects that are more expensive to build may be the less expensive to maintain.

Next Steps

Alta Planning + Design summarized some suggested key next steps for consideration by TRPA/TMPO and local regional partners to continue the momentum and realize progress.

Embolden Design Flexibility & Engineering Judgment by Creating a Learning Environment

It is important to the future of the Tahoe area that practitioners utilize engineering judgment and design flexibility. Documentation of decisions is critical for design immunity. Practitioners should move past applying outdated standards and create new guidelines and standards that are tailored to solve the Tahoe area's unique challenges.

If you are a leader at your organization, create an environment that encourages staff to create adaptive projects that improve over time. Learning and growing agency cultures are focused on balancing risk and reward when trying something new.

Bring Training to Each Agency

While individuals from all regional agencies attended the Transforming Tahoe Transportation Workshop, it is crucial for people to bring information back to their entire agency. Knowledge is power and staff at all levels of each organization need to be in alignment.

Collaboration Between Disciplines is Critical: Concept to Construction to Maintenance

Every project has the opportunity to be a complete streets project. Agencies need to integrate their departments and disciplines so that opportunities for multiple-benefit projects are not missed.

Facilitate an Elected Officials Transportation Summit for Tahoe

The Tahoe area is seeing changes in how people want to live and travel. New research and rules are creating opportunities for new solutions to be part of the discussion.

Create an occasion for elected officials to learn from each other and focus on real and perceived challenges, economic opportunities, environmental constraints, equity imbalances, and safety issues facing the Region. Elected officials can band together on the regional vision and how the transportation system contributes to that vision.

Redefine the Problem(s) to be Solved

Often how a problem is defined dictates the approach and the solutions that are proposed. As projects move forward, agency staff and elected officials need to be aware of how focusing on only one transportation concern at a time can create other problems for different users. Scoping a project to move and connect transportation users of all types more efficiently and safely will yield more holistic results rather than improving capacity for motor vehicles only.

Continue Agency Knowledge Share

TRPA/TMPO are committed to continuing agency knowledge sharing as an annual forum. This will create opportunities to share victories, successes, lesson learned, challenges overcome, and brainstorm solutions to existing challenges. The updated TRPA Code of Ordinances coverage requirements which exempt bicycle trails are a great example of taking steps to reduce barriers to the development of transportation and recreational facilities. More issues like this will come to surface as agencies collaborate and solutions can be found.

Be a Multi-Modal User

What we see or experience from the windshield of a car is often dramatically different than what people experience on foot or on a bike. When designing projects, get out onto the street and truly experience the challenges and opportunities from another perspective.

Actions

As a 12-month assignment, agency participants are challenged to accomplish the following in 2016:

1. Move towards adopting a complete street strategy or policy. If a policy is present, review it to see how it could be more effective and supported through standards, code, and other agency policies.

2. Identify at least one pilot project where small changes could create big improvements. Use it as a learning opportunity to test coordination and cooperation between staff, elected officials and the public. Pilot projects can use interim materials and be flexible in their approach. Report back at next annual complete streets meeting on your lessons learned.

3. Examine the funding realities. Complete streets elements should be seen as essential components of the agency's transportation infrastructure rather than as optional elements which must be funded separately. Take steps towards identifying or creating new local funding sources such as paid parking, fees, taxes, etc.

Participants Networking During Day 1

INTRODUCTION

INTRODUCTION

POLICY GUIDANCE

This appendix to the Linking Tahoe: Active Transportation Plan presents an overview of bicycle and pedestrian facility designs, based on appropriate MUTCD and Highway Design Manuals, and is supplemented by national best practices developed by FHWA and NACTO, as well as state standards and Tahoe-specific design guidelines. The purpose is to provide readers and project designers with an understanding of the facility types that are proposed in the Plan, and with specific treatments that are recommended or required region-wide. This appendix also acts as a stand alone document for implementing agencies to use as a reference guide for designing projects that provide for all roadway user mobility and safety.

Discussion

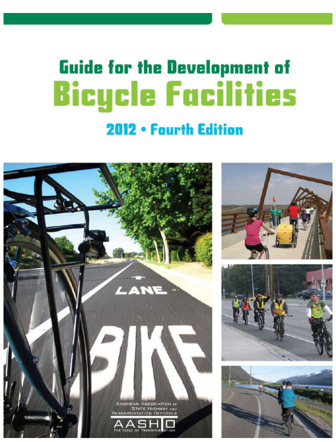
The Lake Tahoe Complete Street Resource Guide presents standards and recommendations that specifically provide for consistency in the Lake Tahoe Region, or where details are needed beyond what is provided by state and federal design standards. All projects must also meet state and federal design standards, as well as other Tahoe Regional Planning Agency (TRPA) design guidelines including scenic requirements and best management practices. Therefore, in addition to these design guidelines, planners and designers should also refer to the following documents and their subsequent updates when planning and designing bicycle and pedestrian facilities. Project designers are encouraged to employ design flexibility in accordance with FHWA and Caltrans directives. Engineering judgment should be employed to ensure that projects are safe and satisfy the needs of all users.

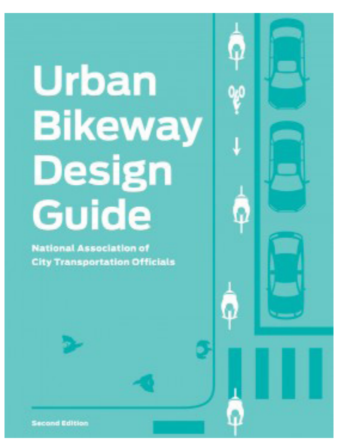
National Guidance

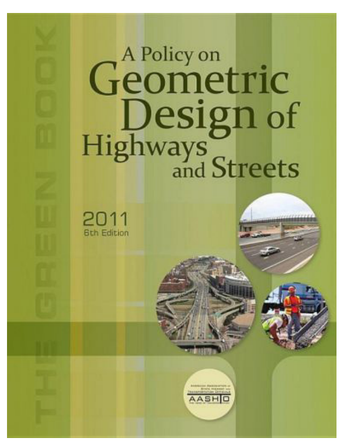
The Federal Highway Administration's (FHWA) **Manual on Uniform Traffic Control Devices (MUTCD)** defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic. The MUTCD is the primary source for guidance on lane striping requirements, signal warrants, and recommended signage and pavement markings. The California portion of the Lake Tahoe Region is governed by the California MUTCD and the Nevada portion is governed by the Federal Highway Administration (FHWA) MUTCD. In the event that a specific treatment is in the California or Federal MUTCD, but not in the other, it may be necessary to go through experimental testing procedures. Experimental testing is overseen by the California Traffic Control Devices Committee (CTCDC) in California and the FHWA in Nevada.

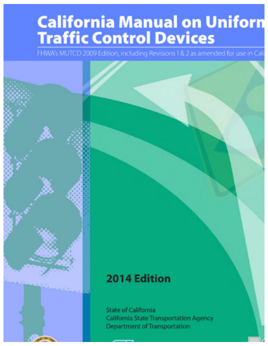
To further clarify the MUTCD, the FHWA created a table of **Bicycle Facilities and the Manual on Uniform Traffic Control Devices**, which lists contemporary bicycle facilities such as bicycle-related signs, markings, signals, and other treatments and identifies their official status (e.g., can be implemented, currently experimental). This table can be found at http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/mutcd/index.cfm.

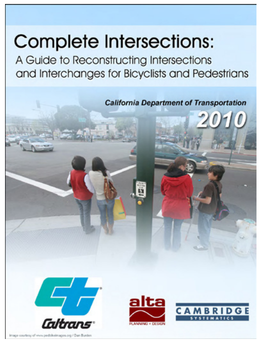
Bikeway treatments not explicitly covered by the MUTCD

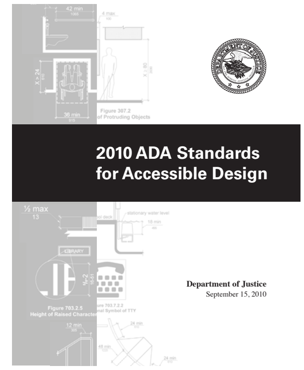












are often subject to experiments, interpretations and official rulings by the FHWA. The **MUTCD Official Rulings** is a resource that allows website visitors to obtain information about these supplementary materials. Copies of various documents (such as incoming request letters, response letters from the FHWA, progress reports, and final reports) are available.

American Association of State Highway and Transportation Officials (AASHTO) **Guide for the Development of Bicycle Facilities (2013)**, updated in June 2012 provides guidance on dimensions, use, and layout of specific bicycle facilities.

Last updated in 2004, the AASHTO provides guidance on dimensions, use, and layout of specific pedestrian facilities. The standards and guidelines presented by AASHTO **Guide for the Planning, Design and Operation of Pedestrian Facilities (2004)** provide basic information, such as minimum sidewalk widths, driveway construction, crosswalk striping requirements and other recommended signage and pavement markings.

The 2011 **AASHTO A Policy on Geometric Design of Highways and Streets (2011)** commonly referred to as the "Green Book," contains the current design research and practices for highway and street geometric design.

FHWA's 2015 **Separated Bike Lane and Planning Design Guide** is the newest publication of nationally recognized bicycle-specific design guidelines, and outlines planning considerations for protected bicycle facilities, presents a suite of design recommendations based on corridor context, and highlights notable case studies from across the US.

The National Association of City Transportation Officials' **(NACTO) Urban Bikeway Design Guide (2012)** is the newest publication of nationally recognized bikeway design standards, and offers guidance on the current state of the practice designs. **NACTO's Urban Streets Design Guide (2013)** is the newest publication of nationally recognized street design guidelines, covering street designs and elements focused on creating walkable, bikeable, transit-friendly places.

Some of the treatments featured in the NACTO guides are not directly referenced in the current versions of the AASHTO Guide or the MUTCD, although many of the elements of these treatments are found within these documents. In all cases, engineering judgment is recommended to ensure that the application makes sense for the context of each treatment, given the many complexities of urban streets.

The Americans with Disabilities Act (ADA) prohibits discrimination against people with disabilities in employment, transportation, public accommodation, communications, and governmental activities. The **Department of Justice 2010 ADA Standards for Accessible Design** and the **DOT ADA Standards for Transportation Facilities** provide accessibility standards for all facilities covered by ADA.

In addition, the United States Access Board published **Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (2011)** but they have been subsequently adopted.

Local Guidance

CALIFORNIA:

The **California Manual on Uniform Traffic Control Devices (CAMUTCD) (2014)** is an amended version of the FHWA MUTCD 2009 edition modified for use in California. While standards presented in the CA MUTCD substantially conform to the FHWA MUTCD, the state of California follows local practices, laws and requirements with regards to signing, striping and other traffic control devices.

The **California Highway Design Manual (HDM) (2015)** establishes uniform policies and procedures to carry out highway design functions for the California Department of Transportation. The 2012 edition incorporated Complete Streets focused revisions to address the Department Directive 64 R-1.

Complete Intersections: A Guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians (2010) is a reference guide that presents information and concepts related to improving conditions for bicyclists and pedestrians at major intersections and interchanges. The guide can be used to inform minor signage and striping changes to intersections, as well as major changes and designs for new intersections.

Main Street, California: A Guide for Improving Community and Transportation Vitality (2013) reflects California's current manuals and policies that improve multimodal access, livability and sustainability within the transportation system. The guide recognizes the overlapping and sometimes competing needs of main streets.

The Caltrans Memo: **Design Flexibility in Multimodal Design (2014)** encourages flexibility in highway design. The memo stated that "publications such as the National Association of City Transportation Officials (NACTO) *Urban Street Design Guide* and *Urban Bikeway Design Guide* are resources that Caltrans and local entities can reference when making planning and design decisions on the State highway system and local streets and roads."

NEVADA:

The **NDOT Road Design Guide (2010)** establishes uniform design criteria and interpretation on AASHTO Green Book geometric design elements.

The **NDOT Standard Plans for Road and Bridge Construction (undergoing update in 2015)** include CAD drawings of street design cross sectional elements and details.

The **NDOT Standard Specifications for Road and Bridge Construction (2014)** includes important details for contractor processes and standards in the design and construction of roads.

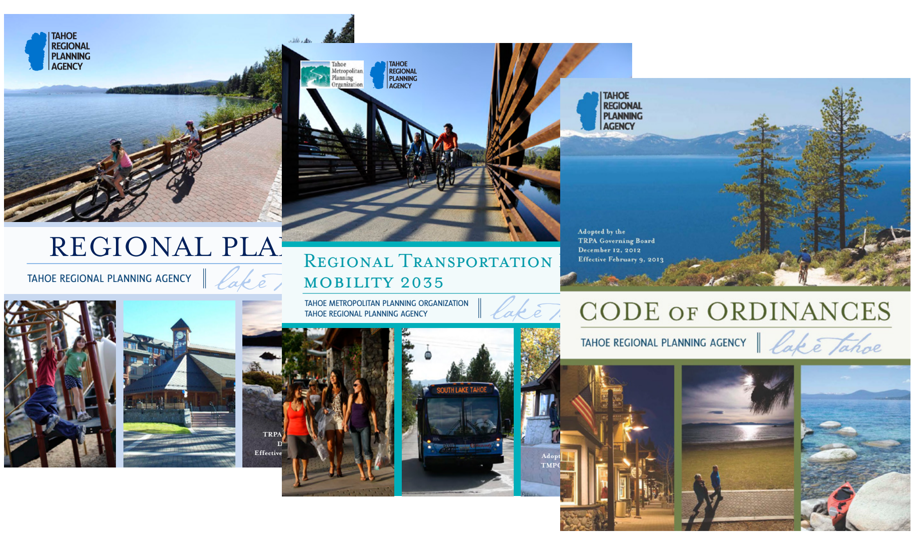
The **NDOT Landscape and Aesthetics Master Plan (2002)** established policies, procedures, standards, and guidelines for landscape and aesthetic treatments on Nevada's roads and highways

TAHOE AREA:

The Tahoe Metropolitan Planning Organization (TMPO) serves as the federally-designated metropolitan planning organization for the Tahoe region while TRPA carries out planning requirements of the Bi-State Tahoe Regional Planning Compact (Public Law 96-551) and serves as the regional transportation planning agency for the California portion of the Lake Tahoe Region. The most recent **Lake Tahoe Regional Plan** was adopted in 2012 by TRPA/TMPO and addressed several policies including ecosystem restoration and economic development. The TRPA/TMPO Regional Transportation Plan, **Mobility 2035,** is the transportation component of the Regional Plan. The RTP contains goals and policies that support the creation of walkable communities and increased transportation choice through sidewalk infill and bike trail projects.

Lake Tahoe Community Plans and Area Plans are part of the TRPA Regional Plan and outline bicycle and pedestrian policies and projects for specific neighborhoods in the Tahoe Region. The next revision of the RTP is scheduled for 2016.

The **TRPA Code of Ordinances** compiles all the laws and ordinances needed to implement the Goals and Policies of the Regional Plan. The Code was last updated in 2013.



BIKEWAY CLASSIFICATION OVERVIEW

Caltrans has defined three types of bikeways in Chapter 1000 of the Highway Design Manual: Class I/Shared-Use Path, Class II/Bike Lane, and Class III/Bike Route. Nevada does not have similar class designations, but uses the AASHTO terms, which include "shared-use path", "bike lane" and "signed shared roadway". For consistency with other Regional and prior plans, this document uses the generic terms "shared-use path", "bike lane" and "bike route". Both AASHTO and Caltrans have similar design standards for these facilities. Facilities using federal or state funding will generally be required to meet the standards below. TRPA recommends that all facilities, regardless of funding source, meet the standards below.

Design Summary

Path Width

8 feet is the minimum allowed for a two-way bicycle path and is only recommended for very low traffic situations.

10 feet is recommended in most situations and will be adequate for moderate to heavy use.

12 feet is recommended for heavy use situations with high concentrations of multiple users such as joggers, bicyclists, rollerbladers and pedestrians. A separate track (5′ minimum) can be provided for pedestrian use.

Bike Lane Width with Adjacent On-Street Parking

6.5′ preferred width, 5′ minimum recommended when parking stalls are marked

Bike Lane Width without Adjacent Parking

Recommended Width: 6′ where right-of-way allows

4′ minimum when no gutter is present (rural road sections)

5′ minimum when adjacent to curb and gutter (3′ more than the gutter pan width if the gutter pan is greater than 2′)

Lane Width for Bicycle Route With Wide Outside Lane

Fourteen feet (14′) minimum is preferred. This can include a striped shoulder. Fifteen feet (15′) should be considered if heavy truck or bus traffic is present. Bike lanes should be considered on roadways with outside lanes wider than 15 feet. This treatment is found on all residential streets, collectors, and minor arterials.

Shared-Use Path

Bike Lane

Bike Route/Shared Signed Roadway

Discussion

Consistent with bicycle facility classifications throughout the nation, these Bicycle Facility Design Guidelines identify the following classes of facilities by degree of separation from motor vehicle traffic.

Shared-Use Paths (Class I) are facilities separated from roadways for use by bicyclists and pedestrians. These facilities provide a completely separated right-of-way for the exclusive use of bicycles and pedestrians with crossflow minimized. A total width of 10 feet is required, but 12 feet is recommended.

On-Street Bikeways (Class II), such as conventional or buffered bike lanes, use signage and striping to delineate the right-of-way assigned to bicyclists and motorists. Bike lanes encourage predictable movements by both bicyclists and motorists. Another variant of on-street bikeway is **Separated Bikeways (Class IV)** which are exclusive bike facilities that combine the user experience of a separated path with the on-street infrastructure of conventional bike lanes. Bicycle lanes of 6-7 feet are recommended, while minimum dimensions are 4-5 feet depending on if a gutter is present.

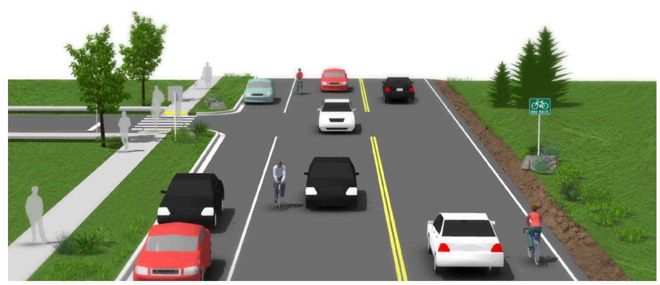
Signed Shared Roadways (Class III) are bikeways where bicyclists and cars operate within the same travel lane, either side by side or in single file depending on roadway configuration. The most basic type of bikeway is a signed shared roadway. This facility provides continuity with other bicycle facilities (usually bike lanes), or designates preferred routes through high-demand corridors. The recommended width of a shared use travel lane is 14 feet.

Bike Routes are designated bicycle route alignments within a street network, identified as the preferred streets and facilities to be used for bicycle travel. A bike routes is a designation, not a facility type, and may be made up of various facilities in order to provide a connected network for bicycle travel.

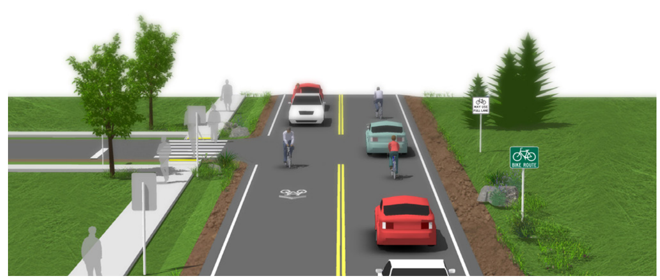
Shared-Use Paths (Class I)

On-Street Bikeway (Class II)

Separated Bikeway (Class IV)



Signed Shared Roadway (Class III)



Signed Shared Roadway with Pavement Markings (Class III)

References

- Caltrans. Highway Design Manual. 2015
- FHWA. Manual of Uniform Traffic Control Devices. 2009.
- Caltrans. Manual of Uniform Traffic Control Devices. 2014.
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Cost

- Shared-use path (10' wide): $475,000 - $3,000,000 per mile
- Bike Lane: $5,000 - $500,000 per mile
- Bike Route: $1,000 - $300,000 per mile

SHARED-USE PATHS

SHARED-USE PATHS

PATHWAY DESIGN

A shared-use path allows for two-way, off-street bicycle use and also may be used by pedestrians, skaters, wheelchair users, joggers and other non-motorized users. Within the Lake Tahoe Region, shared-use paths are often found in urbanized areas and connecting urbanized areas to popular recreation sites or other population centers. Shared-use paths can also include amenities such as lighting, signage, and fencing (where appropriate).

General Design Practices

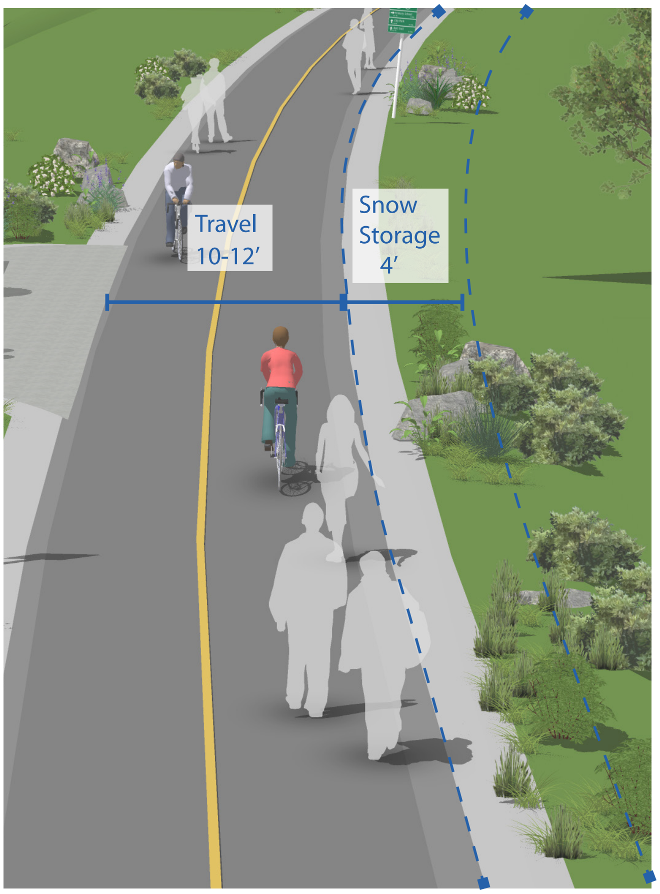
Shared-use paths can provide a desirable facility for users of all skill levels preferring separation from traffic. Some of the elements that enhance off-street path design include:

- Frequent access points from the local road network;
- Placing directional signs to direct users to and from the path;
- Limiting the number of at-grade crossings with streets or driveways;
- Identifying and addressing potential security problems up front;
- Whenever possible, and especially where heavy use by bicycle users can be expected, separate pedestrian ways should be provided to reduce conflicts.

The AASHTO Guide for the Development of Bicycle Facilities generally recommends against the development of shared-use paths directly adjacent to roadways, although at Lake Tahoe, due to geographical constraints, this is often necessary. Also known as "sidepaths", these facilities create a situation where a portion of the bicycle traffic rides against the normal flow of motor vehicle traffic. This can result in an unsafe situation where motorists entering or crossing the roadway at intersections and driveways do not notice bicyclists coming from their right, as they are not expecting traffic coming from that direction. The guide explores solutions to this problem on page 18.

As bicyclists gain experience and realize some of the advantages of riding on the roadway, many stop riding on paths adjacent to roadways. Bicyclists may also tend to prefer the roadway as pedestrian traffic on the bicycle path increases. When designing a bikeway network, the presence of a nearby or parallel path should not be used as a reason to not provide adequate shoulder or bicycle lane width on the roadway, as the on-street bicycle facility will generally be superior to the "sidepath" for experienced bicyclists and those who are bicycling for transportation purposes. Bicycle lanes should be provided as an alternate (more transportation-oriented) facility whenever possible.

Bicycle paths must also include the proper "Best Management Practices" (BMPs) for treating runoff from the facility. These designs are not included here, but path designers can find more information on the TRPA's BMP website at: http://www.tahoebmp.org.



Discussion

Twelve-foot wide paths are usually best for accommodating all uses, and better for long-term maintenance and emergency vehicle access. When motor vehicles are driven on shared-use paths, their wheels often will be at or very near the edges of the path. Since this can cause edge damage that, in turn, will reduce the effective operating width of the path, adequate edge support should be provided. Edge support can be either in the form of stabilized shoulders, a concrete "ribbon curb" along one or more edges of the path, or constructing additional pavement width or thickness. Constructing a typical pavement width of 12 feet, where right-of-way and other conditions permit, lessens the edge raveling problem.

Surfacing and Path Construction

Thicker surfacing and a well-prepared sub-grade will reduce deformation over time and reduce long-term maintenance costs. At a minimum, off-street paths should be designed with sufficient surfacing structural depth for the sub-grade soil type to support maintenance and emergency vehicles.

Asphalt and concrete are the most common surface treatment for multi-use paths, however the material composition and construction methods used can have a significant determination on the longevity of the pathway. Concrete is not as durable in cold climates and may not be suitable on a large scale for Lake Tahoe. Alternative surface materials such as decomposed granite may be appropriate in some circumstances. Each jurisdiction needs to consider durability and snow removal needs (grooming vs. clearing) when selecting an alternative surface material such as decomposed granite. Surface selection should take place during the design process.

Recommendation

The following pathway construction design is recommended for improved durability and low maintenance at Lake Tahoe:

• Asphalt Option: 4 inches of type B asphalt over a minimum of 9 inches of 1.5 inch minus crushed gravel base material. An asphalt path has the advantage of melting out more quickly after a snowfall under sunlight than a concrete path.

If trees are adjacent to the path, a root barrier should be installed along the path to avoid root uplift.

Design Summary

Width

- 10 feet width preferred, 8 feet minimum.
- 12 feet or more is recommended in areas with heavy anticipated bicycle and/or pedestrian traffic (Caltrans, 2015). AASHTO recommends a paved width of 10 feet minimum, with up to 14 feet being the preferred width.
- A 3-4 foot native surface path may be considered alongside shared-use paths for runners.

Separation From Highway

When two-way shared-use paths are located adjacent to a roadway, wide separation between a shared-use path and the adjacent highway is desirable. Bike paths closer than 5 feet from the edge of the shoulder shall include a physical barrier to prevent bicyclists from encroaching onto the highway (Caltrans, 2015). Where used, the barrier should be a minimum of 42 inches high (AASHTO, 2012).

Snow Storage

If a facility is to be plowed or blown in the winter, shoulder or clear width should be increased to provide adequate snow storage. In constrained locations, snow may need to be trucked out instead of stored on-site. As an alternative to snow clearance, a facility may be groomed to allow cross-country skiers and snowshoers to use it.

References

- Caltrans. Highway Design Manual. 2015.
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- Caltrans. Manual of Uniform Traffic Control Devices. 2014.

Cost

Shared-use Path (10' wide): $475,000 - $3,000,000 per mile

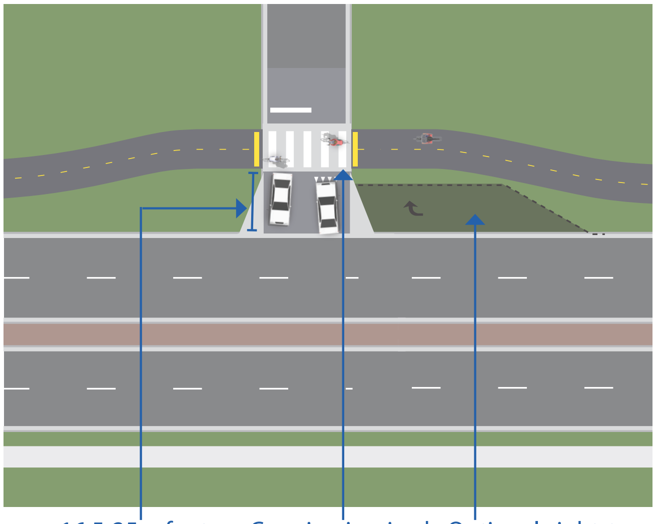
Costs can vary substantially based on the materials used, right-of-way costs, path width and other factors. A paved, multi-use trail can range in cost from approximately $65,000 per mile to more than $4 million per mile. An unpaved path can range from approximately $30,000 to $400,000 per mile.

SHARED USE PATHS

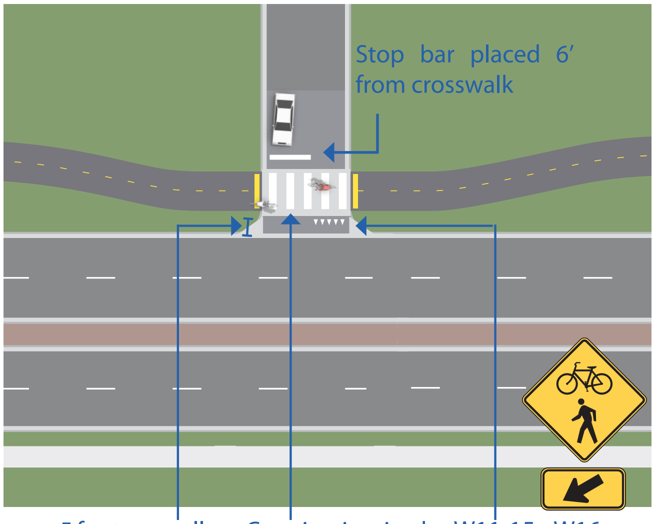
SIDE PATHS AT DRIVEWAYS AND MINOR STREETS

Shared use paths along roadways, also called Sidepaths, are a type of path that run adjacent to a street. Because of operational concerns it is generally preferable to place paths within independent rights-of-way away from roadways. However, there are situations where existing roads provide the only corridors available.

Setback Path Crossing



Adjacent Path Crossing



Discussion

Guidance for sidepaths should follow that for general design practices of shared use paths.

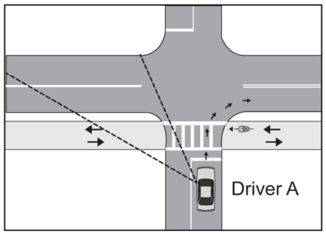
Crossing design should emphasize visibility of users and clarity of expected yielding behavior. Where possible, path users should have right-of-way priority over traffic on side streets. Crossings may be STOP or YIELD controlled for motor vehicles depending on sight lines and bicycle motor vehicle volumes and speeds.

Design Summary

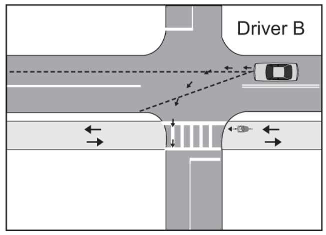
- In general, there are two approaches to driveway crossings: setback crossings and adjacent crossings, illustrated above.
- **Setback Crossing** - A set back of 25 feet separates the path crossing from merging/turning movements that may be competing for a driver's attention.
- **Adjacent Crossing** - A separation of 5 feet or less emphasizes the conspicuity of riders at the approach to the crossing.

Sidepath Conflicts (AASHTO 2012)

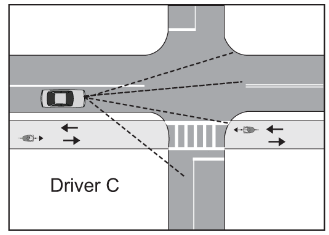
The AASHTO Guide for the Development of Bicycle Facilities cautions practitioners of the use of two-way sidepaths on urban or suburban streets with many driveways and street crossings. The setback path crossing configuration shown on page 18 is the preferred design to mitigate these design concerns.



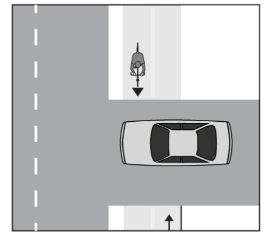
Right turning Driver A is looking for traffic on the left. A contraflow bicyclist is not in the driver's main field of vision.



Left turning Driver B is looking for traffic ahead. A contraflow bicyclist is not in the driver's main field of vision.



Right turning Driver C is looking for left turning traffic on the main road and traffic on the minor road. A bicyclist riding with traffic is not in the driver's main field of vision.



Stopped motor vehicles on side streets or driveways may block the path.

Additional Considerations

- Along roadways, these facilities create a situation where a portion of the bicycle traffic rides against the normal flow of motor vehicle traffic and can result in wrong-way riding where bicyclists enter or leave the path. Therefore, appropriate connecting facilities must be provided.
- 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 bike lanes, but should 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. **(AASHTO 2012)**

References

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- FHWA. Roundabouts: An Informational Guide. 2000.
- TRB. Roundabouts: An Informational Guide, Second Edition. NCHRP 672. 2010.

Cost

Costs can vary substantially based on the materials used, right-of-way costs, and other factors. A paved, multi-use trail can range in cost from approximately $65,000 per mile to more than $4 million per mile.

SHARED-USE PATHS

TREAD-SEPARATED SHARED-USE PATH

As user volumes on shared-use paths increase, the degree of mobility, usability and comfort for those users decreases. In high volume scenarios, shared-use paths should separate users through lane delineation, materials, or physical separation.

Discussion

Tread-separated shared-use paths are typically used when there are high volumes of users, or high potential demand for the facility. They are also appropriate for segments of paths that connect to conventional or separated bike lanes.

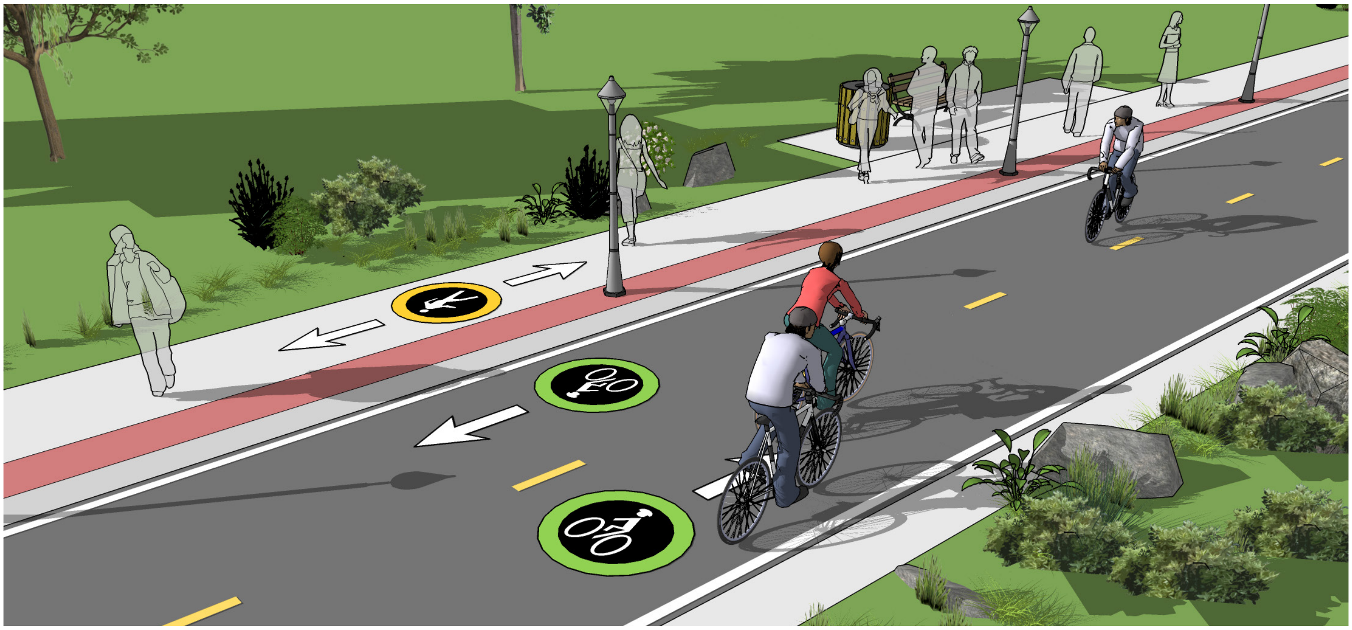
User separation increases mobility during path segments, but may introduce additional conflicts at intersections or connections to other paths. Clear signing and markings should be used to specify yielding expectations

References

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Design Summary

- 15 feet minimum width to allow for tread separation: 10 feet wide path for bicycle only use, with 5 ft section for pedestrian-only use.
- User delineation may be lane striping or differing paving materials. If different materials are used, consider concrete for pedestrians and asphalt for bicyclists.
- In areas with extra width available, user treads may be separated further, with materials such as cobblestones, or planted landscaping.
- Lighting is recommended and provides security and safety benefits, allowing the facility to be used after dusk, particularly during the winter months.
- Clear signs should be used to specify user positioning.
- If markings are used, use small-scale symbols instead of full-sized roadway markings.



SHARED-USE PATHS

BOARDWALKS

Boardwalk construction may be used in sensitive areas such as stream environment zones and in areas of steep slopes. Boardwalk construction is typically much more expensive than standard paved paths. Boardwalks should have a surface that is comfortable and safe for bicyclist use and should be considered in relation to environmental needs, budget, and potential use needs and management issues.

Design Summary

Design Criteria

If bicyclists are allowed, design criteria for boardwalks should meet AASHTO design recommendations for paved shared-use paths. Paths should also be designed to structurally support the weight of a small truck or a light-weight maintenance vehicle.

Width

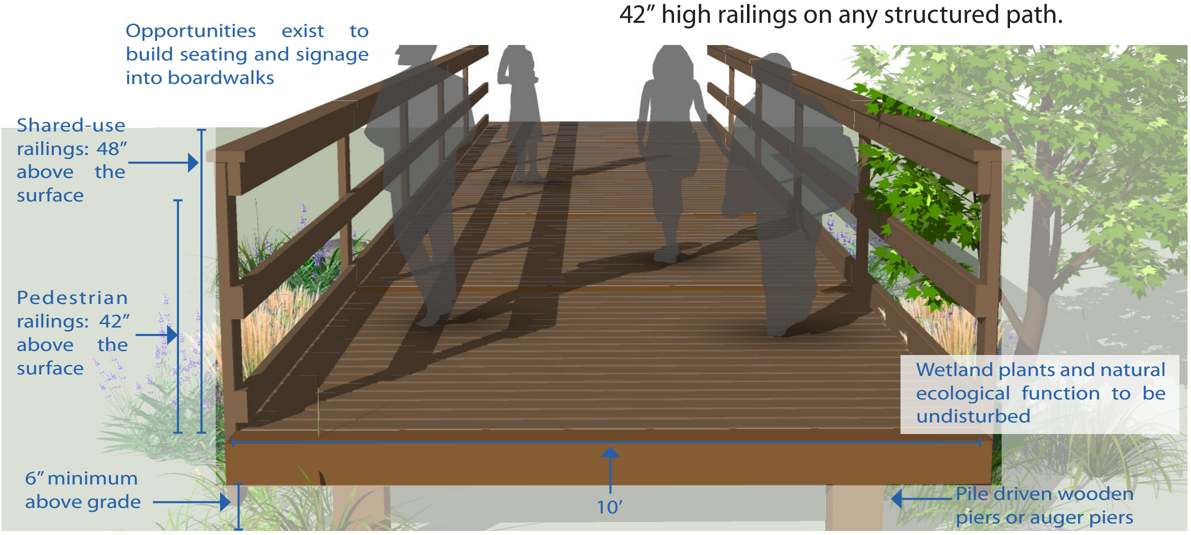
Path width should be a minimum of 10 feet when no rail is used. A 12 foot width is preferred in areas with high anticipated use and whenever rails are used. AASHTO recommends carrying the clear area (or 2 foot space on either side of path) across the structure. This provides an appropriate horizontal shy distance from the railing and allows for maneuvering space to avoid conflicts with users stopped on the structure. A 10 foot width is recommended only for low-use areas.

Height from Ground

Path height should be set to allow for small animal movement under the structure and passage of expected water flows, a minimum of 6” above grade.

Railings

Paths less than 30” above grade may not require a railing according to current building standards. Six inch curb rails may be used. Paths higher than 30” above grade require a 42” high rail. It should be noted that AASHTO recommends 42” high railings on any structured path.



References

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- Department of Justice. ADA Standards for Accessible Design. 2010.

Cost

Dependent on use of railings, materials, width, height, and anticipated loads. Can vary between $2.25M and $4M per mile for a 10 foot wide path.

SHARED-USE PATHS

CAUSEWAYS

Causeways or “burm” type path construction may be used to minimize disturbance of water flow in stream environment zones. Paths are elevated above wet ground using a permeable fill material as a base. Path edges incorporate small boulders or a rock riprap to contain the permeable fill. Geotextile mats and other construction materials such as geocells can be incorporated to ensure a stable base on which asphalt or concrete paving may be applied. The path should be built up to an elevation no greater than 30 inches above natural grade.

Design Summary

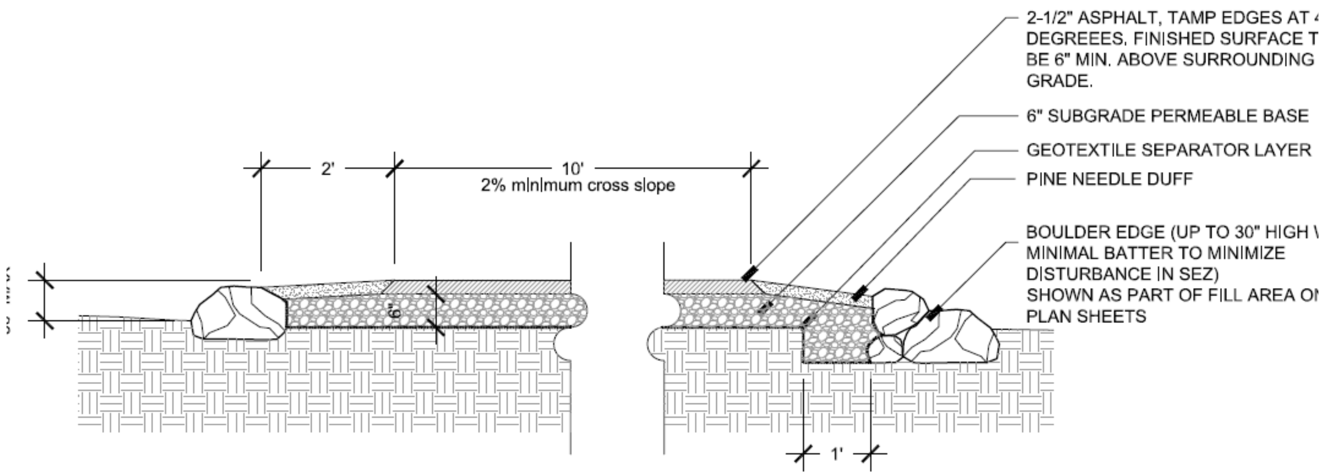
Design Criteria

Design criteria for causeways should meet AASHTO and Caltrans design recommendations for paved shared-use paths.

Base

Path construction and detailing depends on water table and surface flows through site. A stable base for paving must be established while allowing for water flow under path. Base materials should be designed so as not to be compromised by future water flows. Firm mineral soil, coarse-grained soils or granular material, or small, well-graded angular rocks are needed for fill.

It should be noted that AASHTO recommends 42” high railings on any structured path.



References

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- United States Forest Service. Trail Construction and Maintenance Notebook. 2007.
- Caltrans. Highway Design Manual. 2015.

Cost

Dependent on surface type. Native surface and decomposed granite surfaces are less expensive than paving. Paved applications would include the typical cost of a paved path plus the riprap edge support.

AGGREGATE SURFACE TRAILS

Aggregate surface trails are most applicable in non-urban environments and in multi-use areas where a variety of recreational use is anticipated. This includes hiking, biking, mountain biking, and equestrian use. Aggregate surface trails composed of crushed rock using pine tar or other trail stabilization techniques can fit in well with a natural setting and can cost less to construct than an asphalt trail.

Discussion

Sustainable design must consider these forces – compaction, displacement, and erosion – that are caused by water and trail use. Compaction will deepen the heavily traveled portion of the trail. Displacement deepens the tread and raises the untraveled edges. Erosion follows and further deepens the tread. Understanding the site soils, topography, water movement, and anticipated use patterns should be considered during the trail design.

This type of trail may be considered for both permanent and temporary use. As a temporary facility, future phasing would then include returning to the site and paving the surface. This allows for major grading and stabilization to be completed during the first phase and paving completed during the second phase.

Design Summary

Width

Trail widths vary depending upon anticipated type and volume of use.

References

- United States Forest Service. Trail Management Handbook (FSH) 2309.18. 2008.
- Minnesota Department of Natural Resource. Trail Planning, Design, and Development Guidelines. 2007
- United States Forest Service. Trail Construction and Maintenance Notebook. 2007

Cost

$75,000 - $150,000 per mile

LIGHTING

Lighting improves the safety of the path user by increasing visibility during non-daylight hours. The fixtures should be installed near benches, drinking fountains, bicycle racks, trailheads, and roadway and path crossings. TRPA recommends lighting in urbanized areas only. Lighting must be downcast to minimize light pollution and must follow the recommendations in the applicable Community Plan or Area Plan.

Photo by Dan Burden via PBIC Image Library

Design Summary

Depending on the location, average maintained horizontal illumination levels of 5 lux to 22 lux should be considered (AASHTO, 2012). Where special security problems exist, higher illumination levels may be considered.

References

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

BOLLARDS

Minimize the use of bollards to avoid creating obstacles for bicyclists. Bollards, particularly solid bollards, have caused serious injury to bicyclists. The California MUTCD explains, "Such devices should be used only where extreme problems are encountered" (Section 9C.101). Instead, design the path entry and use signage to alert drivers that motor vehicles are prohibited. Please see the next page for alternative design solutions to bollards.

Discussion

Flexible bollards and posts are designed to give way on impact and can be used instead of steel or solid posts. These bollards are typically made of plastic that is bolted to the roadway and bend and return to their original position when hit. They are intended to deter access, but allow vehicles through in an emergency.

Bollards are typically installed using one of two methods: 1) The bollard is set into concrete footing in the ground; and 2) the bollard is attached to the surface by mechanical means (mechanical anchoring or chemical anchor).

The TRPA recommends flexible bollards or no bollards as opposed to solid posts.

Design Summary

- Where removable bollards are used, the top of the mount point should be flush with the path's surface so as not to create a hazard or potentially be damaged by snow removal devices when the bollard is not in place. Posts shall be permanently reflectorized for nighttime visibility and painted a bright color for improved daytime visibility.
- Striping an envelope around the post is recommended.
- When more than one post is used, an odd number of posts at 1.5m (5-foot) spacing is desirable. Wider spacing can allow entry by adult tricycles, wheelchair users and bicycles with trailers.

Examples of Flexible Bollards

References

- Caltrans. Manual of Uniform Traffic Control Devices. 2014.
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Cost

- Bollard, fixed: $220 - $800 each
- Bollard, removable: $680 - $940 each

BOLLARD ALTERNATIVES

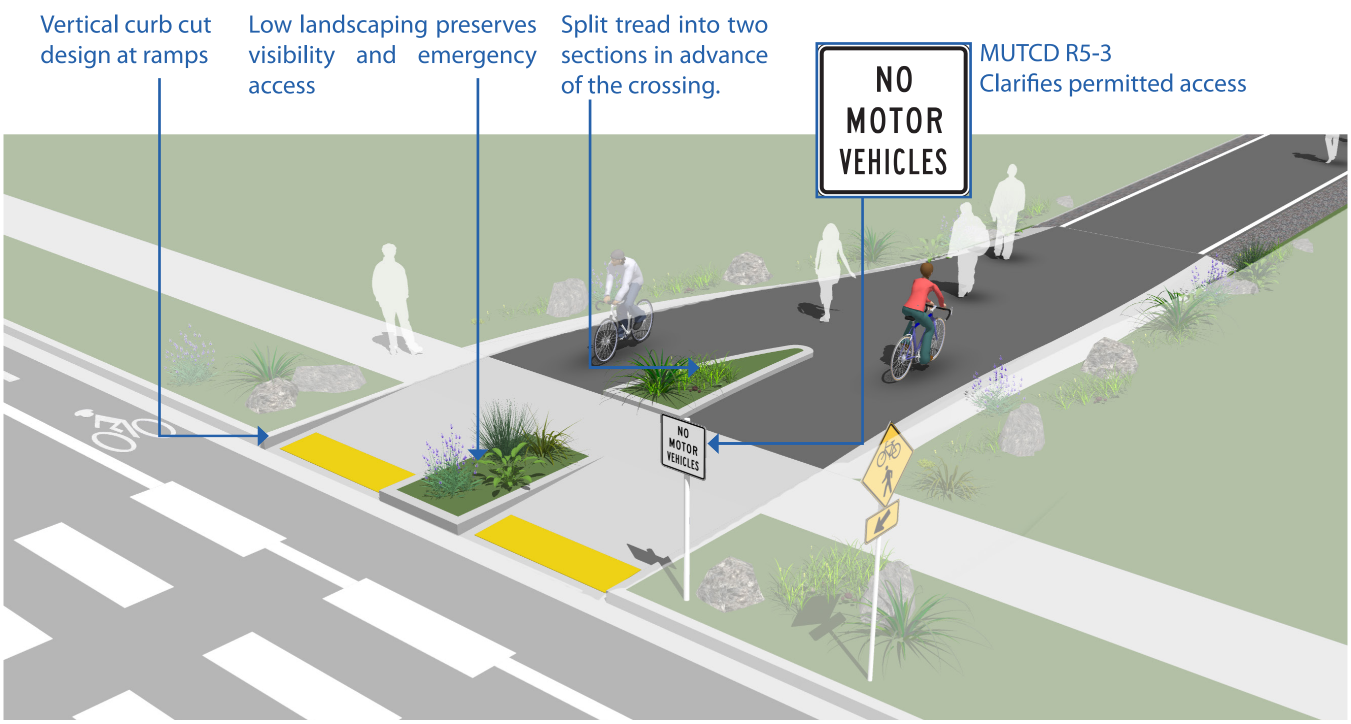
Bollards are physical barriers designed to restrict motor vehicle access to the multi-use path. Unfortunately, physical barriers are often ineffective at preventing access, and create obstacles to legitimate trail users. Alternative design strategies use signage, landscaping and curb cut design to reduce the likelihood of motor vehicle access.

Discussion

Bollards or other barriers should not be used unless there is a documented history of unauthorized intrusion by motor vehicles. If unauthorized use persists, assess whether the problems posed by unauthorized access exceed the risks and issues posed by bollards and other barriers.

Design Summary

- "No Motor Vehicles" signage (MUTCD R5-3) may be used to reinforce access rules.
- At intersections, split the path tread into two sections separated by low landscaping.
- Vertical curb cuts should be used to discourage motor vehicle access.
- Consider targeted surveillance and enforcement at specific intrusion locations



References

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Cost

- Reconstructing a path crossing entry can range from $2,000 to $4,000.

RECOMMENDED YIELD POLICIES

TRPA is collaborating with partner jurisdictions through the Bikeway Partnership on an education campaign aimed at reducing user conflicts on shared-use paths between pedestrians and bicyclists. Custom signage may be installed to guide path users on proper etiquette, especially in areas where conflicts are likely to occur. Local agencies should coordinate with advocacy groups to develop consistent Trail "rules" and campaign materials. Funding and staff capacity is also necessary to implement signage and outreach programs.

Discussion

FHWA has developed and promoted campaigns that educate active transportation users how to travel safely. The FHWA has several pedestrian and bicyclist tools to assist educators, such as "Safer Journey" videos, and interactive websites. The campaigns promote three basic themes: Be Visible, Be Predictable and Follow the Rules of the Road. California State Parks also has basic rules for the trail to reduce user conflict between pedestrians, bicyclists, and equestrians and has implemented signage throughout their vast network of trails.

A centerline marking is particularly beneficial in the following circumstances: A) Where there is heavy use; B) On curves with restricted sight distance; and C) Where the path is unlighted and nighttime riding is expected. A centerline stripe may also be applied uniformly across the entire facility.

Design Summary

Signage

Etiquette signage and education campaigns are recommended by TRPA/TMPO as ways to encourage path users to yield to each other and to keep the paths clear. They also help to encourage predictable user behavior, especially in areas of high use or where conflicts have occurred. Cyclists, pedestrians, and equestrians (where applicable) are advised to adhere to the path rules and share the trail. Under certain conditions such as during times with lower activity and faster bicyclists, it may be advantageous to walk against traffic, however, it is likely not the safest practice for all conditions and thus should not be regulated with signage. To accommodate counterflow walking, no center line should be marked on the path in order to permit maximum flexibility in path user positioning during passing and approaching maneuvers.

User Etiquette Signs Along Multi-Use Paths

References

- FHWA. Manual of Uniform Traffic Control Devices. 2009.
- Caltrans. Manual of Uniform Traffic Control Devices. 2014.
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Cost

- Signs, trail regulation: $150 each
- Signs, trail wayfinding / information: $500 - $2,000 each

SUMMARY OF COVERAGE REQUIREMENTS

Coverage is regulated in Chapter 30 of the TRPA Code of Ordinances. In 2013, the Code was updated to provide exemptions for the provision of ADA facilities and non-motorized public trails. This is an important development that makes planning and building these types of facilities easier for implementors, both public and private.

Discussion

In the Lake Tahoe Region, due to the need to maintain the natural filtration function of soils to reduce runoff into the Lake, there are limits on the amounts of new pavement, or "coverage" that may be constructed. Where the coverage limitation on a parcel or project area is exceeded, new coverage must be transferred in, and mitigated by removing other coverage within the same watershed, or by purchasing banked coverage. Depending on the land capability of the project area, new coverage must be mitigated by removing other coverage at a ratio of 1:1 or 1.5:1.

In certain situations, private property owners will donate or sell easements for implementation of a bicycle path or sidewalk. In this case, any coverage used to construct the path within the easement does not count towards the property owner's total allowable coverage, since the easement area is effectively part of a "project area" that is separate from the parcel. Memorandums of Understanding (MOUs) may be put in place for either the public entity or the private parcel owner to conduct maintenance, such as the snow removal.

References

- TRPA. Code of Ordinances. 2013.

Detailed Guidance

Section 30.4.1. Base Land Coverage Requirements

This section describes the amount of allowable coverage for different land capability districts. Lower land capability districts, such as wetlands or steep slopes, are allowed only 1% of their area to be covered by impermeable surfaces. The highest land capability districts, where water filtration is the best, may have up to 30% of their area covered by impermeable surfaces.

Section 30.4.2. Transferred Land Coverage Requirements

Subsection (2), Linear Public Facilities, establishes that this use is eligible for transferring coverage. Bicycle paths, sidewalks, and bicycle lanes are linear public service facilities.

Section 30.5. Prohibition of Additional Land Coverage in Land Capability Districts 1a, 1c, 2 and 3 and 1b (Stream Environment Zones)

Subsections 30.5.1(C) and 30.5.2(C) describe the conditions under which additional land coverage may be transferred into the most sensitive land capability districts for linear public service facility projects.

Section 30.4.6. Exemptions and Partial Exemptions from Calculations of Land Coverage

Subsection C notes that the provision of ADA-required features are typically exempt from the calculation of land coverage. Under Subsection D3, Non-Motorized Public Trails are exempt from the calculation of land coverage subject to design limitations.

SHARED-USE PATH CROSSINGS

PATH CROSSING AT INTERSECTION

The evaluation of a roadway crossing involves analysis of vehicular traffic and path user travel patterns, including speeds, street width, traffic volumes (average daily traffic, peak hour traffic), line of sight, and path user profile (age distribution and destinations). When engineering judgment determines that the visibility of the intersection is limited on the shared-use path approach, Intersection Warning signs should be used.

Design Summary

A path should cross at a signalized intersection if there is a signalized intersection within 350 feet of the path and the crossroad is crossing a major arterial with a high ADT.

Signage

Intersection Warning (W2-1 through W2-5) signs may be used on a roadway, street, or shared-use path in advance of an intersection to indicate the presence of an intersection and the possibility of turning or entering traffic, no less than 50 feet before the intersection. A path-sized stop sign (R1-1) should be placed about 5 feet before the intersection.

Traffic Calming

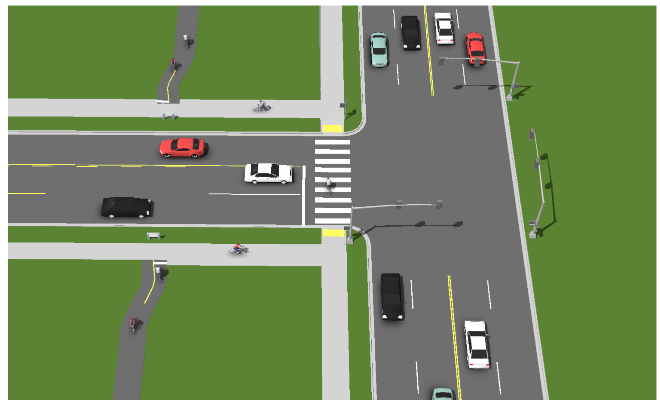
Reducing the speed of the conflicting motor vehicle traffic should be considered. Options may include: transverse rumble strips approaching the path crossing; sinusoidal speed humps (compatible with slow speed snow removal operations).[1]

Crosswalk Markings

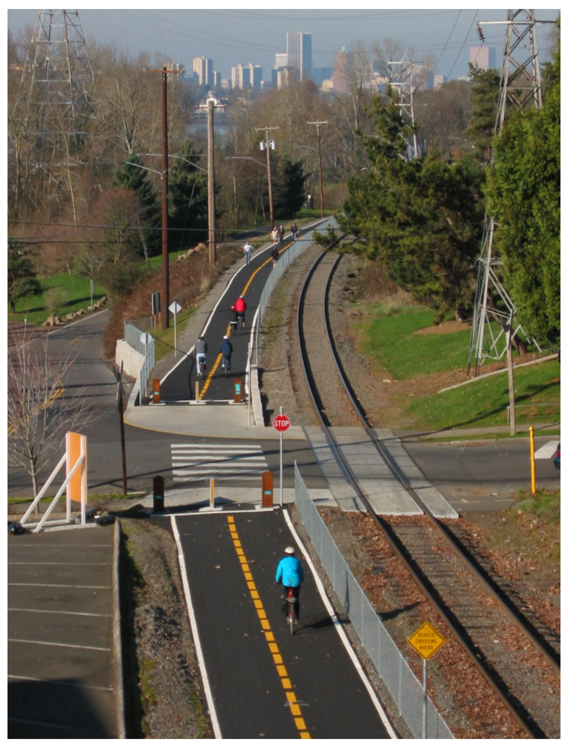
Colored and/or high visibility crosswalks are recommended.

Path Speed Control

A chicane, or swerve in multi-use path approaching the crossing is recommended to slow bicyclist speed. Path users traveling in different directions should be separated either with physical separation (such as a raised median) or a centerline. If a centerline is used, it should be striped for the last 100 feet of the approach.



Recommended "Typical" At-Grade Crossing of a Major Arterial at an Intersection Where Path is Within 350 Feet of a Roadway Intersection



1 Humps with a sinusoidal profile are similar to round-top humps but have a shallower initial rise (similar to a sine wave). They were developed to provide a more comfortable ride for cyclists in traffic calmed areas.

STOP VERSUS YIELD MARKINGS AT CROSSINGS

Where conditions require path users, but not roadway users, to stop or yield, the STOP sign or YIELD sign should be placed on the path. When placement of STOP or YIELD signs is considered, priority at a shared-use path/roadway intersection should be assigned with consideration of the relative speeds of shared-use path and roadway users, relative volumes of shared-use path and roadway traffic, and whether the crossing is parallel to or across a major roadway.

Discussion

Speed should not be the sole factor used to determine priority, as it is sometimes appropriate to give priority to a high-volume shared-use path crossing a low-volume street, or to a Regional shared-use path crossing a minor collector street. This is most prevalent when crossing a minor street in parallel with a major street, such as a sidepath. In some cases it may be appropriate to control the roadway only, while not controlling the path. The least restrictive appropriate controls should be used. STOP signs should not be used where YIELD signs would be acceptable.

The *Side Paths at Driveways and Minor Streets* reference sheet provides more guidance.

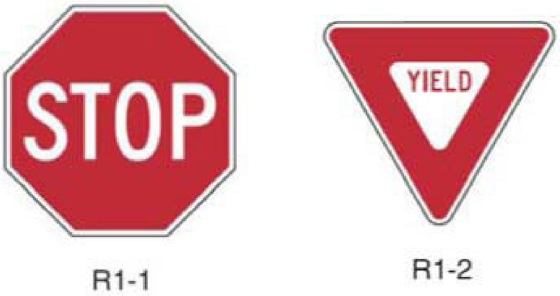
References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. Manual of Uniform Traffic Control Devices. 2014.
- AASHTO. Guide for the Development of Bicycle Facilities,. 2012.

Design Summary

Path Crossing Signage

STOP (R1-1) signs shall be installed on shared-use paths at points where bicyclists are required to stop. YIELD (R1-2) signs shall be installed on shared-use paths at points where bicyclists have an adequate view of conflicting traffic as they approach the sign, and where bicyclists are required to yield the right-of-way to that conflicting traffic.



Cost

- Stop limit bars/yield teeth: $200-$530 per set
- Stop pavement markings: $420 each
- Pavement Markings (Thermoplastic): $3.39 per square foot
- Signs, Path Crossing: $780 each
- Signs, Path Stop/Path Yield: $520 each
- Signs, Path Regulation: $150 each

MARKED/UNSIGNALIZED MID-BLOCK CROSSINGS

A marked/unsignalized crossing typically consists of a marked crossing area, signage and other markings to slow or stop traffic. The approach to designing crossings at mid-block locations depends on an evaluation of vehicular traffic, line of sight, pathway traffic, use patterns, vehicle speed, road type, road width, and other safety issues such as proximity to major attractions. When space is available, using a median refuge island improves user safety by providing pedestrians and bicyclists space to perform the safe crossing of one side of the street at a time.

Discussion

Unsignalized crossings of multi-lane arterials over 15,000 ADT may be possible with features such as sufficient crossing gaps (more than 60 opportunities to cross per hour), median refuges, and/or active warning devices like rectangular rapid flash beacons, and excellent sight distance. For more information see the discussion of active warning beacons.

This treatment is appropriate for crossings located in school zones.

Design Summary

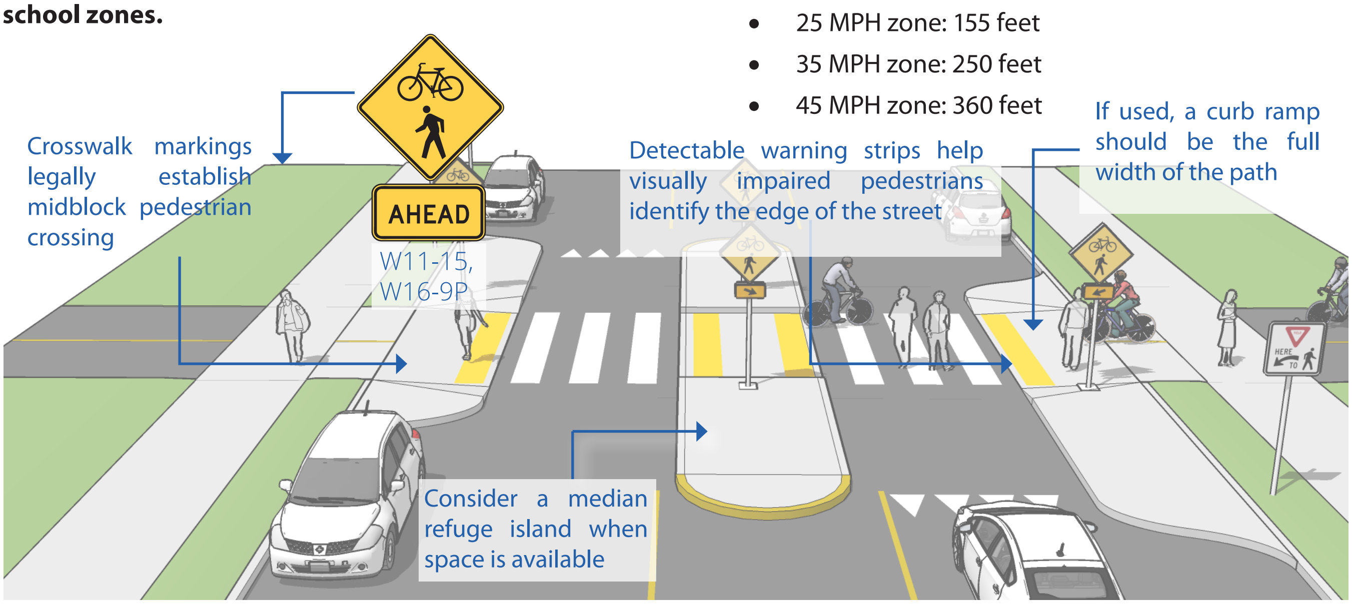
Maximum traffic volumes

- ≤9,000-12,000 Average Daily Traffic (ADT) volume
- Up to 15,000 ADT on two-lane roads, preferably with a median
- Up to 12,000 ADT on four-lane roads with median

Maximum travel speed: 35 MPH

Minimum line of sight

- 25 MPH zone: 155 feet
- 35 MPH zone: 250 feet
- 45 MPH zone: 360 feet



References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- NDOT. Process for the Evaluation of Uncontrolled Crosswalk Locations. 2014.

Cost

- Signage: $125 each
- Marked Crosswalk, $550 each
- Stop limit bars/yield teeth: $200-$530 per set
- Median Refuge Island (optional): $8,500 - $33,000 each

ACTIVE WARNING BEACONS

Active warning beacons are user actuated illuminated devices designed to increase motor vehicle yielding compliance at crossings of multi lane or high volume roadways. Types of active warning beacons include conventional circular yellow flashing beacons, in-roadway warning lights, or Rectangular Rapid Flash Beacons (RRFB).

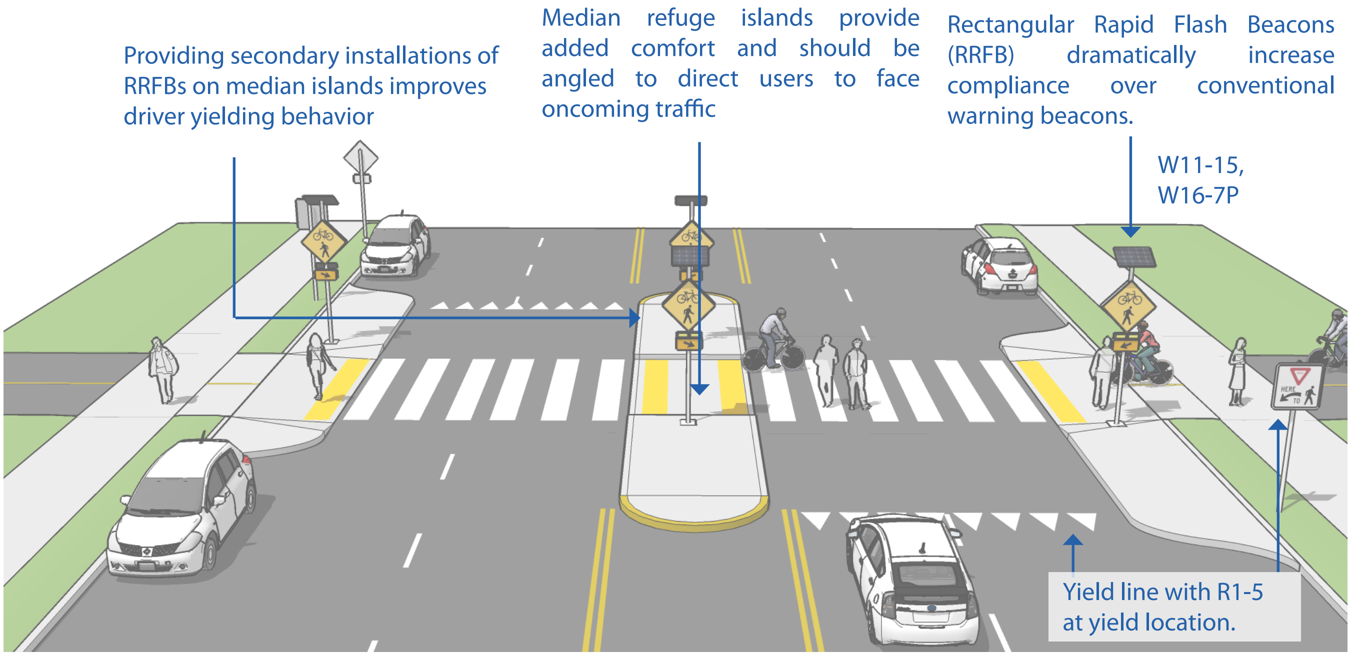
Discussion

Rectangular rapid flash beacons have the highest compliance of all the warning beacon enhancement options.

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 percent.

Design Summary

- Warning beacons shall not be used at crosswalks controlled by YIELD signs, STOP signs, or traffic signals.
- Warning beacons shall initiate operation based on pedestrian or bicyclist actuation and shall cease operation at a predetermined time after actuation or, with passive detection, after the pedestrian or bicyclist clears the crosswalk.



References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- NDOT. Process for the Evaluation of Uncontrolled Crosswalk Locations. 2014.

Cost

- Actuated Pedestrian Crossing: $40,000 each
- Marked Crosswalk, $550 each
- Signage: $125 each
- Median Refuge Island (optional): $8,500 - $33,000 each

SHARED-USE PATH CROSSINGS

HYBRID BEACONS

Hybrid beacons are used to improve non-motorized crossings of major streets. A hybrid beacon 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.

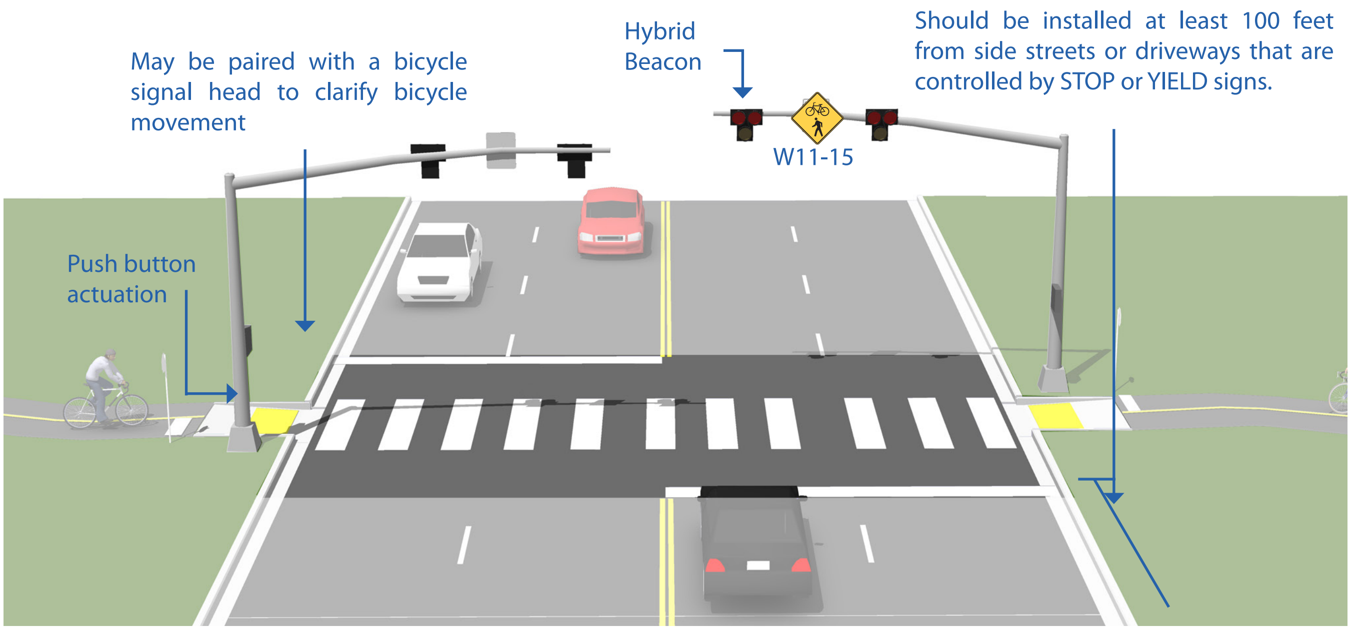
Discussion

Hybrid beacon signals are normally activated by push buttons, but may also be triggered by infrared, microwave or video detectors. The maximum delay for activation of the signal should be two minutes, with minimum crossing times determined by the width of the street. 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.

This treatment is appropriate for crossings located within school zones.

Design Summary

- Hybrid beacons 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 hybrid signal to be coordinated with other signals.
- Parking and other sight obstructions should be prohibited for at least 100 feet in advance of and at least 20 feet beyond the marked crosswalk to provide adequate sight distance.



References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- NACTO. Urban Bikeway Design Guide. 2012.

Cost

- Crossing, Hybrid Beacon $50,000+ each
- Marked Crosswalk, $550 each
- Signage: $125 each

Photo above by Mike Cynecki via PBIC Image Library

SHARED-USE PATH CROSSINGS

SIGNALIZED MID-BLOCK CROSSING

Warrants from the MUTCD combined with sound engineering judgment should be considered when determining the type of traffic control device to be installed at path-roadway intersections. Traffic signals for path-roadway intersections are appropriate under certain circumstances. The MUTCD lists 11 warrants for traffic signals, and although path crossings are not addressed, bicycle traffic on the path may be functionally classified as vehicular traffic and the warrants applied accordingly. Pedestrian volumes can also be used for warrants.

Discussion

Experimental Treatment

A Toucan crossing (derived from: “two can cross”) is used in higher traffic areas where pedestrians and bicyclists are crossing together.

This treatment is appropriate for crossings located within school zones.

References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- AASHTO Guide for the Development of Bicycle Facilities. 2012.

Design Summary

Warrants

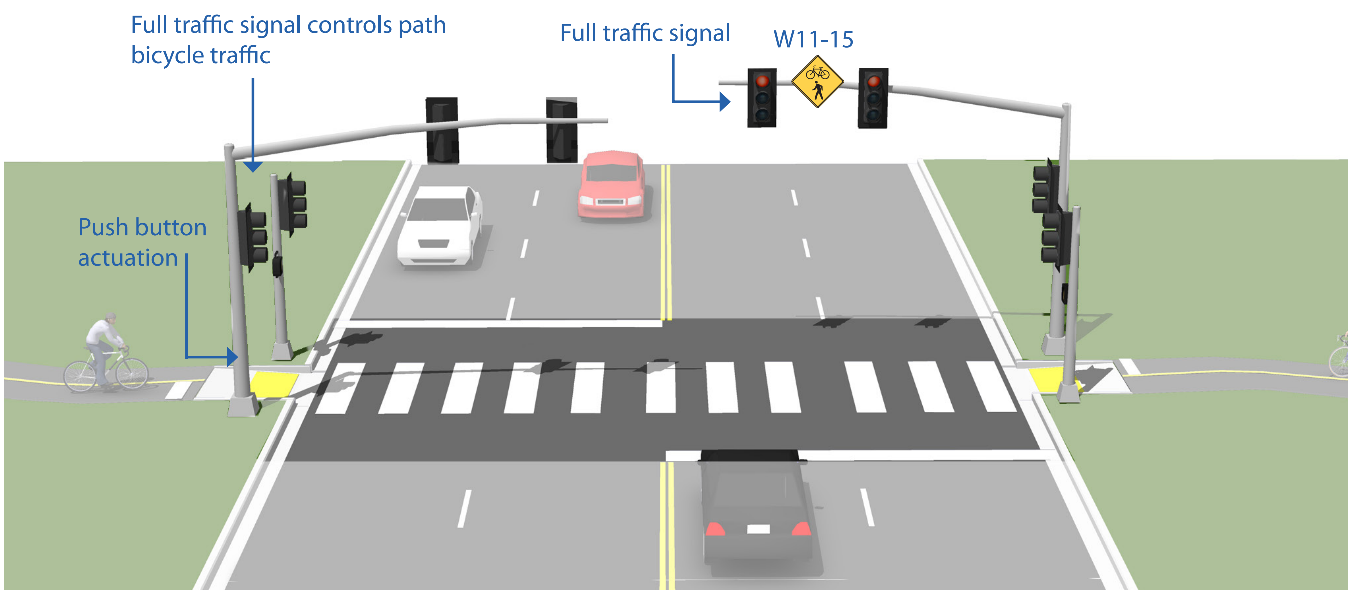
Section 4C.05 in the MUTCD and CAMUTCD describes pedestrian volume minimum requirements (referred to as warrants) for a mid-block pedestrian-actuated signal. Note that California and Nevada have different warrants.

Pavement Markings

Stop lines at midblock signalized locations should be placed at least 40 feet in advance of the nearest signal indication.

Cost

- Crossing, Toucan: $90,000 each
- Marked Crosswalk, $550 each
- Signage, $125 each



INTERSECTIONS WITH SMALL STREETS

The California and Nevada Vehicle Code requires that motorists yield right-of-way to pedestrians within crosswalks. This requirement for motorists to yield is not explicitly extended to bicyclists, and the rights and responsibilities for bicyclists within crosswalks is ambiguous. On crossings of minor streets, design solutions should resolve this ambiguity where possible by giving people on bicycles priority within the crossing. Where this is not possible, the design should create conditions and slow speeds that encourage safe interactions in the case of a user error. Determination of priority between streets and paths can be found in the TRB Highway Capacity Manual (2010),

Benefits

Crosswalk markings establish a legal crosswalk at areas away from intersections (MUTCD Section 3B.18).

Motorists decrease speed in the vicinity of marked crosswalks and crosswalk usage increases with the installations of crosswalk markings (Knoblauch, 2001).

Motorists are statistically more likely to yield right-of-way to pedestrians in a marked crosswalk than an unmarked crosswalk (Mitman, 2008).

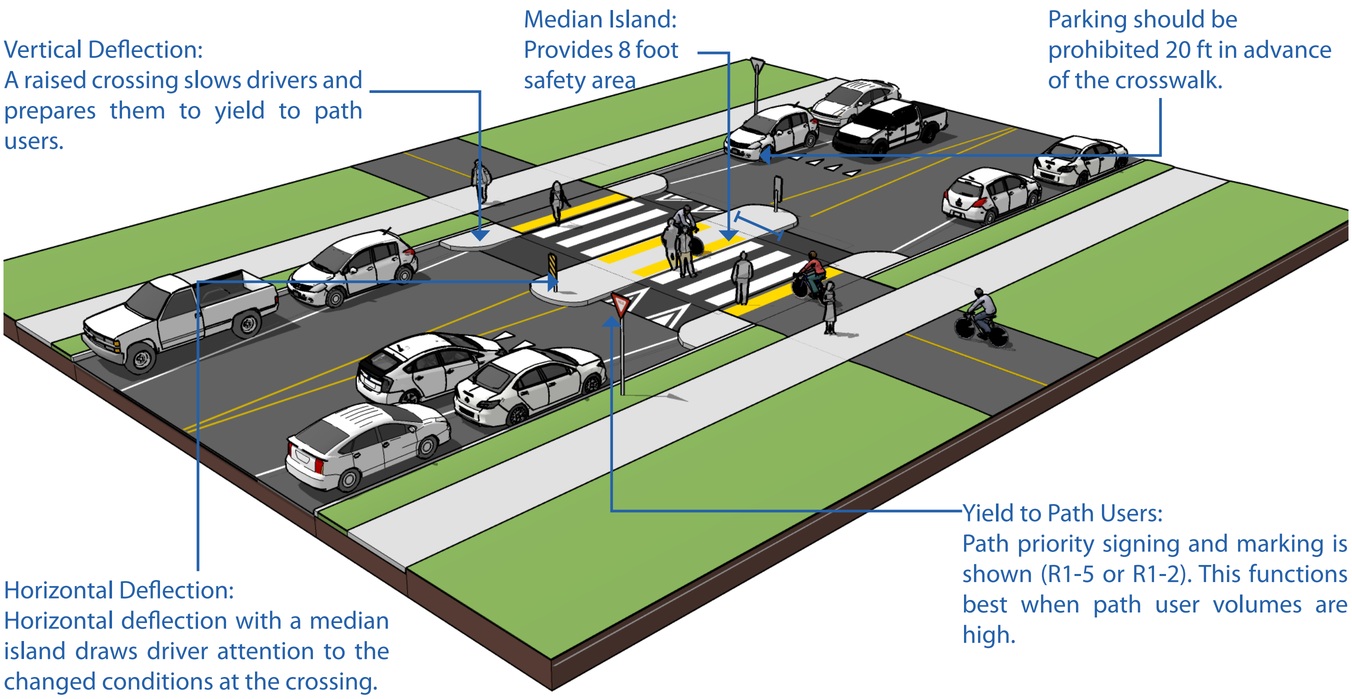
Discussion

Geometric design should promote a high degree of yielding to path users through raised crossings, horizontal deflection, signing, and striping.

The approach to designing path crossings of streets depends on an evaluation of vehicular traffic, line of sight, pathway traffic, use patterns, vehicle speed, road type, road width, and other safety issues such as proximity to major attractions.

On high speed and high volumes roadways, crosswalk markings alone are not a viable safety measure. This supports the creation of more robust crossing solutions (Zeeger, 2001).

Path Priority Crossing



Design Summary

Crossing Geometry

In Nevada, parking is prohibited within 20 feet of any marked crosswalk.

A median safety island should allow path users to cross one lane of traffic at a time. The bicycle waiting area should 8 feet wide or wider to allow for a variety of bicycle types.

Raised crossings should raise 4 inches above the roadway with a steep 1:6 (16%) ramp. The raise should use a sinusoidal profile to facilitate snow plow operation. Advisory speed signs may be used to indicate the required slow crossing speed.

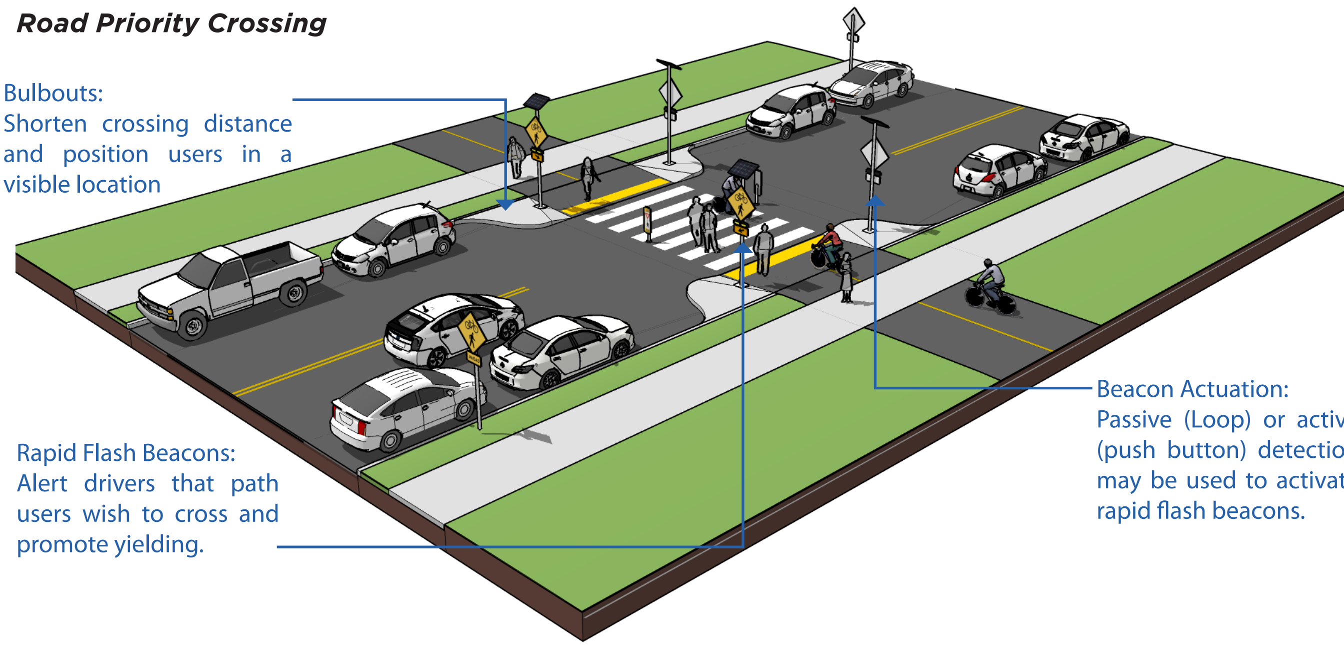
Markings

High-visibility crosswalk markings are the preferred marking type at uncontrolled marked crossings (FHWA, 2013). Transverse lines are "essentially not visible" when viewed from a standard approaching vehicle. (ITE, 2010)

Stop or Yield lines may be used on the roadway 20 ft. in advance of crosswalks when right-of-way priority is given to path users (CA MUTCD 3B.18). A yield line must be paired with a Yield (R1-2) or Yield Here To Pedestrians (R1-5) sign.

In roadway Yield to Pedestrians (R1-6) signs may be used along the centerline point of a crosswalk.

Road Priority Crossing



References

- Caltrans. California Highway Design Manual (CAHDM). 2015.
- Caltrans. California Manual on Uniform Traffic Control Devices (CAMUTCD). 2014.
- ITE. Pavement Marking Patterns Used at Uncontrolled Pedestrian Crossings. 2010.
- Mitman, M.F., Ragland, D.R., and C.V. Zegeer. The Marked Crosswalk Dilemma: Uncovering Some Missing Links in a 35-Year Debate. 2008.
- Knoblauch, R., M. Nitzburg, and R. Seifert. Pedestrian Crosswalk Case Studies. 2001.
- Zeeger, C., J. Stewart, and H. Huang. Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations. 2001.
- NDOT. Standard Specifications for Road and Bridge Construction. 2014.

Cost

- Striped crosswalks costs range from approximately $100 to 2,100 each.
- Curb extension costs can range from $2,000 to $20,000 depending on the design and site condition.
- Rapid flash beacons costs can range from $15,000 to $60,000 depending on the number of beacons.

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ON-STREET BICYCLE FACILITY DESIGN

BICYCLE BOULEVARD

Bicycle boulevards are low-volume, low-speed streets modified to enhance bicyclist comfort by using treatments such as signage, pavement markings, traffic calming, traffic reduction, and intersection modifications. These treatments allow through movements of bicyclists while discouraging similar through-trips by non-local motorized traffic.

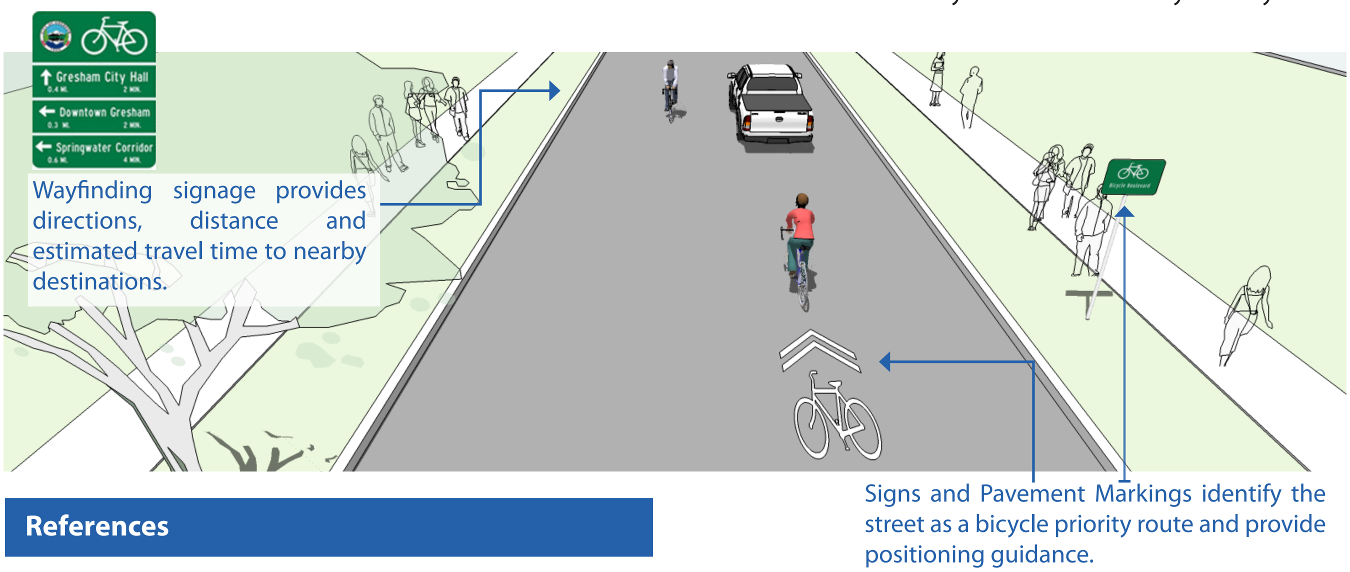
Discussion

Bicycle 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 bicycle boulevard and compromise safety. Traffic calming can deter motorists from driving on a street, increasing safety for active transportation. Anticipate and monitor vehicle volumes to determine whether traffic calming results in the displacement of traffic volumes to adjacent residential streets. Traffic calming can be implemented on a trial basis.

This treatment is appropriate for school zones.

Design Summary

- Signs and pavement markings are the minimum treatments necessary to designate a street as a bicycle boulevard.
- Bicycle boulevards should have a maximum posted speed of 25 mph. Use traffic calming to maintain an 85th percentile speed below 20 mph.
- Implement volume control treatments based on the context of the bicycle boulevard, using engineering judgment. Target motor vehicle volumes are under 1,000.
- Intersection crossings should be designed to enhance safety and minimize delay for bicyclists.



References

- Alta Planning + Design and IBPI. Bicycle Boulevard Planning and Design Handbook. 2009.
- FHWA. BikeSafe Bicycle Countermeasure Selection System. 2014.
- NACTO. Urban Bikeway Design Guide. 2012.
- Reid Ewing and Steven Brown. US Traffic Calming Manual. 2009.

Cost

- Bike Boulevard: $1,000-$40,000 per mile (assumes no major renovation is required)
- Bike Boulevard: $150,000-$300,000 (assuming moderate to major roadway renovation)

ON-STREET BICYCLE FACILITY DESIGN

SHOULDER BIKEWAY

Paved shoulders on rural arterials and state highways can offer a functional option to the installation of bicycle lanes when bicycle lanes are not possible. Major intersection designs should still have bicycle pockets (if applicable) and other treatments to make bicycle travel safer and more visible.

Design Summary

Shoulder Width:

Shoulder width should be 4 feet wide minimum (in addition to a gutter pan, if present) to accommodate a shoulder bike route. Shoulder width of at least 5 feet is recommended when a guardrail, curb, or other roadside barrier is present to provide additional shy distance. If a rumble strip is present (such as on a state highway) it is recommended to include a skip (or gap) in the rumble strip to allow bicyclists to cross from the shoulder to the travel lane when encountering debris.

Sign Placement:

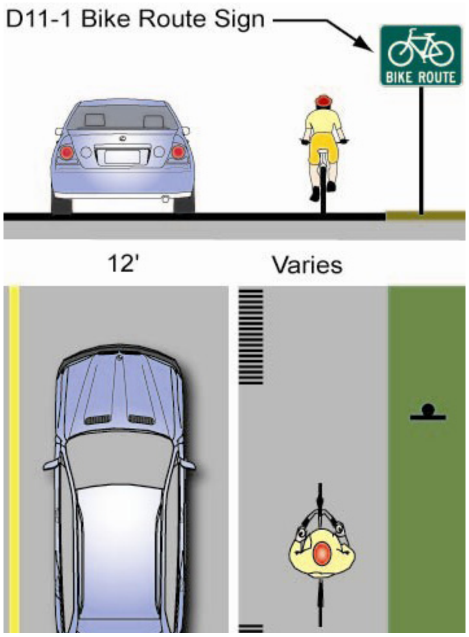
Bicycle Route signage should be applied at intervals frequent enough to keep bicyclists informed of changes in route direction and to remind motorists of the presence of bicyclists.

References

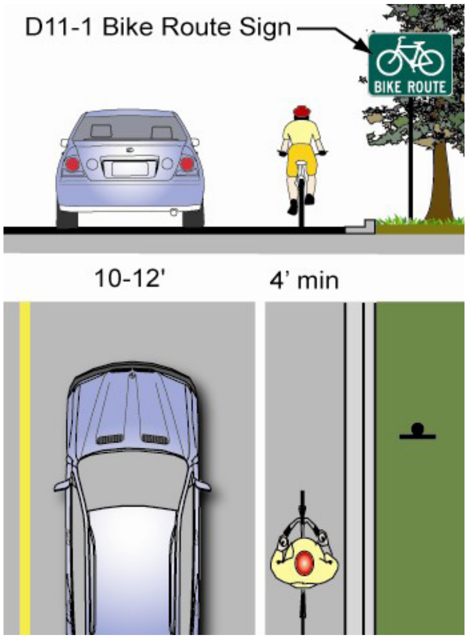
- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Cost

- Bike Route signs with Shoulder Stripe: $5,000 - $10,000 per mile (assumes no major renovation is required)
- Rumble Strip: $0.10 to $0.50 per linear foot



Bike Route with Wide Shoulder and Bicycle Friendly Rumble Strip



Bike Route with Shoulder Stripe

SHARED LANE MARKINGS (SHARROWS)

Shared Lane Markings (also called "Sharrows") are used as an additional treatment for shared roadway facilities. The stencil 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 avoid "dooring" collisions.

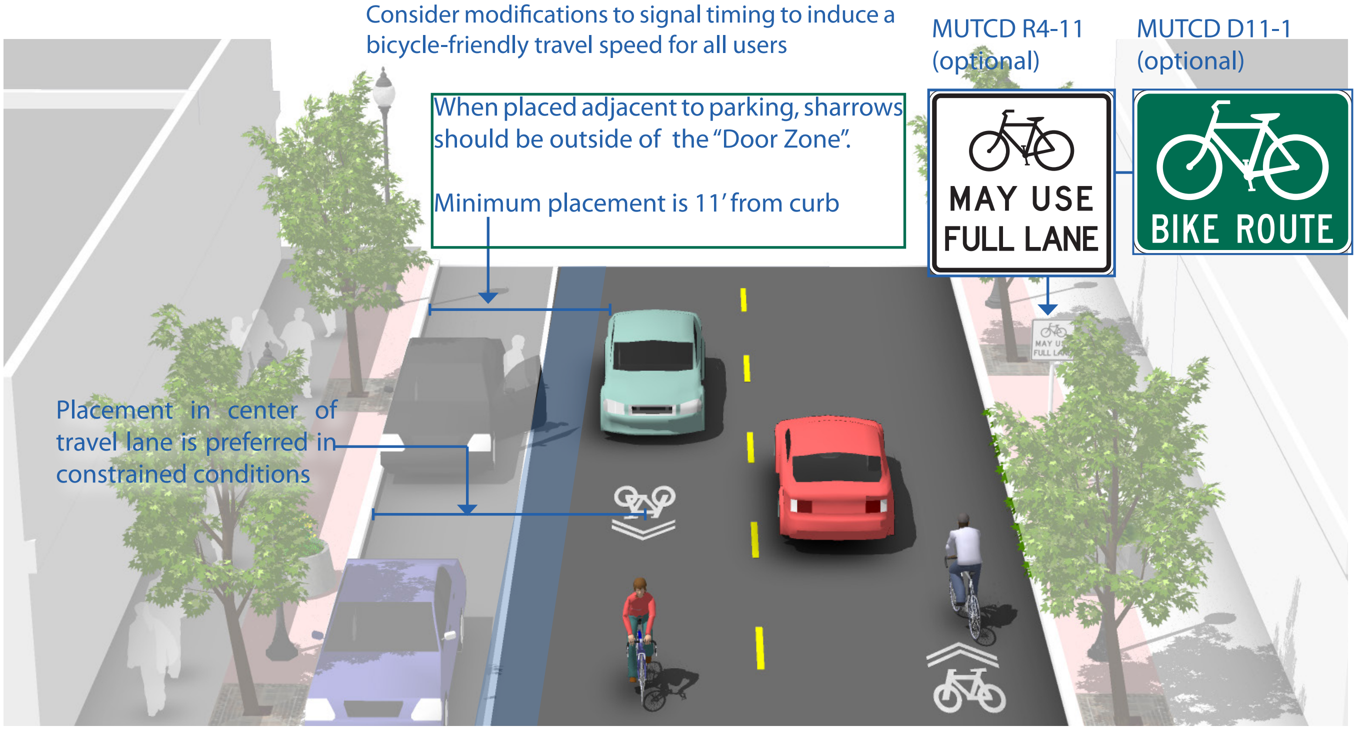
Discussion

Shared lane markings are not appropriate on paved shoulders or in bike lanes, and should not be used on roadways that have a speed limit above 35 mph. Markings should be placed immediately after intersections and spaced at 250 ft intervals thereafter. 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.

Design Summary

Sign Placement:

Shared Lane Markings pair well with Bikes May Use Full Lane signs.



References

- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Cost

- Shared Lane Marking application: $90 each

BIKE LANE WITH NO ON-STREET PARKING

Recommended bicycle lane width is 5 feet minimum when adjacent to curb and gutter. Wider bicycle lanes are desirable in certain circumstances such as on higher speed arterials (45 mph+) where a wider bicycle lane can increase separation between passing vehicles and bicyclists. Appropriate signing and stenciling is important with wide bicycle lanes to ensure motorists do not mistake the lane for a vehicle lane or parking lane. Bicycle lanes wider than 7 feet are not recommended.

Design Summary

Bike Lane Width:

4′ minimum when no gutter is present (rural road sections)

5′ minimum when adjacent to curb and gutter (3′ more than the gutter pan width if the gutter pan is greater than 2′)

Recommended Width:

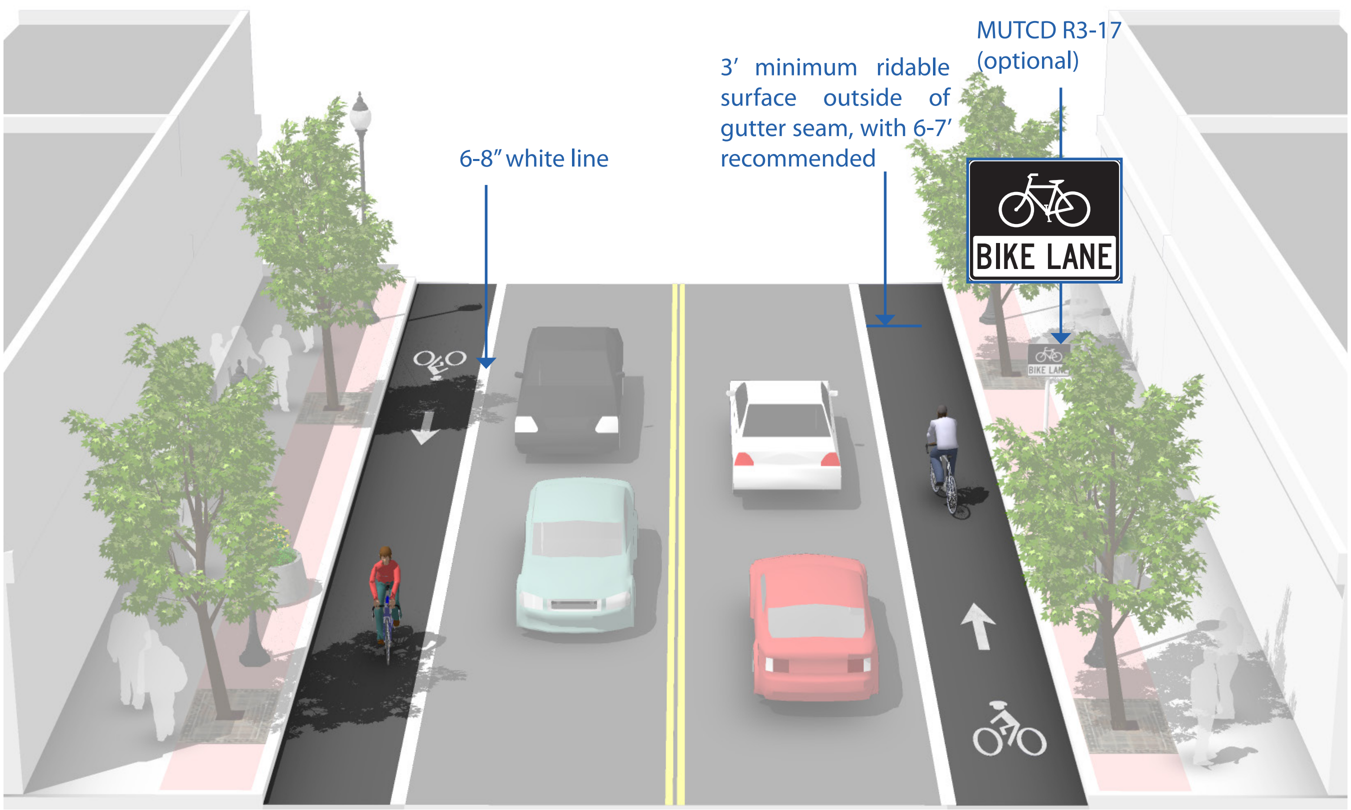
6-7′ where right-of-way allows, in areas of high bicycle use, or on high-speed, high-volume roadways (or with heavy truck volumes) where wider bicycle lanes provide additional lateral separation

References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Cost

- Bike Lane: $5,000 - $10,000 per mile



ON-STREET BICYCLE FACILITY DESIGN

BIKE LANE WITH ON-STREET PARALLEL PARKING

Bike lanes adjacent to parallel parking should be designed to be wide enough to allow bicyclists to ride without conflicts with opening car doors.

Design Summary

Bike Lane Width:

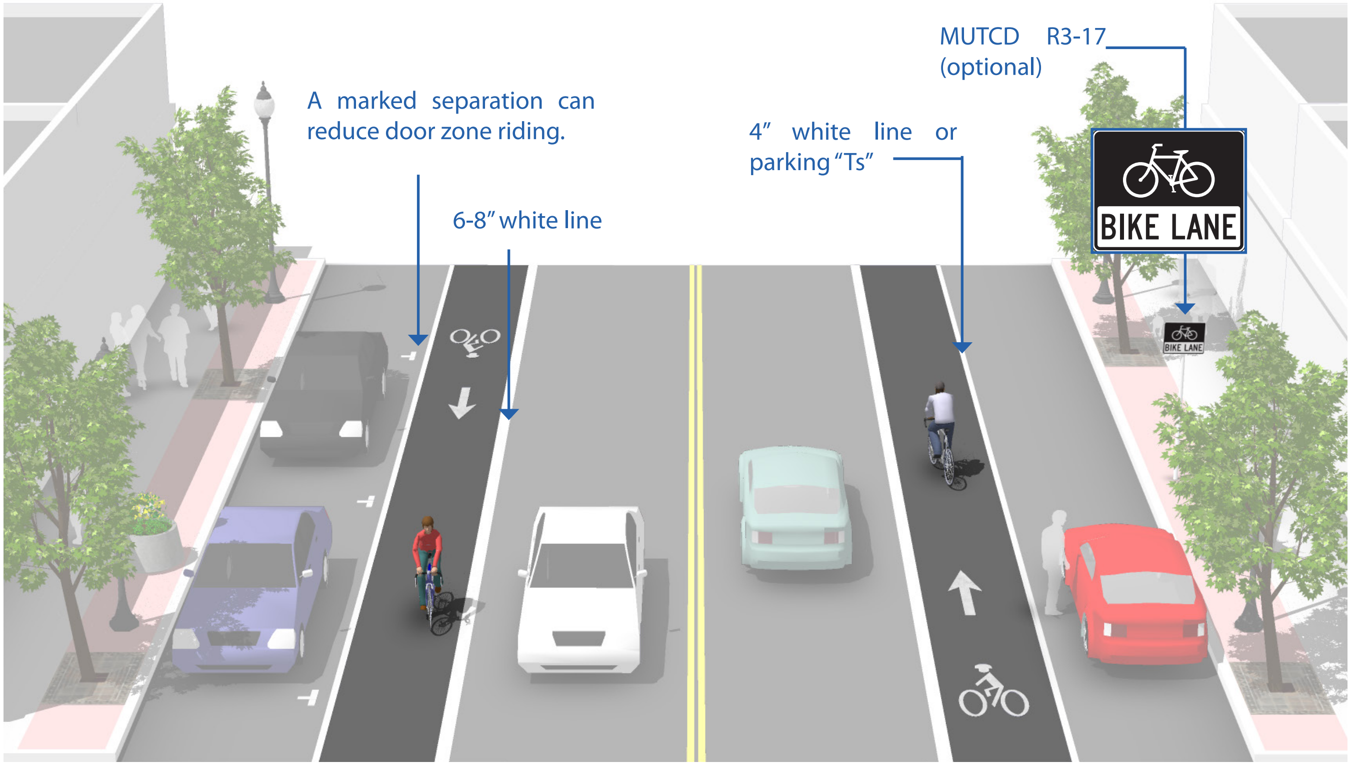
- 6-7 feet recommended to reduce dooring risk in areas with high parking turnover.
- 5 feet minimum recommended when parking stalls are marked
- If wider bike lanes are desired, configure as a buffered bike lane.

References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Cost

- Bike Lane: $5,000 - $10,000 per mile



BUFFERED BIKE LANE

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. Buffered bike lanes are designed to increase the space between the bike lane and the travel lane and/or parked cars. Buffer striping is called Preferential Lane Longitudinal Markings in Section 3D.02 the MUTCD. This treatment is appropriate for bike lanes on roadways with high motor vehicle traffic volumes and speed, adjacent to parking lanes, or a high volume of truck or oversized vehicle traffic.

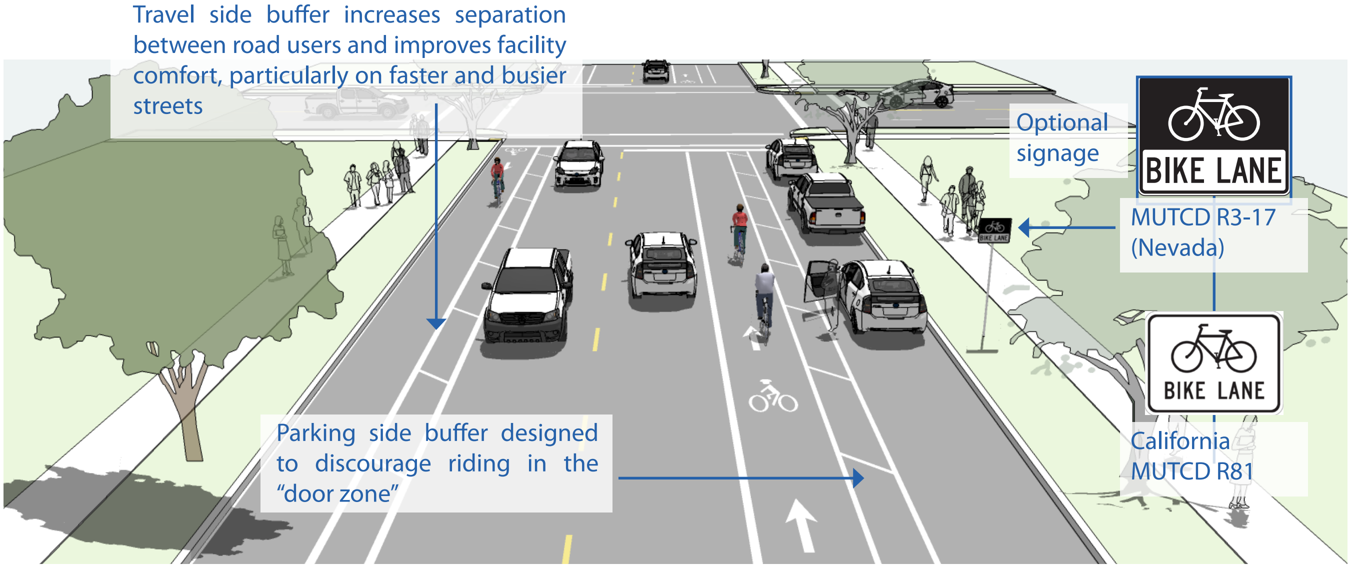
Discussion

Frequency of right turns by motor vehicles at major intersections should determine whether continuous or truncated buffer striping should be used approaching the intersection. Commonly configured as a buffer between the bicycle lane and motor vehicle travel lane, a parking side buffer may also be provided to help bicyclists avoid the 'door zone' of parked cars.

This treatment is appropriate for school zones.

Design Summary

- The minimum bicycle travel area (not including buffer) is 5 feet wide.
- Buffers should be at least 2 feet wide. If 3 feet or wider, mark with diagonal or chevron hatching. For clarity at driveways or minor street crossings, consider a dotted line for the inside buffer boundary where cars are expected to cross.



References

- FHWA. Separated Bike Lane Planning and Design Guide. 2015.
- NACTO. Urban Bikeway Design Guide. 2012.
- Caltrans. MUTCD. 2014.

Cost

- Bike Lane: $5,000 - $10,000 per mile

SEPARATED BIKEWAY (CYCLE TRACK)

Separated bikeways, also known as cycle tracks or protected bike lanes, are exclusive bike facilities that combine the user experience of a separated path with the on-street infrastructure of a conventional bike lane. They are physically separated from motor traffic and distinct from the sidewalk. Separated bikeways have different forms but all share common elements—they provide space that is intended to be exclusively or primarily used by bicycles, and are separated from motor vehicle travel lanes, parking lanes, and sidewalks. Raised bike lanes may be at the level of the adjacent sidewalk or set at an intermediate level between the roadway and sidewalk to separate the bike lane from the pedestrian space.

Discussion

Special consideration should be given at transit stops to manage bicycle and pedestrian interactions. Driveways and minor street crossings are unique challenges to separated bike lane design. Parking should be prohibited within 30 feet of the intersection to improve visibility. Color, yield markings and "Yield to Bikes" signage should be used to identify the conflict area and make it clear that the bike lane has priority over entering and exiting traffic.

Protection is provided through physical barriers and can include bollards, parking, a planter strip, an extruded curb, or on-street parking. Bike lanes using these protection elements typically share the same elevation as adjacent travel lanes. Raised cycle tracks may be at the level of the adjacent sidewalk or set at an intermediate level between the roadway and sidewalk to separate the facility from the pedestrian area. **This treatment is appropriate for school zones.**

Design Summary

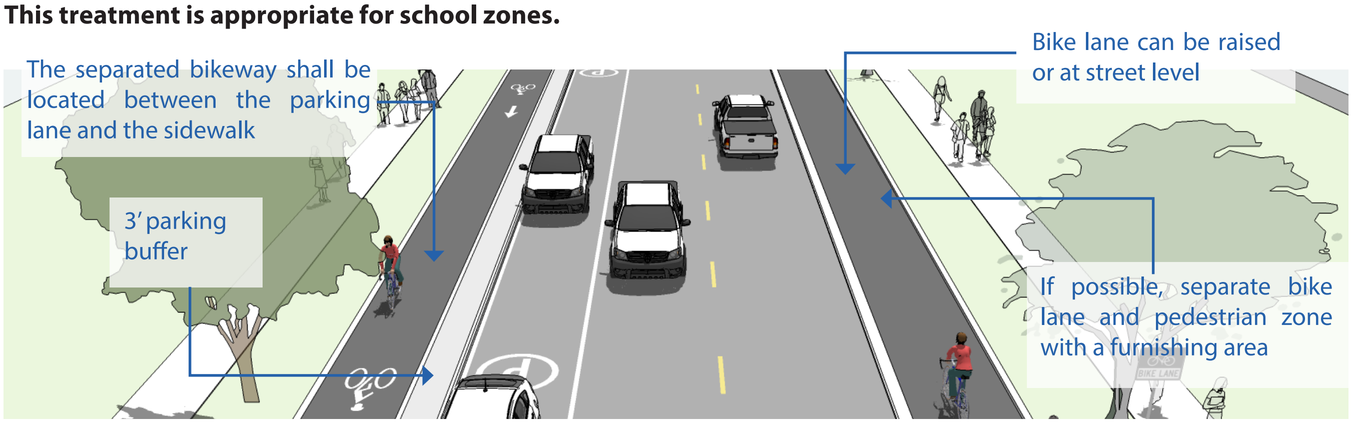
Separated bikeways should ideally be placed along streets with long blocks and few driveways or mid-block access points for motor vehicles.

One-Way Separated Bike Lanes

- 7 foot recommended minimum to allow passing. 5 foot minimum width in constrained locations.

Two-Way Separated Bike Lanes

- Separated bike lanes located on one-way streets have fewer potential conflict areas than those on two-way streets.
- 12 foot recommended minimum for two-way facility. 8 foot minimum in constrained locations



References

- NACTO. Urban Bikeway Design Guide. 2012.
- FHWA. Separated Bike Lane Planning and Design Guide. 2015.

Cost

- Cost varies depending on design and site conditions.

ADVISORY BIKE LANE

Advisory bicycle lanes (also called dashed bicycle lanes) provide a bicycle-priority space on a two-lane street too narrow for conventional bicycle lanes. Similar in appearance to bicycle lanes, advisory bicycle lanes are distinct in that they are temporarily shared with motor vehicles during head-on approaching maneuvers and turning movements. They are most appropriate on streets where there is no centerline, or on wide and rural residential streets.

Discussion

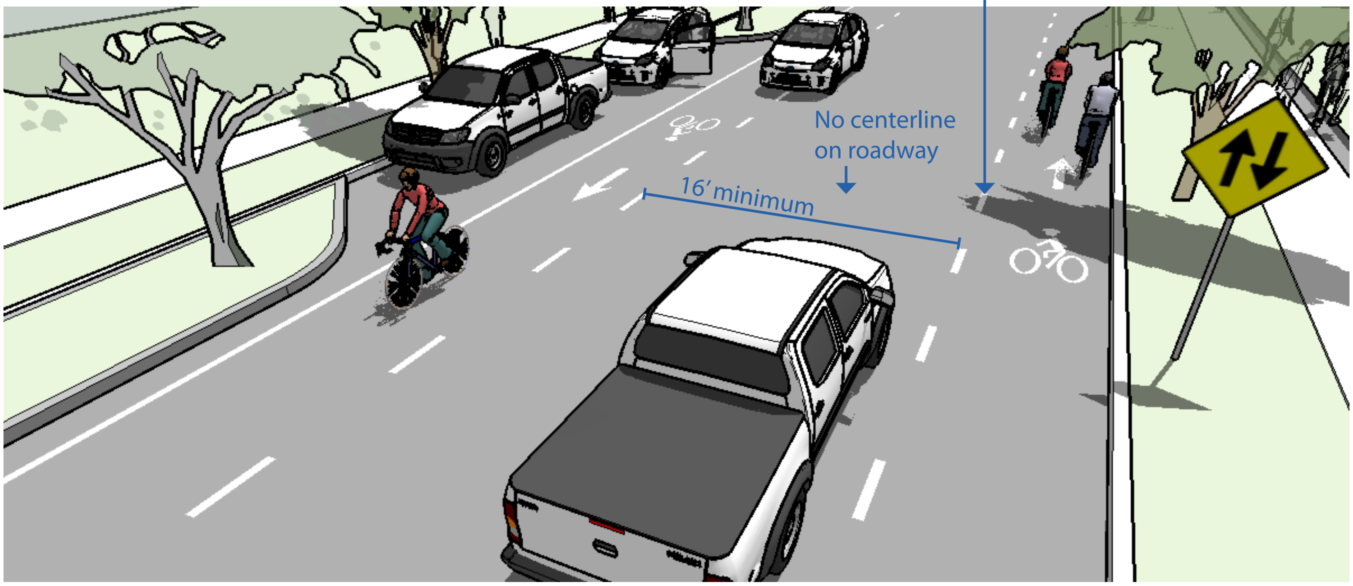
This treatment is considered experimental by FHWA and may require a *Request to Experiment* as described in section 1A.10 of the MUTCD. Specific design detail should conform to MUTCD and Ca-TCDC experimentation requirements.

Consider the use of colored pavement within the advisory bicycle lane area to discourage unnecessary encroachment by motorists or parked vehicles.

Design Summary

Advisory bike lanes should have the following characteristics:

- Motor vehicle traffic is <4000 motor vehicles per day (<2000 preferred).
- Advisory bike lane width of 5 to 7 ft.
- Recommended two-way motor vehicle travel lane width of 16 ft. Some installations have worked with center lane as narrow as 10 ft.



References

- City of Minneapolis. Request To Experiment. 2010.

Cost

- Bike Lane: $5,000-$10,000 per mile

ADDITIONAL BIKE ROUTE SIGNAGE

Signs may be used to raise awareness of the presence of bikes on the roadway beyond that of the conventional "Bike Route" sign. These signs are intended to reduce motor vehicle/bicyclist conflict and are appropriate to be placed on routes that lack paved shoulders or other bicycle facilities.

Discussion

In higher speed rural contexts, a bicycle warning sign (W11-1) paired with a legend plaque reading "ON ROADWAY" may clarify to motor vehicle drivers to expect bicyclists.

In more developed areas, "Bikes May Use Full Lane" (BMUFL) (R4-11) signs encourages bicyclists to take the lane when the lane is too narrow. They typically work best when placed near activity centers such as schools, shopping centers and other destinations that attract bicycle traffic.

A study by researchers at North Carolina State University concluded that the BMUFL sign achieves greater clarity of understanding than the "Share the Road" (W16-1P) plaque often used in similar situations.

Study responses indicated a lack of awareness of the meaning of the Share the Road plaque. Due to this lack of public understanding and lack of support by local bicycle groups, at least one state DOT has discontinued use of the Share The Road plaque. (DelDOT, Memorandum: Bicycle Warning Sign and Share the Road Plaque. November 2013)

Dedicated bicycle facilities are recommended for roadways with speed limits above 35 mph where the need for bicycle access exists.

W11-1 with custom "ON ROADWAY" legend plaque. Under MUTCD 2C.03 P04, a state or local road agency is permitted to use word messages on warning signs other than those shown in the MUTCD.

R4-11

Design Summary

- Use with travel lanes less than 14 feet wide, which are too narrow for safe passing within the lane.
- Signs should be placed at regular intervals along routes with no designated bicycle facilities.

References

- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- Hess G, Peterson MN (2015) "Bicycles May Use Full Lane" Signage Communicates U.S. Roadway Rules and Increases Perception of Safety.

Cost

- Sign, regulation: $150 each

ON-STREET BICYCLE FACILITY DESIGN

MANHOLES AND DRAINAGE GATES

Utility infrastructure within the roadway can present significant hazards to bicyclists. Manholes, water valve covers, drain inlets and other obstructions can present an abrupt change in level, or present a situation where the bicyclist's tire could become stuck, potentially causing a collision. Every effort should be made to avoid placing these hazards within the likely travel path of bicyclists on new roadway construction.

Discussion

For existing roadways, the roadway surface can be ground down around the manhole or drainage grate to be no more than half an inch of vertical drop. When roadways undergo overlays, this step is often omitted and significant elevation differences can result in hazardous conditions for bicyclists.

Bicycle drainage grates should not have longitudinal slats that can catch a bicycle tire and potentially cause a crash. Acceptable grate designs are presented (top right) as A: patterned, B: transverse grate, or C: modified longitudinal with no more than 6" between transverse supports). Type C is the least desirable as it could still cause problems with some bicycle tires.

The drop in-inlet shown to the right avoids all issues with grates in the bicyclists' line of travel. However, these drainage inlets are less efficient than grate inlets, and therefore require installing more closely spaced inlets, much longer inlets and perhaps supplemental means of capturing runoff. For this reason TRPA does not recommend replacing existing grate inlets with drop-in inlets, and suggests agencies weigh the additional costs of drop-in inlets in new construction with the possible benefits.

The MUTCD recommends providing a diagonal solid white line for hazards or obstructions in bikeways (see right).

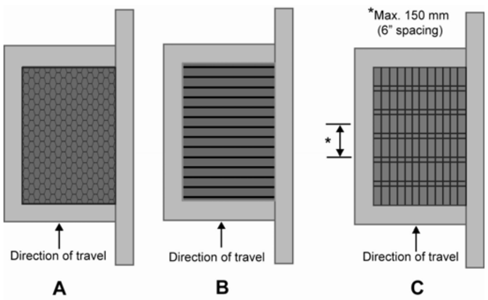
References

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- NDOT Standard Plans for Road and Bridge Construction.
- NDOT Standard Specifications for Road and Bridge Construction.

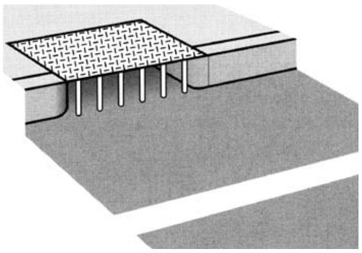
Design Summary

Placement:

Manholes should be placed outside of any bike lanes. Drainage grates should be of one of the types below.



Bicycle Compatible Drainage Grates



Drop-in inlet flush with in the curb face (Oregon DOT)
(Not approved for use on California Highways)

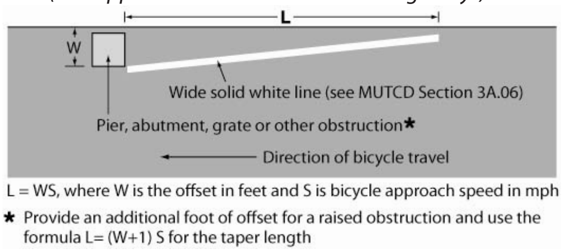


Figure 9C-8B (National MUTCD)

Cost

- Striping: $2 per linear foot
- Drainage grate: $500

BICYCLE ACCESS DURING CONSTRUCTION ACTIVITIES

When construction impedes a bicycle facility, the provision for bicycle access shall be developed during the construction project planning. Long detour routing should be avoided because of lack of compliance. Where there is no detour, provide for passage of bicyclists through or adjacent to the construction area, with signage or other indication of where cyclists should go.

Discussion

Advance warning of the detour should be placed at appropriate locations and clear wayfinding should be implemented to enable bicyclists to continue safe operation along travel corridor. Traffic control signs should not be placed within bike lanes or road shoulders.

References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.

Design Summary

Construction Detour Signs:

Detours should be adequately marked with standard temporary route and destination signs (M409a and M4-9c).

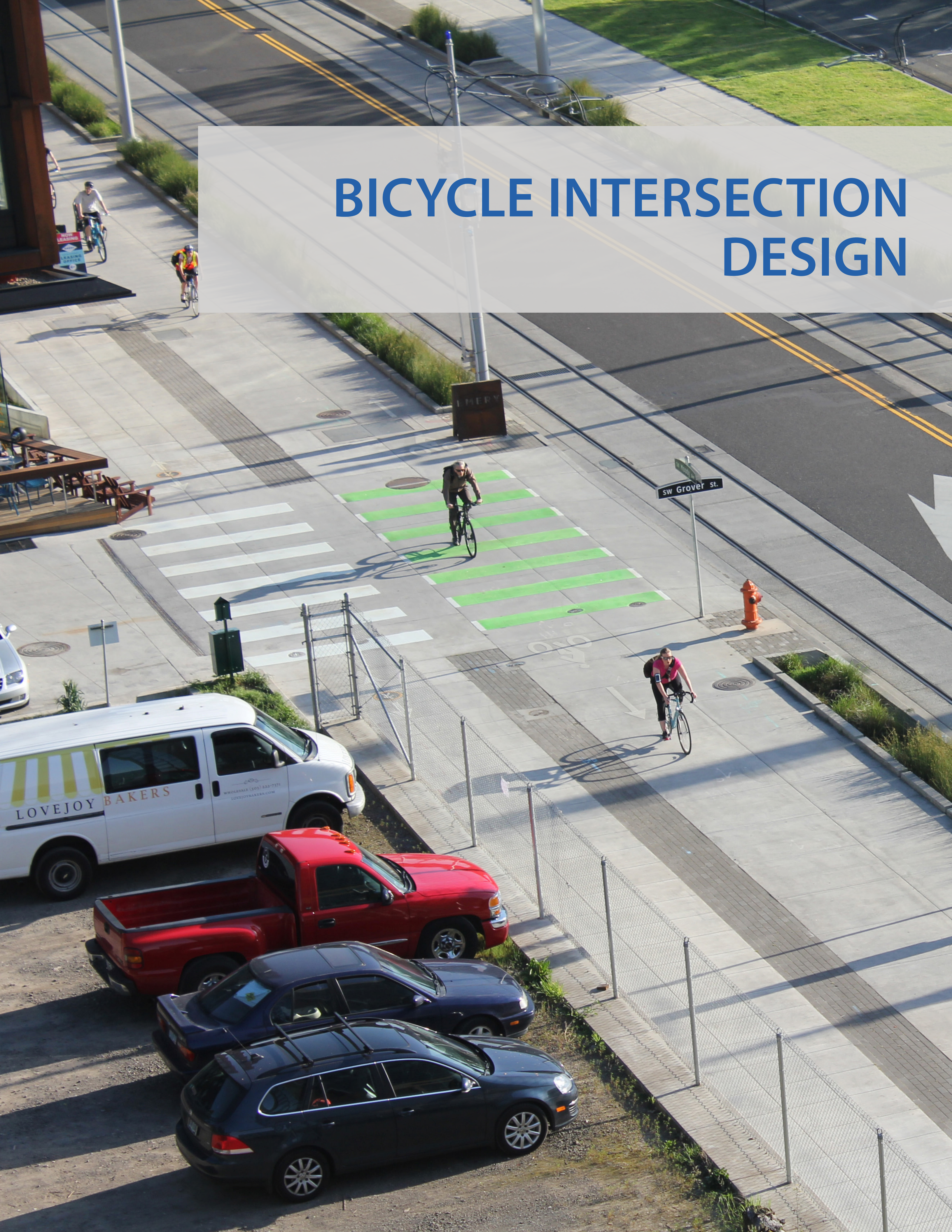
The Pedestrian/Bicycle Detour sign should have an arrow pointing in the appropriate direction.

National MUTCD

Cost

- Sign, regulation: $150 each

BICYCLE INTERSECTION DESIGN



BICYCLE DETECTION AT SIGNALIZED INTERSECTIONS

Proper bicycle detection should meet two primary criteria: 1) accurately detects bicyclists and 2) provides clear guidance to bicyclists on how to actuate detection (e.g., what button to push, where to stand). Bicycle loops and other detection mechanisms can also provide bicyclists with an extended green time before the main signal turns green.

Discussion

Push Button Actuation

User-activated button mounted on a pole facing the street.

Loop Detectors

Bicycle-activated loop detectors are installed within the roadway to allow the presence of a bicycle to trigger a change in the traffic signal. This allows the bicyclist to stay within the lane of travel without having to maneuver to the side of the road to trigger a push button.

Loops that are sensitive enough to detect bicycles should be supplemented with pavement markings to instruct bicyclists how to trip them.

Video Detection Cameras

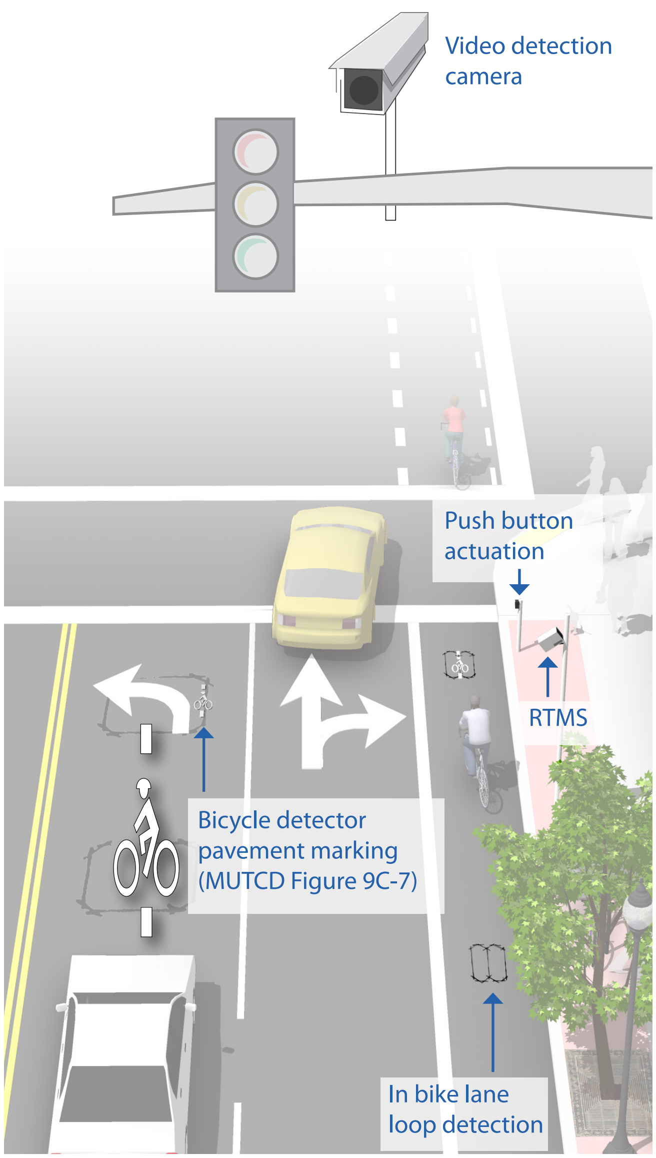
Video detection systems use digital image processing to detect a change in the image at a location. These systems can be calibrated to detect bicycles. Video camera system costs range from $20,000 to $25,000 per intersection.

Remote Traffic Microwave Sensor Detection (RTMS)

RTMS is a system which uses frequency modulated continuous wave radio signals to detect objects in the roadway. This method marks the detected object with a time code to determine its distance from the sensor. The RTMS system is unaffected by temperature and lighting, which can affect standard video detection.

References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- AASHTO Guide for the Development of Bicycle Facilities. 2012.
- NACTO. Urban Bikeway Design Guide. 2012.



Cost

- Bicycle Loop Detector: $1,000-$2,500 each

LOOP DETECTOR PAVEMENT MARKINGS AND SIGNAGE

Bicycle Detector Pavement Markings guide bicyclists to position themselves at an intersection to trigger signal actuation. The CA MUTCD has a different recommended configuration for these pavement markings that the National MUTCD. Frequently these pavement markings are accompanied by signage that can provide additional guidance (see below).

Design Summary

Locate Bicycle Detector Pavement Marking over center of quadrupole loop detector if in bike lane, or where bicycle can be detected in a shared lane by loop detector or other detection technology.

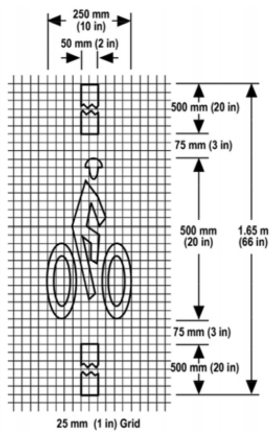


Figure 9C-7 - CAMUTCD

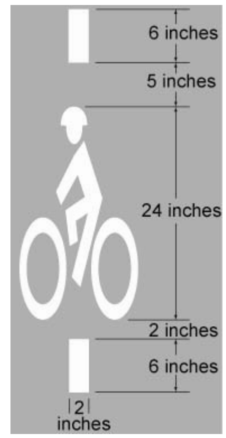


Figure 9C-7 - National MUTCD

Accompanying Signage (R10-22)

References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- Caltrans. Standard Plans ES-5B. 2010.
- AASHTO Guide for the Development of Bicycle Facilities. 2012.

Cost

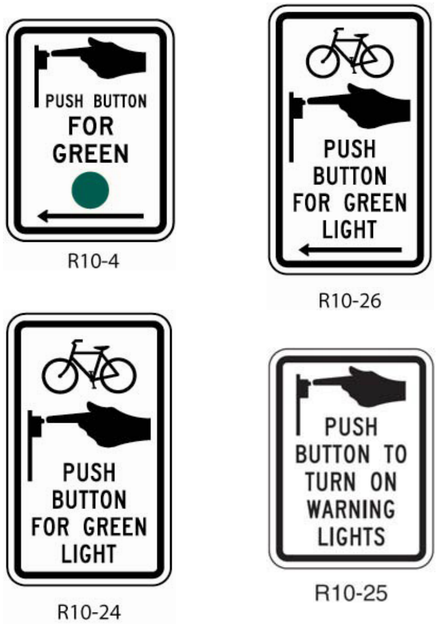
- Bicycle -> Loop -> Detector, -> Install -> stencils: -> $100per intersection leg

BICYCLE PUSH BUTTONS

Bicycle push buttons can also provide signal actuation and timing adjustments for bicyclists. Push buttons are recommended for use with shared-use paths or other unique interactions with bicycle facilities. Push buttons are generally unsuitable for conventional bike lane situations as the bicyclist would have to leave the roadway to activate the signal. An acceptable situation exists where a push button can be located closer to the bike lane if no vehicle right turn lane is present so that the bicyclist does not have to dismount to reach the signal.

Design Summary

- Bicycle push buttons may be used where a push button detector has been installed exclusively to activate a green phase for bicyclists.
- The R10-4, R10-24, R10-25, R10-26 and R62C signs should be installed near the edge of the sidewalk, in the vicinity of where bicyclists will be crossing the street.



2009 National MUTCD

R62C (California Only) sign

References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- AASHTO Guide for the Development of Bicycle Facilities. 2012.

Cost

- Push Button: $600-$1,390 each

BICYCLE INTERSECTION DESIGN

BICYCLE SIGNAL PHASE

Protected 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.

Discussion

A bicycle signal should be considered for use only when the volume/collision or volume/geometric warrants have been met. (CAMUTCD 4C.102)

FHWA has approved bicycle signals for use, if they comply with requirements from Interim Approval 16 (I.A. 16).

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.

Design Summary

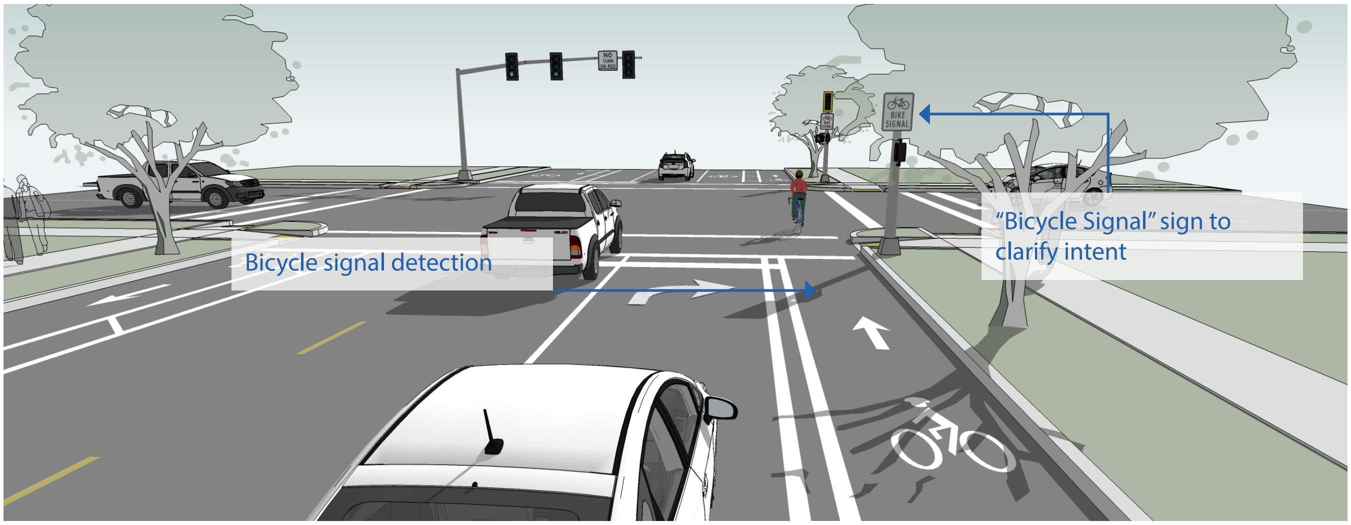
Application:

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

Design:

An additional “Bicycle Signal” sign should be installed below the bicycle signal head.

Designs for bicycles at signalized crossings should allow bicyclists to trigger signals and safely maneuver the crossing.



References

- FHWA. Interim Approval for Optional Use of a Bicycle Signal Face (IA-16). 2013.

Cost

- Bicycle signal heads have an average cost of $12,800.
- Video detection camera system costs range from $20,000 to $25,000 per intersection.

BICYCLE INTERSECTION DESIGN

BIKE BOX

A bike box is a designated area located at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible space to get in front of queuing motorized traffic during the red signal phase. Motor vehicles must queue behind the white stop line at the rear of the bike box.

Discussion

Bike boxes are considered experimental by the FHWA. They should be placed only at signalized intersections, and right turns on red shall be prohibited for motor vehicles. Bike boxes should be used in locations that have a large volume of bicyclists and are best utilized in central areas where traffic is usually moving more slowly. Prohibiting right turns on red improves safety for bicyclists yet does not significantly impede motor vehicle travel.

References

- NACTO. Urban Bikeway Design Guide. 2012.

Application of green pavement coloring addressed in:

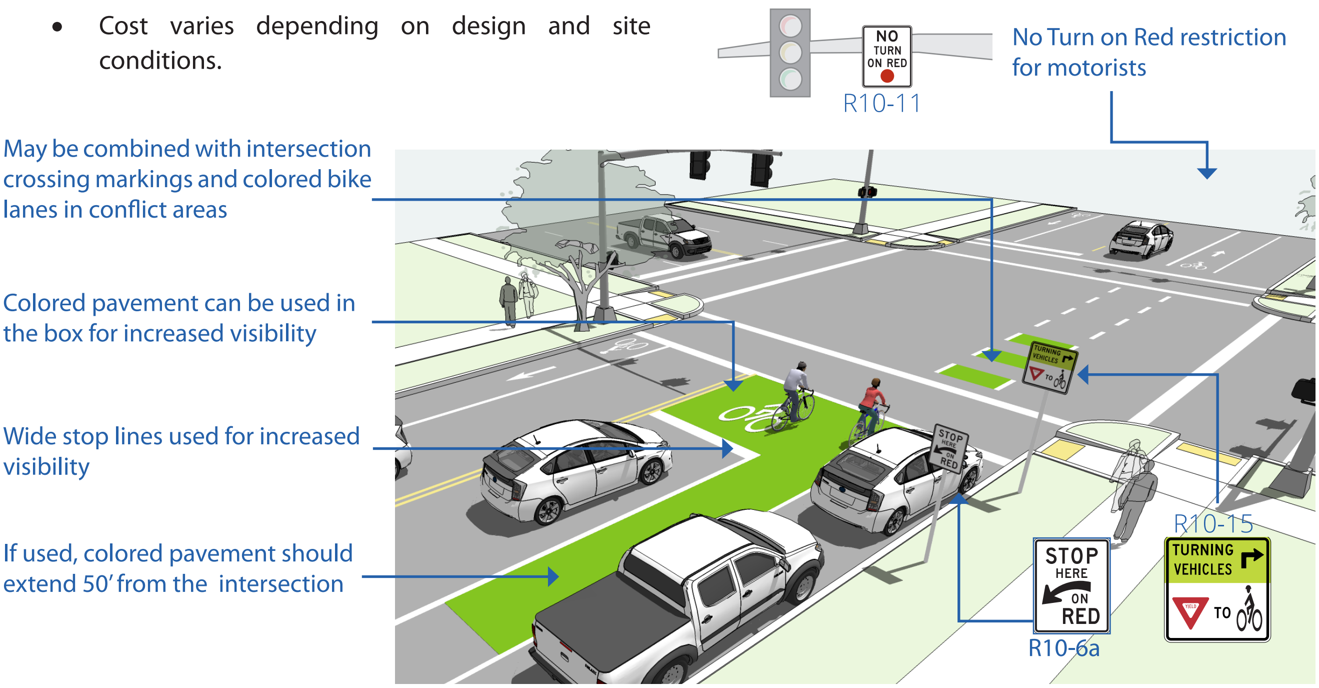
- FHWA. Interim Approval (IA-14). 2014.

Cost

- Cost varies depending on design and site conditions.

Design Summary

- 14’ minimum depth
- 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” sign should be post-mounted at the stop line to reinforce observance of the stop line.
- A “Yield to Bikes” sign should be post-mounted in advance of and in conjunction with an egress lane to reinforce that bicyclists have the right-of-way going through the intersection.
- An ingress lane should be used to provide access to the box.
- A supplemental “Wait Here” legend can be provided in advance of the stop bar to increase clarity to motorists.



TWO-STAGE LEFT TURN BOX

Two-stage turn boxes offer bicyclists a safe way to make turns at multi-lane signalized intersections from a separated or conventional bike lane, as an alternative to making a vehicular left turn by “taking the lane”. On high-speed, high-volume streets, bicyclists are often unable to merge into traffic to turn making the provision of two-stage left turn boxes critical. Design guidance for two-stage turns apply to both conventional and separated bike lanes.

Discussion

Two-Stage turn boxes are considered experimental by FHWA. While two stage turns may increase bicyclist comfort in many locations, this configuration will typically result in higher average signal delay for bicyclists due to the need to receive two separate green signal indications (one for the through street, followed by one for the cross street) before proceeding.

References

- NACTO. Urban Bikeway Design Guide. 2012.

Application of green pavement coloring addressed in:

- FHWA. Interim Approval (IA-14). 2014.

Cost

- Cost varies depending on design and site conditions.

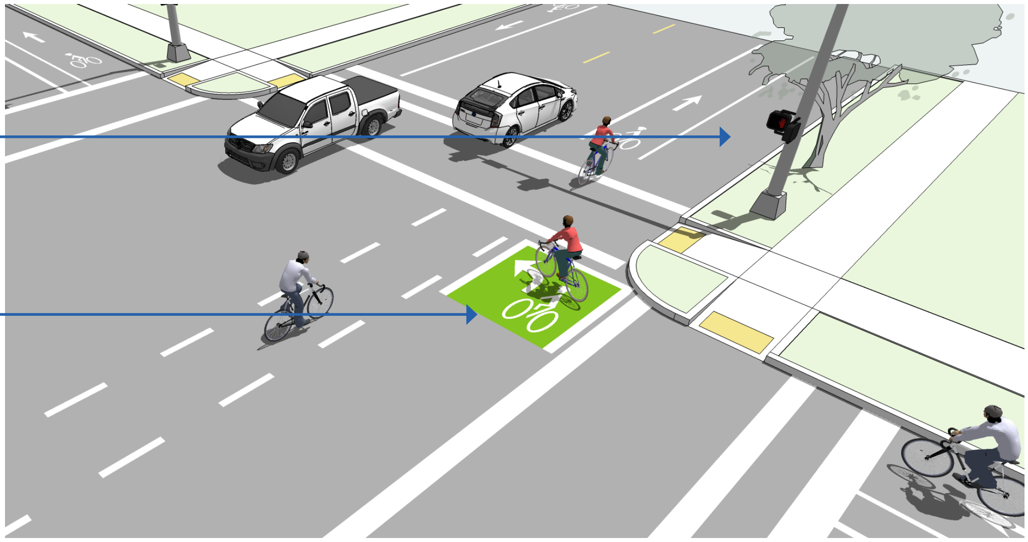
Design Summary

- The queue box shall be placed in a protected area. Typically this is within an on-street parking lane or separated bike lane buffer area.
- 6’ minimum depth of bicycle storage area
- Bicycle stencil and turn arrow pavement markings shall be used to indicate proper bicycle direction and positioning.
- A “No Turn on Red” (MUTCD R10-11) sign shall be installed on the cross street to prevent vehicles from entering the turn box.

Turns from cycle tracks may be protected by a parking lane or other physical buffer

Turns from a bicycle lane may be protected by an adjacent parking lane or crosswalk setback space.

Consider using colored pavement inside the box to further define the bicycle space



BIKE LANE AT INTERSECTION WITH RIGHT TURN ONLY LANE

The appropriate treatment at right turn only lanes is to introduce an added turn lane to the outside of the bicycle lane. The area where people driving must weave across the bicycle lane should be marked with dotted lines and dotted green pavement to identify the potential conflict areas. Signage should indicate that motorists must yield to bicyclists through the conflict area.

Discussion

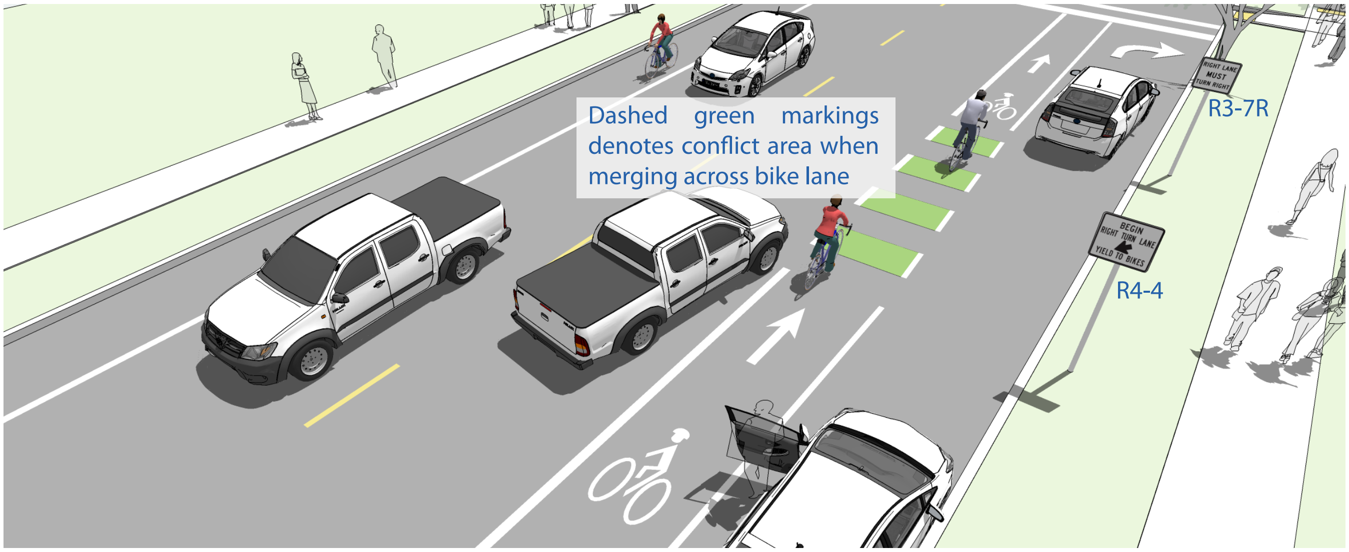
Maintaining a straight bicycle path reinforces the priority of bicyclists over turning cars. Drivers must yield to bicyclists before crossing the bike lane to enter the turn only lane.

The use of dual right-turn-only lanes should be avoided on streets with bike lanes (AASHTO, 2012). Where there are dual right-turn-only lanes, the bike lane should be placed to the left of both right-turn lanes, in the same manner as where there is just one right-turn-only lane.

Design Summary

Design details should emphasis that motorists should yield to bicyclists through the merge area. Travel lane width reductions may be required to achieve this design.

- Mark inside line with 6” stripe.
- Continue existing bike lane width; standard width of 5 to 6 feet (4 feet in constrained locations.)
- Use R4-4 BEGIN RIGHT TURN LANE YIELD TO BIKES signage to indicate that motorists should yield to bicyclists through the conflict area.
- Consider using colored markings in the conflict areas to promote visibility of the dashed weaving area.



References

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Application of green pavement coloring addressed in:

- FHWA. Interim Approval (IA-14). 2014.

Cost

- Cost varies depending on design and site conditions.

COMBINED BIKE LANE/TURN LANE

The combined bike lane/turn lane places shared lane markings within a right turn only lane. A dotted line delineates the space for bicyclists and motorists within the shared lane. Where there isn't room for a conventional bicycle lane and turn lane, a combined bike/turn lane creates a combined lane where bicyclists can ride and turning motor vehicles yield to through traveling bicyclists. This treatment includes markings advising bicyclists of proper positioning within the lane and is recommended at intersections lacking sufficient space to accommodate both a standard through bike lane and right turn lane.

Discussion

Case studies cited by the Pedestrian and Bicycle Information Center indicate that this treatment works best on streets with lower posted speeds (30 MPH or less) and with lower traffic volumes (10,000 ADT or less). May not be appropriate for high-speed arterials or intersections with long right turn lanes.

References

- NACTO. Urban Bikeway Design Guide. 2012.

Cost

- Cost varies depending on design and site conditions.

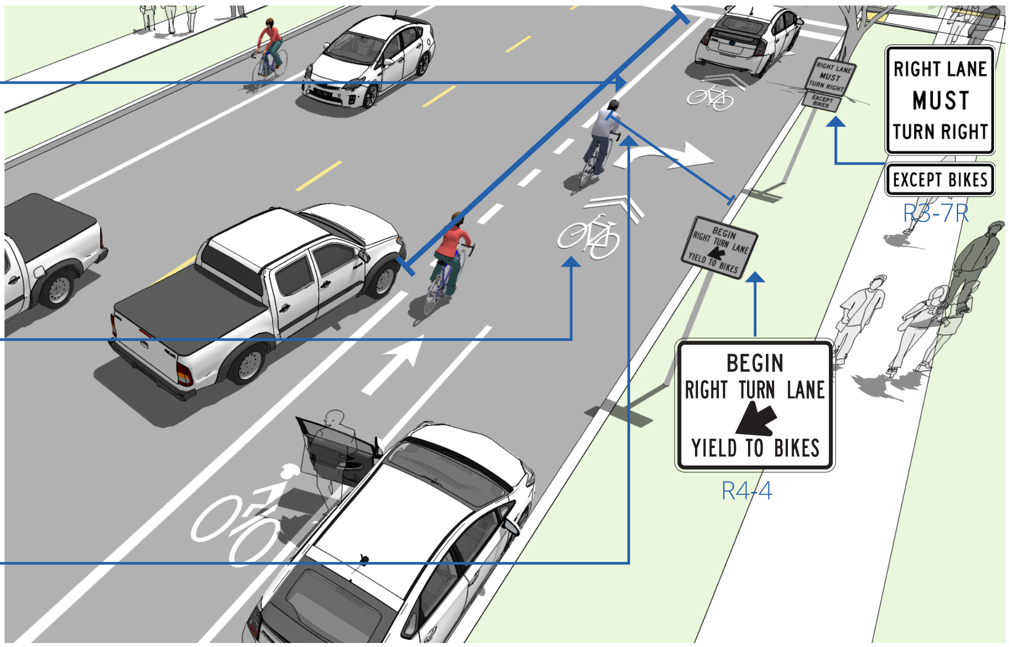
Design Summary

- Maximum shared turn lane width is 13 feet; narrower is preferable.
- Shared lane markings maintain bicycle priority and indicate preferred positioning of bicyclists within the combined turn lane.
- Use R4-4 BEGIN RIGHT TURN LANE YIELD TO BIKES signage to indicate that motorists should yield to bicyclists through the conflict area.
- An R3-7R "Right Turn Only" sign with an "Except Bicycles" plaque may be needed to make it legal for through bicyclists to use a right turn lane.

Short length turn pockets encourage slower motor vehicle speeds

Shared lane markings maintain priority for bicyclists within the combined lane

Maximum shared turn lane width is 13 feet



INTERSECTION DESIGN

BIKE LANE AT DROP LANE

When a through lane transitions directly into a right turn only lane, bicyclists traveling in a curbside bike lane must move laterally to the left of the right turn lane. Designers should provide the opportunity for bicyclists to accept gaps in traffic and control the transition.

Discussion

This treatment is used on streets with curbside bike lanes where a moderate-high speed (≥30 mph) through travel lane transitions into a right turn only lane. Right turn only drop lanes should be avoided where possible.

This treatment functions for skilled riders, but is not appropriate for riders of all ages and abilities. The design should not suggests to bicyclists that they do not need to yield to motorists when moving laterally. This differs from added right turn lanes in important details:

- Do not use a R4-4-YIELD TO BIKES sign
- The bike lane line should not be striped diagonally across the travel lane (with or without colored pavement), as this inappropriately suggests to bicyclists that they do not need to yield to motorists when moving laterally.

Cost

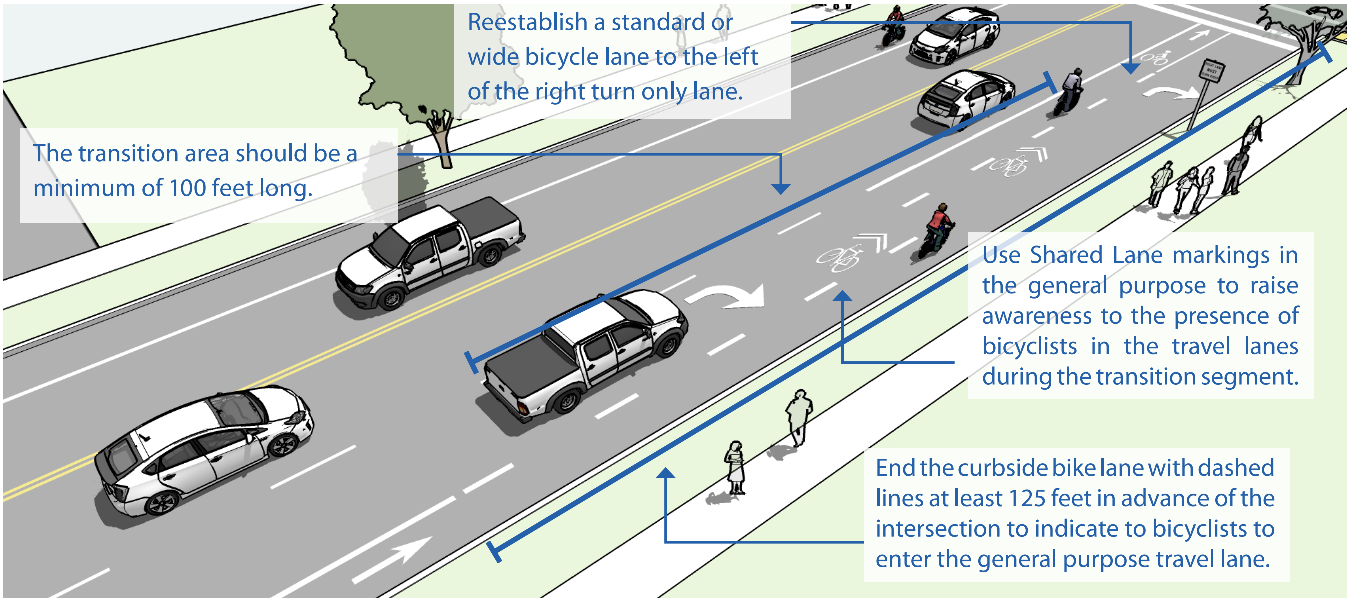
- Cost varies depending on design and site conditions.

Design Summary

- Maximum shared turn lane width is 13 feet; narrower is preferable.
- Shared lane markings maintain bicycle priority and indicate preferred positioning of bicyclists within the combined turn lane.
- Use R4-4 BEGIN RIGHT TURN LANE YIELD TO BIKES signage to indicate that motorists should yield to bicyclists through the conflict area.
- An R3-7R “Right Turn Only” sign with an “Except Bicycles” plaque may be needed to make it legal for through bicyclists to use a right turn lane.

References

- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.



SEPARATED BIKE LANE INTERSECTION APPROACHES

Separated bike lanes provide additional distance and physical barriers between the bike lane and adjacent travel lane. This separation requires careful design and consideration at intersections to encourage safe interactions.

Discussion

Intersection approach designs depend on available right-of-way, turn lane configuration and bike lane separation distance.

Designs consist of one of the following concepts:

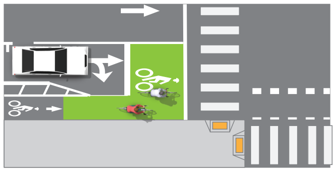
- Exclusive right turn only lanes
- Adjacent shared through/right turn lanes

Signal phasing may have significant impacts on the safety and efficiency of intersections. Where possible, offer protected left-turn signal phases to remove left-hook conflicts. Where right turn volumes are high, consider an exclusive right turn lane and protected right turn signal phase to separate conflicting movements with bicyclists.

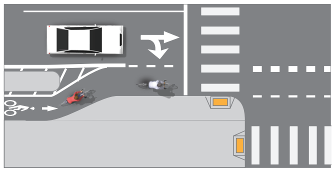
Design Summary

All design approaches use the following principles:

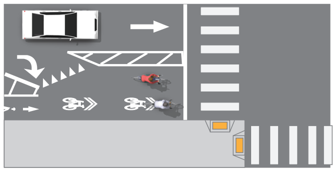
- Increase awareness – Use color, signs and other markings to indicate potential conflict points.
- Raise conspicuity – align the bike lane and remove visual obstruction so that drivers can see bicyclists.
- Isolate conflicts – Focus bicyclists and motor vehicle interactions at specific locations to simplify user expectations.
- Assign priority – In ambiguous situations, clarify who has responsibility to yield.



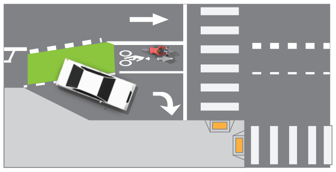
Bike Lane/Bike Box



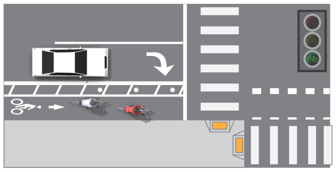
Bend-In



Mixing Zone



Through Bike Lane



Bicycle Signal Phase

References

- NACTO. Urban Bikeway Design Guide. 2012.
- FHWA. Separated Bike Lane Planning and Design Guide. 2015.

Application of green pavement coloring addressed in:

- FHWA. Interim Approval (IA-14). 2014.

Cost

- Cost varies depending on design and site conditions.

SINGLE LANE ROUNDABOUTS

In single lane roundabouts it is important to indicate to motorists, bicyclists and pedestrians the right-of-way rules and correct way for them to circulate, using appropriately designed signage, pavement markings, and geometric design elements.

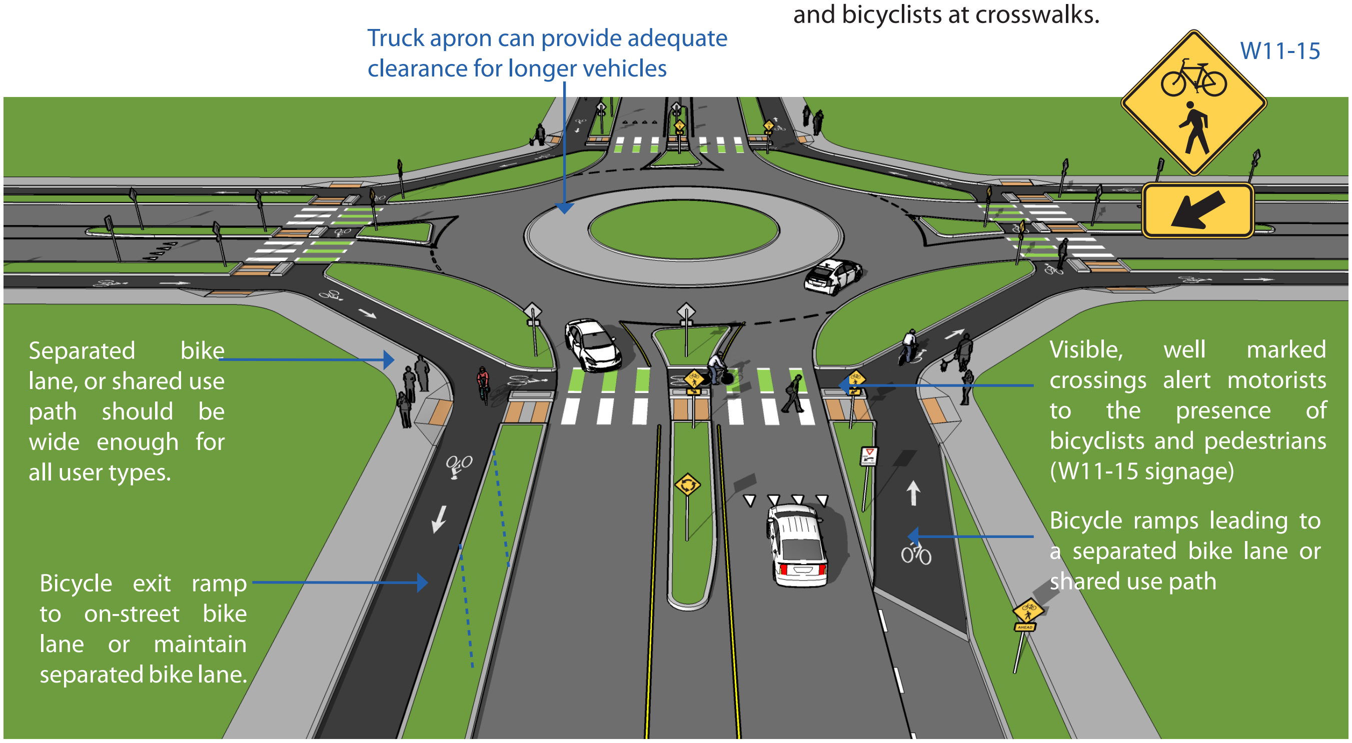
Discussion

Research indicates that while single-lane roundabouts may benefit bicyclists and pedestrians by slowing traffic, multi-lane roundabouts may present greater challenges and significantly increase safety problems for these users.

While some bicyclists will operate within the roadway, provide separated facilities for bicyclists who prefer not to navigate in mixed traffic.

Design Summary

- Design approaches/exits to the lowest speeds possible. 10-15 mph preferred with 25 mph maximum circulating design speed.
- Allow bicyclist to exit the roadway onto a separated bike lane or shared use path that circulates around the roundabout.
- Maximize yielding rate of motorists to pedestrians and bicyclists at crosswalks.



Guidance

- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- FHWA. Roundabouts: An Informational Guide. 2000.
- TRB. Roundabouts: An Informational Guide, Second Edition. NCHRP 672. 2010.

Cost

- Roundabouts cost $250,000 - $500,000 depending on the size, site conditions, and right-of-way acquisitions. Roundabouts usually have lower ongoing maintenance costs than traffic signals, depending on whether the roundabout is landscaped.

BICYCLE INTERSECTION DESIGN

PROTECTED INTERSECTIONS

A protected intersection 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.

Discussion

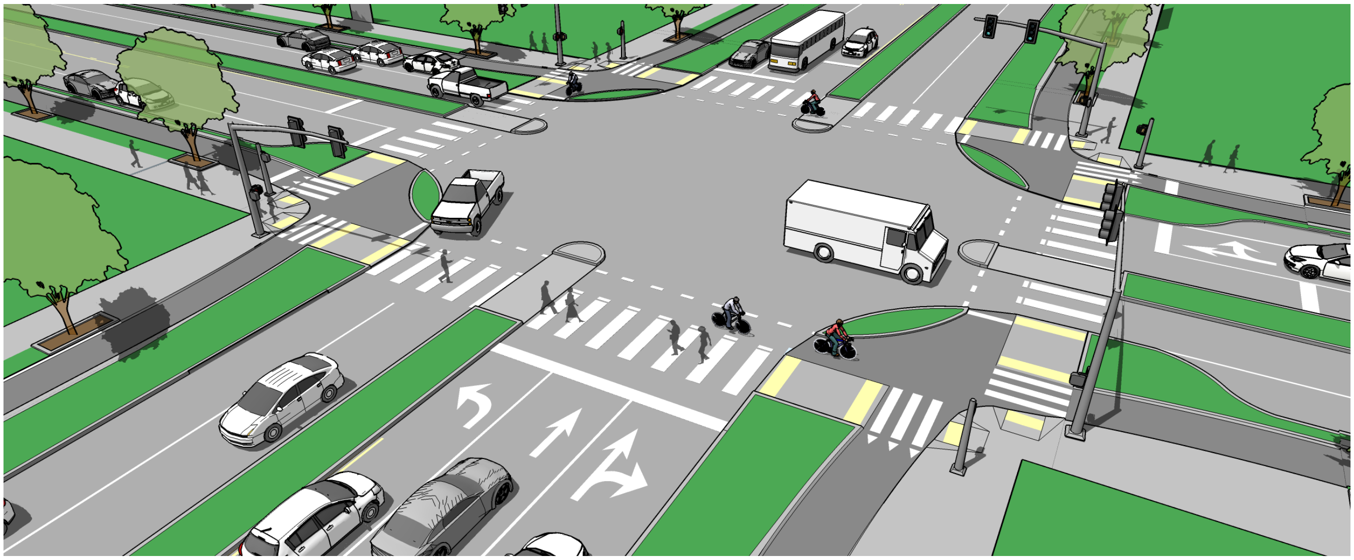
Protected intersections are included in the 2015 Caltrans DIB 89.

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.

Design Summary

- Setback bicycle crossing of 16.5 feet allows for one passenger car to queue while yielding. Smaller setback distance is possible in slow-speed, space constrained conditions.
- Corner safety 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.
- Intersection crossing markings should be used.



References

- Caltrans. DIB 89: Class IV Bikeway Guidance.2015.
- FHWA. Separated Bike Lane Planning and Design Guide. 2015.
- MassDOT. Separated Bike Lane Planning and Design Guide. 2015.

Cost

- Reconstruction costs comparable to a full intersection.
- Retrofit implementation may be possible at lower costs if existing curbs and drainage are maintained.

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PEDESTRIAN FACILITY DESIGN

PEDESTRIAN FACILITY DESIGN

SIDEWALK WIDTHS

Medium to high-density pedestrian zones located in areas with commercial or retail activity provide excellent opportunities to develop an inviting pedestrian environment. The frontage zone in retail and commercial areas may include seating for cafés and restaurants or extensions of retail establishments. The furnishings zone may include seating, transit shelters, newspaper racks, water fountains, utility boxes, lampposts, street trees and other landscaping. The medium to high-density pedestrian zone should provide an interesting and inviting environment for walking and window shopping.

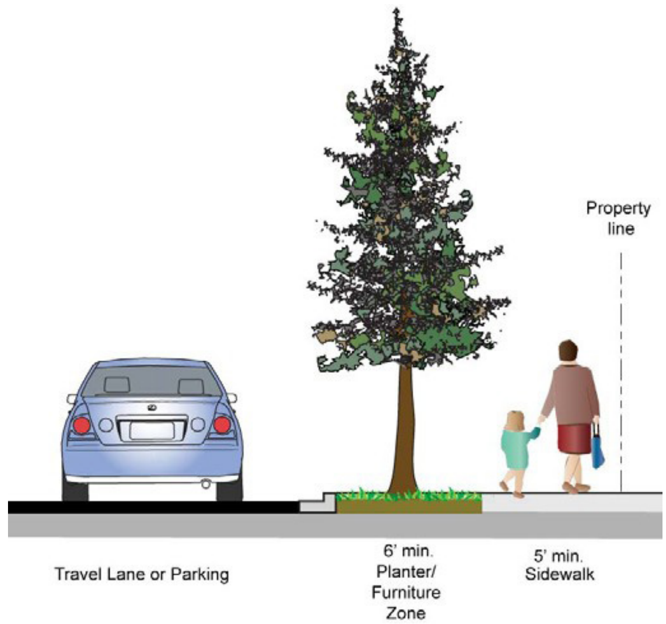
Design Summary

Width Considerations

The ITE recommends planning sidewalks that are a minimum of 5 feet wide with a planting strip of 2 feet on local streets and in residential and commercial areas.

The Caltrans HDM establishes 8 feet minimum width for sidewalks between curbs and buildings when in urban and rural main street place types. For all other locations, the minimum width should be 6 feet when adjacent to a curb or 5 feet when separated by a planting strip.

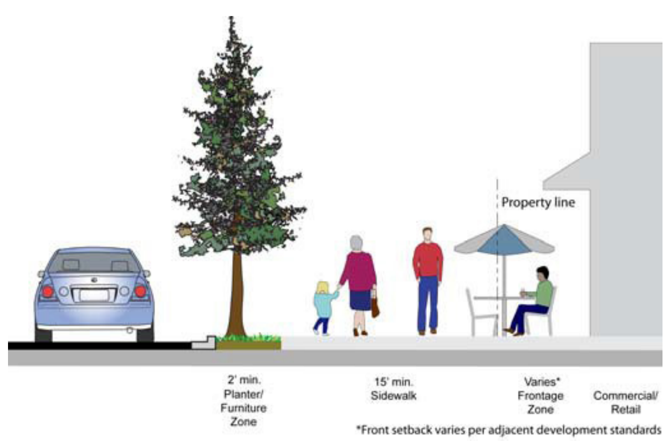
TRPA/TMPO recommends all new development provide width for shared-use paths where feasible, and if close to a connecting path. If a standard shared-use path is not feasible then as a wide a sidewalk as possible should be implemented. Asphalt is preferred over concrete for active transportation comfort. The use of vertical-face or rolled curbs is determined by stormwater best management practices, impacts on snow maintenance operations, and safety of road users.



Typical Sidewalk on Arterial/Major Collector

References

- Institute of Transportation Engineers. Design and Safety of Pedestrian Facilities. 1998.
- AASHTO. Guide for the Planning, Design, and Operation or Pedestrian Facilities. 2004.
- Caltrans. Highway Design Manual. 2015.
- US Access Board. Accessible Public Rights-of-Way Planning and Design for Alterations. 2007.



Typical Commercial Area Sidewalk

Cost

- Sidewalk, concrete: $240,000 - $750,000 (with curb and gutter) per mile

SIDEWALK MATERIAL

Sidewalks should be firm and stable, and resistant to slipping. Sidewalks are normally constructed out of Portland cement concrete. Although multi-use pathways may be constructed out of asphalt, it is not suitable for sidewalk construction due to its shorter lifespan and higher maintenance costs. Asphalt and concrete are the most common surfaces for sidewalks; however, some sidewalks are designed using decorative materials, such as brick or cobblestone. Although these surfaces may improve the aesthetic quality of the sidewalk, they may also present challenges to people with mobility impairments. For example, tiles that are not spaced tightly together can create grooves that catch wheelchair casters. Concrete may not hold up as well under snowy conditions.

Discussion

Facilities should be designed so that they are easy to maintain. Of particular importance is including an area for snow storage adjacent to sidewalks, on-street facilities and pathways. Currently, Caltrans and NDOT use sidewalks and paths adjacent to roadways as temporary snow storage areas, resulting in degradation and limited access.

Wherever possible, sidewalks should be separated from the roadway by a paved or landscaped furnishing zone. This zone should be used for locating trees, landscaping, lighting, and for seasonal snow storage outside of the through paths of pedestrians.

Tahoe City Sidewalk

Asphalt Surfacing (non local)

Design Summary

In the Lake Tahoe Region, some Area Plans or local jurisdictions provide design guidelines for sidewalk materials. For example, the City of South Lake Tahoe City-Wide Design Standards state that sidewalks shall be constructed of asphalt (or concrete subject to City approval). The El Dorado County Transit Authority states that sidewalks should be constructed of an impervious material, such as concrete and that surfaces should be non-slip, stable, firm, and well-drained. Other jurisdictions do not recommend or require a specific material type.

Asphalt

- Maintenance life: 40 years plus (with no tree root damage)
- Cost: $2.89/sq ft [1], 20 Year Cost : $1.44/sq ft

1 The 20-year cost normalizes the cost by the useful product life.

Concrete

- Maintenance life: up to 75 years plus (with no tree root damage)
- Cost: $3.37/sq ft, 20 Year Cost: $0.90/sq ft

Concrete Pavers

- Acceptable material for use where aesthetic treatment is desired. May be best suited for the Furnishings Zone as streetscape accent where pedestrian through travel is not expected. Not recommended for use on sidewalk through-zone.
- Maintenance life: 20 years plus
- Cost: $5.77/sq ft, 20 Year Cost: $5.77/sq ft

Concrete Surfacing (non local)

References

- AASHTO. Guide for the Planning, Design, and Operation or Pedestrian Facilities. 2004.

Cost

- Asphalt: $2.89/sq ft
- Concrete: $3.37/sq ft
- Concrete pavers: $5.77/sq ft

FURNISHINGS

The furnishings zone is the area between the curb zone and the through passage zone, where pedestrians pass. The furnishings zone creates an important buffer between pedestrians and vehicle travel lanes by providing horizontal separation, and can also be used for snow storage in the winter time.

Design Summary

Width

A minimum width of 24 inches (48 inches if planting trees) is recommended. On sidewalks of ten feet or greater, the furnishings zone width should be a minimum of four feet. A wider zone should be provided in areas with large planters and/or seating areas. The TRPA recommends a minimum 6 foot wide landscaped buffer on arterials and major collectors.

Transit Stop/Shelter Placement

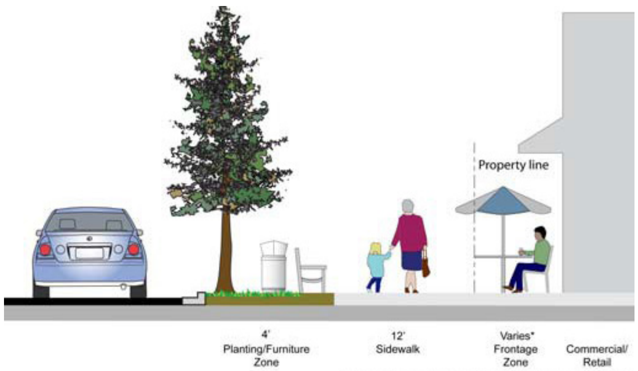
BlueGO and Tahoe Area Regional Transit (TART) on the North Shore both have guidelines for transit shelter design and placement, which can be obtained by contacting these agencies.

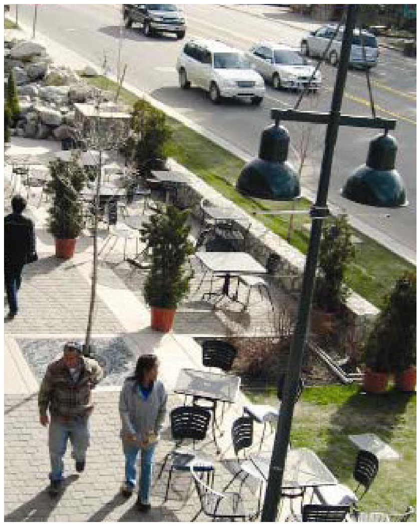
Street Trees and Plantings

Wherever the sidewalk is wide enough, the furnishings zone should include street trees. In order to maintain line of sight to stop signs or other traffic control devices at intersections, when planning for new trees, care should be taken not to plant street trees within 25 feet of corners of any intersection. However, native plants and bioswales can be used in these areas as long as they do not obstruct the vision of road users.

Street Furniture and Amenities

Street furniture should be placed in the furnishings zone to maintain through passage zones for pedestrians and to provide a buffer between the sidewalk and the street.





References

- FHWA. Designing Sidewalks and Trails for Access Part II of II: Best Practices Design Guide. 2001.
- AASHTO. Guide for Planning, Design and Operation of Pedestrian Facilities. 2010.
- USDOT. ADA Standards for Transportation Facilities. 2006.
- El Dorado County Transit Authority. Transit Design Manual. 2007.

Cost

- Bus Shelter: $5,340 - $10,800 each
- Bus concrete pad: $1,200 to $6,940 each
- Trees: $50 - $880 each

PEDESTRIAN FACILITY DESIGN

CURB RAMPS

Curb ramps are necessary for people who use wheelchairs to access sidewalks and crosswalks. ADA requires the installation of curb ramps in new sidewalks, as well as retrofitting existing sidewalks. Curb ramps may be placed at each end of the crosswalk (perpendicular curb ramps), or between crosswalks (diagonal curb ramps).

Design Summary

Orientation and Alignment

Perpendicular curb ramps should be used at large intersections. Curb ramps should be aligned with crosswalks, unless they are installed in a retrofitting effort and are located in an area with low vehicular traffic.

Drainage

Adequate drainage should be provided to prevent flooding of curb ramps.

Detectable Warnings

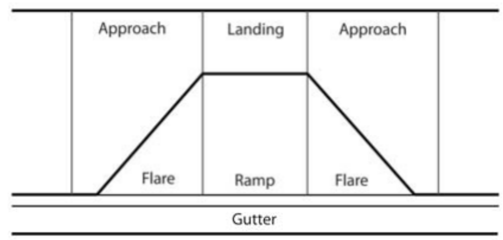
Detectable warnings, consisting of raised truncated domes that visually contrast with the surrounding materials, must be used to assist sight-impaired pedestrians in locating the curb ramp. Certain exemptions apply (see USDOT ADA Standards Section 406 and the ADA Access Board Guidelines on Accessible Public Rights of Way).

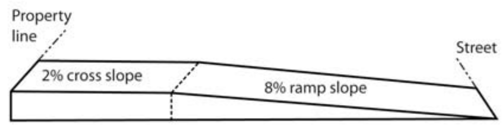
References

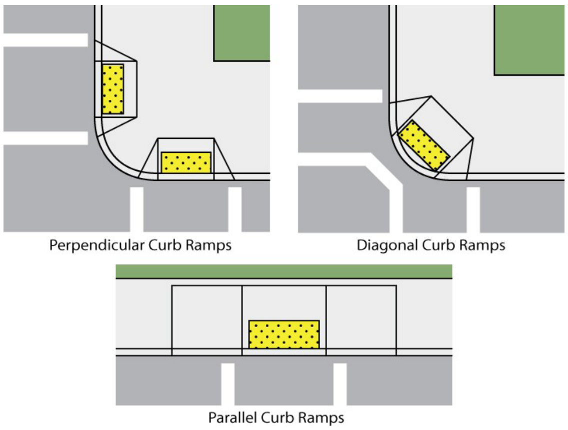
- AASHTO. Guide for Planning, Design and Operation of Pedestrian Facilities. 2004..
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.
- USDOT. ADA Standards for Transportation Facilities. 2006.
- ADA Access Board. Proposed Guidelines on Accessible Public Rights of Way. 2011.

Cost

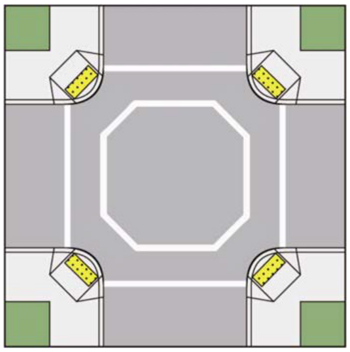
- Curb Ramps, Retrofit (diagonal, per corner): $800 - $5,340 each
- Curb Ramps, Retrofit (perpendicular, per corner): $5,340 - $10,000 each







Typical Sidewalk on Arterial/Major Collector



Crosswalk Striping when using Diagonal Curb Ramps

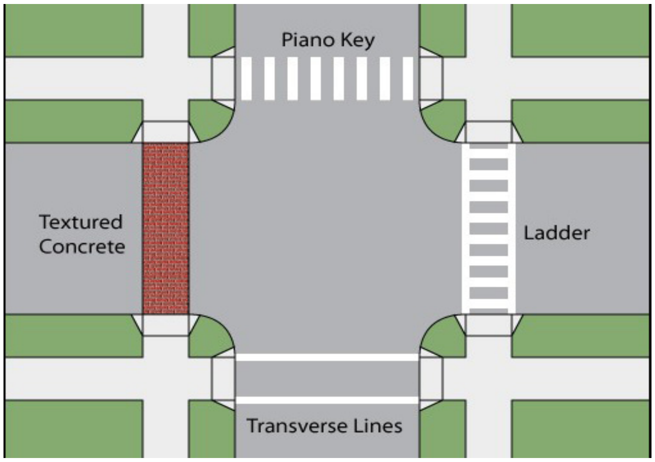
PEDESTRIAN INTERSECTION DESIGN

PEDESTRIAN CROSSWALK DESIGN

Crosswalks are to be marked on all legs of a signalized intersection. At unsignalized intersections, crosswalks should be marked when they help orient pedestrians, or help position pedestrians where they can best be seen by oncoming traffic. At mid-block locations, crosswalks are marked where there is a demand for crossing, and there are no nearby marked crosswalks.

Discussion

High-visibility markings such as Piano Key or Ladder crosswalks are recommended for crosswalks in the Tahoe Region due to their increased visibility and resistance to wear if they are located out of the wheel paths. Crosswalks forming transverse lines will wear quickly in snow country.



Crosswalk Types

References

- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- AASHTO Guide for the Development of Bicycle Facilities. 2012.

Design Summary

Ladder or piano key crosswalk markings are recommended for most crosswalks in the Tahoe Region, including school crossings, across arterial streets for pedestrian-only signals, at mid- block crosswalks, and where the crosswalk crosses a street not controlled by signals or stop signs.

- A piano key pavement marking consists of 2' wide bars spaced 2' apart.
- A ladder pavement marking consists of 2' wide bars spaced 2' apart.
- Transverse lines consist of 1' wide bars spaced no less than 6' apart.

Cost

- Crosswalk, Thermoplastic: $6 per sf
- Crosswalk, Transverse: $550 each
- Crosswalk, Permeable Pavement (brick, includes demo of existing): $14 per sf
- Crosswalk, Scored Concrete (includes demolition of existing): $9-$14 each

PEDESTRIAN REFUGE ISLANDS

Pedestrian refuge islands reduce pedestrian exposure to motor vehicles, allow pedestrians to consider traffic coming from one direction at a time and provide a place for slower pedestrians to rest or wait. Pedestrian refuge islands can be installed at intersections or at mid block locations.

Design Summary

Pedestrian refuge islands should be considered at all crossings of multi-lane roadways. Depending on the signal timing, median islands should be considered when the crossing distance exceeds 60 feet, but can be used at intersections with shorter crossing distances where a need has been recognized. **This treatment is recommended in school zones.**

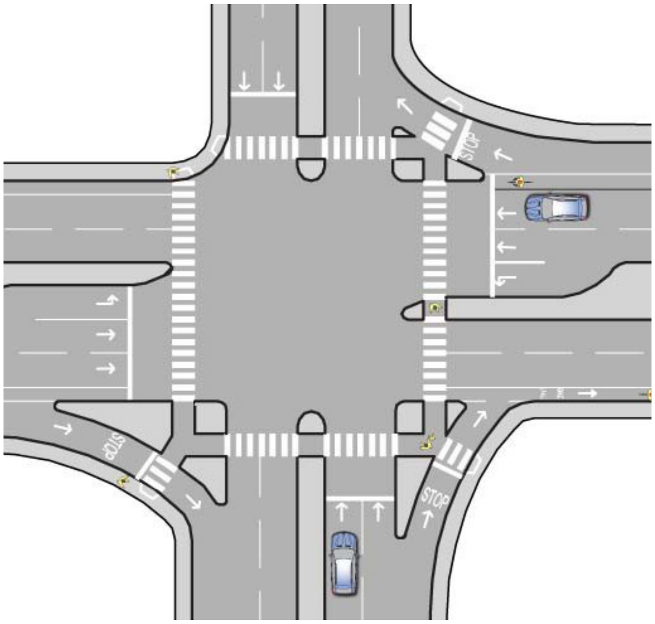
See the ADA Access Board Guidelines on Accessible Public Rights of Way for more information on median islands.

References

- ADA Access Board. Proposed Guidelines on Accessible Public Rights of Way. 2011.
- AASHTO. Guide for the Development of Pedestrian Facilities. 2004.
- AASHTO. Guide for the Planning, Design, and Operation of Pedestrian Facilities. 2010.

Cost

- Median, Pedestrian Refuge Island: $8,500-$33,000 each



The median "noses"shown are not required by MUTCD.

Median "nose" (non-local)

PEDESTRIAN INTERSECTION DESIGN

IN-STREET CROSSWALK SIGNAGE

The In-Street Pedestrian Crossing (R1-6) sign should be used to remind users of laws regarding the right of way at an unsignalized pedestrian crossing (CA and NV). These paddles are installed at the center stripe of the roadway on the leading edge of the crosswalk. Approaching motorists are warned to yield to crossing pedestrians.

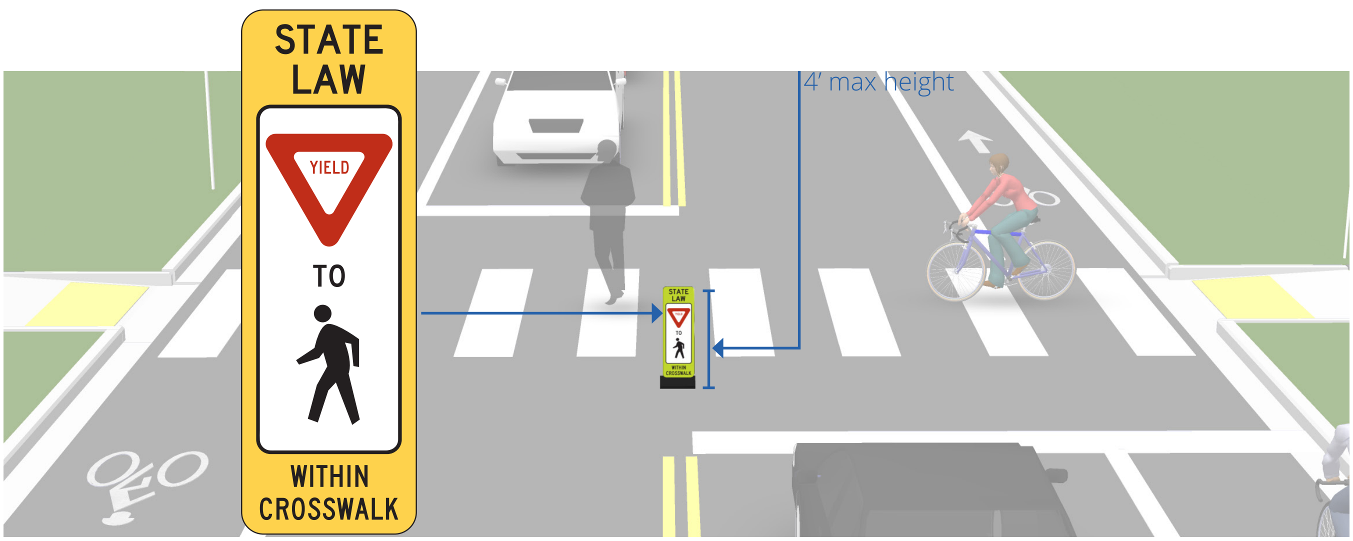
Discussion

These flexible signs must be extremely durable to withstand potential impacts with motor vehicles. Semi-permanent installations are also possible when the sign is combined with a movable base. This allows for day-time only applications. The signs perform better on narrow roadways, where the visibility of the signs is maximized. On multi-lane roadways, consider active warning beacons for improved yielding compliance.

This treatment is appropriate for crosswalks located in school zones.

Design Summary

- The in-street pedestrian crossing sign shall be placed in the roadway at the crosswalk location on the center line, on a lane line, or on a median island. The top of an in-street pedestrian crossing sign shall be a maximum of 4 feet above the pavement or median island surface.
- Install in a manner that does not impede pedestrian flow and outside the turn radius of vehicles that may be approaching from cross street.
- May be placed on a median island (when available).



References

- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- AASHTO. Guide for the Development of Pedestrian Facilities. 2004.

Cost

- Crosswalk, Thermoplastic: $6 per sf
- Crosswalk, Transverse: $320-$550 each
- Crosswalk, Permeable Pavement (brick, includes demo of existing): $14 per sf
- Crosswalk, Scored Concrete (includes demolition of existing): $9-$14 each

PEDESTRIAN FACILITY DESIGN

CURB EXTENSIONS (BULB OUTS)

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. They are appropriate for any crosswalk where it is desirable to shorten the crossing distance and there is a parking lane adjacent to the curb.

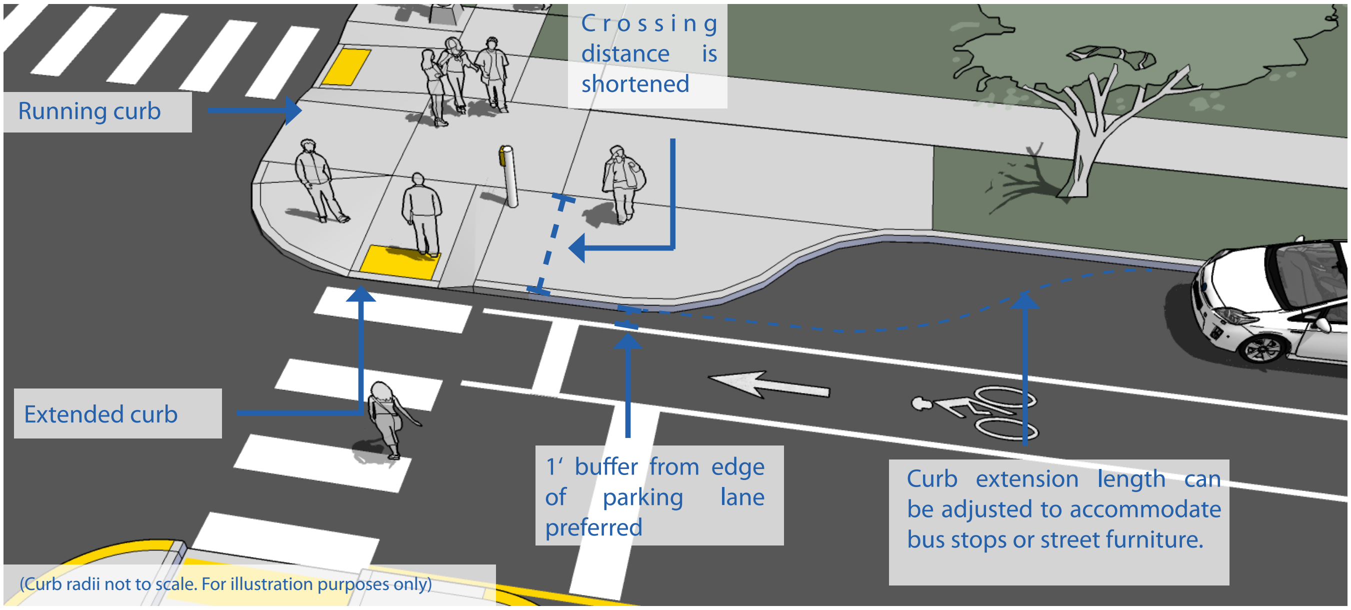
Discussion

Adding curb extensions may not be possible if there is no parking lane. Curb extensions should not block bike lanes or shoulders used by bicyclists.

This treatment is recommended at intersections in school zones.

Design Summary

- In most cases, the curb extensions should be designed to transition between the extended curb and the running curb in the shortest practicable distance.
- 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.
- Curb extensions should terminate one foot short of the parking lane to maximize bicyclist safety.



References

- AASHTO. Policy on Geometric Design of Highways and Streets. 2011.
- AASHTO. Guide for the Development of Bicycle Facilities. 2012.

Cost

- Curb Extension: $12,000 each

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DESIGN OF INTERPRETIVE AND WAYFINDING SIGNAGE

INTERPRETIVE SIGNAGE

Interpretive signs enhance the trail or bikeway experience by providing information about the history and culture of the area. Signs may discuss local ecology, people, environmental issues, and other educational information. Educational information may be placed at scenic view areas or in relation to specific elements being interpreted. They may take on many forms including textual messages, plaques, markers, panels, and demonstrations.

Design Summary

Because interpretive signs need to relate directly to the needs of a site, no specific guidelines have been established for their format. However, interpretive signs should be concise and should be an integral part of an overall area sign plan.

Cost

- Signs, Path Wayfinding / Information: $550 - $2,000 each

WAYFINDING SIGNAGE - LOCAL GUIDELINES

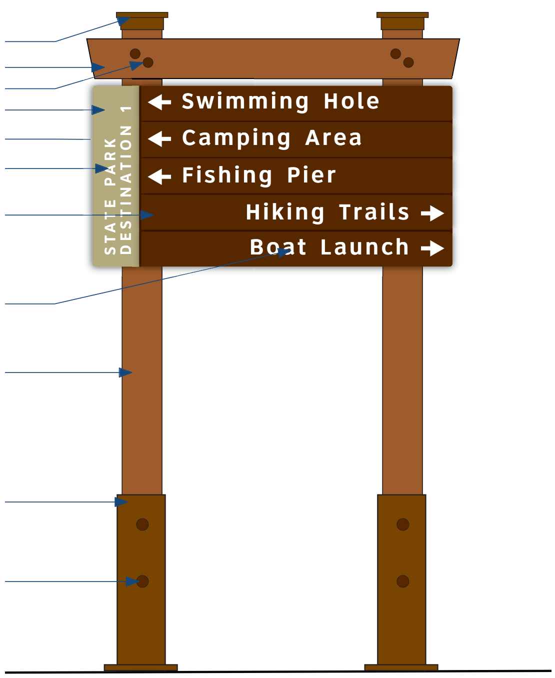
Three local documents currently govern the design of wayfinding signs in the Tahoe area. The North Lake Tahoe Community Wayfinding Signage Design Standards Manual (May 2013) provides design standards related to community wayfinding in public-accessible areas, such as recreational areas, commercial zones or neighborhood districts. It includes clear, schematic concepts for signage design while remaining adaptable to variations in local features. This manual also contains information about applying for permits for signs.

South Lake Tahoe community wayfinding standards are presented in the Wayfinding in South Lake Tahoe Status Report #3 (August 2008). Guidelines specific to bicycle route wayfinding in South Lake Tahoe are provided in the South Lake Tahoe Bicycle Transportation Signage System report (May 2013). The guidelines build upon and enhance standard wayfinding signs in the California MUTCD.

Design Summary

Unless superseded by locally approved design standards, Signage shall conform to the National MUTCD when in Nevada and CA MUTCD in California.

On bicycle wayfinding, mileage should be listed to the right side of each destination.



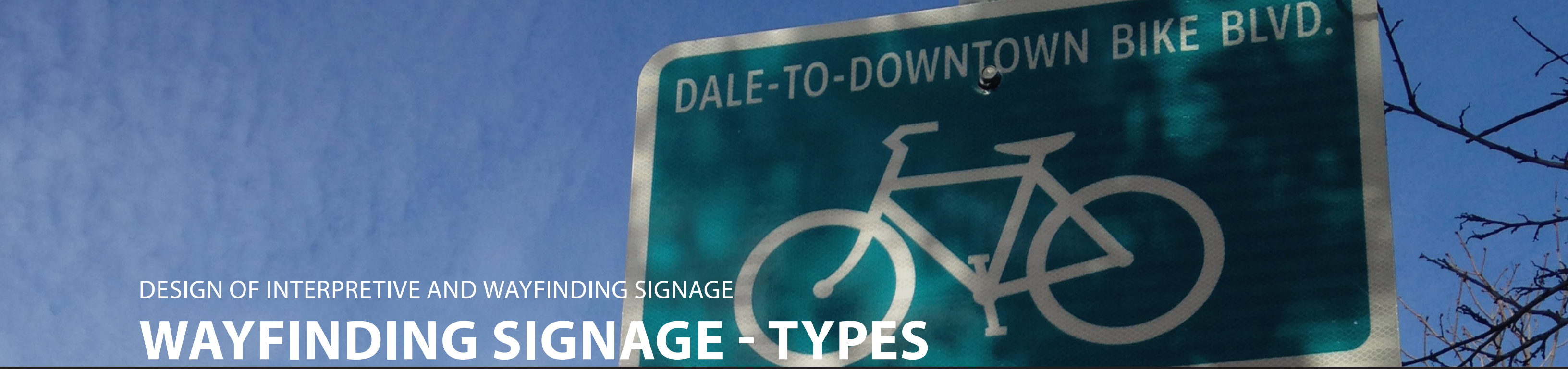
Example sign assembly from the North Lake Tahoe Community Wayfinding Signage Design Standards Manual

References

- North Lake Tahoe Community Wayfinding Signage Design Standards Manual (May 2013)
- South Lake Tahoe Bicycle Transportation Signage System (May 2013)
- Wayfinding in South Lake Tahoe Status Report #3 (August 2008)

Community Wayfinding in South Lake Tahoe

Bicycle specific wayfinding design from the South Lake Tahoe Bicycle Signage System Report.



WAYFINDING SIGNAGE - TYPES

A bicycle wayfinding system consists of comprehensive signing and/or pavement markings to guide bicyclists to their destinations along preferred bicycle routes. There are three general types of wayfinding signs: confirmation signs, turn signs, and decision signs.

Discussion

Confirmation Signs

Indicate to bicyclists that they are on a designated bikeway. Make motorists aware of the bicycle route.

Can include destinations and distance/time. Do not include arrows.

Turn Signs

Indicate where a bikeway turns from one street onto another street. Can be used with pavement markings.

Include destinations and arrows.

Decisions Signs

Mark the junction of two or more bikeways.

Inform bicyclists of “four D’s,” distance, direction, duration and destinations.

Travel times are optional but recommended.

Design Summary

There is no standard color for bicycle wayfinding signage. Section 1A.12 of the MUTCD establishes the general meaning for signage colors. Green is the color used for directional guidance and is the most common color of bicycle wayfinding signage in the US, including those in the MUTCD.

References

- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- AASHTO Guide for the Development of Bicycle Facilities. 2012.
- NACTO. Urban Bikeway Design Guide. 2012.
- Caltrans. Highway Design Manual. 2015.

Cost

- Sign, regulatory: $150 - $250 per sign

WAYFINDING SIGNAGE - PLACEMENT

Wayfinding signage acts as a "map on the street" for cyclists, pedestrians, and path users. Signs are typically placed at decision points along bicycle routes – typically at the intersection of two or more bikeways and at other key locations leading to and along bicycle routes.

Discussion

Confirmation Signs

Every ¼ to ½ mile on off-street facilities and every 2 to 3 blocks along on-street bicycle facilities, unless another type of sign is used (e.g., within 150 ft of a turn or decision sign). Should be placed soon after turns to confirm destination(s). Pavement markings can also act as confirmation that a bicyclist is on a preferred route.

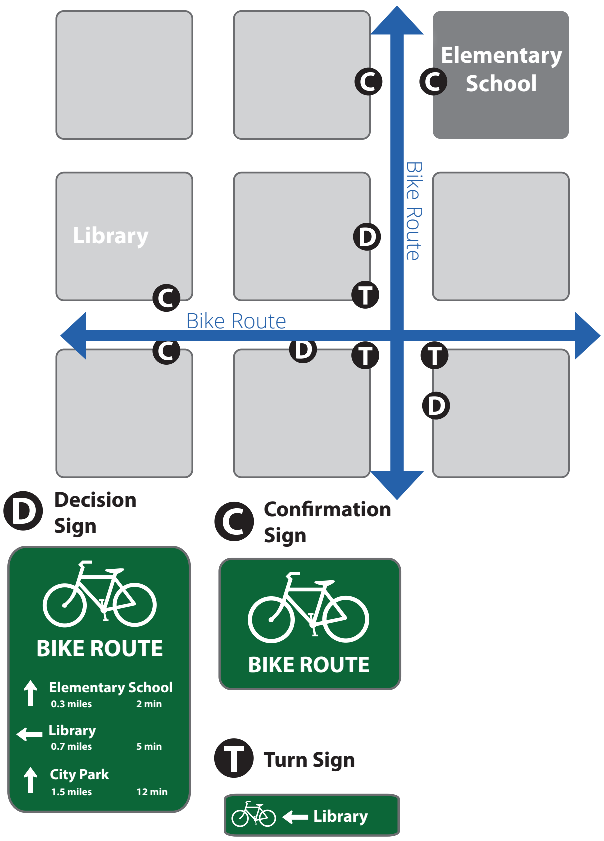
Turn Signs

Near-side of intersections where bike routes turn (e.g., where the street ceases to be a bicycle route or does not go through). Pavement markings can also indicate the need to turn to the bicyclist.

Decisions Signs

Near-side of intersections in advance of a junction with another bicycle route.

Along a route to indicate a nearby destination.



Design Summary

It can be useful to classify a list of destinations for inclusion on the signs based on their relative importance to users throughout the area. A particular destination's presence on the sign can be a function of its physical distance from which the locations are signed. For example, primary destinations (such as the downtown area) may be included on signage up to 5 miles away. Secondary destinations (such as a transit station) may be included on signage up to two miles away. Tertiary destinations (such as a park) may be included on signage up to one mile away.

References

- Caltrans. Highway Design Manual. 2015.
- Caltrans. MUTCD. 2014.
- FHWA. MUTCD. 2009.
- AASHTO Guide for the Development of Bicycle Facilities. 2012.
- NACTO. Urban Bikeway Design Guide. 2012.

Cost

- Sign, regulatory: $150 - $250 per sign

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SUPPORT AND END OF TRIP FACILITIES

RECOMMENDED RATES OF BICYCLE PARKING

Bicyclists expect 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. In addition, safe and easy access to bicycle parking facilities is necessary to encourage commuters to access transit via bicycle. Providing bicycle access to transit and space for bicycles on buses and rail vehicles can increase the feasibility of transit in lower-density areas, where transit stops are beyond walking distance of many residences. People are often willing to walk only a quarter-mile to half-mile to access a bus stop, while they might bike as much as two or more miles to reach a transit station.

Discussion

Bicycle parking rack styles vary from simple inverted-U racks in concrete to more flexible styles that can be moved around to accommodate the seasons.

Short-Term Bicycle Parking

Design Standards

- All bicycle parking facilities should be dedicated for the exclusive use of bicycles.
- Short-term bicycle parking serves users who will park for less than two hours, typically for shopping and recreation. This type of parking should be convenient. Short-term parking is typically provided with bicycle racks (see table below).
- Long-term bicycle parking should serve users who park their bicycles for a period longer than two hours. This type of parking should provide a high level of security. Long-term parking is typically provided with bicycle lockers and bicycle cages (see table below).
- The rates below are minimums. Actual use of areas may indicate additional parking capacity is needed. Both short-term and long-term parking should be required.

References

- TRPA. Code of Ordinances
- Association of Bicycle and Pedestrian Professionals. Bicycle Parking Guidelines.

Costs

- Bicycle racks: $175-$300 each
- Bicycle lockers: $665-$3,000 each

Bike parking requirements by land use

Land Use or location	Physical location	Short-Term Bicycle Parking Capacity	Long-Term Bicycle Parking Capacity
Multi-Family Residential (with private garage for each unit)	Near building entrance with good visibility	0.05 spaces for each bedroom (2 spaces minimum for whole complex	0
Multi-Family Residentiall (without private garage for each unit)	Near building entrance with good visibility	0.05 spaces for each bedroom (2 spaces minimum)	0.15 spaces for each bedroom (2 spaces minimum)
Park	Adjacent to restrooms, picnic areas, fields and other attractions	8 spaces	0
Schools	Near office entrance with good visibility	8 spaces	4 spaces per Classroom
Public Facilities (city hall, libraries, community centers)	Near main entrance with good visibility	8 spaces	1 space per 20 employees
Commercial, retail and industrial developments over 10,000 gross square feet	Near main entrance with good visibility	8 spaces per 10,000 square feet	2 locker spaces per 10,000 square feet
Shopping Centers over 10,000 gross square feet	Near main entrance with good visibility	8 spaces per 10,000 square feet	2 locker spaces per 10,000 square feet
Commercial Districts	Near main entrance with good visibility	4 spaces every 200 feet	0
Transit stations and/ or mobility hubs	Near boarding area or security guard	8 spaces	21 locker spaces for every 30 parking spaces

Secure bike parking area

SUPPORT AND END OF TRIP FACILITIES

BICYCLE PARKING

Bicyclists expect 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.

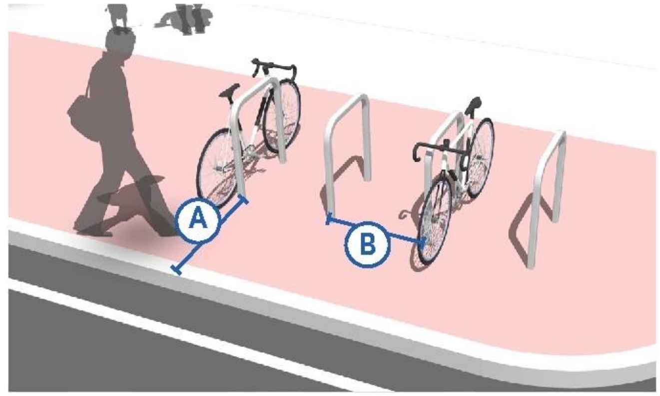
Typical Application

- Bike racks provide short-term bicycle parking and is meant to accommodate visitors, customers, and others expected to depart within two hours. It should be an approved standard rack appropriate location and placement, and weather protection.
- 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.
- Bicycle lockers are intended to provide long-term bicycle storage for employees, students, residents, commuters, and others expected to park more than two hours. Long-term facilities protect the entire bicycle, its components and accessories against theft and against inclement weather, including snow and wind-driven rain.
- A Secure Parking Area for bicycles, also known as a Bike Spa or Bike & Ride (when located at mobility hubs), is a semi-enclosed space that offers a higher level of security than ordinary bike racks. Accessible via key-card, combination locks, or keys, Bike SPAs provide high-capacity parking for 10 to 100 or more bicycles. Increased security measures create an additional transportation option for those whose biggest concern is theft and vulnerability.

Design Features

Bike Racks

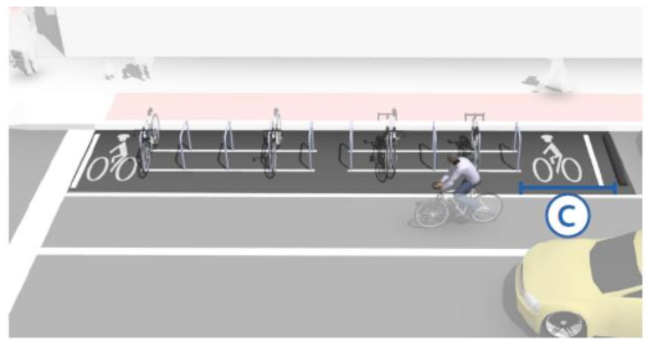
- (A) 2 feet minimum from the curb face to avoid 'dooring.'
- (B) 4 feet between racks to provide maneuvering room.
- Locate close to destinations; 50 feet maximum distance from main building entrance.
- Minimum clear distance of 6 feet should be provided between the bicycle rack and the property line.



Perpendicular Bike Racks

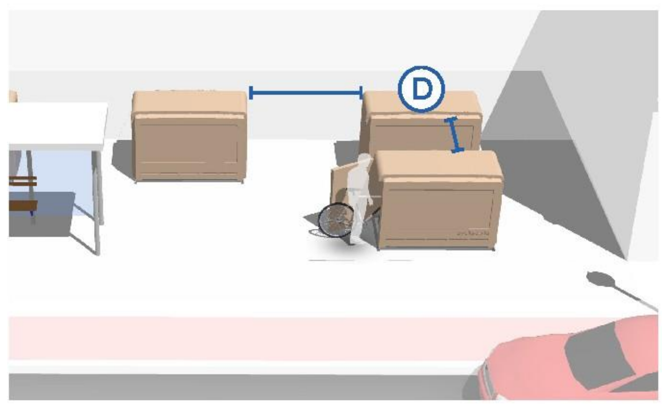
Bike Corrals

- Bicyclists should have an entrance width from the roadway of 5-6 feet.
- (C) 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.
- Bike corrals are great additions for existing residential buildings that may not have bike rooms. Covered corrals are encouraged however check with local and regional regulations regarding coverage.



Bike Lockers

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



Secure Parking Area

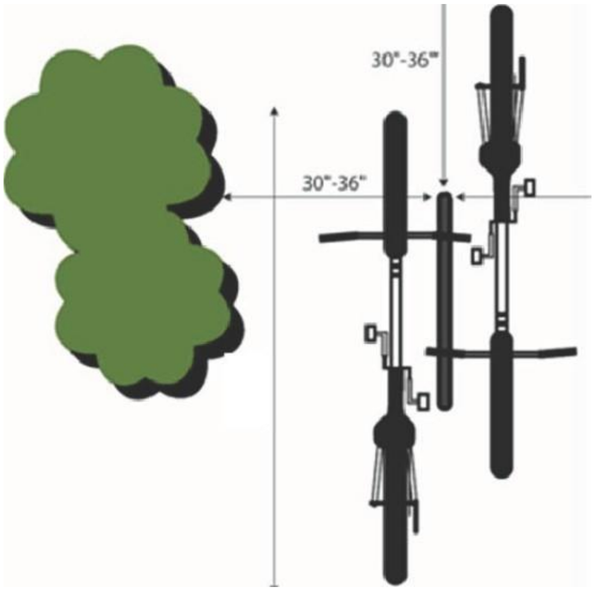
- Closed-circuit television monitoring with secure access for users are great options for residential and commercial uses.
- (E) Double high racks & cargo bike spaces with the ability to lock up a bike individually
- Bike repair station with bench and bike tube and maintenance item vending machine.
- Electrical outlets well placed for charging and even for maintenance tools.

SUPPORT AND END OF TRIP FACILITIES

BICYCLE RACK DESIGN

Short-term bicycle parking is meant to accommodate visitors, customers, and others expected to depart within two hours. It should have an approved standard rack, appropriate location and placement and weather protection. The Association for Pedestrian and Bicycle Professionals (APBP) recommends selecting a bicycle rack that supports the bicycle in at least two places, preventing it from falling over, allows locking of the frame and one or both wheels with a U-lock, is securely anchored to ground, and resists cutting, rusting and bending or deformation.

Discussion



Design Summary

- Bicycle racks should be a design that is intuitive and easy to use.
- A standard inverted-U style or staple rack is recommended for Lake Tahoe.
- Bicycle racks should be securely anchored to a surface or structure and positioned racks out of the walkway's clear zone.
- The rack element (part of the rack that supports the bicycle) should keep the bicycle upright by supporting the frame in two places without the bicycle frame touching the rack. The rack should allow one or both wheels to be secured.
- Avoid use of multiple-capacity "wave" style racks. Users commonly misunderstand how to correctly park at wave racks, placing their bikes parallel to the rack and limiting capacity to 1 or 2 bikes.
- Position racks so there is enough room between parked bicycles. Racks should be situated on 36" minimum centers.
- A five-foot aisle for bicycle maneuvering should be provided and maintained beside or between each row of bicycle racks.
- Racks should be located close to a main building entrance, in a lighted, high-visibility area protected from the elements.

References

- Association of Bicycle and Pedestrian Professionals. Bicycle Parking Guidelines.
- City of Oakland, CA. Bicycle Parking Standards.

Cost

- Bicycle racks: $175-$300 each

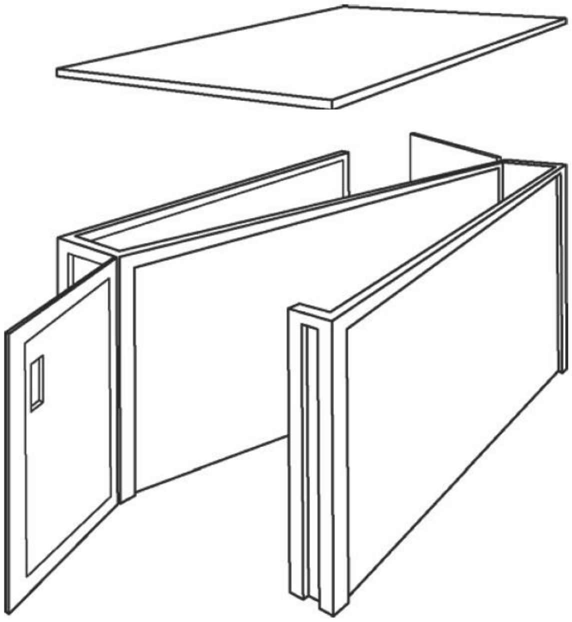
BICYCLE LOCKER DESIGN

Bicycle lockers are intended to provide long-term bicycle storage for employees, students, residents, commuters, and others expected to park more than two hours. Long-term facilities protect the entire bicycle, its components and accessories against theft and against inclement weather, including snow and wind-driven rain. Bicycle lockers provide space to store a few accessories or rain gear in addition to containing the bicycle. Some lockers allow access to two users- a partition separating the two bicycles can help users feel their bike is secure. Lockers can also be stacked, reducing the footprint of the area, although that makes them more difficult to use.

Discussion

Bicycle Parking Manufacturers:

- Palmer: www.bikeparking.com
- Dero: www.dero.com
- Creative Pipe: www.creativepipe.com
- Cycle Safe: www.cyclesafe.com



Design Summary

- Bicycle lockers should be a design that is intuitive and easy to use.
- Bicycle lockers should be securely anchored to a surface or structure.
- Bicycle lockers should be constructed to provide protection from theft, vandalism, and weather.
- A five-foot aisle for bicycle maneuvering should be provided and maintained beside or between each row of bicycle lockers.
- Lockers should be located close to a main building entrance, in a lighted, high-visibility area protected from the elements. Long-term parking should always be protected from the weather.

References

- Association of Bicycle and Pedestrian Professionals. Bicycle Parking Guidelines.
- City of Oakland, CA. Bicycle Parking Standards.

Cost

- Bicycle lockers: $665 -$3,000 each

SHOWERS AND LOCKERS

Discussion

Shower and locker facilities at large commercial developments encourage bicycling by providing storage space for clothing and an opportunity to freshen up before work. Employees who exercise on their lunch break can also benefit from shower and locker facilities.

Design Summary

- Two shower facilities (one per gender) should be provided by employers of 100-200 persons.
- 20 lockers (10 per gender) should be provided by employers of 100-200 persons.
- Four shower facilities (two per gender) should be provided by employers of more than 200 persons. An additional four showers (two per gender) should be provided for every additional 500 employees over the initial 200 employees.
- 40 lockers (20 per gender) should be provided by employers of more than 200 persons. An additional 20 lockers (10 per gender) should be provided for every additional 500 employees over the initial 200 employees

Cost

- Costs Vary

References

- Association of Bicycle and Pedestrian Professionals Bicycle Parking Guidelines.
- City of Oakland, CA. Bicycle Parking Standards.

MAINTENANCE STANDARDS

SHARED-USE PATH MAINTENANCE STANDARDS

Standards Summary

SURFACE GAP REPAIR

To provide for accessibility and functionality for all users, shared use paths must be maintained to provide a continuous clear width of firm stable surface.

Path Surface

- The surface of the pedestrian access route shall be firm, stable and slip resistant (US Access Board, PROWAG, Section R302.7).

Vertical Changes in Level

- Surface discontinuities shall not exceed ½ inch maximum. Vertical discontinuities between ¼ inch and ½ inch maximum shall be beveled at 1:2 minimum. The bevel shall be applied across the entire level change (PROWAG, Section R302.7.2). Changes in level greater than ½ inch shall be accomplished by means of an accessible ramp.

Gaps and Elongated Openings

- Walkway Joints and Gratings. Openings shall not permit passage of a sphere more than ½ inch in diameter. Elongated openings shall be placed so that the long dimension is perpendicular to the dominant direction of travel (PROWAG, Section R302.7.3).

Discussion

Basic Maintenance

- Path pavement should be repaired as needed to avoid safety issues and to ensure ADA compliance.
- Paths should be swept regularly.
- Shoulder vegetation should be cleared and trimmed regularly.

Long-Term Maintenance

- Paths should be slurry sealed, at minimum, 10 years after construction.
- Paths should receive an overlay, at minimum, 15 years after construction.

Maintenance Activity	Frequency
Surface gap repair	As needed (see additional guidance below)
Inspections	Monthly
Pavement sweeping/blowing	As needed, weekly in Fall
Snow removal	As needed, or as feasible
Pavement markings replacement	1-3 years, or as needed
Signage replacement	1-3 years, or as needed
Shoulder plant trimming (weeds, trees, brambles)	Twice a year, middle of growing season and early Fall
Tree and shrub plantings, trimming	1-3 years
Major damage response (washouts, fallen trees, flooding)	As soon as possible

Maintenance Challenges

- Most agencies pay for sidewalk and path maintenance out of their maintenance and operations budget. This funding is generally enough to provide seasonal maintenance, but is not enough to fund long-term preventative maintenance, such as overlays.
- Grant funding is not generally available for maintenance activities.
- Paths with year-round use or with commuting utility should be cleared of snow.
- If snow is removed from paths, snow must be removed far enough back from the pavement so that it does not melt, refreeze and create black ice. Sand is not permitted on many paths because they are adjacent to the lake and sanding increases costs.
- Small plows, which have been purchased by some Lake Tahoe agencies, are not strong enough to clear heavy snows or densely packed snows. Specialized blowers may be needed to clear deep snow or snow that has condensed by freeze/thaw.

References

- ADA Access Board. Proposed Guidelines on Accessible Public Rights of Way. 2011.

Cost

- $1,000-14,000 per mile per year

ON-STREET FACILITY MAINTENANCE STANDARDS

Discussion

Basic Maintenance

Bicyclists often avoid shoulders and bike lanes filled with sanding materials, gravel, broken glass and other debris; they will ride in the roadway to avoid these hazards, causing conflicts with motorists. A regularly scheduled inspection and maintenance program helps ensure that roadway debris is regularly picked up or swept. Roadways should also be swept after automobile collisions.

Long-Term Maintenance

Roadway surface is a critical issue for bicyclists' quality. Bicycles are much more sensitive to subtle changes in roadway surface than are motor vehicles. Examine pavement quality and transitions during every roadway project for new construction, maintenance activities, and construction project activities that occur in streets.

Street sweeper

Maintenance Activity	Frequency
Inspections	Seasonal - at beginning and end of summer
Pavement sweeping/blowing	As needed, weekly in Fall
Snow removal	As needed, or as feasible
Pavement sealing, potholes	5 - 15 years
Culvert and drainage grate inspection	Before Winter and after major storms
Pavement markings replacement (includes crosswalks)	1-3 years
Signage replacement	1-3 years
Shoulder plant trimming (weeds, trees, brambles)	Twice a year, middle of growing season and early Fall
Tree and shrub plantings, trimming	1-3 years
Major damage response (washouts, fallen trees, flooding)	As soon as possible

Standards Summary

NOTE: Caltrans recommends tolerance of surface discontinuities no more than ½ inch wide when parallel to the direction of travel on bike lanes (Class II) and bike routes (Class III).

Cost

- $2,000 per mile per year

SEPARATED BIKE LANE MAINTENANCE

Separated bike lanes require increased maintenance effort compared to conventional bicycle lanes. Some designs are more maintenance-friendly than others and implications for snow storage, removal and clearance should be considered.

Discussion

All bikeways should be maintained free of debris, including snow, leaves and gravel.

Design Summary

Consider barrier type on snow storage.

- Street level separated bike lanes collect more debris than raised separated bike lanes. Fully raised sidewalk –level separated bike lanes may be plowed at the same time as the adjacent sidewalk. Bollards may be designed for seasonal removal to allow for plowing during snow events.

Design for access and egress

- Snow removal vehicles must be able to maneuver into and out of the separated bike lane.

Design adequate width for sweepers

- A clear bike lane/buffer width of 10’ should be considered for maximum compatibility with most snowplow equipment. Smaller sized sweepers should be used when facilities are smaller than this size.

Provide capacity for snow storage

- Snow should not be stored within the through-zone of the bike lane. Snow may be stored in the separated bike lane buffer area, or the furnishing zone of the adjacent sidewalk.

Separated bike lanes should be promptly cleared after snow events.

Fallen leaves accumulating separated bike lanes cause hazardous conditions in wet weather.

References

- FHWA. Separated Bike Lane Planning and Design Guide. 2015.

Appendix B

Tahoe Transportation Survey

Tell Us About Transportation Safety in Tahoe

The first 5 questions apply to transportation in the Tahoe Region as a whole:

What is your primary mode of transportation in a typical week?

A. Walking/rolling
B. Bicycle
C. Transit
D. Vehicle
E. Motorcycle
F. Shared Mobility/E-scooters
G. Using a special transportation service, such as one for seniors or persons with disabilities

Please circle how you feel about the following statement:

The Lake Tahoe Region is a safe place for all road users—motorists, bicyclists, and pedestrians—to travel.

Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

Please rate how you feel travelling by each mode of transportation:

	Very safe	Somewhat safe	Neutral	Somewhat unsafe	Very unsafe	I don't travel by this mode
Vehicle	○	○	○	○	○	○
Walking/Rolling	○	○	○	○	○	○
Bicycling	○	○	○	○	○	○
Transit	○	○	○	○	○	○
Motorcycle	○	○	○	○	○	○
Shared Mobility/E-scooters	○	○	○	○	○	○
Special Transportation Service (e.g. paratransit)	○	○	○	○	○	○

Which type of bicyclist do you most closely identify with?

A. Strong and Fearless: People willing to bicycle with limited or no bicycle-specific infrastructure

B. Enthused and Confident: People willing to bicycle if some bicycle-specific infrastructure is in place

C. Interested but Concerned: People willing to bicycle if high-quality bicycle infrastructure is in place

D. No Way, No How: People unwilling to bicycle but may if high-quality bicycle infrastructure is in place

Vision Zero is a strategy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all. Have you heard of Vision Zero?

A. Yes

B. No

What are your biggest safety concerns while travelling in Tahoe? Select the top 3:

A. Speeding

B. Distracted driving

C. Driving under the influence

D. Not enough lighting

E. Not enough crosswalks

F. Not enough bicycle lanes or bicycle paths

G. Poorly maintained bicycle routes (snow, debris or potholes)

H. Winter weather conditions

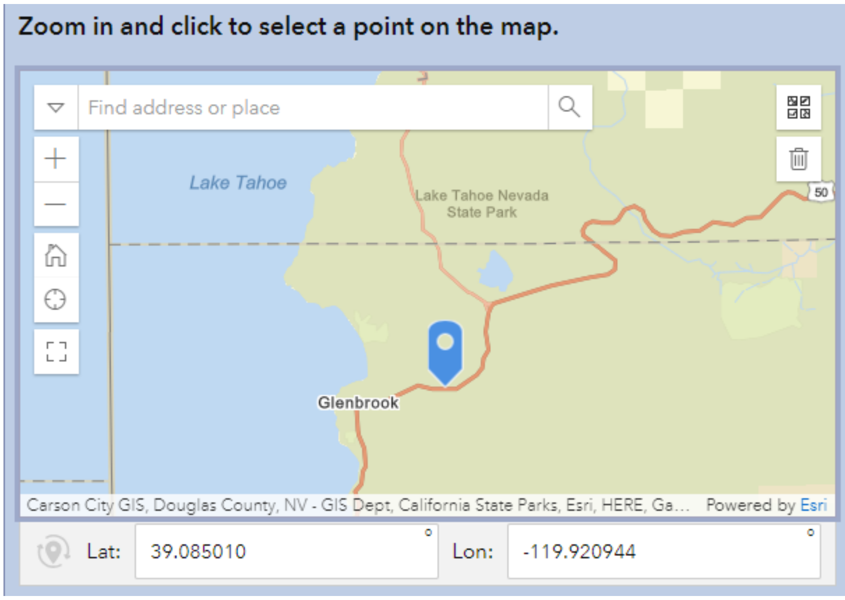
I. Drivers not yielding to people in crosswalks

J. Poor sightline visibility (the length of roadway visible to a driver, i.e. at driveways, bicycle crossings, roundabouts)

K. Other: ____

The following 5 questions apply to a specific location in the Tahoe Region. This could be a street, intersection, roundabout, bicycle lane, etc.

Which location would you like to provide feedback on? (You may comment on multiple locations.)



For this location, what mode of transportation would you like to give feedback on?

A. Bicycle
B. Walk
C. Assisted Mobility
D. Roll (scooter, skateboard, one-wheel)
E. Vehicle
F. Transit

How safe do you feel travelling at this location? (Circle below)

Safe or low-stress Neutral Unsafe or high-stress

If you selected unsafe, have you had a near miss at this location? A near miss is a narrowly avoided collision with another party.

A. Yes
B. No

Additional Comments

Please Tell Us A Little About Yourself

Which of the following best describes your residency in the Lake Tahoe Region?

A. Full-time resident
B. Seasonal resident
C. Commuter (live outside the basin, but commute to the basin to work)
D. Visitor

What's the zip code of your primary residence? ___________________

What is your age?

A. Under 18
B. 19-24
C. 25-34
D. 35-44
E. 45-54
F. 55-65
G. 65+

What gender do you identify as?

A. Female
B. Male
C. Non-binary
D. Transgender
E. Prefer not to say
F. Other _____________

How many people live in your household (as a family unit)?

A. 1 person
B. 2 people
C. 3 people
D. 4 people
E. 5 people
F. 6 or more people

What is your total family income?

A. Under $20,000
B. $20,000 to $30,000
C. $31,000 to $40,000
D. $41,000 to $50,000
E. $51,000 to $75,000
F. $76,000 to $100,000
G. Above $100,000

Appendix C

Bicycle Level of Traffic Stress & Pedestrian Experience Index Technical Memorandums

CAMBRIDGE SYSTEMATICS

Bicycle Level of Traffic Stress

report

prepared for

Tahoe Regional Planning Agency

prepared by

Cambridge Systematics, Inc.

November 16, 2023

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technical report

Bicycle Level of Traffic Stress

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November 16, 2023

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1.0 Executive Summary

This document outlines the technical methodology for the Bicycle Level of Traffic Stress (BLTS) Analysis conducted in the summer and fall of 2023. Through a systematic evaluation process, the goal was to delineate the varying levels of stress encountered by bicyclists, thereby facilitating a nuanced understanding of the cycling environment. The results of this analysis provide an understanding of the level of bicycle comfort for each intersection and segment within the Tahoe Basin Area. The results are useful for understanding the existing baseline performance of transportation in terms of bicycle traffic stress.

A BLTS analysis is an approach used by transportation planners and engineers to evaluate the level of comfort of bicycling at a given location. It is a deterministic method of assessing the level of stress that bicyclists might experience when traveling on a particular street, intersection, or other bicycle facility.

Traffic stress analyses are useful for understanding how comfortable a given location within the transportation network feels for a person traveling along or across a given location. These analyses rely on environmental factors that the road user will encounter while traveling within the network, for example, average daily traffic volumes, roadway geometries, speed, number of lanes, and other features.

A score of 1 indicates a low-stress environment where bicycling is comfortable for people of all ages and abilities. A score of 2 indicates a moderately low-stress environment where bicycling is comfortable for most people but may be challenging for some. A score of 3 indicates a moderately high-stress environment where only experienced and confident bicyclists may feel comfortable. A score of 4 indicates a high-stress environment where only the most confident and skilled bicyclists would attempt to ride. The scoring approach is intended to align with the different skill and ability levels of people on the roads. The following summarizes each score.

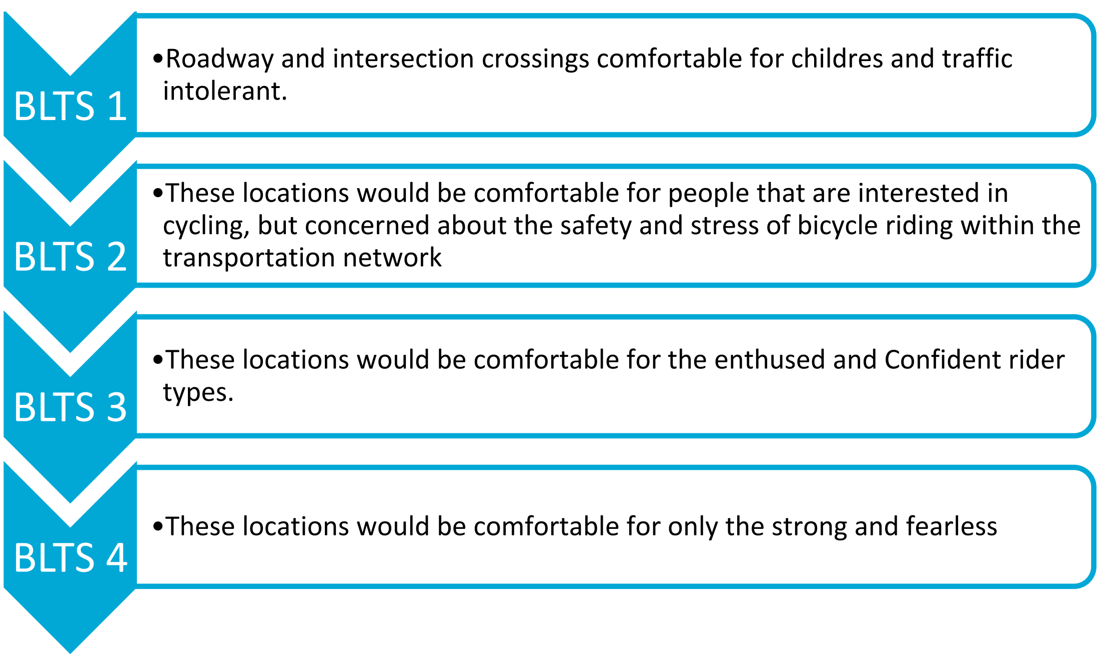

Figure 1: Summary of BLTS Scores

2.0 Methodology

The bicycle level of traffic stress was measured across all paved road segment and intersection locations in the Tahoe Basin. The analysis considers all paved roads and shared-use paths in developing the scores. The team used the Oregon Department of Transportation and published in the Oregon Analysis Procedural Manual, Chapter 14[1] as guidance for conducting segment and intersection BLTS analyses.

This Oregon Procedure Manual provides a concise summary of various multimodal analysis types applicable to plans and projects of varying detail levels, including multimodal traffic stress, pedestrian level of traffic stress, and bicycle level of traffic stress. The manual delineates several variations of bicycle levels of traffic stress, encompassing intersection and segment-level BLTS analyses. This methodology leveraged intersection BLTS and urban/suburban BLTS scores as per the Manual guidelines. Comprehensive tables detailing BLTS scores for segments can be found in Appendix A, while scores for intersections are cataloged in Appendix B.

The assessment of the transportation system network in this study utilized data gathered during the fall and summer of 2023, with subsequent updates continuously integrated throughout the analysis period for the BLTS analysis.

The BLTS analysis takes into account various factors that influence rider discomfort. These include traffic volume, vehicle speed, the presence of bike lanes or other bicycle facilities, land use type, and other roadway characteristics. The analysis results in a numerical score from 1 to 4, with higher numbers indicating higher levels of stress. The project team added a score of 4.5 to the analysis to account for exceptionally stressful locations for cyclists within the Tahoe Basin. This includes several arterial roads, for example, Nevada State Route 28 between US Route 50 and Inline Village, and sections of California Route 89. All class I facilities were all scored with a BLTS score of 1.

During the evaluation of intersection, the project team discussed how to treat flashing beacon countermeasures in assigning the final BLTS scores at intersections. The team agreed to follow the suggestion of Peter Fruth to treat them as signalized intersections[2].

The thorough analysis considered multiple factors at the segment level to assess the level of traffic stress for bicyclists. These factors included the maximum posted speed limit, number of travel lanes, existing bicycle facilities, bicycle lane width, one-way travel, and average annual daily traffic. At the intersection level, the analysis scrutinized the intersection's characteristics, factoring in elements such as the number and type of traffic signals, maximum posted travel speed, maximum number of lanes, and functional classification.

The following summarizes the factors used to measure the level of traffic stress for each segment within the Tahoe Basin. The data sources are supplied in the table in the second column.

Table 1: BLTS Measure

Measure	Source	Utility
Number of Travel Lanes	TRPA, Open Street Map	Segment BLTS, Intersection

[1] https://www.oregon.gov/odot/planning/pages/apm.aspx

[2] https://peterfurth.sites.northeastern.edu/level-of-traffic-stress/

Maximum Speed Limit	TRPA, Open Street Map	Segment BLTS, Intersection
Average Annual Daily Traffic	Replica	Segment BLTS
One way designation	Open Street Map	Segment BLTS
Existing Bicycle Facilities	TRPA	Segment BLTS
Signalized Intersection	Open Street Map	Intersections BLTS
Functional Classification	Open Street Map	Segment BLTS, Intersection
Bicycle Facility Width	Open Street Map	Segment BLTS
Roadway Width	Open Street Map	Segment BLTS

In instances where specific information was absent in the source data, assumptions were judiciously made to address gaps. For example, when the maximum posted speed limit was unavailable, the road network's functional classification was utilized to infer the road's speed limit. This approach operated under the assumption that higher functional class roads generally have higher posted speed limits. The following describes assumptions made to fill data gaps, providing transparency regarding the methodology applied in the analysis.

One way

- no road was considered one way unless it was a motorway or had one a single lane

Number of lane

- 1: one way residential roads, Class I bicycle facility, or service road
- 2: residential roads or tertiary road,
- 4: primary and secondary arterials

Centerline

- Center lines were considered to be present in all cases except residential roads, Class I roads, service roads, and any road with only 1 lane.

Max Posted Speed Limtied

- 10 MPH: Class I bicycle infrastructure
- 25 MPH: All residential and service roads
- 30 MPH: Tertiary roads
- 40 MPH: Primary and secondary arterials

No roadside parking was available at the time of the analysis and all roads were assumed to allow roadside parking. Since no available pavement width data was available at the time of the analysis, all roads were considered 50 feet wide, Class I facilities were assumed to be 6 feet wide, and Class II and IV facilities were assumed to be 5 feet wide.

Each factor identified for the BLTS analyses were built onto a base road and intersections layer. These can be considered consolidated digital versions of the transportation network. Over 750 miles of roads within the Tahoe Basin were analyzed, and over 2500 intersections were analyzed.

Once the project team built the digital road networks, each location was scored independently. These draft results were shared with the project team before collecting feedback from the Bicycle Advisory Committee. This process is described in greater detail in the Stakeholder Engagement section.

3.0 Stakeholder Engagement

The project team employed an interactive map application to present the GIS data mentioned earlier to TRPA for evaluation. This approach facilitated the collection of location-specific comments, enabling the team to document responses systematically within an online repository. A screenshot of the map can be found in Figure 2.

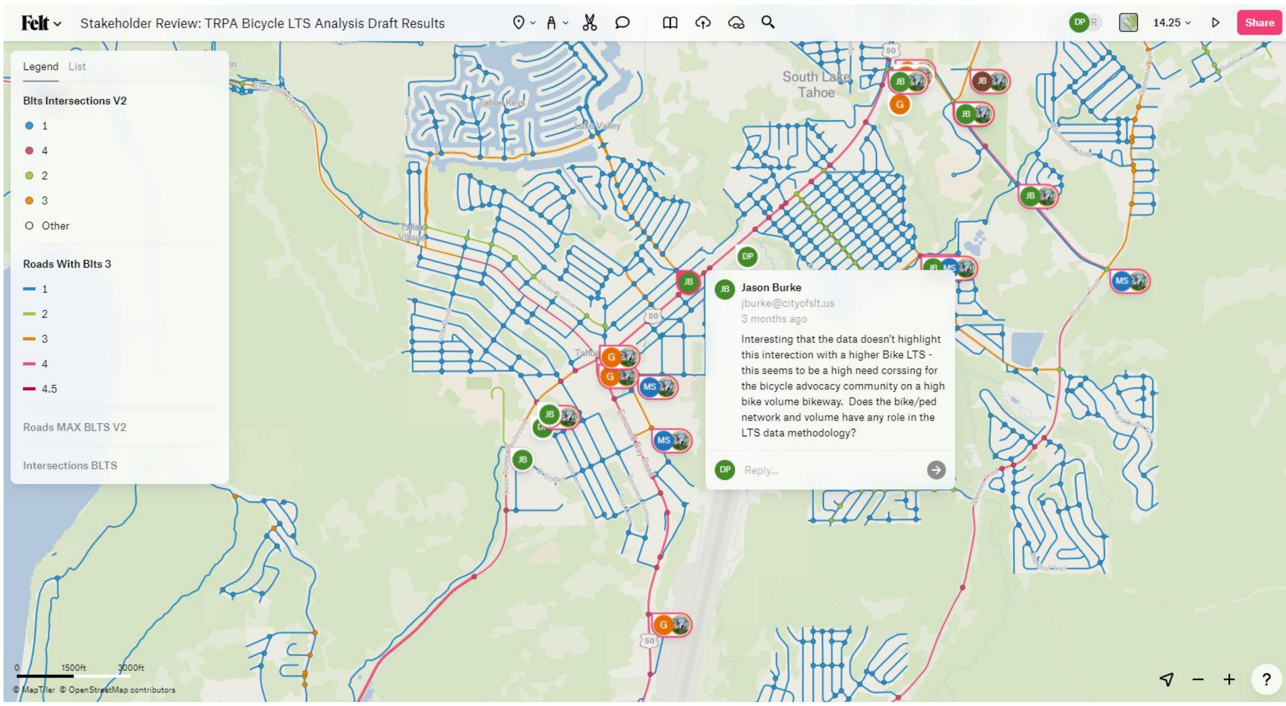

Figure 2: Map of Stakeholder Engagement

The project team enlisted the Bicycle Technical Advisory Committee to offer feedback on the preliminary BLTS analysis. A comprehensive total of 47 comments were submitted by members of this stakeholder group. The project team meticulously deliberated on each comment, engaging in detailed discussions and conducting follow-ups with individual members when necessary. Subsequently, all comments were integrated into the final BLTS results.

Every individual response underwent thorough scrutiny by the analysis team, and adjustments were implemented in alignment with the recommendations put forth during the review, as approved by the project management team.

4.0 Results and Future Work

The final results were delivered to TRPA in shapefile format. This included all roads and intersections included in the analysis. These data also included the attributes that contributed to the LTS score. These analysis results can be used in various ways, including:

- Help riders identify comfortable routes
- Inform bicycle wayfinding program implementation
- Identify gaps in the low stress bikeway network to inform facility plans and project prioritization
- Inform street project design decisions

As our understanding of urban mobility continues to evolve, the BLTS analysis presented in this study serves as a pivotal step toward enhancing the cycling experience within the TRPA planning area. However, recognizing the dynamic nature of transportation systems and the ongoing advancements in infrastructure design, additional avenues exist for future work and refinement of this BLTS analysis. The following highlights potential enhancements to the existing BLTS framework and additional use cases of the BLTS analyses.

- Expand the BLTS framework to include multi-modal measures of traffic stress
- Expand the BLTS to include pedestrian travel stress score
- Update the BLTS to include new and updated data sources when they become available, such as when new facilities or digital infrastructure data are available.
- Consider how improvements to the bicycle network will improve bicycle stress crossing and travel along segments.
- Identify which high-stress road segments do not have adjacent shared-use paths.

The BLTS analysis is a valuable tool for transportation planners and engineers to identify locations for investments into active transportation to make cycling safer and more accessible for people of all ages and abilities. By identifying areas of high stress and developing strategies to reduce that stress, communities can encourage more people to choose bicycling as a safe and convenient mode of transportation.

Appendix A.

Each of the following tables were sourced from the Oregon Analysis Procedures Manual Chapter 14.

Table 2: BLTS Criteria for Segment with Bike Lane and Adjacent Parking Lane

Prevailing or Posted Speed	1 Lane per direction			≥2 lanes per direction	
	≥ 15' bike lane + parking	14' – 14.5' bike lane + parking	≤ 13' bike lane + parking or Frequent blockage[1]	≥ 15' bike lane + parking	≤ 14.5' bike lane + parking or Frequent blockage[1]
≤25 mph	BLTS 1	BLTS 2	BLTS 3	BLTS 2	BLTS 3
30 mph	BLTS 1	BLTS 2	BLTS 3	BLTS 2	BLTS 3
35 mph	BLTS 2	BLTS 3	BLTS 3	BLTS 3	BLTS 3
≥40 mph	BLTS 2	BLTS 4	BLTS 4	BLTS 3	BLTS 4

Table 3: BLTS Criteria for Segment with Bike Lane, no Adjacent Parking Lane

Prevailing or Posted Speed	1 Lane per direction				≥2 lanes per direction	
	≥ 7' (Buffered bike lane)	5.5' – 7' Bike lane	≤ 5.5' Bike lane	Frequent bike lane blockage[1]	≥ 7' (Buffered bike lane)	<7' bike lane or frequent blockage[1]
≤30 mph	BLTS 1	BLTS 1	BLTS 2	BLTS 3	BLTS 1	BLTS 3
35 mph	BLTS 2	BLTS 3	BLTS 3	BLTS 3	BLTS 2	BLTS 3
≥40 mph	BLTS 3	BLTS 4	BLTS 4	BLTS 4	BLTS 3	BLTS 4

Table 4: Criteria for Urban/Suburban Mixed Traffic Segment – 30 mph or less

Number of Lanes	ADT (vph)[1]	Functional Class	Posted or Prevailing Speed (mph)		
			≤20	25	30
Unmarked Centerline	≤750	Local	BLTS 1	BLTS 1	BLTS 2
	750 - ≤1,500	Local /Collector	BLTS 1	BLTS 1	BLTS 2
	1,500 - ≤3,000	Collector	BLTS 2	BLTS 2	BLTS 2
	>3,000	Arterial	BLTS 2	BLTS 3	BLTS 3
1 through lane per direction	≤750	Local	BLTS 1	BLTS 1	BLTS 2
	750 - ≤1,500	Local /Collector	BLTS 2	BLTS 2	BLTS 2
	1,500 - ≤3,000	Collector	BLTS 2	BLTS 3	BLTS 3
	>3,000	Arterial	BLTS 3	BLTS 3	BLTS 3
2 through lanes per direction	≤8,000	Arterial	BLTS 3	BLTS 3	BLTS 3
	>8,000	Arterial	BLTS 3	BLTS 3	BLTS 4
3+ though lanes per direction	Any ADT	Arterial	BLTS 3	BLTS 3	BLTS 4

Table 5: Criteria for Urban/Suburban Mixed Traffic Segment – 35 mph or More

Number of Lanes	ADT (vph)[1]	Functional Class	Posted or Prevailing Speed (mph)		
			35	40	>45
Unmarked Centerline	≤750	Local	BLTS 2	BLTS 3	BLTS 3
	750 - ≤1,500	Local /Collector	BLTS 3	BLTS 3	BLTS 4
	1,500 - ≤3,000	Collector	BLTS 3	BLTS 4	BLTS 4
	>3,000	Arterial	BLTS 3	BLTS 4	BLTS 4
1 through lane per direction	≤750	Local	BLTS 2	BLTS 3	BLTS 3
	750 - ≤1,500	Local /Collector	BLTS 3	BLTS 3	BLTS 4
	1,500 - ≤3,000	Collector	BLTS 3	BLTS 4	BLTS 4
	>3,000	Arterial	BLTS 3	BLTS 4	BLTS 4
2 through lanes per direction	≤8,000	Arterial	BLTS 3	BLTS 4	BLTS 4
	>8,000	Arterial	BLTS 4	BLTS 4	BLTS 4
3+ though lanes per direction	Any ADT	Arterial	BLTS 4	BLTS 4	BLTS 4

Appendix B.

The following table was sourced from the Oregon Analysis Procedures Manual Chapter 14.

Table 6: BLTS Criteria for Unsignalized Intersection Crossing Without a Median

Prevailing Speed or Speed Limit (mph)	Total Through/Turn Lanes Crossed (Both Directions)[2]					
	≤ 3 Lanes			4 -5 Lanes		≥ 6 Lanes
	Functional Class/ADT (vpd)					
	Local	Collector	Arterial	Arterial		Arterial
	≤ 1,200	1,200 - ≤3,000	>3,000	≤ 8,000	>8,000	Any ADT
≤ 25	BLTS 1	BLTS 1	BLTS 2	BLTS 3	BLTS 4	BLTS 4
30		BLTS 1	BLTS 3	BLTS 3	BLTS 4	BLTS 4
35		BLTS 2	BLTS 3	BLTS 4	BLTS 4	BLTS 4
≥ 40		BLTS 3	BLTS 4	BLTS 4	BLTS 4	BLTS 4

Pedestrian Experience Index (PEI) Methodology

technical

memorandum

prepared for

Tahoe Regional Planning Agency

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FebruaryOctober 12, 20234

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technical memorandum

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1.0 Pedestrian Experience Index Approach Summary

The Pedestrian Experience Index (PEI) analysis is useful for transportation planners and engineers to identify areas that need improvements to enhance the overall pedestrian environment, and better understanding individual factors that influence the day-to-day quality of the pedestrian experience. Understanding individual contributing factors can be used to plan improvements to safety and the built environment, and offset negative impacts on the pedestrian experience such as those related to infrastructure that are challenging to modify.

The PEI analysis results in a numerical score ranging from 0 percent (%) – 100 percent (%) for each road centerline link within the Tahoe Basin transportation system, with higher scores indicating a better pedestrian environment.

The analysis was conducted on road segments throughout the Tahoe Basin. Road segments were defined as road centerline between intersections. Dirt roads were excluded from the analysis.

2.0 Proposed Factors to Measure the Pedestrian Experience

The following table summarizes the PEI variables selected for the Tahoe Regional Planning Agency's (TRPA) analysis. The variables are broken down into 4 categories, including infrastructure, street design, community activity, and economic activity.

1. Infrastructure: A measure of the quality and accessibility of pedestrian infrastructure such as sidewalks, crosswalks, and driveways, influencing the ease and safety of walking.

2. Street Design: An assessment of how streets are laid out and designed, including factors such as block length, tree canopy, and traffic speed, impacting pedestrian comfort and enjoyment.

3. Community Activity: A gauge of the vibrancy and liveliness of the surrounding community, encompassing factors such as the presence of parks and cultural attractions, contributing to the pedestrian experience through opportunities for social interaction and engagement.

4. Economic Activity: An evaluation of the economic vitality and diversity of the area, including factors such as the number of shops which can influence the pedestrian experience.

Table 1: Pedestrian Experience Index Factor Summary

Category	Variable	Source (GIS Layer Name)	Method
Infrastructure	Presence of Sidewalk	TRPA, Active Transportation Infrastructure Data	Higher score assigned to segments with more sidewalk coverage.
	Presence of adjacent Bike Lane	TRPA, Bike Infrastructure Data	Higher score assigned to segments with greater percent coverage of bike infrastructure (Class I, II, IV).
	Density of Driveways	TRPA, Surface type	Lower score assigned to segments with higher driveway densities.
	Density of pedestrian crossing amenities (crosswalk, pedestrian signal, median)	TRPA, Intersections	Greater score to locations with higher density of crossing amenities.
Street Design	Posted Travel Speed	TRPA, Open Street Map	Lower score assigned to roads with higher posted speed limits.
	Block Length	Open Street Map	Higher scores assigned to road segments with shorter block lengths.
	Building Setbacks	Open Street Map and TRPA 2019 Impervious Layer	Higher scores assigned to roads with greater setback.
	Tree Canopy Coverage	TRPA, LiDAR Derivative	Greater score to roads with higher density forest canopy coverage.
	Number of Travel Lanes	TRPA, Open Street Map	Greater score to roads with higher number of travel lanes.
Community Activity	Natural Scenery	TRPA	Greater score assigned to segments with greater percentage of road within scenic boundary.
	Density of amenities	TRPA, town centers	Higher score assigned to segments with greater density of amenities.
	Density of Dwelling Units	TRPA, parcels, number of units	Greater score assigned to locations with greater density of nearby dwelling units.
	Cultural / Historical Importance	TRPA, historic designation data	Greater score assigned to segments with greater density of nearby cultural historical locations.
Economic Activity	Density of Business Addresses	Urban Footprint	Higher scores of assigned to road segments with greater density of amenities.

3.0 Excluded Factors

Several factors were considered but ultimately excluded from the proposed methodology, including the presence of adjacent parking lanes and land use mix. These factors could be included in future updates to this analysis.

1. *Presence of Adjacent Parking Lanes*: This factor was considered in the methodology, but data regarding the presence of adjacent parking lanes was determined to be unavailable during the development of the bicycle level of traffic stress analysis. Therefore, it was excluded from the analysis due to data limitations.

2. *Land Use Mix*: A higher degree of mixed land use patterns is associated with an elevated pedestrian experience. However, a method for estimating land use mix has not been defined by the project team. Additional analysis is required to select and implement a method for defining land use mix.

4.0 PEI Weighting

Once the variables described above were calculated for each road segment, the final PEI score was determined using the weighting scheme outlined below. Before applying the weighting scheme, each percentile rank was used to normalize variable measures between 0% and 100%.

Table 2: Variable Weights

Category	Factor	Factor Weight	Category Weight
Infrastructure	Presence of Sidewalk	50	30
	Presence of Adjacent Bike Lane	20	
	Density of Driveways	10	
	Density of Pedestrian Crossing Amenities	30	
Street Design	Posted Travel Speed	25	25
	Block Length	20	
	Building Setbacks	25	
	Tree Canopy Coverage	20	
	Number of Travel Lanes	10	
Community Activity	Density of Resident Addresses	25	25
	Natural Scenery	25	
	Density of amenities	25	
	Cultural / Historical Importance	25	
Economic Activity	Density of Business Addresses	100	20

5.0 Final Scores and Analysis

Draft results were delivered to TRPA for internal review before finalizing the results. The review was conducted using an online interactive web mapping application.

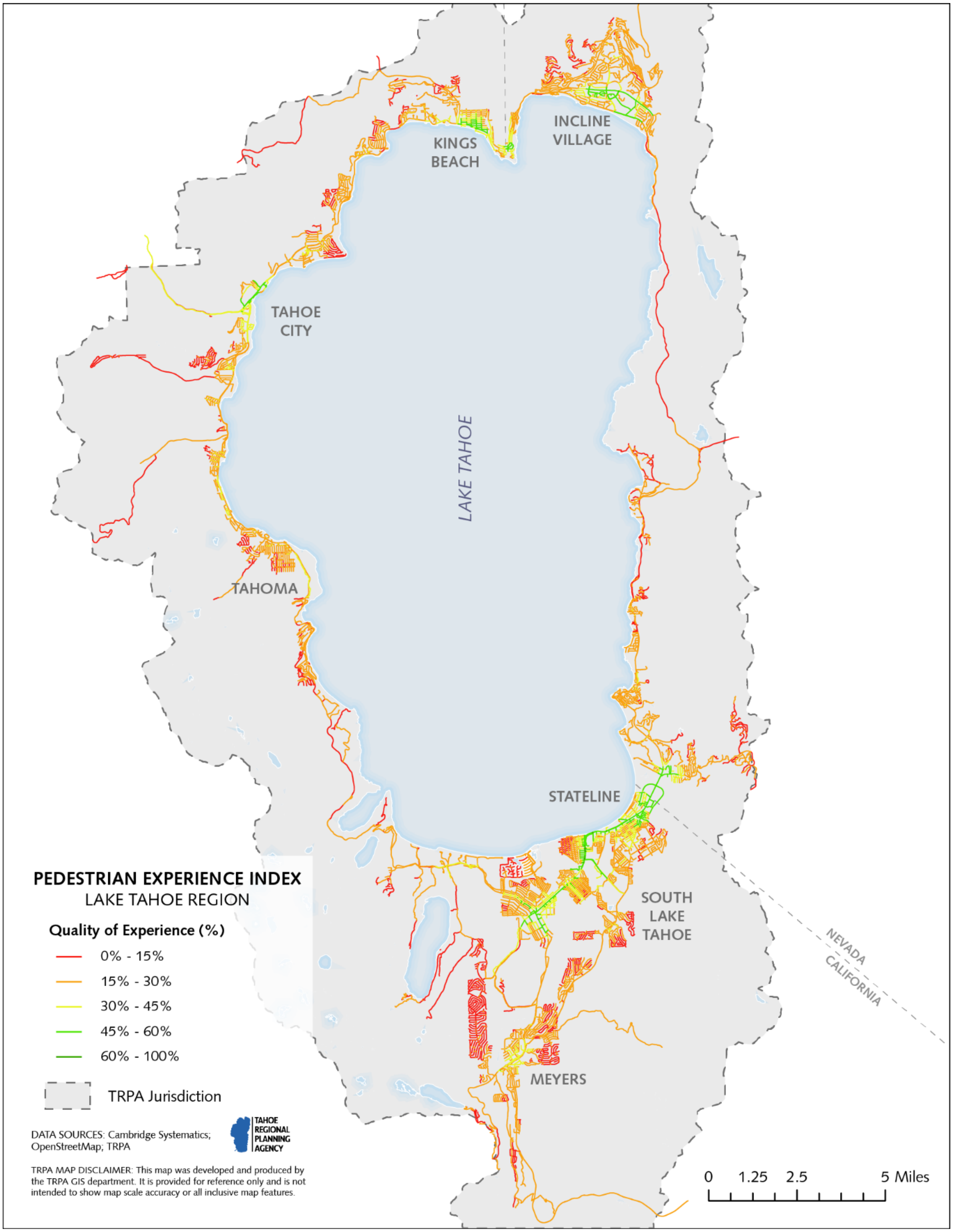

Figure 1: PEI Results

The final analysis can be used to explore opportunities to identify areas where the overall pedestrian experience can be improved by factors that are already the subject of policy discussion, such as potential safety improvements, new transportation infrastructure, sidewalk enhancements, and additional amenities.

6.0 Limitations and Future Work

Methodological limitations include the limited literature on the application of the PEI approach in quantifying the pedestrian experience by block face for an entire area. Differences in variable weighting may be appropriate for different types of land use, such as urban vs. rural areas, building setback, or number of dwelling units. In rural areas, the presence of sidewalks and natural scenery may carry more weight than in urban areas that may weigh shopping or building setback more heavily to align with the intended activities of the area.

Future adjustments could involve ground-truthing to refine variable weights or distributing the weighting scheme depending on other independent variables, such as land context information. Additionally, several data sources were excluded from the analysis, including a measure of land use mix and the presence of roadside parking lanes. Future versions of this measure can include new data as it becomes available. Lastly, other data sources could be added to capture the behavioral characteristics of an area, such as bicycle, micromobility, or pedestrian counts, to account for the relative number of interactions people are likely to encounter while walking within a given area.

Appendix D

Bicycle and Pedestrian Monitoring Protocol

2023 BICYCLE AND PEDESTRIAN MONITORING SUMMARY

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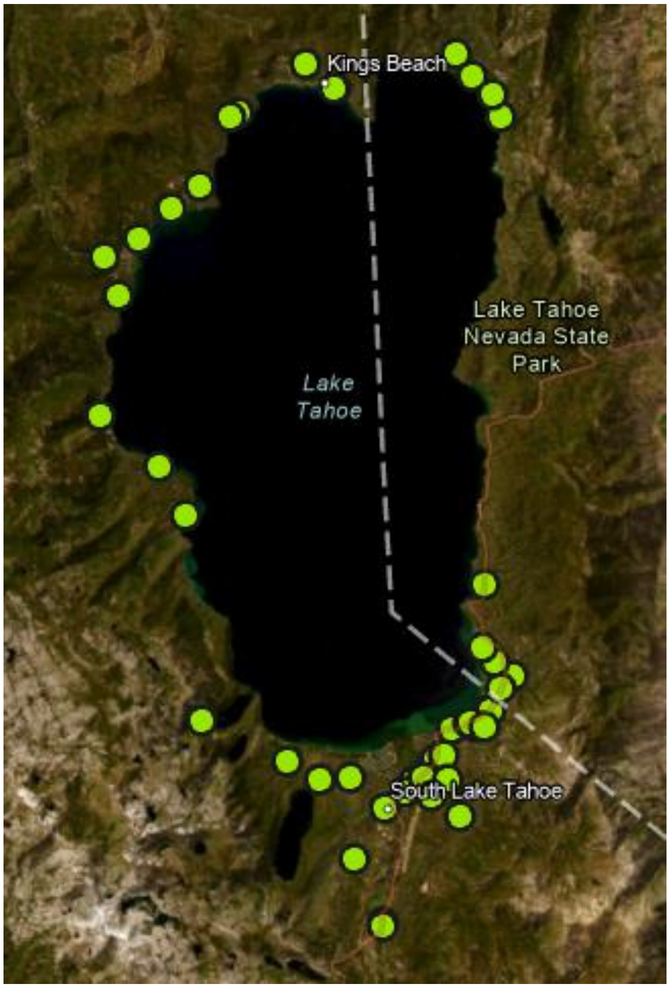
- Ongoing issues 6

OVERVIEW

In 2015, as part of the update to the Active Transportation Plan, the Tahoe Regional Planning Agency (TRPA) developed the Lake Tahoe Region Bicycle and Pedestrian Monitoring Protocol. Implementation of the protocol began in 2015 with seasonal videos recorded and limited automated counting. In 2016, TRPA purchased automated bicycle and pedestrian counters that collect year-round counts, differentiate between the two different users (bicyclists vs. pedestrians), and collect directional information. Through partnerships with local jurisdictions, these automated counters were installed on shared-use paths throughout the Region. Installation of counters has continued since 2016 and counters are installed when new path segments are constructed.

As of 2023, there are 48 active bicycle and pedestrian monitoring locations around the Lake Tahoe Basin. TRPA and local partners regularly monitor bicycle and pedestrian activity to understand high use areas and trends, measure mode-split, and support infrastructure grant management and reporting. Count information also informs policies and programs targeted to improve and support active transportation. All data can be found at https://monitoring.laketahoeinfo.org and downloaded at https://www.tahoeopendata.org/datasets/bike-and-pedestrian-counts/explore.

Figure 1 Map of all the existing bike and pedestrian monitoring locations.



RESULTS

4.8 million users have been counted across the entirety of TRPA's bicycle and pedestrian monitoring program. On average, 320 people travel past a monitor every day.

Annual Data

A comparison of total users counted by the monitoring network shows that the busiest year to date is 2020 with almost 3 million users. Counts dropped drastically in 2021, but have been climbing since. 2.29 million users were counted across all sites in 2023.

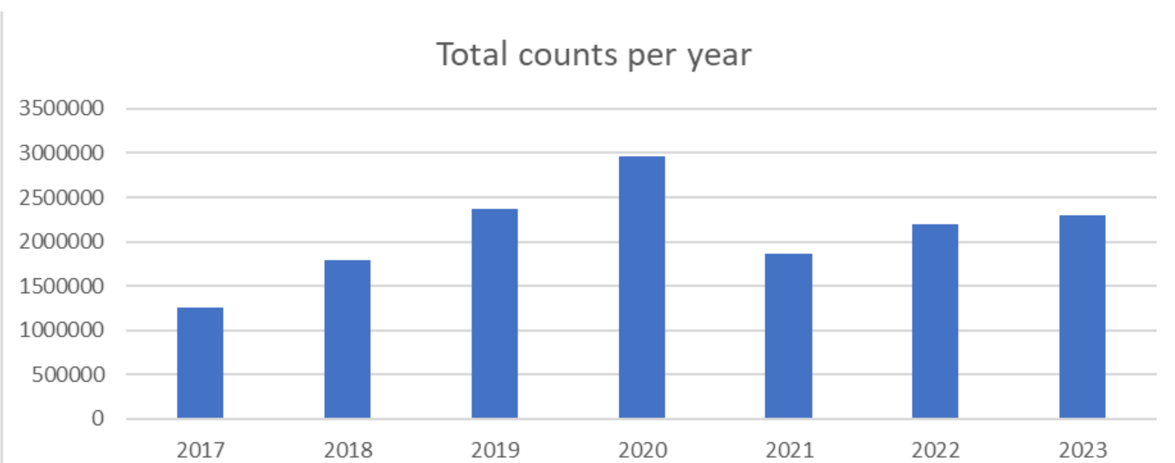


Figure 2 Total users every year 2017-2023

Average Daily Use

Looking at the data for each site, average daily usage ranges from 14 users per day to 1,140. The most used site is at the intersection of US 50 and Pioneer near the Heavenly Village with an average of 1,140 users per day. The next most used monitoring location is on the East Shore trail, then the Lakeside trail in Tahoe City.

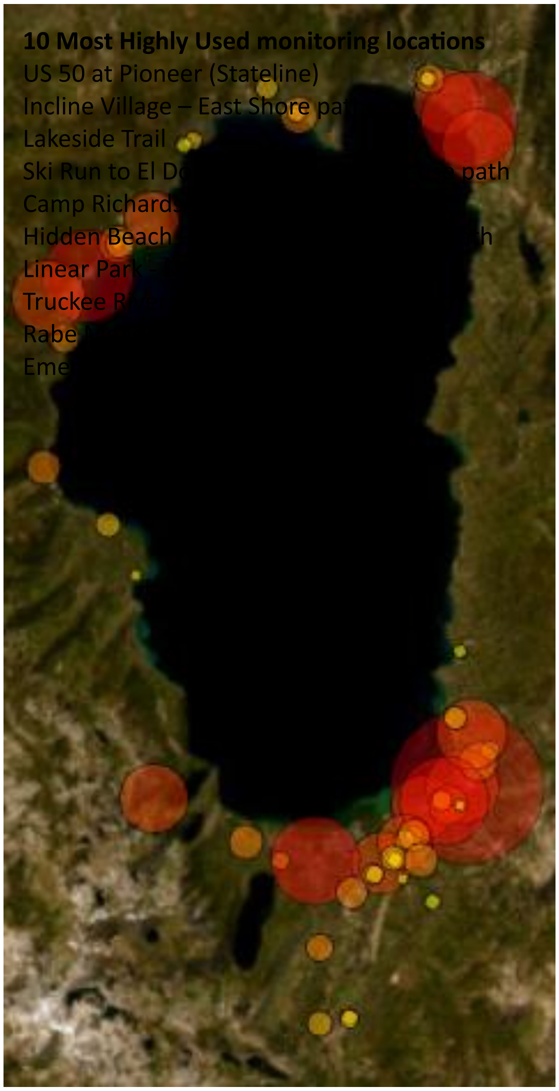


Figure 3: The busiest monitoring location is at US 50 and Pioneer trail near Heavenly Village.

Figure 4. Average Daily Total at each site ranges from 14 users per day to 1140. The lower end of the scale is depicted in smaller yellow icons, the high end in larger red icons.

Hourly Use

Hourly usage varies across different monitor locations. In the figure below, several sites have been selected to show average hourly counts at a few popular locations. The monitoring sites within the City of South Lake Tahoe, which are typically along heavily-used commuting routes include US 50 and Pioneer Trail, Linear Park, Ski Run and Lakeview commons (shown in orange- yellow). These locations have consistent use throughout the day whereas, popular recreation sites including Emerald Bay and Camp Richardson (shown in green) have a more prounouced peak period between 10am and 4pm.

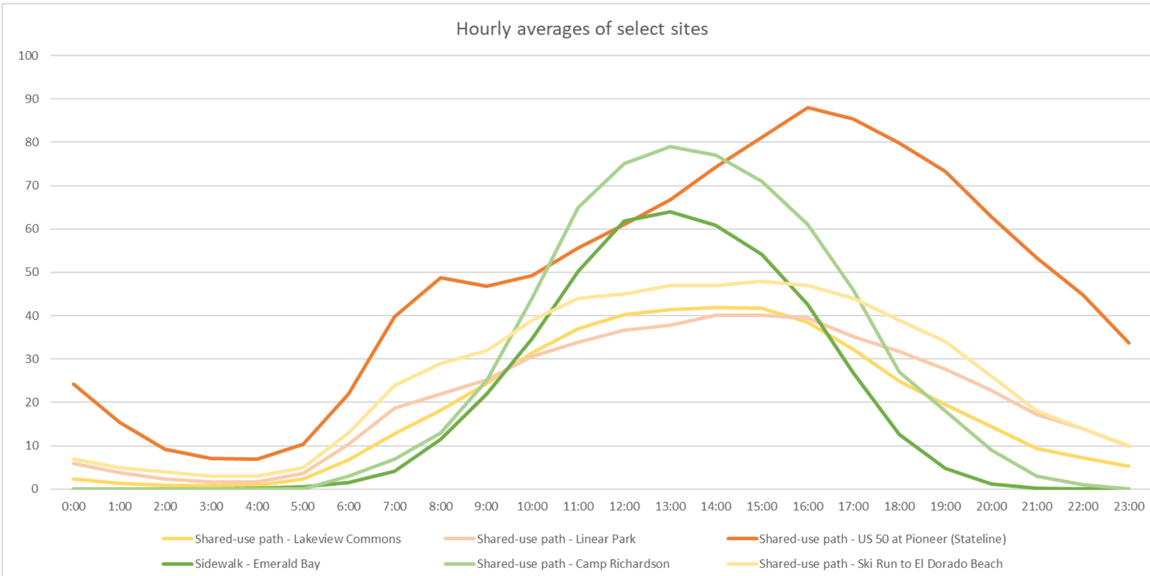


Figure 5: US 50 at Pioneer and sites along the Lake Tahoe Bikeway have high usage throughout the day compared to Emerald Bay and Camp Richardson.

Seasonal Use

Not surprisingly, use of shared-use paths is strongly driven by the weather. 62 percent of all usage is recorded during summer months (June, July, August, September), 25 percent of use is recorded during off-season months (April, May, October, November), and 13 percent of total path use is recorded during the winter (December, January, February). There are also more cyclists using trails during the warmer months from May-October and more pedestrians during the winter.

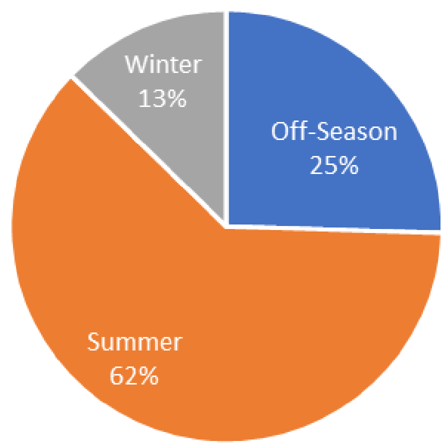


Figure 6: Seasonal use percentages across all sites

Figure 7 Monthly usage by user type across all sites 2017- Jan 10 2024

Project Monitoring

In addition to regular trend monitoring outlined in the monitoring plan, TRPA has been doing some pre and post project monitoring. The City of South Lake Tahoe completed the Al Tahoe Safety and Mobility Enhancement Project in 2020, which included construction of a shared-use path. Prior to path construction, a dirt path had an average of 54 users per day. After construction monitors recorded an average of 167 users per day, which is an increase of over 300 percent.

Figure 9: A monitor located on Al Tahoe before the Al Tahoe Safety and Mobility Project

Figure 8: After the Al Tahoe Safety and Mobility Project

In 2023, pre-project monitoring took place at Pioneer and Larch, Apache Ave, and Lodi/ Barbara.

Fire/Smoke Impacts

Looking back to the summer of 2021, the Caldor Fire and smoke impacts in the basin dramatically impacted shared-use path utility as evidenced by count data. During the evacuation in August 2021, the number of total users across South Shore locations decreases nearly to zero. The graph below shows counts during the evacuation period (between 8/30-9/6 marked with red lines).

2021 was a particularly smoky season with both the Tamarack fire and Caldor fire close by. The added air quality metric in the graph shows a positive relationship between low path usage and poor air quality. The blue line shows particulate matter PM10 taken from the monitor at the TRPA office. Multiple dates with elevated PM numbers have a drop in trail usage indicating that trail use numbers are affected by poor air quality.

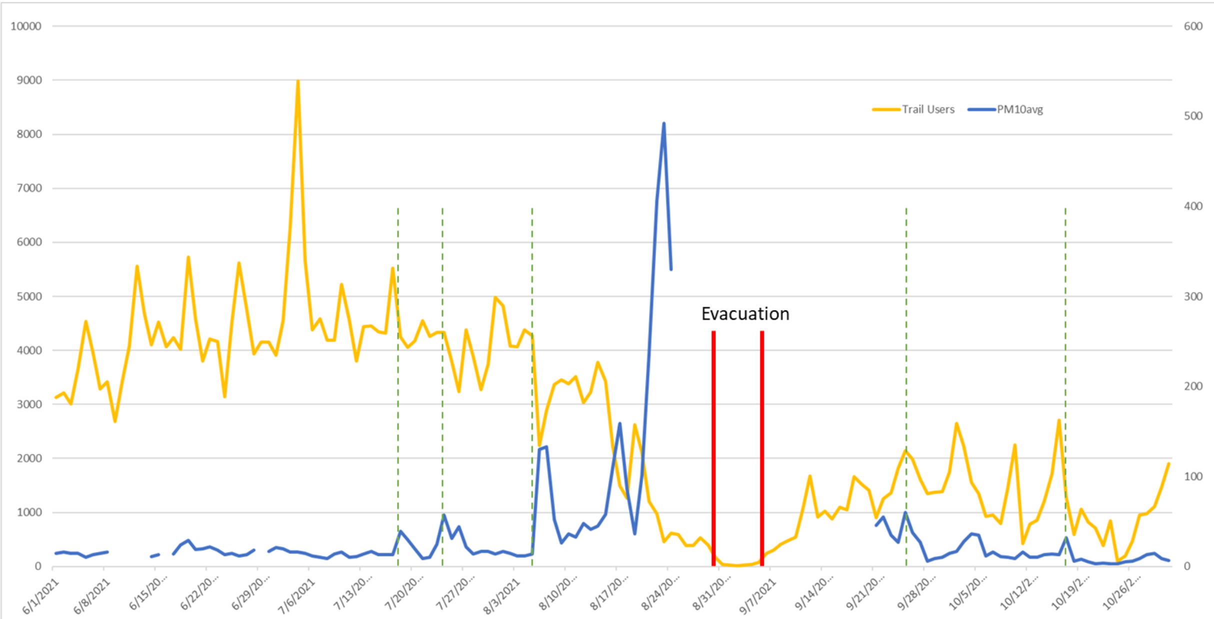


Figure 10. Air Quality and Caldor fire evacuation impacts on path usage. South Lake Tahoe path users are plotted in yellow, Air Quality metric for particulate matter 10 in blue. Caldor fire evacuation period framed in red. Spikes in PM10 are marked with green dotted lines.

New Locations

Sites Added in 2023: Four additional permanent monitors have been added to the network in 2023.

Tahoe City Public Utility District added three new permanent monitors at Northshore, Sunnyside, and Tahoma. Two of these locations are replacing movable trend monitors that are already part of the program.

El Dorado County also added a new monitor on the newly constructed East to West San Bernadino shared-use path (pictured).

Ongoing Issues

There are monitors that require replacement between Lake Tahoe Community College and South Tahoe Public Utility District facility on the Dennis T. Machida Greenway. Responsibility belongs to the City of South Lake Tahoe. This is the only monitor on the greenway.

Two trafx movable monitors were stolen or damaged in 2023 and need to be replaced at a cost of about $500 each. Lock boxes also need to be purchased, which are approximately $40 each.

Appendix E

Maintenance Responsibilities Chart and Template

TAHOE REGIONAL PLANNING AGENCY

Mail
PO Box 5310
Stateline, NV 89449-5310

Location
128 Market Street
Stateline, NV 89449

Contact
Phone: 775-588-4547
Fax: 775-588-4527
www.trpa.gov

MAINTENANCE RESPONSIBILITIES CHART AND PLAN

Entities responsible for the construction and maintenance of all projects containing active transportation facilities are required to submit a Maintenance Responsibilities Chart and Plan prior to permit issuance. The plan must clearly identify responsibilities for capital improvements and annual infrastructure operation and maintenance and identify funding needs and sources. This information will be included in issued permits.

How to Complete the Maintenance Responsibilities Chart and Plan:

1. Fill out each lead entity's name in the top row and assign maintenance roles to each entity by checking the appropriate boxes in the columns. Boxes must be checked in the column that corresponds to the entity responsible for the maintenance task listed in that row. For sections that are not relevant, leave those blank.

2. Applicants must also fill out the anticipated funding sources in the appropriate spaces on the second page and identify the expected funding entity.

3. Before submittal to TRPA, each entity partner must sign the plan at the bottom of the sheet.

Any questions should be directed to the TRPA transportation department at (775) 589-5401.

MAINTENANCE RESPONSIBILITIES CHART AND PLAN

Task	Lead Entity (1)	Lead Entity (2)	Lead Entity (3)	Lead Entity (4)	Lead Entity (5)	Lead Entity (6)
Parking Lots						
Parking Meter Maintenance	☐	☐	☐	☐	☐	☐
Meter Collection / Administration	☐	☐	☐	☐	☐	☐
Sweeping	☐	☐	☐	☐	☐	☐
Garbage Pickup	☐	☐	☐	☐	☐	☐
Litter Patrol	☐	☐	☐	☐	☐	☐
Regulatory Sign Replacement	☐	☐	☐	☐	☐	☐
Visitor Signage	☐	☐	☐	☐	☐	☐
Vista, Transit Stops, & Emergency Turnouts						
Sweeping	☐	☐	☐	☐	☐	☐
Garbage Pickup	☐	☐	☐	☐	☐	☐
Litter Patrol	☐	☐	☐	☐	☐	☐
Restroom Cleaning	☐	☐	☐	☐	☐	☐
Graffiti Removal	☐	☐	☐	☐	☐	☐
Regulatory Sign Replacement	☐	☐	☐	☐	☐	☐
Visitor/Wayfinding/Interpretive Signage	☐	☐	☐	☐	☐	☐
Snow Removal	☐	☐	☐	☐	☐	☐
Scenic Byway Brochures	☐	☐	☐	☐	☐	☐
Bikeway						
Sweeping	☐	☐	☐	☐	☐	☐
Litter Patrol	☐	☐	☐	☐	☐	☐
Regulatory Sign Replacement	☐	☐	☐	☐	☐	☐
Vista Point Interpretive Signs	☐	☐	☐	☐	☐	☐
Public Information	☐	☐	☐	☐	☐	☐
Authorized Trails						
Routine Tread Maintenance	☐	☐	☐	☐	☐	☐
Visitor Signage	☐	☐	☐	☐	☐	☐
Litter Patrol	☐	☐	☐	☐	☐	☐
Monitoring Unauthorized Trails	☐	☐	☐	☐	☐	☐
Public Info/Trail Guides	☐	☐	☐	☐	☐	☐
Transit						
Transit Funding	☐	☐	☐	☐	☐	☐
Bus Operation	☐	☐	☐	☐	☐	☐
Bus Stop Kiosk Maintenance	☐	☐	☐	☐	☐	☐
Brochure Time Table	☐	☐	☐	☐	☐	☐
DMS Messaging	☐	☐	☐	☐	☐	☐
Public Information	☐	☐	☐	☐	☐	☐
Intercept Lot Litter Pickup	☐	☐	☐	☐	☐	☐

Task	Lead Entity (1)	Lead Entity (2)	Lead Entity (3)	Lead Entity (4)	Lead Entity (5)	Lead Entity (6)
Capital Infrastructure Maintenance						
Bus Replacement	☐	☐	☐	☐	☐	☐
Parking Lot Striping	☐	☐	☐	☐	☐	☐
Parking Lot Resealing	☐	☐	☐	☐	☐	☐
Parking Lot Overlay	☐	☐	☐	☐	☐	☐
Parking Lot Concrete – Curbs	☐	☐	☐	☐	☐	☐
Parking Lot Stormwater Treatment Systems	☐	☐	☐	☐	☐	☐
Bike Lane Striping/Resealing	☐	☐	☐	☐	☐	☐
Bikeway Striping/Resealing	☐	☐	☐	☐	☐	☐
Bikeway Overlay	☐	☐	☐	☐	☐	☐
Bikeway Co-location Project	☐	☐	☐	☐	☐	☐
Viewpoint/Highway Transit Stop/Emergency Turnout Striping/Resealing	☐	☐	☐	☐	☐	☐
Viewpoint/Highway Transit Stop/Emergency Turnout Overlay	☐	☐	☐	☐	☐	☐
Bridge Inspections	☐	☐	☐	☐	☐	☐
Interpretive Sign Replacement	☐	☐	☐	☐	☐	☐
Bench Replacement	☐	☐	☐	☐	☐	☐
Bear Proof Can Replacement	☐	☐	☐	☐	☐	☐
Scenic Byway Entry Signage	☐	☐	☐	☐	☐	☐
Monitoring Equipment	☐	☐	☐	☐	☐	☐

Anticipated Funding Sources by Agency:

1. **Agency Name:** ______________________________
    a. **Funding Source(s)** ______________________________
2. **Agency Name:** ______________________________
    a. **Funding Source(s)** ______________________________
3. **Agency Name:** ______________________________
    a. **Funding Source(s)** ______________________________
4. **Agency Name:** ______________________________
    a. **Funding Source(s)** ______________________________

Partner Signatures: *Please make sure to require all partnering agency signatures when formalizing this document.*

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(Signature, Entity)

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(Signature, Entity)

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(Signature, Entity)

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(Signature, Entity)

Appendix F

Proposed Active Transportation Project List

EIP NUMBER	ATP 2024 PRIORITY	PROJECT NAME	CLASS	IMPLEMENTER	MILES	ESTIMATED_COST	PHASE	START YEAR	COMPLETE YEAR	URL	CORRIDOR
03.02.02.0085	1	Johnson Meadow Bridge	1	El Dorado County	1.14	$9,153,626	Planning/Design	2020	2027	https://eip.laketaho	MEYERS Y
NOT LISTED	1	Lake Tahoe Blvd bike lanes	2	El Dorado County	1.59	$274,275	Planning	2025	2030		MEYERS Y
01.01.01.0033	1	Tahoe Valley Greenbelt Class 1 Paths	1	City of South Lake Tahoe	0.51	$15,000,000	Implementation	2009	2025	https://eip.laketaho	MEYERS Y
03.02.02.0022	1	Third St Complete Streets	5	City of South Lake Tahoe	0.39	$6,727,500	Deferred	2030	2035	https://eip.laketaho	MEYERS Y
NOT LISTED	1	US Hwy 50 Complete Streets Improvements	5	California Department of Transportation	1.6	$2,300,000	Planning/Design	2025	2035		MEYERS Y
NOT LISTED	2	B Street Overpass	0	California Department of Transportation	0.12	$8,050,000	Planning/Design	2025	2035		MEYERS Y
NOT LISTED	2	Black Bart bike route	3	El Dorado County	1.02	$5,865	Planning/Design	2025	2035		MEYERS Y
03.02.01.0054	2	Fallen Leaf Road Bike Path	1	El Dorado County	1.56	$3,050,000	Planning/Design	2021	2029	https://eip.laketaho	MEYERS Y
NOT LISTED	2	Greenway 4a - Pioneer to Elks Club	1	El Dorado County	1.2	$13,800,000	Planning	2025	2028		MEYERS Y
NOT LISTED	2	Greenway 4b - Elks Club to Nottaway	1	El Dorado County	1	$11,500,000	Planning	2025	2030		MEYERS Y
NOT LISTED	2	Greenway 4c - Nottaway to Golden Bear	1	El Dorado County	1.74	$20,010,000	Planning	2025	2032		MEYERS Y
NOT LISTED	2	Greenway 4d - Golden Bear to Johnson	1	El Dorado County	1.12	$12,880,000	Planning	2025	2032		MEYERS Y
NOT LISTED	2	Hwy 50 to NUT Bike Path	1	California Department of Transportation	0.34	$4,140,000	Planning/Design	2030	2035		MEYERS Y
NOT LISTED	2	Kyburz Ave Bike Route	3	City of South Lake Tahoe	0.48	$2,760	Planning/Design	2025	2035		MEYERS Y
NOT LISTED	2	Lake Tahoe Blvd bike lane - gap closure	2	El Dorado County	0.71	$65,320	Planning/Design	2030	2032		MEYERS Y
NOT LISTED	2	Mt. Rainier Bike Route	3	El Dorado County	0.58	$3,335	Planning/Design	2024	2025		MEYERS Y
NOT LISTED	2	S Upper Truckee Rd Bike Route	3	El Dorado County	4.66	$26,795	Planning/Design	2028	2030		MEYERS Y
01.01.01.0033	2	South Ave Bike Route	3	City of South Lake Tahoe	0.52	$2,990	Implementation	2009	2025	https://eip.laketaho	MEYERS Y
NOT LISTED	2	Tahoe Keys Blvd Complete Streets	5	City of South Lake Tahoe	0.9	$15,525,000	Planning/Design	2035	2040		MEYERS Y
NOT LISTED	2	Viking Rd Bike Path	1	City of South Lake Tahoe	0.28	$3,220,000	Planning/Design	2035	2045		MEYERS Y
03.02.02.0059	2	Washington Ave Complete Streets	5	City of South Lake Tahoe	0.19	$3,277,500	Deferred	2030	2040	https://eip.laketaho	MEYERS Y
NOT LISTED	3	13th St Bike Route	3	City of South Lake Tahoe	0.58	$3,335	Planning/Design	2025	2030		MEYERS Y
NOT LISTED	3	3rd St Bike Route to Barton	3	City of South Lake Tahoe	0.41	$2,358	Planning/Design	2025	2035		MEYERS Y
NOT LISTED	3	5th Ave Bike Route	3	City of South Lake Tahoe	0.15	$750	Planning	2025	2030		MEYERS Y
NOT LISTED	3	B St/Tata Ln Bike Route	3	City of South Lake Tahoe	0.31	$1,783	Planning/Design	2025	2035		MEYERS Y
01.01.01.0033	3	Barton Ave Bike Route	3	City of South Lake Tahoe	0.4	$2,000	Implementation	2009	2025	https://eip.laketaho	MEYERS Y
NOT LISTED	3	Blitzen Rd bike route	3	El Dorado County	1.53	$8,798	Planning/Design	2035	2045		MEYERS Y
NOT LISTED	3	C St Bike Route	3	City of South Lake Tahoe	0.1	$575	Planning/Design	2025	2035		MEYERS Y
03.02.02.0028	3	Christmas Valley Bike Path	1	El Dorado County	2.44	$28,060,000	Planning	2025	2030	https://eip.laketaho	MEYERS Y
NOT LISTED	3	Council Rock Dr bike route	3	City of South Lake Tahoe	0.22	$1,265	Planning/Design	2025	2035		MEYERS Y
NOT LISTED	3	D St Bike Route	3	City of South Lake Tahoe	0.69	$3,968	Planning/Design	2025	2035		MEYERS Y
NOT LISTED	3	Dunlap Dr Bike Route	3	City of South Lake Tahoe	0.27	$1,553	Planning/Design	2025	2035		MEYERS Y
NOT LISTED	3	E St Bike Route	3	City of South Lake Tahoe	0.11	$633	Planning/Design	2025	2035		MEYERS Y
NOT LISTED	3	Glorene Ave Bike Route	3	City of South Lake Tahoe	1.14	$6,555	Planning/Design	2025	2030		MEYERS Y
03.02.02.0071	3	Hwy 50 bike path to airport	1	City of South Lake Tahoe	0.4	$4,600,000	Planning/Design	2035	2045	https://eip.laketaho	MEYERS Y
NOT LISTED	3	James Ave Class I connection	1	City of South Lake tahoe	0.03	$345,000	Planning/Design	2030	2032		MEYERS Y
NOT LISTED	3	Julie Ln Bike Route	3	City of South Lake Tahoe	0.87	$5,003	Planning/Design	2025	2030		MEYERS Y
NOT LISTED	3	Melba Dr Bike Route	3	City of South Lake Tahoe	0.19	$1,093	Planning/Design	2025	2035		MEYERS Y
03.02.02.0065	3	Sawmill to City Bike Path	1	California Department of Transportation	1.39	$15,985,000	Deferred	2030	2040	https://eip.laketaho	MEYERS Y
NOT LISTED	3	Tahoe Mtn to Lake Tahoe Blvd Class I Connector	1	El Dorado County	0.25	$2,875,000	Planning/Design	2035	2045		MEYERS Y
NOT LISTED	3	US hwy 50 bike lane Meyers to City	2	California Department of Transportation	2.01	$606,625	Planning/Design	2025	2035		MEYERS Y
NOT LISTED	3	Wyoming Tahoe Valley Connector	1	City of South Lake Tahoe	0.06	$690,000	Planning/Design	2035	2040		MEYERS Y
03.02.02.0006	Construction 2024	Apache Avenue Complete Streets	5	El Dorado County	0.4	$4,058,000	Planning/Design	2020	2026	https://eip.laketaho	MEYERS Y
NOT LISTED	1	Northwood Blvd Bike path	1	Washoe County	0.61	$7,015,000	Planning/Design	2025	2035		NV SR 28
03.02.01.0061	1	Sand Harbor to Thunderbird Cove Bike Path	1	Tahoe Transportation District	1.21	$46,000,000	Planning/Design	2023	2027	https://eip.laketaho	NV SR 28
03.02.02.0062	1	SR 28 Class I Crystal Bay to Incline	1	Washoe County	2.63	$16,200,000	Planning/Design	2024	2035	https://eip.laketaho	NV SR 28
03.02.02.0072	1	SR28 Preston to Northwood Bike Path	1	Washoe County	0.3	$3,450,000	Deferred	2035	2045	https://eip.laketaho	NV SR 28
NOT LISTED	1	Village Blvd Bike Lanes	2	Washoe County	1.92	$331,200	Planning/Design	2025	2035		NV SR 28
NOT LISTED	2	Country Club Dr Bike Lanes	2	Washoe County	2.68	$462,300	Planning/Design	2025	2035		NV SR 28
NOT LISTED	2	Mt. Rose Hwy Bike Lanes	2	Nevada Department of Transportation	6.63	$1,906,125	Planning/Design	2035	2045		NV SR 28
NOT LISTED	2	SR28 Class 1 Country Club to Glen	1	Washoe County	0.26	$2,990,000	Planning	2030	2035		NV SR 28
NOT LISTED	2	SR28 Class 1 Country Club to Sweetwater	1	Washoe County	0.67	$7,705,000	Planning	2030	2035		NV SR 28
03.02.01.0017	2	Thunderbird Cove to Spooner Improvements	1	Tahoe Transportation District	5.93	$100,810,000	Planning/Design	2026	2040	https://eip.laketaho	NV SR 28
NOT LISTED	3	Mt. Rose Bike Path	1	Nevada Department of Transportation	2.54	$29,210,000	Planning/Design	2035	2045		NV SR 28
NOT LISTED	1	Dolly Varden/Deer St Sidewalks	0	Placer County	0.31	$62,000	Planning	2030	2040		SR 89 28
NOT LISTED	1	Fox & Speckled Complete Streets	5	Placer County	1.16	$20,010,000	Planning/Design	2025	2035		SR 89 28
01.01.01.0168	1	Kings Beach Western Approach - sidewalks	0	Placer County	0.26	$14,222,000	Planning/Design	2016	2026	https://eip.laketaho	SR 89 28
NOT LISTED	1	N Tahoe Trail (Carnelian Ave to Carnelian Bay - 2)	1	Placer County	1.77	$17,700,000	Planning/Design	2030	2040		SR 89 28
03.02.02.0003	1	N Tahoe Trail (Carnelian Ave to N Tahoe Park - 3)	1	Placer County	2.6	$26,020,000	Planning/Design	2008	2030	https://eip.laketaho	SR 89 28
01.01.01.0086	1	N Tahoe Trail (Dollar Point to Carnelian Bay - 1)	1	Placer County	1.73	$7,730,000	Planning/Design	2021	2025	https://eip.laketaho	SR 89 28
NOT LISTED	1	Stateline to Kings Beach Sidewalks	0	California Department of Transportation	0.8	$184,000	Planning	2030	2040		SR 89 28
03.02.02.0089	1	Tahoe City Lakeside Trail Missing Link	1	Placer County	0.19	$1,000,000	Planning/Design	2018	2024	https://eip.laketaho	SR 89 28
NOT LISTED	2	Kings Beach to Stateline Shared Use Path	1	Placer County	1.88	$36,754,000	Planning/Design	2035	2045		SR 89 28
NOT LISTED	2	Lake Forest Rd Complete Streets	5	Placer County	0.9	$15,525,000	Planning/Design	2025	2035		SR 89 28
NOT LISTED	2	Tahoe City Golf Course Shared-use Path	1	Placer County	0.35	$4,025,000	Planning/Design	2024	2028		SR 89 28
NOT LISTED	3	Donner Rd bike Route	3	North Tahoe Public Utility District	0.22	$1,265	Planning/Design	2025	2035		SR 89 28
NOT LISTED	3	North Tahoe Regional Trail (Segment 4)	1	Placer County	0.53	$6,095,000	Planning/Design	2025	2035		SR 89 28
03.02.02.0029	2	Baldwin Beach Bike Path	1	U.S. Forest Service - Lake Tahoe Basin Management Unit	0.36	$1,450,000	Implementation	2017	2025	https://eip.laketaho	SR 89 REC
NOT LISTED	2	Cascade to Meeks Trail - Segment 1	1	Unknown	1.61	$11,772,259	Planning/Design	2022	2050		SR 89 REC
NOT LISTED	2	Cascade to Meeks Trail - Segment 10	1	Unknown	1.49	$19,669,449	Planning/Design	2022	2050		SR 89 REC

NOT LISTED	2	Cascade to Meeks Trail - Segment 2	1	Unknown	0.93	$13,084,385	Planning/Design	2022	2050		SR 89 REC
NOT LISTED	2	Cascade to Meeks Trail - Segment 3	1	Unknown	2.05	$12,780,296	Planning/Design	2022	2050		SR 89 REC
NOT LISTED	2	Cascade to Meeks Trail - Segment 4	1	Unknown	1.87	$37,258,815	Planning/Design	2022	2050		SR 89 REC
NOT LISTED	2	Cascade to Meeks Trail - Segment 5	1	Unknown	0.88	$7,930,359	Planning/Design	2022	2050		SR 89 REC
NOT LISTED	2	Cascade to Meeks Trail - Segment 6	1	Unknown	1.2	$35,062,182	Planning/Design	2022	2050		SR 89 REC
NOT LISTED	2	Cascade to Meeks Trail - Segment 7	1	Unknown	1.51	$35,355,831	Planning/Design	2022	2050		SR 89 REC
NOT LISTED	2	Cascade to Meeks Trail - Segment 8	1	Unknown	0.95	$94,426,500	Planning/Design	2022	2050		SR 89 REC
NOT LISTED	2	Cascade to Meeks Trail - Segment 9	1	Unknown	1.41	$35,186,430	Planning/Design	2022	2050		SR 89 REC
03.02.02.0030	2	Pope Beach Bike Path	1	U.S. Forest Service - Lake Tahoe Basin Management Unit	0.17	$1,955,000	Deferred	2020	2030	https://eip.laketaho	SR 89 REC
NOT LISTED	1	Elks Point Rd Bike Lane Extension	2	Douglas County	0.09	$8,280	Planning/Design	2025	2035		US 50 ES
03.02.01.0032	2	Stateline to Stateline Bikeway D, E, F	5	Nevada Department of Transportation	11.39	$196,477,500	Planning/Design	2035	2045	https://eip.laketaho	US 50 ES
03.02.02.0092	1	Bijou Bike Park Connector	1	City of South Lake Tahoe	0.57	$1,849,056	Planning/Design	2021	2025	https://eip.laketaho	US 50 SS
NOT LISTED	1	Hwy 50 at Stateline Bike Lanes (NV)	2	Nevada Department of Transportation	0.86	$247,250	Planning/Design	2025	2035		US 50 SS
03.02.02.0093	1	Johnson Blvd Complete Streets	5	City of South Lake Tahoe	0.98	$4,346,450	Planning/Design	2025	2028	https://eip.laketaho	US 50 SS
03.02.01.0055	1	Kahle Drive Complete Street	5	Nevada Tahoe Conservation District	0.88	$3,631,339	Planning/Design	2018	2025	https://eip.laketaho	US 50 SS
03.02.02.0058	1	Kingsbury to Stateline Sidewalk	0	Douglas County	0.3	$500,000	Planning/Design	2025	2035	https://eip.laketaho	US 50 SS
NOT LISTED	1	Lake Pkwy South Sidewalks	0	City of South Lake Tahoe	0.22	$44,000	Planning	2030	2040		US 50 SS
03.02.02.0055	1	Laura Dr to Stateline Bike Path	1	Tahoe Transportation District	0.42	$4,830,000	Planning/Design	2024	2030	https://eip.laketaho	US 50 SS
03.02.01.0060	1	Park Avenue and Lakeshore Blvd Complete Streets	5	City of South Lake Tahoe	0.73	$6,500,000	Planning/Design	2025	2030	https://eip.laketaho	US 50 SS
03.02.02.0095	1	South Tahoe Greenway Phase 1c	1	California Tahoe Conservancy	0.54	$9,500,000	Planning/Design	2022	2028	https://eip.laketaho	US 50 SS
03.02.02.0097	1	Spruce and Blackwood SRTS	5	City of South Lake Tahoe	0.89	$15,352,500	Planning/Design	2025	2030	https://eip.laketaho	US 50 SS
03.02.02.0096	1	Stateline Avenue Complete Streets Project	5	City of South Lake Tahoe	0.45	$6,750,000	Planning/Design	2025	2030	https://eip.laketaho	US 50 SS
03.01.02.0030	1	Van Sickle Phase III Shared Use Trails	1	California Tahoe Conservancy	0.44	$6,000,000	Planning/Design	2022	2025	https://eip.laketaho	US 50 SS
NOT LISTED	2	Complete streets from Pioneer Trail to Heavenly	5	City of South Lake Tahoe	0.9	$13,500,000	Planning	2040	2050		US 50 SS
NOT LISTED	2	Fairway Dr Bike Lanes	2	City of South Lake Tahoe	0.37	$34,040	Planning/Design	2025	2035		US 50 SS
NOT LISTED	2	Glenwood Way bike lanes	2	City of South Lake Tahoe	1.6	$147,200	Planning/Design	2035	2045		US 50 SS
03.02.02.0076	2	Greenway Phase 3 - Ski Run Blvd to Van Sickle	1	California Tahoe Conservancy	1.45	$25,000,000	Planning	2028	2032	https://eip.laketaho	US 50 SS
NOT LISTED	2	Herbert Ave Complete Streets	5	City of South Lake Tahoe	0.51	$7,650,000	Planning/Design	2030	2040		US 50 SS
NOT LISTED	2	Herbert Ave Sidewalks	0	City of South Lake Tahoe	0.47	$75,200	Planning	2035	2045		US 50 SS
NOT LISTED	2	Johnson Blvd to Lester Ave bike path connector	1	City of South Lake Tahoe	0.32	$3,680,000	Planning/Design	2035	2045		US 50 SS
03.02.01.0007	2	Lake Pkwy Complete Streets	5	Tahoe Transportation District	0.52	$8,970,000	Planning/Design	2025	2027	https://eip.laketaho	US 50 SS
NOT LISTED	2	Lake Pkwy South Bike Lanes	2	City of South Lake Tahoe	0.27	$46,575	Planning/Design	2035	2045		US 50 SS
NOT LISTED	2	Link Road to Sussex Ave	1	California Tahoe Conservancy	0.16	$6,000,000	Planning	2028	2032		US 50 SS
03.02.02.0094	2	Palmira Ave Connector	1	City of South Lake Tahoe	0.14	$1,370,000	Planning/Design	2022	2027	https://eip.laketaho	US 50 SS
NOT LISTED	2	Ski Run Blvd Bike Lanes	2	City of South Lake Tahoe	0.59	$101,775	Planning/Design	2025	2035		US 50 SS
NOT LISTED	2	Spruce Class 1 Connector Bridge	1	U.S. Forest Service	0.08	$1,360,000	Planning	2025	2030		US 50 SS
NOT LISTED	3	Hwy 50 at Stateline Bike lanes (CA)	2	California Department of Transportation	0.89	$255,875	Planning/Design	2025	2035		US 50 SS
NOT LISTED	3	Los Angeles Ave bike route	3	City of South Lake Tahoe	0.19	$1,093	Planning/Design	2025	2035		US 50 SS
NOT LISTED	3	Marlette Cir bike route	3	City of South Lake Tahoe	0.1	$575	Planning/Design	2025	2035		US 50 SS
NOT LISTED	3	Marlette Cir to Rufus Allen class I connector	1	City of South Lake Tahoe	0.1	$1,150,000	Planning/Design	2025	2035		US 50 SS
NOT LISTED	3	Oakland Ave bike route	3	City of South Lake Tahoe	0.71	$4,083	Planning/Design	2035	2045		US 50 SS
NOT LISTED	3	Oakland Ave class I bridge over trout creek	1	City of South Lake Tahoe	0.12	$2,346,000	Planning/Design	2035	2045		US 50 SS
NOT LISTED	3	Pine Ridge Dr to Kahle Class I	1	Douglas County	0.48	$5,520,000	Planning/Design	2035	2045		US 50 SS
NOT LISTED	3	Pineridge Dr Bike route	3	Douglas County	0.27	$1,553	Planning/Design	2035	2045		US 50 SS
03.02.02.0080	3	Rufus Allen Blvd Complete Streets	5	City of South Lake Tahoe	0.76	$13,110,000	Deferred	2030	2035	https://eip.laketaho	US 50 SS
NOT LISTED	3	San Francisco Ave bike route	3	City of South Lake Tahoe	0.75	$4,313	Planning/Design	2035	2045		US 50 SS
NOT LISTED	3	Spruce Bike Route	3	City of South Lake Tahoe	0.15	$750	Planning/Design	2030	2030		US 50 SS
NOT LISTED	3	Tamarack Ave Sidewalks	0	City of South Lake Tahoe	0.48	$96,000	Planning	2040	2050		US 50 SS
NOT LISTED	3	Victor St bike route	3	City of South Lake Tahoe	0.05	$288	Planning/Design	2025	2035		US 50 SS
NOT LISTED	3	Wildwood Ave Sidewalks	0	City of South Lake Tahoe	0.32	$64,000	Planning	2040	2050		US 50 SS
03.02.02.0078	Construction 2024	Pioneer Trail Sidewalk	5	City of South Lake Tahoe	0.46	$5,118,028	Implementation	2017	2024	https://eip.laketaho	US 50 SS

Appendix G

Adoption Resolutions