WASHINGTON CITY, UTAH

Active Transportation Plan

AUGUST 2017 PUBLIC DRAFT

Washington City would like to thank the hundreds of residents who helped to shape this plan. In addition to their assistance, thanks and acknowledgment are due to the plan's steering committee, consultants, and City leaders for their guidance and expertise.

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This plan was prepared for Washington City by Alta Planning + Design and Horrocks Engineers, with funding assistance from Washington City, Dixie Metropolitan Planning Organization, and Southwest Utah Health Department.

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Photo: SUBA

Chapter 1: Introduction & Existing Conditions

Active transportation can be defined as people walking or riding bicycles, which are active forms of personal transportation wherein people move under their own power. About **6.8%** of all trips in Washington City are done on foot or by bike, which is comparable to Washington County as a whole. Roughly **36%** of all trips in Washington City are two miles or less, which are trips that can be more easily completed by walking or bicycling if comfortable and connected infrastructure and programs were in place to support users. About **38%** of Washington City's population is either under 16 or over 70 years old, either too young to drive or significantly less likely to drive, respectively. These 8,500 residents would benefit from access to safe and diverse mobility options.

There are approximately 94.5 miles of walking and bicycling facilities in Washington City today.

Under current conditions, there are **14** separate "islands" of low-stress streets (i.e. comfortable enough to ride with or as a child) in Washington City. These "islands" are separated by gaps in the network and major, busy intersections. Telegraph Street, Washington Parkway, and Washington Fields Road, in particular, have high levels of traffic stress due to high speeds and a lack of dedicated bicycle facilities.

Despite 6.8% of trips being made by bicycling or walking, only **2.3%** of the 1,305 crashes in Washington City between 2010 and 2016 involved people walking or riding a bike. Most of these occurred at intersections when motorists turned right across the path of a pedestrian or bicyclist.

This plan reinforces the goals established by Washington City's General, Economic Development, Transportation, and other Plans. In particular, this plan's recommendations build upon the Parks & Recreation Master Plan and continue the efforts from that plan to provide safe and comfortable transportation and recreation options for people in and near Washington City (overlapping analysis and recommendations are indicated by the **green leaf symbol** at right).

Executive Summary

Chapter 2: Public Involvement

More than **700 people**, nearly all of which were Washington City residents, participated in the public process for the Active Transportation Plan.

The plan's **steering committee**, made up of City and Dixie MPO staff, community volunteers, advocacy representatives, and elected officials, created and distributed an **online survey and an interactive existing conditions map** to Washington City residents representative of the population's ages, family types, and neighborhoods.

571 people (~2.5% of the City) took the plan's online survey.

Other public input efforts included participation in **public events**, such as the Dixie Transportation Expo and Cotton Days. About 100 Washington City residents that had not yet been involved with the plan contributed their comments, support, and other ideas at Cotton Days on April 29, 2017.

Washington City residents generally consider the city to be friendly for walking and bicycling. Most, however, indicated a desire to walk and ride a bicycle more if new trails, connections, and safer streets were prioritized and improved.

"I support all efforts to continue to build and add bicycling and walking trails in the city."

"We are a young, vibrant community with very active families."

"Improve connectivity between trails and commercial developments adjacent to them."

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Photo: WalltoWall.com

Chapter 3: Policy and Program Recommendations & Design Guidance

This chapter recommends incorporating active transportation facility **design best practices** and the plan's vision and goals into the City's existing **codes, guidelines, and standards**. Several modifications to and new recommendations for the City's Construction Design Standards (Appendix A), Construction Design Details (Appendix B), and Code (Appendix C); as well as active transportation and roadway design guidelines (Appendix D) are summarized in this chapter of the Active Transportation Plan and included later. These recommendations include bicycle parking, improving existing roadway cross sections, accessible pedestrian curb ramps, access management, pavement management, construction zones, sidewalk widths, traffic calming, and maintenance.

The plan's **policy and program** recommendations support proposed infrastructure from Chapter 4. These will help to foster smart growth, complete the active transportation system, encourage and educate residents and visitors about bicycling or walking, monitor and report usage, and support the infrastructure and programmatic recommendations of this plan.

Policies

- Complete Streets
- Sidewalk and Crosswalk Infill
- Target Mode Share-Based Funding
- Automated User Counters
- Schools in Low Density or Rural Areas
- Routine & Capital Maintenance Best Practices
- Autonomous Vehicles

Programs

- Traffic Citation Diversion Education Classes
- Safe Routes to Schools
- Awareness Media Campaigns
- Educational Courses
- Walking and Bicycling-Focused Community Events
- Biannual Bicycle and Pedestrian Infrastructure Condition Evaluation

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Chapter 4: Future Network Recommendations

The vision and goals of this plan include making walking and bicycling normal and safe everyday activities for people of **all ages and abilities** (AAA). Recommended walking and bicycling facilities, like separated bike lanes, shared use paths, wide and/or landscaped sidewalks, and bicycle boulevards, create a network that is appropriate for the majority of Washington City residents. These facilities are considered high comfort because of physical protection, separation from traffic, or, in the case of bicycle boulevards, the use of low volume, low speed streets.

Washington City's 94.5 existing miles of walking & bicycling facilities are recommended to increase to 224 total miles.

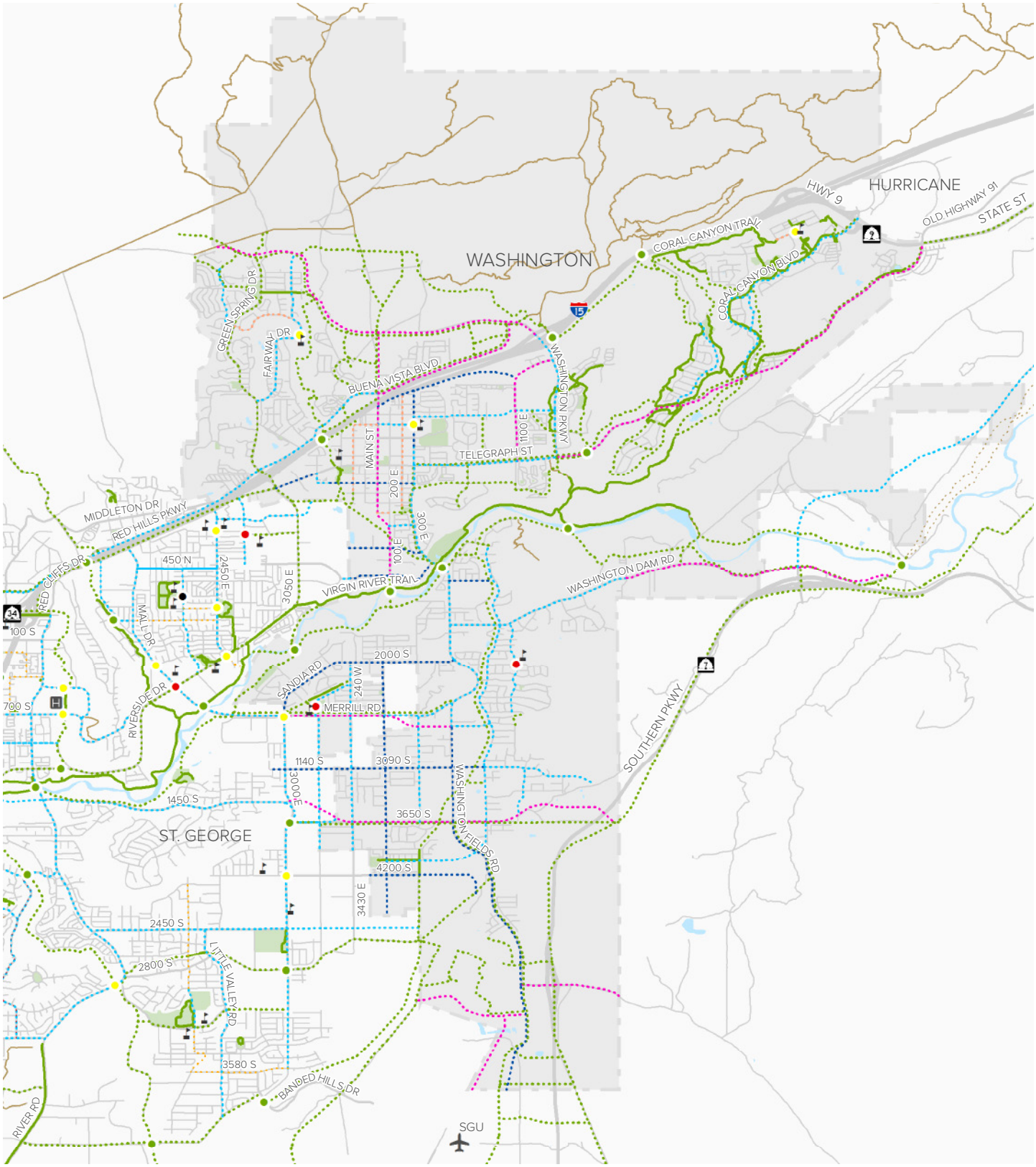
These include 94.1 miles of paved shared use paths, 55.3 miles of unpaved trails, 21.6 miles of separated bike lanes, 21.2 miles of buffered bike lanes, 28.8 miles of bike lanes, and 2.7 miles of bicycle boulevard. A future recommendations map (Map 4.1 from p. 65) is included on the following page.

If recommendations are implemented, there will be approximately six "islands" of **low-stress streets**, compared to the current 14. Fewer islands means increased low-stress connectivity, more active transportation mobility for people of all ages and abilities, and **safer crossings** of major barriers like major roadways and natural features.

Projects for which the plan provides additional details include:

- Telegraph Street Buffered Bike Lanes (Green Spring Dr to 500 West)
- Canal Trail
- Washington Fields Road/300 East Bike Lanes (Telegraph St to 2000 South)
- 200 East Bicycle Boulevard (Northern Terminus to Dogtown Park)

Renderings of what the four projects mentioned at left may look like.



Map 4.1:

Recommended Future Facilities

Washington City Active Transportation Plan

Recommended Facilities

- Shared Use Path
- Unpaved Trail
- Separated Bike Lane
- Buffered Bike Lane
- Bike Lane
- Bicycle Boulevard
- Sidewalk
- Bridge or Undercrossing
- Crossing Beacon
- Intersection Improvement
- Misc. Improvement

Existing Facilities

- Shared Use Path
- Unpaved Trail
- Bike Lane

Base Data

- School
- Hospital
- Water
- Park
- Washington City Limits

0 1 2 MILES

3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

Data provided by Washington City, AGRC, City of St. George, UDOT, Dixie MPO. Map produced May 2017.

Executive Summary

Chapter 5: Implementation, Evaluation & Funding

Implementation, evaluation, and funding strategies for active transportation infrastructure, programs, and policies require a blend of careful planning and opportunistic decision-making. All of the projects were prioritized and phased so that the City and regional partners can best determine how and when to allocate funds. Phasing was based on the Transportation Improvement Program and the Parks & Recreation Master Plan. The three phases were broken down as follows:

- **Phase 1 (1-5 Years).** 70.7/152.8 miles and 7/14 spot improvements (see Map 5.1)
- **Phase 2 (6-10 Years).** 46.5/152.8 miles and 3/14 spot improvements (see Map 5.2)
- **Phase 3 (11-20 Years).** 35.6/152.8 miles and 4/14 spot improvements (see Map 5.3)

Guidance for improving the **routine and capital maintenance** of the existing and proposed on and off-street active transportation network in the city is included in Chapter 5.

Approximately 30 different **funding sources** are identified, including: municipal (bonds, impact fees, CIP), regional, state, & federal (USDOT, UDOT, sales taxes, RAP tax, bonds, HSIP, SSIP, CDBG, STDBG, STIP), and private, non-profit, and corporate (i.e. community fundraising, foundations).

Performance measures will help Washington City assess the success of the plan and the implementation of its proposed facilities, programs, and policies.

- Reduce rates of bicycle and pedestrian collisions and injuries
- Mode share goal-based funding for bicycling and walking projects
- Increase reach and participation in public involvement activities, existing and recommended programs
- Increase awareness within Washington City departments about statutes, standards, and laws pertaining to active transportation
- Track percentage of the recommended bicycle and pedestrian network from the active transportation plan completed
- Improve results of the Biannual Bicycle and Pedestrian Infrastructure Condition Evaluation

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36.4 to 58.1 million more bicycling and walking trips

- *22.1 to 43.7 million fewer vehicle miles traveled (VMT)*
- *11,000 to 21,700 fewer metric tons of greenhouse gases and criteria pollutants (resulting in $2.2 to $4.4 million in avoided environmental damage or mitigation costs*
- *Increased physical activity resulting in $2.4 to $6.8 million in healthcare savings*
- *$13.9 million to $27.4 million in household transportation expenses, $1.2 million to $2.4 million in costs related to traffic congestion, and $87.9 million in costs related to collisions*

Cost-Benefit Analysis

Improving and expanding active transportation infrastructure will likely contribute to more people walking and bicycling. The benefits that can be derived from walking and bicycling will likely include economic competitiveness, environmental sustainability, safety, quality of life, and freedom of choice, among others. Because an expanded network will require at least partial financial commitment from the City, the plan includes a summary (Chapter 5) and a complete analysis (Appendix E) of the quantifiable, **monetary benefits** based on approximate increased future usage.

It should also be noted that because Washington City's bicycle commute mode share (American Community Survey [Census]) is 0.0%, the derived benefits based on the mode shares of other communities likely differ slightly from actual future benefits. The cost-benefit analysis should be performed again once infrastructure buildout is progressing and/or when the data is more accurate.

If Washington City **increased its rate of bicycling and walking** to match communities with similar populations, land uses, and active transportation networks (existing networks similar to Washington City's proposed network), the community could expect to reap the following net benefits (total benefits less capital and maintenance costs) within 40 years.

At a 3% discount rate, the net cumulative value of the recommended projects ranges between $4,600,000 and $10,230,000 (in 2017 dollars).

"We are a young, vibrant community with very active families."

"I support all efforts to continue to build and add bicycling and walking trails in the city."

"Design and build paths before areas are developed."

"Improve connectivity between trails and commercial developments adjacent to them."

Vision, goals, and objectives are the principles that will guide the development and implementation of the Washington City Active Transportation Plan, where resources are allocated, how programs are operated, and how priorities are determined for years to come.

Vision

"Washington City will improve its **quality of life and collective health** by creating and promoting an integrated bikeway, sidewalk, and trail system for transportation and recreation that will connect neighborhoods, places of work, and commercial centers."

Goals & Objectives

Goal 1: Safety

- Create a safe network of walking and bicycling facilities
- Address safety concerns expressed by residents and visitors to encourage more people to walk and ride
- Reduce the number and severity of crashes involving people walking and bicycling

Goal 2: Funding

- Create a dedicated, regular local funding source for walking and bicycling improvements
- Support more local and state funding sources
- Reduce infrastructure costs by completing improvements in conjunction with routine maintenance, park construction or modification, and future roadway redesign or reconstruction projects

Goal 3: Community-Driven Network Planning & Design

- Create a network of active transportation solutions that reflect community needs and desires

- Ensure that people have a voice in determining facility and program planning and design
- Establish a hierarchy of facility types that are appropriate on different types of roadways
- Build and maintain safe routes to schools in order to improve health, academic performance, and congestion
- Coordinate with outside planning efforts in order to ensure that the active transportation system is seamless at city boundaries and that local and regional facilities are interconnected

Goal 4: Education

- The plan's vision will be implemented through education strategies and events organized by the Washington City Active Transportation Committee, other committees, and the Southern Utah Bicycle Alliance
- Support and educate leaders about implementing this and other active transportation plans and projects
- Educate people about safety, economic, and health benefits related to active transportation

Goal 5: Connectivity

- Decrease dependence on automobiles and improve community health by increasing local and regional connectivity to shopping, recreation, entertainment, and other desired destinations
- Ensure that connections to origins and destinations match users' needs and interests

Goal 6: Operations & Maintenance

- Maintain roadways and other bicycling and walking facilities, like sidewalks and trails, so that they are safe and comfortable
- Ensure that the design and implementation of bicycling and walking facilities minimize future maintenance costs by specifying quality materials and standard products
- Perform a regular survey of the people using facilities as well as the facilities themselves to ensure that very few are unsatisfactory

“I walk on the Virgin River Trail with my dog, Hershey, almost every day.”

- CECE & HERSHEY

Chapter One:

Introduction & Existing Conditions

- Who lives in Washington City?
- What is active transportation?
- How many people walk and bike in Washington City and our region?
- What does our active transportation system look like right now?
- Where are there gaps in the existing walking and bicycling network?
- Where do crashes involving people walking and bicycling occur and how can they be prevented?
- What has already been planned?

Photo: Red Rock Bicycle Co.

Washington City & the Region

Overview & History

Washington City is the second-most populous city (next to St. George) in Washington County, Utah's fifth largest county by population. In the roughly 110 years between the city's first pioneer settlement in 1857 and 1970, the city had always had fewer than 1,000 residents. Following a massive population increase (+312%)[1] between 1970 and 1980, the city's population has continued to rise to approximately **22,080** in 2015 (see Table 1.2).[2] Countywide, the population is expected to increase by 242% between 2010 and 2050 (see Table 1.1), meaning that there will likely be significant additional growth and development in Washington City.

Washington City was initially intended to be the first town in the Virgin River basin settled for the purpose of growing and producing cotton. Southern Utah's agricultural tradition, ability to grow tropical plants and fruits, like cotton and sugar cane, and its temperate winter climate earned the area the nickname "Utah's Dixie". Indeed, to this day, one of the overarching goals of Washington City is to preserve its open space and agricultural lands, and therefore its heritage as well as its economic capacity and diversity.

Table 1.1. *Existing & Projected Population (Data: Utah State Governor's Office of Management & Budget, 2015; Subcounty Population Projections, 2012)*

	2010	2020	2030	2040	2050
Washington City	**18,761**	**26,727**	**38,110**	**50,496**	**64,192**
St. George	72,897	103,851	148,078	196,206	249,421
Washington County	138,115	196,762	280,558	371,743	472,567
Utah	2,927,643	3,336,353	3,829,201	4,333,400	4,825,101

1 1980 U.S. Decennial Census
2 U.S. Census Bureau, American Community Survey 2011-2015, Five-Year Estimates

Regionally, southern Utah's mild winter temperatures, open space, recreational opportunities, economic competitiveness, and natural beauty attract visitors from around the world for conventions, sports competitions, business, and leisure. To that end, Washington City provides world-class amenities for its residents and visitors while preserving its character and improving community health.

Demographics

The data in Table 1.2 indicate that Washington City residents make up about 14% of the county's population, earn more money than others in Washington County but less than the median statewide, and are more likely to participate in the labor force than Washington County. Washington City residents are also younger than other Washington County residents but older than the statewide median.

About 38% of Washington City's and 39% of Washington County's population is either under 16 or over 70 years old are therefore too young to drive or significantly less likely to drive, respectively. Together, these represent about 8,500 residents who would benefit from access to safe and diverse mobility options.

Table 1.2. *Local, Regional, and Statewide Demographics (Data: U.S. Census Bureau, 2011-2015 American Community Survey 5-Year Estimates)*

	Total Population[1]	Median Household Income[2]	Median Age[3]	Population Under 16[3]	Population Over 70[3]	Labor Force Participation Rate[4]
Washington City	**22,080**	**$52,885**	**32.5**	**26.4%**	**11.3%**	**59.8%**
Washington County	155,602	$50,774	34.6	25.7%	13.3%	52.5%
Utah	2,995,919	$60,727	30.1	27.8%	6.4%	63.8%

Notes. (1) Demographic & Housing Estimates; (2) Income in the Past 12 Months (2015 inflation-adj. dollars); (3) Median Age by Sex; (4) Employment Status

Photo: SUBA

Photo: SUBA

Introduction to Active Transportation

Active transportation can be defined as people walking or riding bicycles,

which are active forms of personal transportation wherein people move under their own power. Active transportation can include children walking or riding a bike to Coral Canyon Elementary School, walking to the store or to church, going for a bike ride on the Virgin River Trail, or bicycling to work instead of driving.

Benefits

Planning for and expanding the active transportation system in Washington City will not only benefit those who choose to walk or ride a bike, but also those who cannot or choose not to use an automobile for transportation. A healthy system of paths, bike lanes, and sidewalks enables freedom of transportation choice.

Freedom of Choice. Investing in and improving active transportation in Washington City will ultimately increase freedom of choice: to drive to work one day, to walk and take the bus the next, or to ride a bike to the park, the drug store, or to school instead of driving or being driven. Some residents are too young or too old to drive. Others have disabilities and impairments that make driving more difficult or impossible altogether. Many more still would like to be able to spend less on transportation, feel safer on their community's streets, and be confident allowing their children to walk to school, to the park, or to friends' houses.

Diversified Investment. Active transportation will help the city diversify its transportation system investment. Like an effective stock portfolio or a well-designed computer system, fiscal diversification and network redundancy, respectively, are key to resilience and prosperity. A transportation network designed for people of all ages and abilities will improve flexibility and cost-efficiency when repairs, natural disasters, or other closures reduce one or more parts' utility.

Healthy and Safe Community. Streets with bicycle and pedestrian infrastructure not only improve safety for people walking and riding bikes but also for those driving by increasing predictability, slowing speeds in some cases, increasing separation between cars and more vulnerable users, and encouraging a more deliberate and attentive use of the roadway system.[3] There is also a "safety in numbers" effect of active transportation. When walking and bicycling rates double, per-mile pedestrian-motorist collision risk can decrease by as much as 34%.[4]

Residents of **WALKABLE COMMUNITIES** are **2x** as **LIKELY TO MEET PHYSICAL ACTIVITY GUIDELINES** compared to those who do not live in walkable neighborhoods

(Frank, 2005)

Property Values. Nationally, people prefer walkable communities.[5] Bicycling and walking facilities also often improve property values. Americans say that having bike lanes or paths in their community is important to them, and 2/3 of homebuyers consider the walkability of an area in their purchase decision[6], proven by homes in walkable neighborhoods having property values $4,000 to $34,000 higher than houses in areas with only average walkability.[7]

Quality of Life. People who can easily and safely walk and ride a bike are happier and experience a higher quality of life, including factors discussed previously like freedom of choice, health, and safety.

BIKE COMMUTERS REPORT LOWER STRESS LEVELS compared to auto commuters

(New Economics Foundation)

Photo: Washington City Museum

3 Ewing, R. and Dumbaugh, E. (2010). The Built Environment and Traffic Safety: A Review of Empirical Evidence. Injury Prevention 16: 211-212.
4 Jacobson, P. (2003). Safety in Numbers: More Walkers and Bicyclists, Safer Walking and Bicycling. Injury Prevention 9: 205-209.
5 Racca, D.P. and Dhanju, A. (2006). Property Value/Desirability Effects of Bike Paths Adjacent to Residential Areas. Prepared for Delaware Center for Transportation and the State of Delaware Department of Transportation.
6 Bureau of Transportation Statistics. (2010). Transportation Statistics Annual Report. Retrieved from http://www.bts.gov/ publications/transportation_statistics_annual_report/2010/.
7 Cortright, J. (2009). Walking the Walk: How Walkability Raises Housing Values in U.S. Cities. CEOs for Cities.

Active Transportation in Washington City

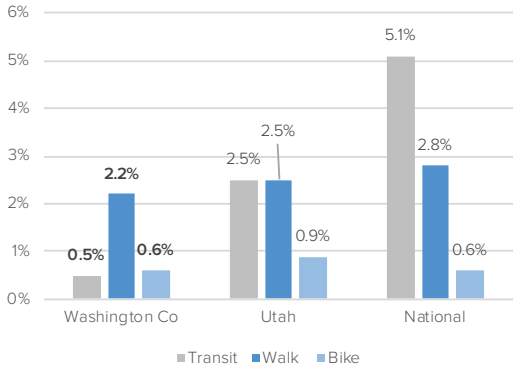
Mode Share

Mode share refers to the percentage of trips taken by a particular mode of transportation (i.e. car, bus, bicycle, walk, taxi). Two data sources are used in this analysis: the American Community Survey (2011-2015) and the Utah Travel Study (2012). Due to small sample sizes for some ACS and UTS data, Washington City may be substituted for Washington County in parts of the following sections.

American Community Survey (ACS)

The Census Bureau's American Community Survey (ACS) Journey to Work data only measures the principal transportation mode from home to work. It excludes or provides incomplete data from those outside of the workforce, those who combine different modes, or those who commute by different means depending on the day, weather, and time of year. ACS data is collected and averaged throughout the year, meaning that rates of walking and bicycling may be higher than the data indicates. In fact, trail counters in some western communities indicate that walk and bike mode shares are more than double the ACS estimates during pleasant weather. Despite its flaws, especially in smaller communities, the ACS is a consistent benchmark of mode choice over longer periods.

Figure 1.1. *Selected Commute to Work Mode Shares in Washington County, Utah, and the U.S. (Data: U.S. Census Bureau, American Community Survey 2011-2015 5-Year Estimates)*



According to the ACS, Washington County's **transit** mode share is 5 or 10 times lower than state and national rates, respectively. However, **walking** and **bicycling** rates are similar between the three geographies. It is important to notice that Washington County mode shares are influenced, in part, by St. George, the largest city in the region, which has invested broadly in pedestrian, bicycle, and transit route facilities and is where Dixie State University is located.

Utah Travel Study (UTS)

The 2012 Utah Travel Study (UTS) was a statewide survey of statewide and local transportation behaviors, attitudes, and trends. The primary tool of the study, the household travel diary, was supplemented by additional surveys including a bicycle and pedestrian barriers survey (see Map 1.6). Unlike the ACS, the UTS collected data on all trips taken by a household, including children walking to school, picking up groceries, commuting to work, and walking around the neighborhood. Because the surveys may only be reproduced every 8-10 years, however, the Study's tremendous amount of valuable data cannot be monitored on a year-to-year basis (like the ACS can), making the monitoring and reporting of incremental changes more difficult.

Because the UTS includes all trips, regardless of purpose, mode share figures in Figure 1.2 are higher than ACS mode shares in Figure 1.1. Also, note that Figure 1.2 includes Washington City and excludes National (U.S.).

6.8% of all trips in Washington City are done on foot or by bike.

Washington City has a higher walking mode share than the county, but a lower bicycling mode share. Their combined active transportation mode share, however, is roughly the same at about 6.7 or 6.8%. Likewise, as transit improves regionally and especially in Washington City, bicycling and walking rates will likely also improve and vice-versa.

About 36% of all trips in Washington City are two miles or less.

Due to the average bicycling trip in Washington County being about 2.5 miles and the average walking trip being about 0.5 miles, there is great potential for a significant change in walking and bicycling mode shares. Much of what will accelerate that shift depends on improved conditions for bicycling and walking in the City and the region. Interestingly, distances of trips that begin in Washington City spiked again around 5 miles, which is roughly the distance from downtown Washington to downtown St. George, the latter of which being where many jobs, destinations, and Dixie State University are located.

Figure 1.2. *Selected Mode Shares in Washington City, Washington County, and Utah (Data: Utah Travel Study, Household Travel Diary, 2012)*

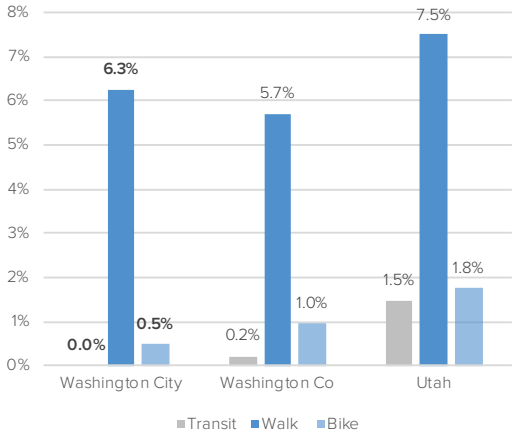
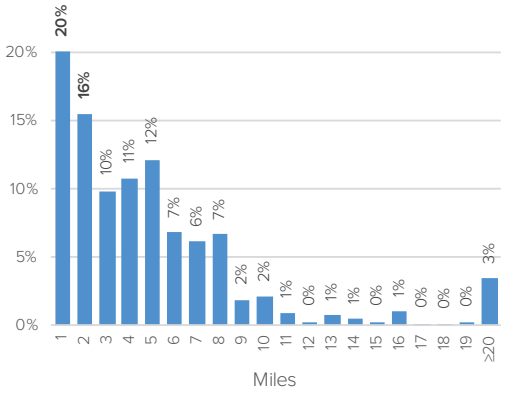


Figure 1.3. *Trip Distances for All Modes in Washington City (Data: Utah Travel Study, Household Travel Diary, 2012)*



Existing Active Transportation System

Washington City's current network of 19.1 miles of paved shared use paths, 51.9 miles of unpaved trails for hiking and mountain biking, and 23.5 centerline miles of signed bike routes (or shared roadways) within city limits enhance livability, health, and safety for residents and visitors.

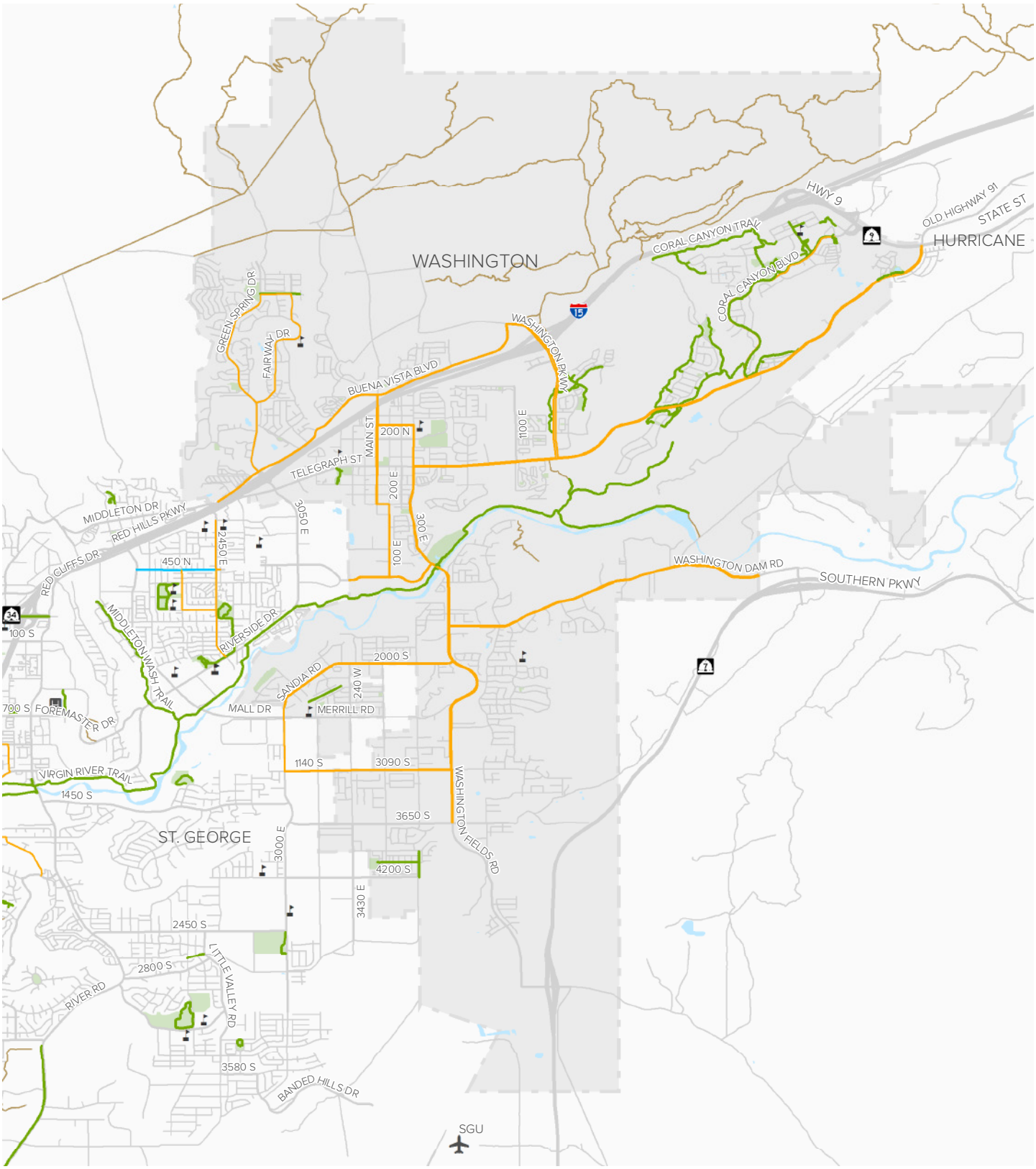
Shared Use Paths (19.1 miles). Sometimes called trails (not to be confused with soft surface trails), paved shared use paths are typically 8-12' wide, constructed of asphalt or concrete, and designed to accommodate people walking, bicycling, rollerblading, skateboarding, and using other non-motorized modes. Washington City's shared use paths along and near the Virgin River and within subdivisions and near schools, like Coral Canyon Elementary, encourage people to recreate and access their homes and destinations by walking and bicycling.

Unpaved Trails (51.9 miles). Soft surface, unpaved trails are located in Washington City's periphery, especially to the north, as well as in other secluded areas of the region. Southern Utah is world-renowned for its red rock mountain biking and hiking trails. Although usually not a transportation *and* recreation facility, these trails may provide meaningful connectivity to destinations if located in developed areas.

Bike Routes (23.5 miles). These are differentiated by signage and/or pavement markings that indicate to people driving and riding bicycles that the roadway is shared. Although bike routes can enhance awareness of bicyclists, shared facilities are not typically recommended on roadways with more than one lane in each direction, traffic speeds above 25 mph, and/or traffic volumes above 3,000 cars per day (AADT).

There are approximately 94.5 miles of walking and bicycling facilities in Washington City.

This plan will recommend how to improve the existing system over the next 10 to 15 years in order to encourage and accommodate walking and bicycling connectivity for all ages and abilities.



Map 1.1:
Existing Active Transportation Network

Washington City
Active Transportation Plan

Existing Facilities
- Shared Use Path
- Unpaved Trail
- Bike Lane
- Bike Route

Base Data
- School
- Hospital
- Water
- Park
- Washington City Limits

MILES
0 1 2
3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

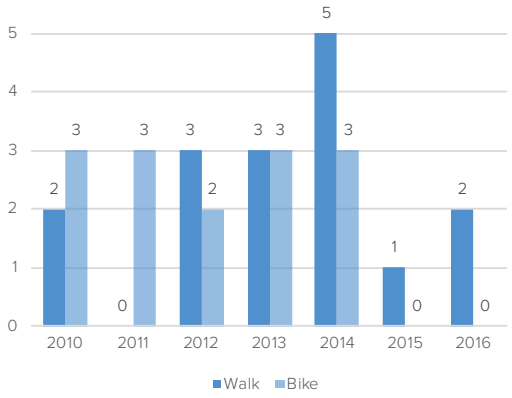
Data provided by Washington City, AGRC, UDOT, Dixie MPO.
Map produced January 2017.

Crash & Safety Analysis

1,305 total traffic collisions were reported in Washington City in the last seven years (January 1st, 2010 to December 31st, 2016), excluding crashes that occurred on Interstate 15 within city limits.

Only 30, or 2.3%, of the 1,305 crashes involved people walking or riding a bike,

Figure 1.4. *Crashes Involving People Walking or Bicycling in Washington City, 2010-2016 (Data: UDOT, Numetric)*



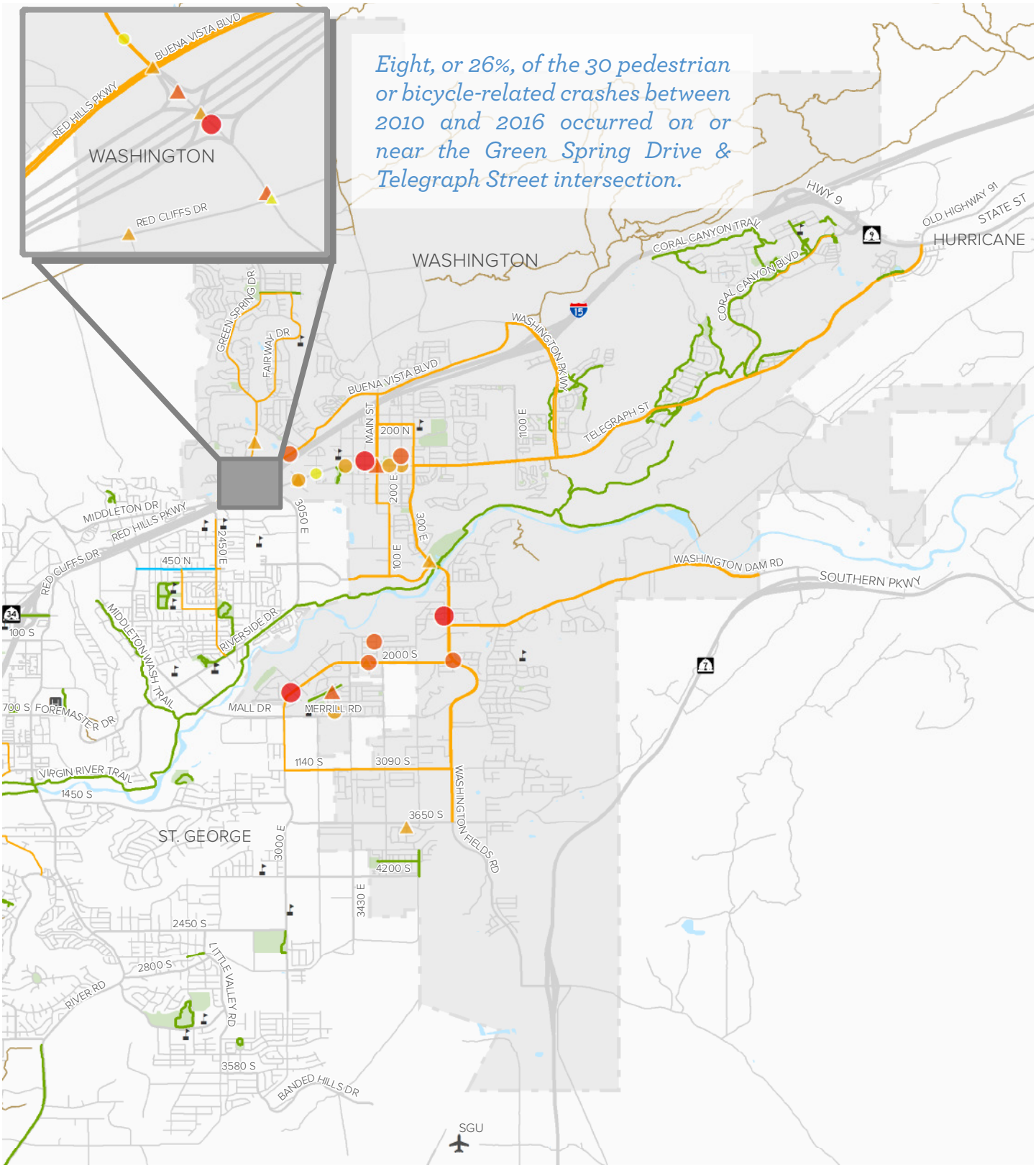
even though approximately 6.8% of all trips in Washington are done on foot or by bike. These 30 crashes include 16 involving pedestrians and 14 involving bicyclists, with no resulting fatalities. The number of pedestrian crashes increased slightly in 2014, yet only three have occurred since then (see). Before 2014, there were about three bicycle crashes per year, but none in 2015 or 2016.

Intersections. 60% of all active transportation-related crashes in the City occurred at intersections. Improving visibility for pedestrians and bicyclists, as well as installing traffic signals where they do not currently exist and where warranted, may reduce the likelihood of crashes in the future.

Right Turns. 36% of these crashes occurred when vehicles turned right across the path of a person walking or riding a bicycle. Traffic calming, lighting, dedicated right turn lanes, education about correct bicycle positioning, and pedestrian islands in the line of sight of motorists could help reduce the severity and number of these types of crashes.

Dedicated Facilities. All 14 bicycle crashes occurred on roads without dedicated infrastructure (i.e. bike lanes, separated bike lanes, shared use paths), highlighting the importance of bicycle infrastructure design, implementation, and education.

Arterials and High Speeds. 13 (43%) of the 30 active transportation-related crashes occurred on roads with posted speeds of 35 mph or higher. As seen in Map 1.2, crashes involving people walking or riding a bicycle tend to occur around arterial roadways, like Telegraph Street and Green Spring Drive, where destinations are located on or near high speed and/or high volume traffic roadways.



Map 1.2:
Crash & Safety Analysis

Washington City
Active Transportation Plan

Crash Severity

Bike Ped

- Serious Injury
- Minor Injury
- Possible Injury
- No Injury

Existing Facilities

- Shared Use Path
- Unpaved Trail
- Bike Lane
- Bike Route

Base Data

- School
- Hospital
- Water
- Park
- Washington City Limits

0 1 2 MILES

3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

N

Data provided by Washington City, AGRC, UDOT, Dixie MPO.
Map produced January 2017.

Existing Roadway Network Suitability

Active transportation connections that are "low-stress" are an important factor in encouraging people of all ages and abilities to walk and ride a bicycle throughout Washington City. Connected networks of low-stress facilities, like shared use paths, separated bike lanes, and bicycle boulevards (latter two facility types will be discussed in Chapter 4) appeal to a diverse cross section of the public, especially on or as alternatives to high volume and/or high speed streets.

Methodology and Criteria

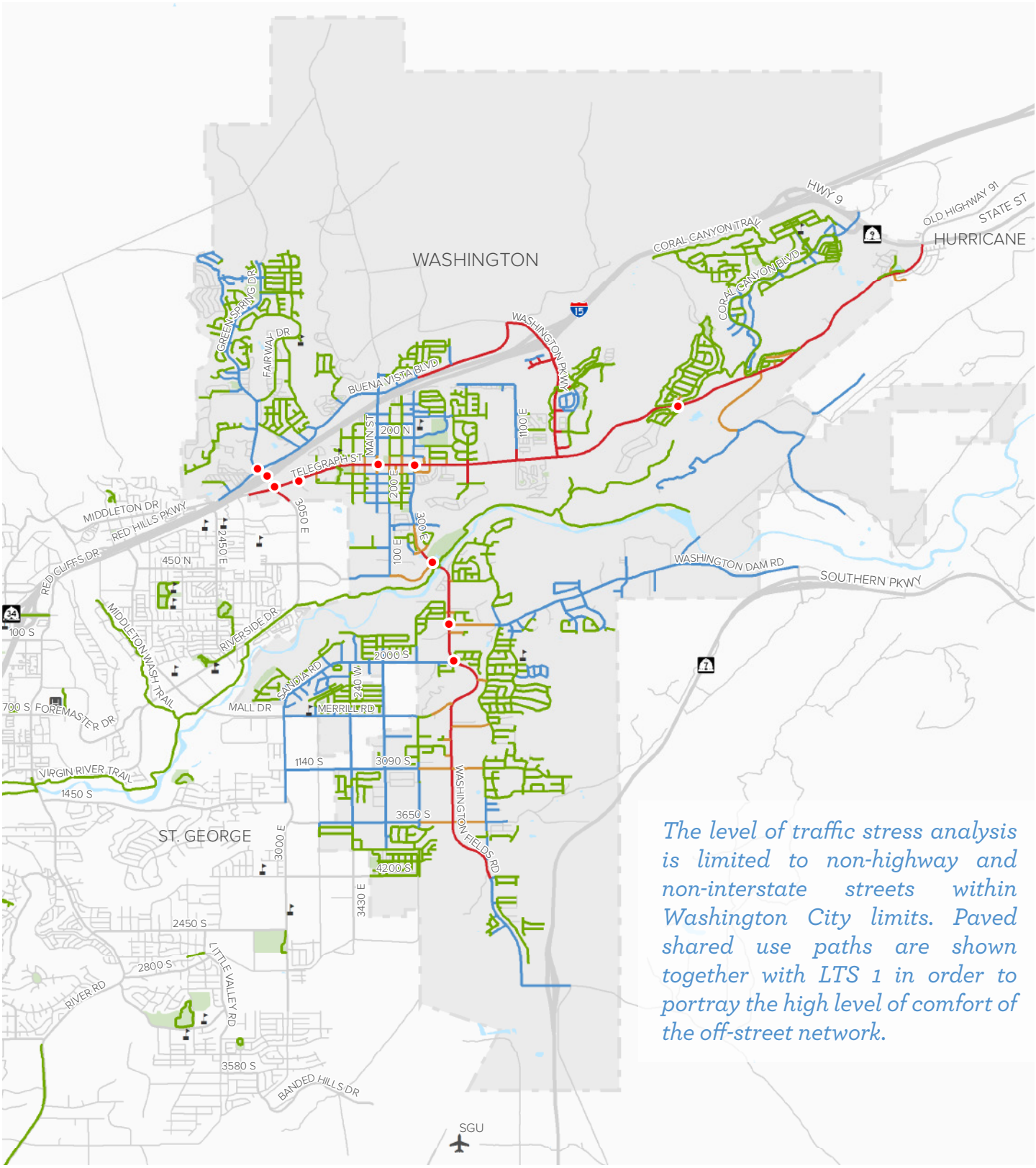
The Level of Traffic Stress (LTS) analysis in Maps 1.3 and 1.4 was adapted from the 2012 Mineta Transportation Institute (MTI) Report 11-19: Low-Stress Bicycling and Network Connectivity. LTS is specifically designed to objectively assess how comfortable roadway conditions are but does not assess conditions on sidewalks. The LTS analysis uses roadway network data (i.e. posted speed limit, street width, number of travel lanes, intersection condition, presence and character of bike lanes, and land use context) as a proxy for bicyclist comfort level.

The combination of these criteria creates four levels of traffic stress for the existing roadway network. The lower the number, the higher the level of comfort for people on bicycles.

- **LTS 1 (57% of roadways).** Low-stress roadways suitable for all ages and abilities; also includes paved shared use paths
- **LTS 2 (31%).** Roadways that are comfortable enough that the mainstream adult population would ride a bicycle on them
- **LTS 3 (4%).** Roadways that would probably only be comfortable ridden by an experienced, confident bicyclist
- **LTS 4 (13%).** Roadways ridden only by strong or fearless bicyclists

88% of the 150 non-highway miles of streets in the city are comfortable (LTS 1 & 2);

however, they may be interrupted by uncomfortable barriers and intersections that negatively impact the experience.



The level of traffic stress analysis is limited to non-highway and non-interstate streets within Washington City limits. Paved shared use paths are shown together with LTS 1 in order to portray the high level of comfort of the off-street network.

Map 1.3:
Level of Traffic Stress Analysis

Washington City
Active Transportation Plan

Level of Traffic Stress
- LTS 1 & Shared Use Paths
- LTS 2
- LTS 3
- LTS 4
- Streets w/o LTS Input Data
- Traffic Signals in Washington City

Base Data
- School
- Hospital
- Water
- Park
- Washington City Limits

0 1 2 MILES

3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

Data provided by Washington City, AGRC, UDOT, Dixie MPO.
Map produced January 2017.

The results of the LTS analysis (see Maps 1.3 and 1.4) help identify existing areas with low-stress streets, as well as high-stress streets that divide them. Telegraph Street, Washington Parkway, and Washington Fields Road, in particular, have high levels of traffic stress due to high speeds and a lack of dedicated bicycle facilities. These roads are also where popular destinations, like Red Cliffs Mall, Downtown Washington City, and Sullivan Park, are located.

Islands of Connectivity

Map 1.4 includes only low-stress streets (LTS 1 and 2), displayed as "islands of connectivity", or, clusters of streets that are connected and accessible to each other.

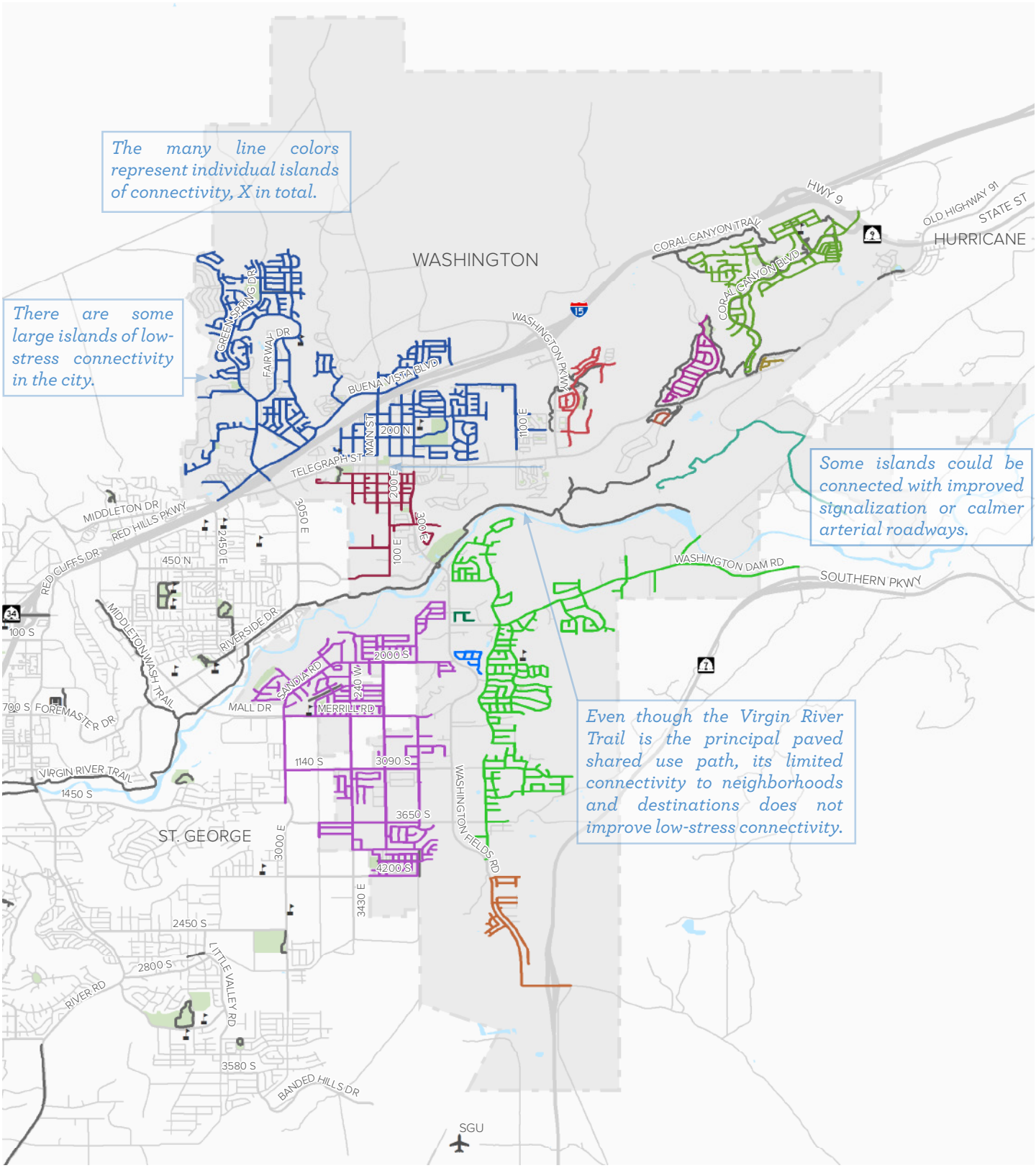
Under current conditions, there are 14 separated islands of low-stress streets in Washington City.

The islands are, in almost every instance, separated either by a high-stress, major roadway or a lack of street network connectivity. Private, unpaved, or other streets lacking adequate data were omitted from the analysis.

Solutions

In addition to linear barriers, infrequent intersection signalization (especially on and across high-stress roadways) limits network connectivity. These barriers require users to cross at uncontrolled, higher stress intersections or other locations. Improving arterial crossings and providing low-stress facilities along arterials, either by way of improved roadway conditions or clear connections to adjacent trails, would produce a more comfortable and connected network.

Map 1.4 shows that it is possible to connect "islands" and create a low-stress network with relatively few linear and crossing improvements.



Map 1.4:

Level of Traffic Stress Analysis & Islands of Connectivity

Washington City
Active Transportation Plan

The Virgin River is a network constraint that could be limited by development of more crossings and neighborhoods connections

Network Gaps & Physical Constraints

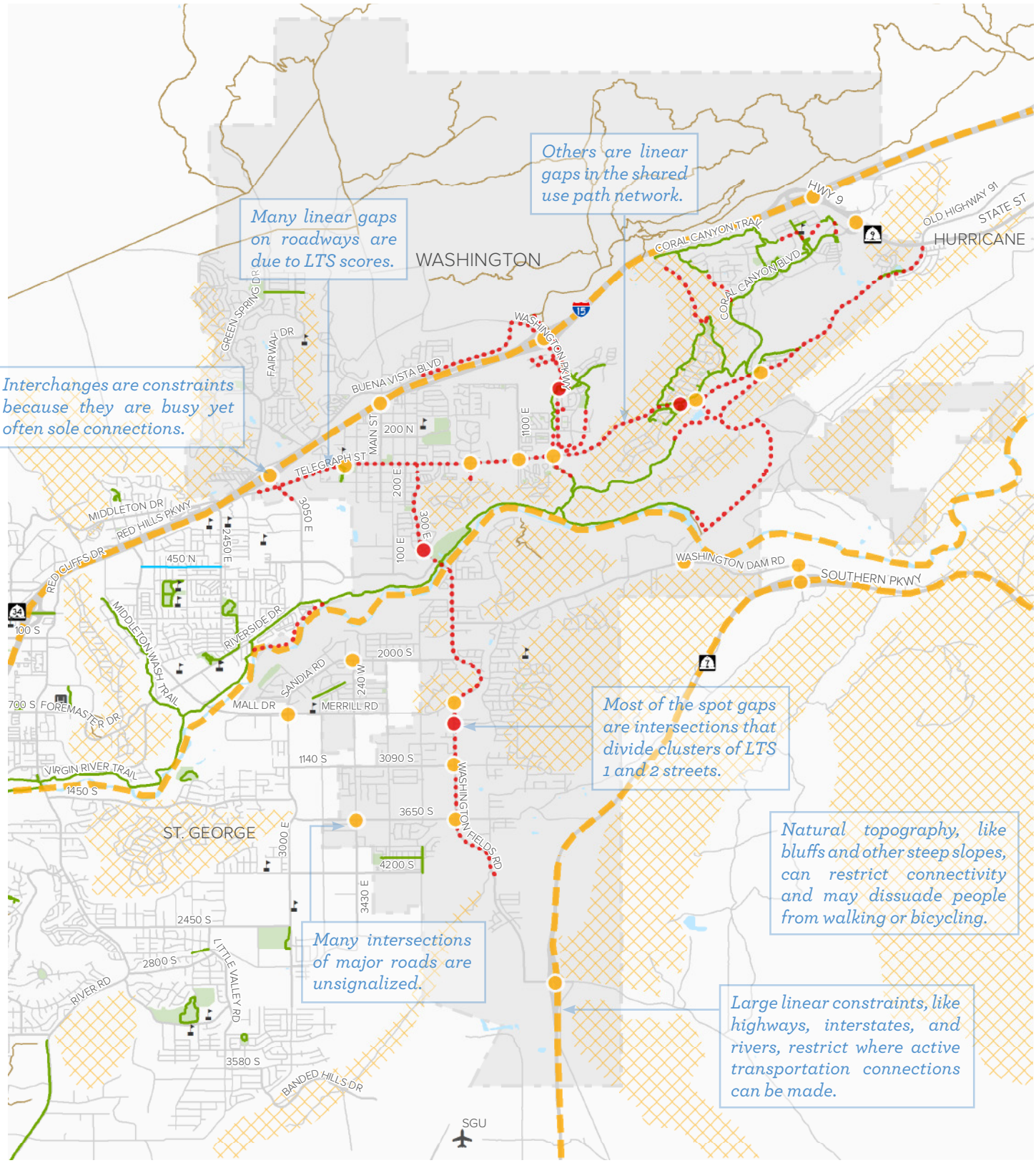
There are many types of gaps and constraints in Washington City that either limit network connectivity or that make refining and connecting the existing bicycling and walking system more difficult.

Gaps

The **gaps** identified in Map 1.5 are primarily gaps between low-stress street clusters shown in Maps 3 & 4, as well as gaps in the existing shared use path network. Because no dedicated on-street facilities currently exist, this plan considers nearly all streets with classifications collector and above as linear gaps.

Constraints

Some **constraints** can limit or alter opportunities, like natural features (bluffs or steep grades) or other man-made physical or jurisdictional limitations and restrictions (freeways, busy roads, unsignalized intersections of major roads, and city limits). Many constraints, however, can also be opportunities, depending on their context.



Map 1.5:

Network Gaps & Physical Constraints

Washington City
Active Transportation Plan

Gaps & Constraints
- Spot Gaps
- Linear Gaps
- Spot Constraints
- Linear Constraints
- Topographic Constraints

Existing Facilities
- Shared Use Path
- Unpaved Trail
- Bike Lane

Base Data
- School
- Hospital
- Water
- Park
- Washington City Limits

0 1 2 MILES
3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

Data provided by Washington City, AGRC, UDOT, Dixie MPO.
Map produced January 2017.

Existing Washington City Plans

Many of Washington City's existing plans specifically address active transportation and how to make Washington a more livable, enjoyable, and healthy community. These plans include goals and objectives as well as specific project recommendations (see Map 1.6) that help guide future active transportation improvements. Continuing and improving upon the efforts and visions from these plans will ensure that active transportation has support from different agencies and partners.

Washington City General Plan

The Washington City General Plan (2016) is the result of input from public and expert sources. It includes guidance for the orderly growth and development of the city.

Six goals identified in the study are pertinent to active transportation:

- Goal 4. Provide for the continued use of farmland
- Goal 6. Provide a transportation system that balances traffic needs with a livable community
- Goal 10. Promote the redevelopment of downtown as a vibrant, mixed use area
- Goal 11. Attract new, quality employers to Washington City, and retain and grow existing businesses
- Goal 12. Provide a wide range of recreation opportunities for all ages in an aesthetically pleasing setting
- Goal 14. Complete a trail system that connects to parks, community destinations, and major open spaces.

These goals support the Washington City Active Transportation Plan by encouraging cost-effective public infrastructure and services; by guiding development to take place in existing centers, thereby encouraging shorter trips and resulting in fewer cars on the road; and by accommodating people walking and bicycling in an interconnected and expanding system of paths, lanes, and sidewalks.

Washington City Economic Development Plan

The Washington City Economic Development Plan (2008) serves as a "guide to monitor and implement economic development activities and programs for Washington City and its business community." Among its twelve main objectives, two are especially important for fostering active transportation:

- Establish a program to revitalize the city center and Telegraph Street
- Support retail commercial development clusters along major transportation corridors

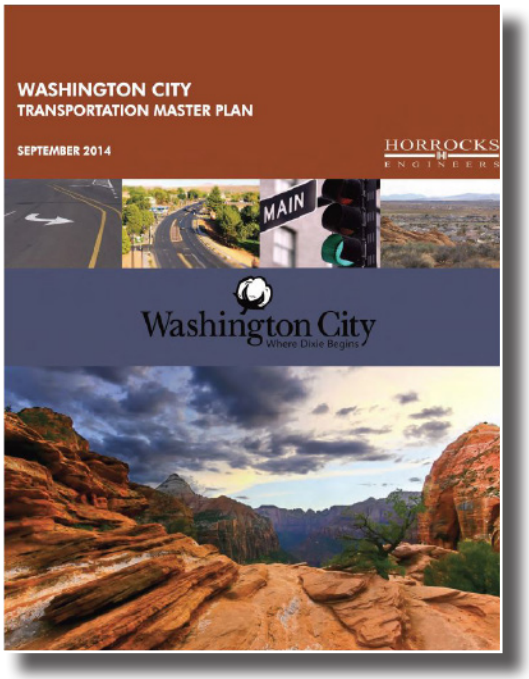
According to the first goal, the City should adopt standards for right-of-way landscaping, public signage, and street furniture that can foster a safe and enjoyable place for people to walk and ride a bicycle.

The latter's objective is help the Community Development Department to identify appropriate locations for retail commercial clusters along the city's major transportation corridors. This should be done in concert with goals to decrease trip distances, reduce parking demand, and encourage more people to choose active transportation.

Washington City Parks & Recreation Master Plan

The Washington City Parks & Recreation Master Plan (2015) aims to ensure that a comprehensive, community-wide park and trail system fulfills the current and future recreational and public health needs of Washington City residents. According to the plan, there are 12 existing parks, 15 trails (totaling 15.89 miles at time of publication) and one community center within Washington City limits. The plan proposes that all park and recreational facilities be accessible by means of interconnecting trails, sidewalks, and streets, and that trails be at least 10' wide. The plan identifies approximately 57.5 miles of new trails in order to enhance recreation, connectivity, and active transportation in the city. 10 of the nearly 60 miles of future trails are required to be built by 2025 (more information regarding phasing can be found in Chapter 5).

The Active Transportation Plan's recommendations (Chapters 3, 4, and 5) build upon the Parks & Recreation Master Plan and continue the efforts from that plan to provide safe and comfortable transportation and recreation options for people in and near Washington City. Overlapping analysis and recommendations are indicated by the **green leaf symbol** at left and throughout this document.



Washington City Transportation Master Plan

This plan outlines the transportation conditions in and future needs of Washington City, including new roads, roadway improvements, signals, and active transportation facilities.

Some of the plan's goals and objectives address active transportation.

» Goal 9. Provide a transportation system that balances traffic needs and those of creating a livable, attractive community. Objective 2 of this goal states that neighborhoods, downtown shopping, and business districts should be pedestrian-friendly. Objectives 6 and 7 state that walking and bicycling should be encouraged through an interconnected system of facilities for non-motorized users that connect destinations.

Washington City and the Dixie MPO have shown their commitment to providing safe and appropriate facilities for people walking and bicycling through their "Multi-Modal Approach":

» Washington City shall work with the Dixie MPO to provide a balanced multi-modal approach to transportation problems by considering...[bi]cycling, pedestrian travel, and other alternative modes of transportation to the single occupant vehicle

The City's strategies for creating a safe transportation system include:

» Providing safe pedestrian street crossings, particularly near school and recreation areas

» Encouraging development of school routing and recreation plans which minimize the potential for vehicle and pedestrian conflicts

» Enforcing speed limits near schools

» Implementing raised medians and islands, as well as striping and other engineering solutions in order to create a predictable system

» Installing and maintaining a safe and efficient sidewalk system that follows the guidelines in Table 1.3.

Table 1.3. *Washington City Transportation Master Plan's "Guidelines for Installing Sidewalks" (Table 5.1 in TMP and sourced from "Design and Safety of Pedestrian Facilities, ITE, 1998))*

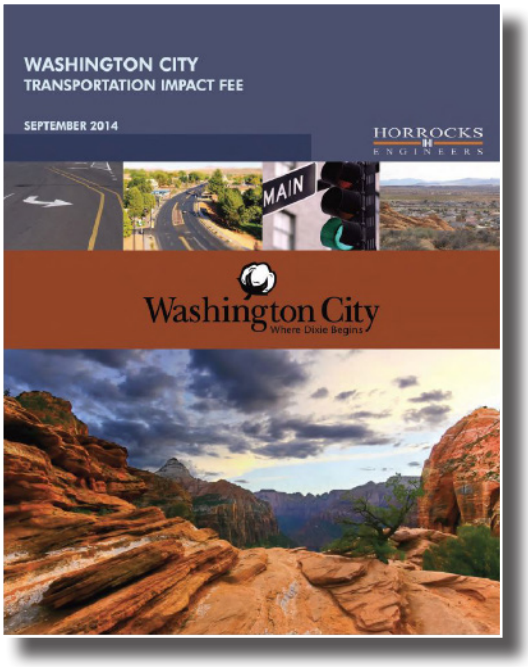
Land Use (Road Classification) or Dwelling Unit Type	New Streets	Existing Streets
Commercial and Industrial (All Streets)	Both sides	Both sides. Every effort should be made to add sidewalks where they do not exist and complete missing links. Unless specifically approved by Council.
Residential (Major Arterials)	Both sides	Both sides. Unless specifically approved by Council.
Residential (Collectors)	Both sides	Multifamily, both sides. Single family dwellings, both sides. Unless specifically approved by Council.
Residential (Local Streets) w/ > 4 units/acre	Both sides	Both sides. Unless specifically approved by Council.
1 to 4 units/acre	Both sides	Both sides. Unless specifically approved by Council.
< 1 unit/acre	Both sides	Both sides. Unless specifically approved by Council.

Notes. Any local street within two blocks of a school site that would be on a walking route to school – sidewalk and curb and gutter required. Sidewalks may be omitted on one side of a new street where that side clearly cannot be developed and where there are not existing or anticipated uses that would generate pedestrian trips on that side. Where there are service roads, the sidewalk adjacent to the main road may be eliminated and replaced by a sidewalk adjacent to the service road on the side away from the main road. For rural roads not likely to serve development, a shoulder at least 4 feet in width, preferably 8 feet on primary highways, should be provided. Surface material should provide a stable, mud-free walking surface.

- Maintaining sidewalk and trail conditions by repairing cracks and heaving, minimizing slopes, improving visibility at corners, avoiding abruptly ending walkways, reducing speeds and traffic, keeping walkways clear of utilities and other obstructions, avoiding poor drainage on sidewalks, and providing ADA-compliant curb cuts and ramps

Section 2.7, "Bicycle and Pedestrian Traffic", includes a map with existing bike routes, the data for which is included in many of the maps in this chapter. The plan's recommendations would allow people to "safely travel to different areas of the community" by bicycle.

Section 5.3.2 requires that "quality of life" and pedestrian and bicycle traffic be included as factors in the design of the roadway network. It specifically states that safety and quality of life are the overriding factors in the design of residential roads and that bicycle and pedestrian traffic be considered in the design of all paved streets. This provision, though a soft recommendation, could be the beginning of a "Complete Streets" policy or ordinance.

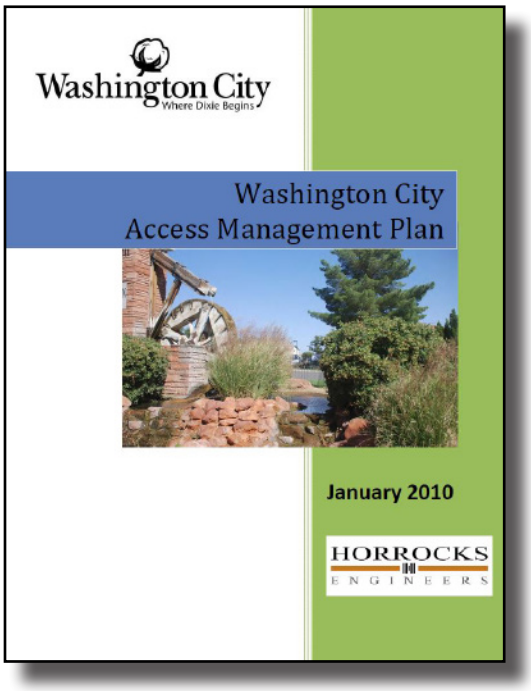


One of the guidelines in Section 5.3.4 states that "bicycle/ pedestrian easements or access ways are required at the end of cul-de-sacs or between residential areas and parks, schools, churches, or other activity centers as directed by the City Engineer." This design provision would ensure active transportation network connectivity in some places where the roadway network is not or will not be connected.

Other, more intensive policies or cross sections included in the Washington City Transportation Master Plan will be included in Chapter 4.

Washington City Transportation Impact Fee Study

The Impact Fee Study states that developers are required to pay toward their development's impact, namely one lane of asphalt and curb, gutter, and sidewalk on their side of the road (assuming the development is only on one side of the road). Eligible impact fee amounts include estimates of sidewalk as part of short term (0-6 year) projects.



Washington City Access Management Plan

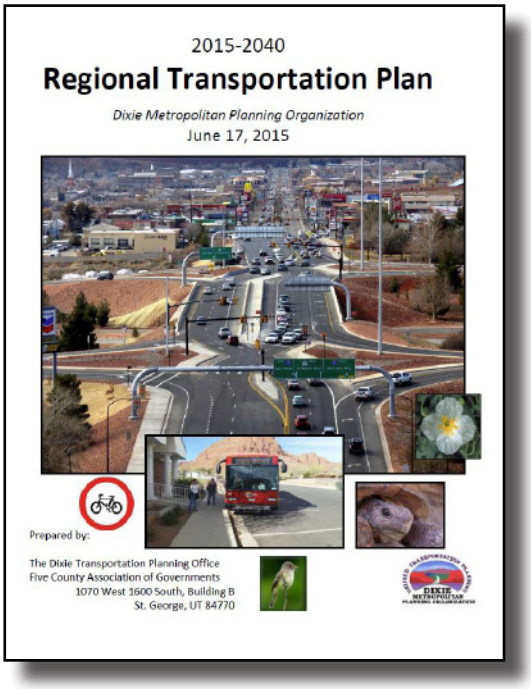
This plan establishes standards for how accesses to businesses, neighborhoods, and streetside amenities are planned, designed, and engineered within the City. Perceived safety and likely usage of active transportation facilities increase as the frequency, unpredictability, and possible severity of conflicts decrease. Medians, controlled accesses, small turn radii, pedestrian access between developments, and clearly identified and designed conflict points are encouraged in the Access Management Plan in order to improve safety, comfort, and accessibility for people walking and bicycling, especially when crossing the path of motor vehicles.

Additionally, the plan states that "a key aspect of access management is reducing the number of vehicle trips," which can be accomplished by connecting developments and allowing short trips to be done comfortably and easily on foot or by bike instead of by car. It also states that "all new development and redevelopment...should address pedestrian and bicycle access to and within the site," especially in terms of pedestrian access needs in parking lots.

Existing Regional Plans

These plans include Washington City and surrounding areas in order to improve regional character, connectivity, and prosperity.

Dixie MPO 2015-2040 Regional Long Range Transportation Plan (RLRTP)



The purpose of this plan is similar to the Washington City Transportation Master Plan in that it establishes visions, goals, and recommended projects for the transportation system. However, this plan identifies the regional transportation needs of urban Washington County for the next 25 years. One of the principal responsibilities of the Dixie Metropolitan Planning Organization and this plan is to model and forecast future regional transportation needs.

The Dixie MPO RLRTP acknowledges the importance of active transportation in providing a balanced transportation system and outlines three key goals:

- Facilitate the appropriate design, construction, and maintenance of bicycle and pedestrian facilities
- Support a multi-modal transportation system for all new construction and reconstruction projects
- Encourage policies and programs that improve bicycle and pedestrian safety

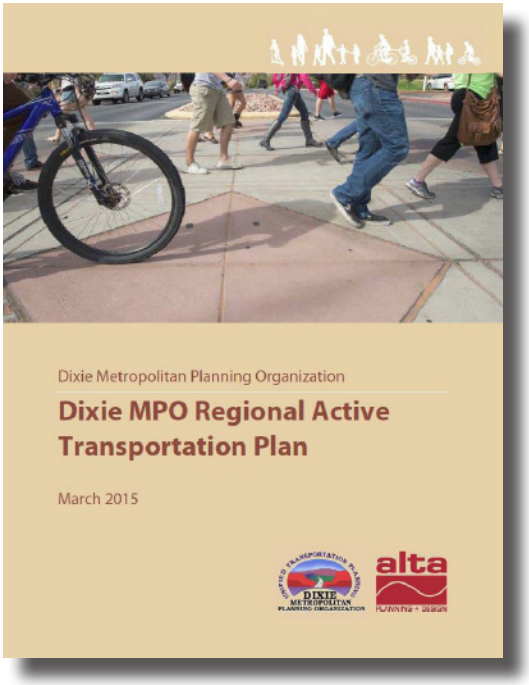
Other sections of the RLRTP address the need for pedestrian-oriented buildings, context sensitive streets, pedestrian movement, bicycle facilities and trails as part of corridor preservation, and “complete streets” that are consistent with Washington City’s General Plan.

Active transportation is highlighted in Chapter 12, which references several of the key principles from “Vision Dixie”, including:

- Provide rich, connected natural recreation and open space (Principle 4)
- Build balanced transportation that includes a system of public transportation, connected roads, and meaningful opportunities to bike and walk (Principle 5)
- Focus growth on walkable, mixed-use centers (Principle 6)

Vision Dixie calls for the implementation of "complete streets" criteria to ensure streets and roads accommodate all users including drivers, transit riders, pedestrians, and bicyclists, as well as for older people, children, and people with disabilities.

In Spring 2014, Dixie MPO staff and the Dixie Technical Advisory Committee (DTAC) acknowledged that the region has an extensive network of trails, and some shared roadways and bike lanes. However, walking and bicycling for transportation are often more difficult. They identified the need to develop a safer, more attractive, and better connected system of pedestrian and bicycle infrastructure.

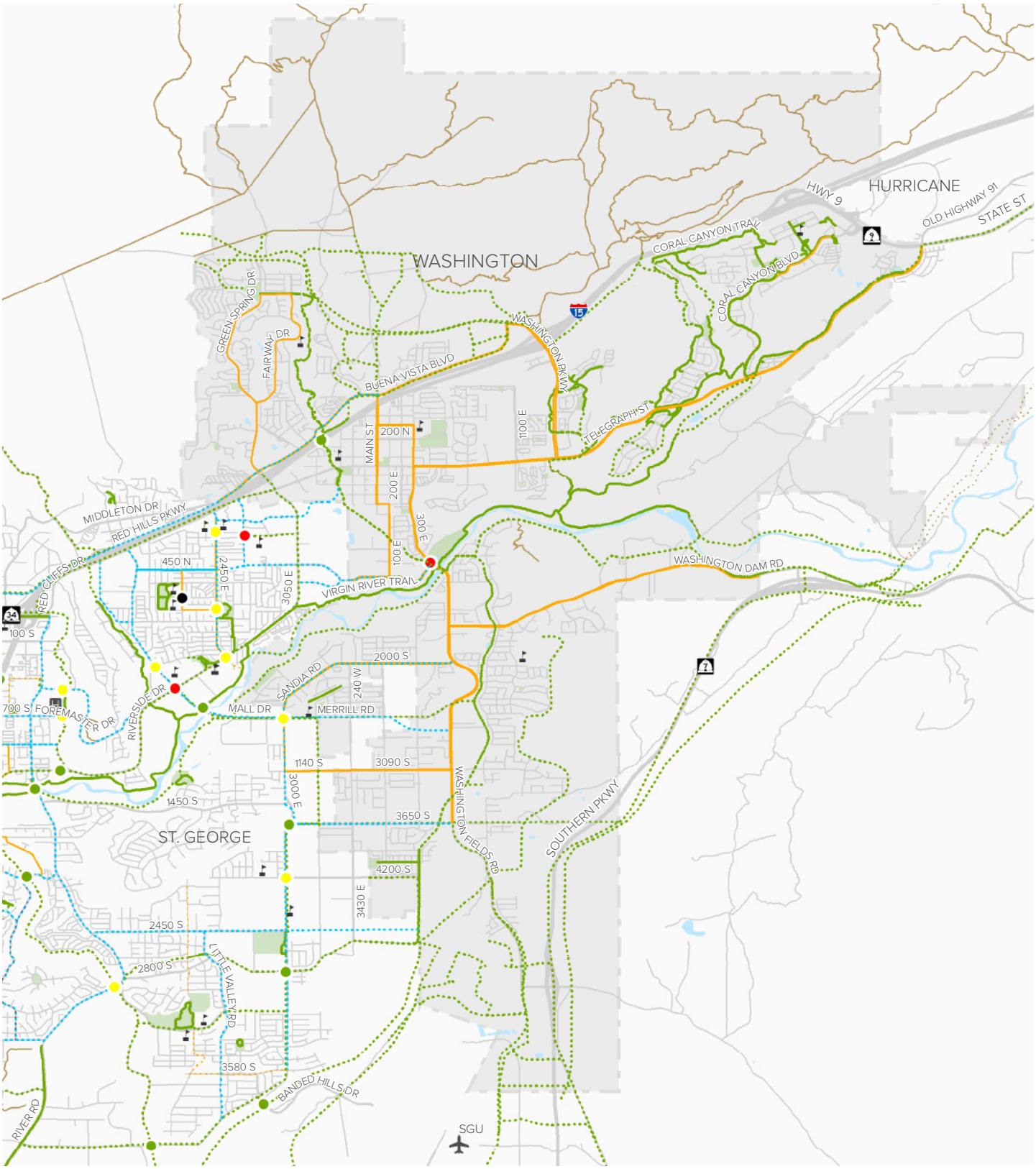


Dixie MPO Regional Active Transportation Plan

Acknowledging the need for better planning for people walking and bicycling, the Dixie MPO commissioned a regional active transportation plan to identify projects and policies in the region that will create a transportation and recreation network conducive to non-motorized modes.

As a result of the input from City of St. George, Hurricane City, Washington City, Ivins City, Santa Clara City, UDOT, Southern Utah Bicycle Alliance, Southwest Utah Public Health Department, Dixie State University, and Washington County School District, the plan identifies regional gaps and proposes solutions. The plan identifies sidewalk connectivity issues in Washington City as well as nine major gaps in its existing network of shared use paths and bike routes. The plan proposes new bike lanes on seven different streets, 12 new trails or trail extensions, as well as crossing improvements and trail connections within Washington City (see Map 1.6).

It is anticipated that many of the recommendations from the Dixie MPO Regional Active Transportation Plan will be reflected in the Washington City Active Transportation Plan.



Map 1.6:

Previously Planned Facilities

Washington City
Active Transportation Plan

Prev. Planned Facilities

- Sidewalk
- Shared Use Path
- Unpaved Trail
- Bike Lane
- Bike Route
- Bridge or Undercrossing
- Signal or Beacon
- Intersection Improvement
- Misc. Improvement

Existing Facilities

- Shared Use Path
- Unpaved Trail
- Bike Lane
- Bike Route

Base Data

- School
- Hospital
- Water
- Park
- Washington City Limits

MILES
1
2
3 MIN
10 MIN
6 MIN
20 MIN
12 MIN BIKE RIDE
40 MIN WALK

Data provided by Washington City, AGRC, UDOT, Dixie MPO.
Map produced January 2017.

"When it's cold and snowy in Cedar City, like today, I come down to Washington to ride or walk on the trails."

- BRUCE

Chapter Two:

Public Involvement

- What do residents and visitors want for the community?
- What are Washington City residents' perceptions about walking and bicycling?
- Where is there demand for more or improved walking and bicycling facilities?

The Washington City Active Transportation Plan process included several public outreach efforts in order to determine the needs of people currently and possibly bicycling and walking. These efforts helped to better understand the needs of people who live, work, and recreate in Washington City. At the beginning of the planning process (February and March 2017), the public were invited to:

- Take an online survey (February-March 2017)
- Draw recommendations and barriers on an interactive online map (February-March 2017)
- Ask questions and provide insight at the regional Dixie Transportation Expo (February 2017)
- Review preliminary recommendations, share ideas for how to improve walking and bicycling in Washington, and participate in active transportation-themed games and activities (April 2017)

Combined, this input helped to provide direction and ideas for the recommendations in and direction of this plan.

Online Public Survey

Background, Format, & Purpose

Washington City distributed a 32-question survey to an email list of Washington City residents that is representative the population's diverse ages, family types, and neighborhoods. Additionally, a separate, public link to the same survey (in order to uniquely identify respondents, if necessary) was distributed on the City's Facebook page and at the Dixie Transportation Expo.

571 people (~2.5% of the City) took the survey.

Outcomes & Lessons Learned

60% of respondents, however, were 55 years old or older compared to 28% overall in the city. However, older residents tend to be among the most vulnerable and cautious walking and bicycling populations. Overall, Washington City residents generally consider the city to be walkable and bikeable, though most indicated a desire to walk and ride a bicycle more if new trails, connections, and safer streets were prioritized and improved. Data trends, quotes, recommendations, and additional insights are included on the following three pages.

"We are a young, vibrant community with very active families."

"I support all efforts to continue to build and add bicycling and walking trails in the city."

"Design and build paths before areas are developed."

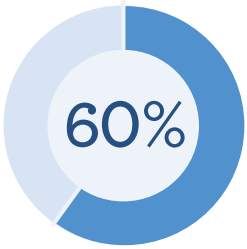
"Improve connectivity between trails and commercial developments adjacent to them."

WASHINGTON CITY, UTAH

Active Transportation Plan

PUBLIC SURVEY RESULTS

Demographics



60% OF RESPONDENTS ARE AGE 55 OR OLDER

46% FEMALE

54% MALE

85% PRIMARY RESIDENCE IN WASHINGTON CITY

Barriers

TOP 3 BARRIERS *to* WALKING

- Destinations are too far away
- Not enough walking paths
- Lack of time

TOP 3 BARRIERS *to* BICYCLING

- Insufficient or unsafe shoulders & bicycling facilities
- Aggressive drivers
- Unsafe intersections

Types of Current Bicyclists

59% LEISURE RIDERS

39% EXPERIENCED MOUNTAIN OR ROAD RIDERS

2% COMMUTER BICYCLISTS

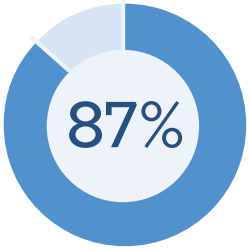
The small percentage commuting to work indicates that American Community Survey (ACS) mode share data do not represent the real share of people bicycling (and walking) in Washington City. Data collection recommendations are found in Chapter 3.

Destinations

MOST POPULAR DESTINATIONS FOR PEOPLE CURRENTLY WALKING AND BICYCLING

- Trailheads
- Parks & Recreation Areas
- Sullivan Soccer Park
- Places of Worship
- Community Centers

Safety



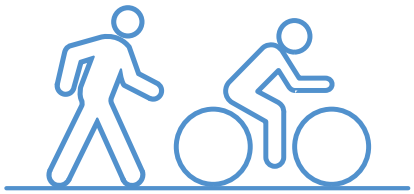
OF RESPONDENTS FEEL SAFE WALKING IN WASHINGTON

THE 13% OF RESPONDENTS WHO *DO NOT* FEEL SAFE WALKING IDENTIFIED THE FOLLOWING FACTORS:

- Poor or no lighting
- No sidewalks
- High vehicle speed

64% OF RESPONDENTS THAT HAVE CHILDREN ARE WILLING TO LET THEM WALK OR BIKE TO SCHOOL

Public Support



73%

of respondents are supportive of extending or creating new trails, including a new Canal Trail.

Online Interactive Mapping Tool

How It Works

Washington City residents were also invited to draw desired bicycling and walking connections and identify the physical barriers that prevent them from walking or bicycling using an interactive mapping tool. The map was centered on Washington City and included parks, streets, trails, paths, and other notable local features to orient users. The map was advertised at the Dixie Transportation Expo in February 2017 and to public survey respondents.

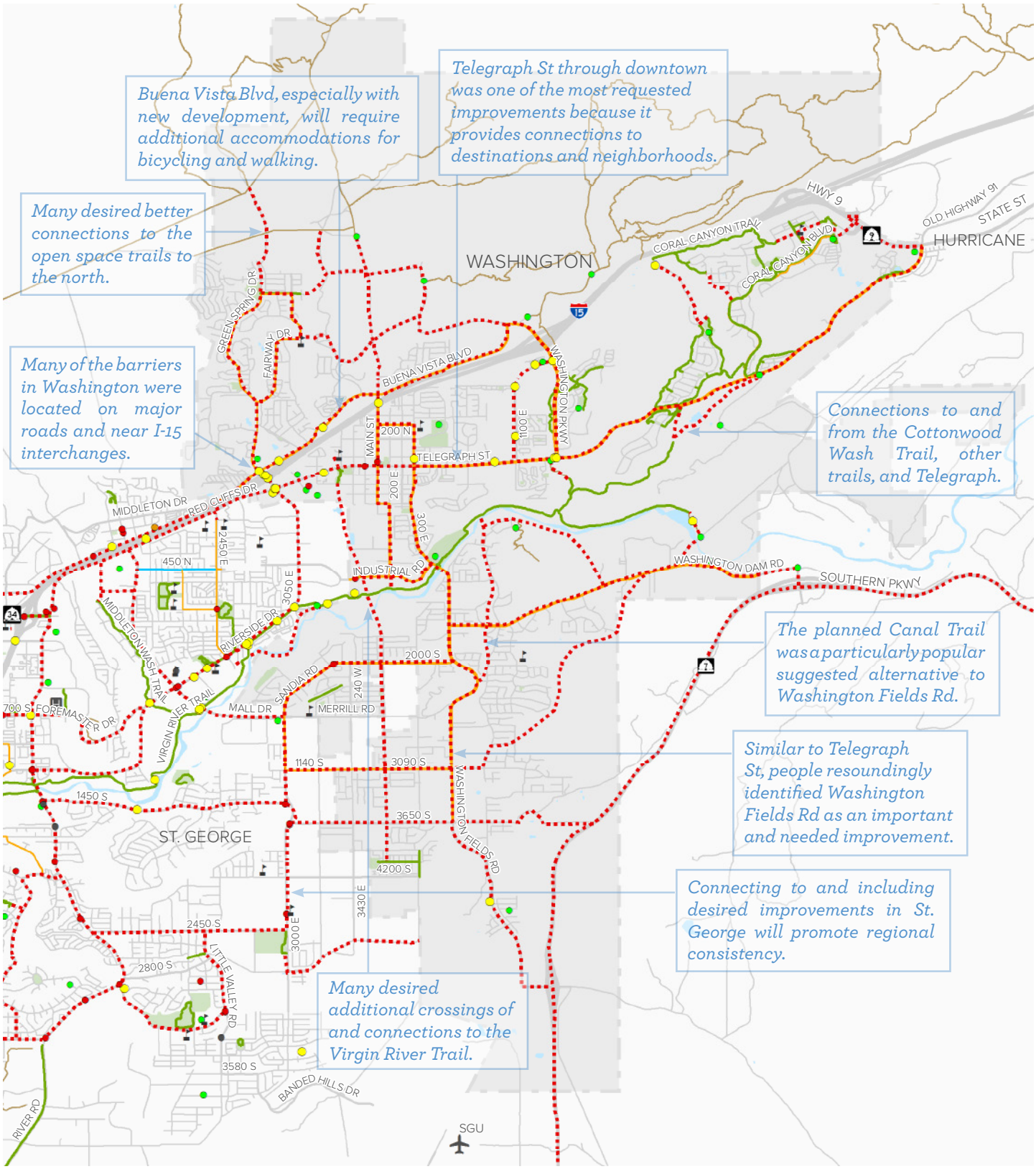
Outcomes

More than 100 points and lines were drawn by 79 unique users during the same five weeks that the survey was open. Most barriers were north of the Virgin River and west of Main Street. These were concentrated near the Green Spring Dr I-15 interchange, where respondents highlighted lack of comfortable crosswalks, fast vehicle speeds, narrow shoulders, missing sidewalks, and lack of ADA ramps. The locations of these barriers are also consistent with the crash analysis in Chapter 1. Respondents also requested completion of small gaps between existing trails, especially those within washes.

Additionally, most of the destinations to which people would like to bike/walk are located north of the Virgin River. This is due to most commercial developments in the City being located along Telegraph and because land uses south of the river are typically residential and industrial. Respondents also desired additional, comfortable connections along and across the Virgin River. Other, non-downtown destinations included trailheads at the Red Cliffs Desert Preserve, parks, and existing trails. Routes that multiple respondents desired to improve for bicycling and walking are included as dashed red lines in Map 2.1.

Additional Feedback Opportunities and Data Sources

Results from the City of St. George Active Transportation Plan's (2017) interactive map, input from the Utah Travel Study's Bicycle and Pedestrian Barriers & Hazards Survey, and contributions from 2017 Dixie Transportation Expo attendees are also included in Map 2.1. This compilation provides additional regional and previously collected feedback that is useful for understanding the needs in Washington City.



Map 2.1:

Existing Network & Interactive Map Results

Washington City
Active Transportation Plan

Interactive Map & Utah Travel Study Results

- Linear Need or Gap
- Barrier to Walking & Bicycling
- Missing Infrastructure (UTS)
- Infrastructure Maint. (UTS)
- Other Infra. Issue (UTS)
- Destination w/o Connections

Existing Facilities

- Shared Use Path
- Unpaved Trail
- Bike Lane
- Bike Route

Base Data

- School
- Hospital
- Water
- Park
- Washington City Limits

0 1 2 MILES

3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

Data provided by Washington City, AGRC, City of St. George, UDOT, Dixie MPO. Map produced March 2017.

Photo: SUBA

Active Transportation User Counts

Purpose

In order to attempt to estimate walking and bicycling usage, three popular Washington City locations were monitored for two hours each in March and April 2017. Count data were analyzed using the National Pedestrian and Bicycle Documentation Project's extrapolation spreadsheet, which produces estimated daily, weekly, monthly, and annual counts based on the two-hour count's totals, date, day of the week, time of day, location (path or street), and climate. Data submitted by users through and purchased by UDOT from Strava, an activity-tracking smart phone and web application, is also included. This data is solely from those who chose to use the application. It is also heavily skewed by recreational trips. Locations, results, and extrapolated projections are included in Map 2.2.

Roadway Counts

Two roadway and sidewalk (on-street) counts were conducted:

» **Telegraph Street & Green Spring Drive** on Thursday, March 9, 2017, from 4:00 - 6:00 pm on a sunny day with moderate temperature. This intersection may see an increase in active transportation use as crosswalks are improved, traffic is calmed, and bicycle facilities are introduced.

» **Coral Canyon Blvd & Canyon Crest Avenue** on Tuesday, April 11, 2017, from 4:00 - 6:00 pm on a sunny day with moderate temperature. This wass the second counting attempt after initial counts in March before returned unusually low numbers. Users were typically casual bicyclists or walkers.

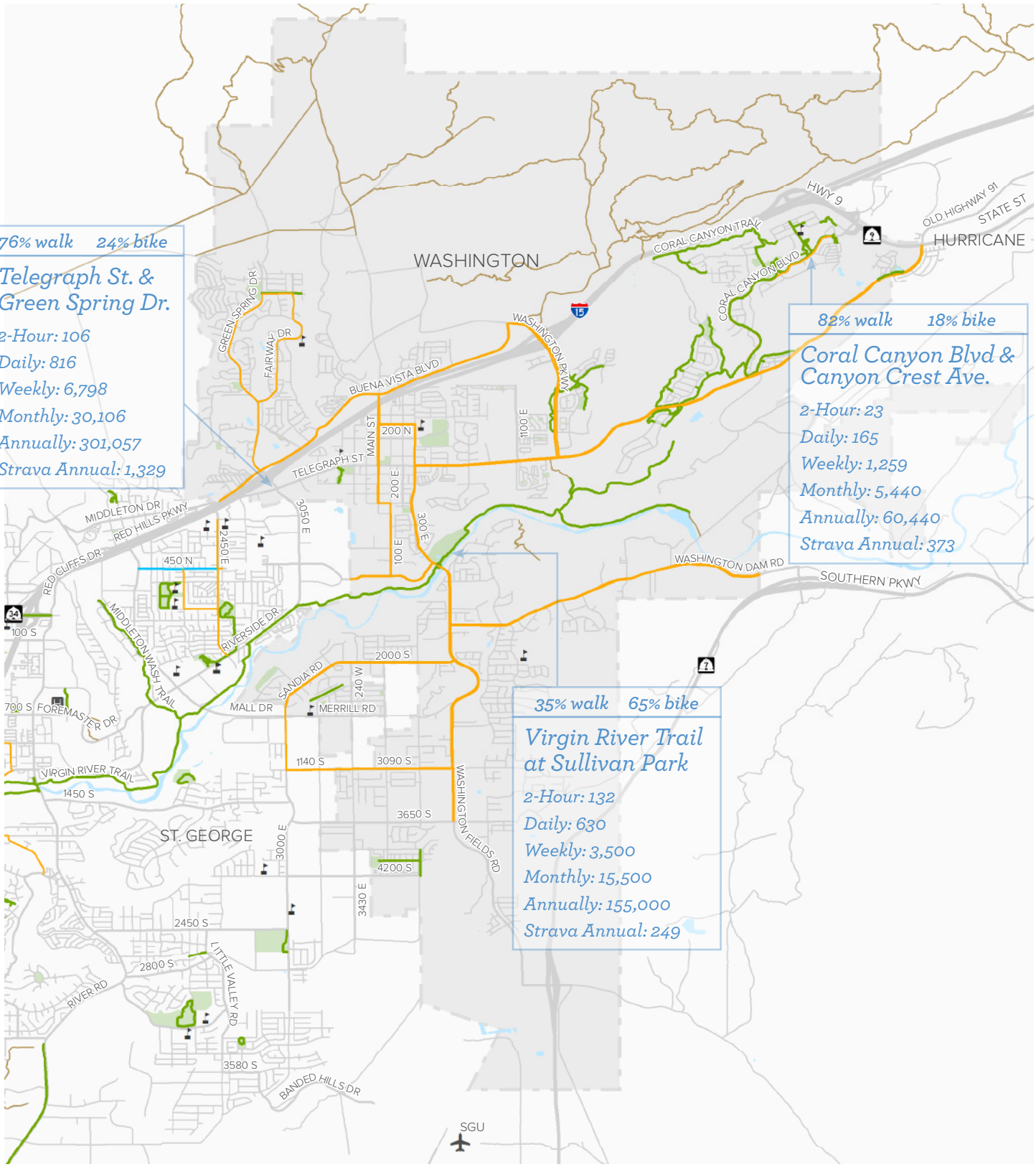
Path Counts

One shared use path (off-street) count was conducted:

» **Virgin River Trail at Sullivan Park** on Saturday, March 11, 2017, from 10:00 am - 12:00 pm on a sunny day with moderate temperature. This is one of the most popular off-street active transportation facilities in Washington City. Replicating the level of comfort that users experience on this trail throughout the city will likely improve use and perceived safety.

Next Steps

These counts are based on a relatively brief amount of time. Chapter 3 recommends that the City expands the user count effort to include automated, 24-hour counters and analysis.



Map 2.2:
Active Transportation Count Locations & Results

Washington City
Active Transportation Plan

Existing Facilities
- Shared Use Path
- Unpaved Trail
- Bike Lane
- Bike Route

Base Data
- School
- Hospital
- Water
- Park
- Washington City Limits

0 1 2 MILES
3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

N

Data provided by Washington City, AGRC, UDOT, Dixie MPO.
Map produced January 2017.

Cotton Days

Purpose

Online surveys, interactive maps, and even events like the Transportation Expo may not attract all of the types and ages of Washington City residents. In order to capture feedback from a more diverse cross section of the population, project consultants, health department staff, and City staff set up a booth at the Cotton Days festival on April 29, 2017.

Content & Activities

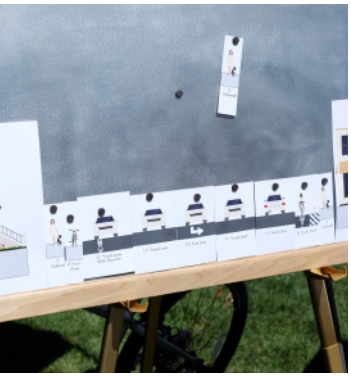
The Active Transportation Plan booth at Cotton Days included activities that attracted about 150 people over the course of four to five hours. If attendees engaged with any of the activities listed below, they could enter to win a helmet from a local bike shop.

- Paper speech bubbles with the phrases “I Bike…”, “We Bike…”, “I Walk…”, “We Walk…”, and “Washington Will Be A Place Where…” printed at the top. Attendees were invited to finish the sentence and pose for a photo with their declaration.
- Word searches with 14 active transportation-related words.
- A “Build Your Own Street” activity in which people could choose place different cross section elements within the width of a major arterial or a residential standard street.
- Draft maps and facility types that included off-street (trails) recommendations from the City’s Parks & Recreation Master Plan, new off-street recommendations, and new on-street recommendations (bike lanes, bicycle boulevards).

Staff from the Southwest Utah Health Department gave away 12 child helmets to participating youth. Additional prizes and giveaways included bike pins, candy, and water bottles.

Outcomes

An overwhelming majority of people were in favor of the proposed trails and bikeways, particularly those that connected to parks and existing trails, the Canal Trail, those that were proposed in the Washington Fields area, and sidewalks near schools. People were appreciative of the efforts that have been made already to enhance walking and bicycling in Washington City.



"I would love to have bike lanes so that I could ride right from my house and not have to throw my bike in the back of the truck."

- COTTON DAYS ATTENDEE

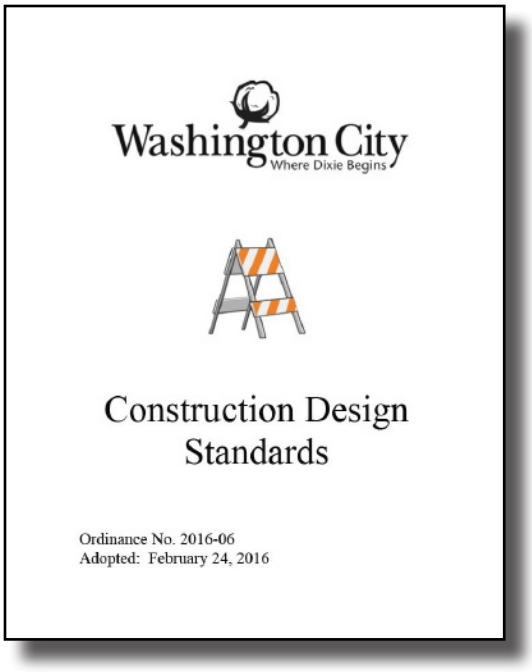
“We come for walks on the Virgin River Trail three or four times a week. It’s beautiful and we enjoy seeing the wildlife, like deer, tortoises, porcupines, and birds. Even a king snake once!”

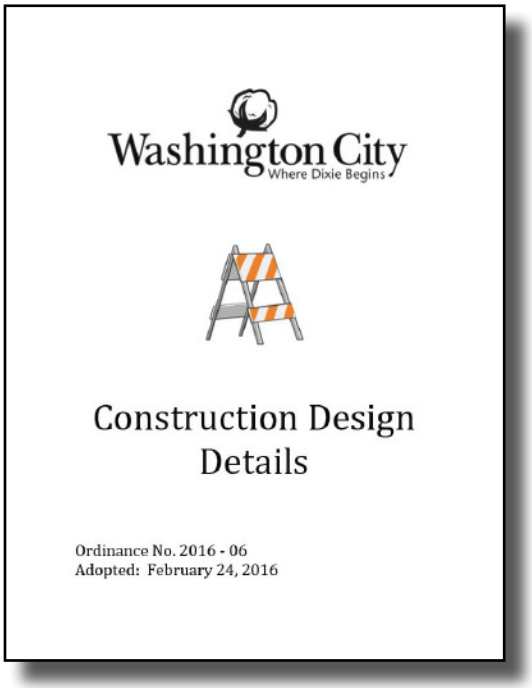
- MIKE AND COLLEEN

Chapter Three:

Policy and Program Recommendations & Design Guidance

- To what standards are paths, bike lanes, and sidewalks designed and built?
- How can these standards make my bike ride or walk easier and more comfortable?
- What can be improved in the City's standards and policies?
- Are there policies and programs that will further improve infrastructure and encourage more people to walk and bike?





Construction Design Standards & Details and City Code (Appendices A–C)

Overview

In an effort to incorporate active transportation facility best practices and the Active Transportation Plan's vision and goals into the City's existing codes, guidelines, and standards, several modifications to and new recommendations for inclusion in the City's Construction Design Standards, Construction Design Details, and Code are included in this plan. Because of their length, these are found in Appendix A (Standards), Appendix B (Details), and Appendix C (City Code).

Summary of Recommendations

These recommendations include:

- Bicycle parking design, placement, and implementation standards
- Improved access management strategies in order to improve safety for bicyclists and pedestrians
- Bicycle-friendly pavement management strategies
- Guidance for accommodating people walking and bicycling in construction zones
- Minimum sidewalk width (5')
- Sidewalk accessibility, especially for those with mobility impairments
- Strategies to calm turning traffic
- Paved shared use path material and finishing guidance
- Pedestrian-friendliness in downtown, mixed-use areas

Design Guidance (Appendix D)

Design guidance, including user types, standards, additional research, resources, and maintenance and implementation considerations for every facility type recommended in this plan, may be found in Appendix D.

The design guidance appendix combines guidance from the NACTO *Urban Bikeway Design Guide*, the AASHTO *Guides for the Development of Bicycle and Pedestrian Facilities*, and other existing standards from FHWA, ADA, AASHTO, MUTCD, and PROWAG. This comprehensive set of guidelines represents contemporary practices studied, accepted, and utilized around the country.

Standard Roadway Cross Sections

Overview & Need

Washington City's existing roadway cross section requirements are included in several adopted City documents, such as the Washington City Construction Design Standards (Table 3.1; see Appendix A), Access Management Plan, and Transportation Master Plan. Some parts of the current cross sections, however, do not adequately accommodate people walking and bicycling.

Recommendations

The following pages include suggestions for how to improve the existing cross sections (Table 3.1 of Construction Design Standards) in two ways:

- **Restriping** and lane narrowing within the existing pavement width. Application/Timeline: Roadway resurfacing or restriping projects.
- **Reallocating** space for cross sections' elements within the existing right of way to realize higher quality active transportation facilities while considering the needs of motorized users. Application/Timeline: Captiol projects, some of which may offer opportunities to widen and beautify.

When higher classification roads (i.e. arterials) are built or reconstructed, separated bicycle facilities and wider sidewalks are desirable because of high volume and high speed vehicle traffic, concerns that Washington City residents expressed in the online survey and interactive mapping tool.

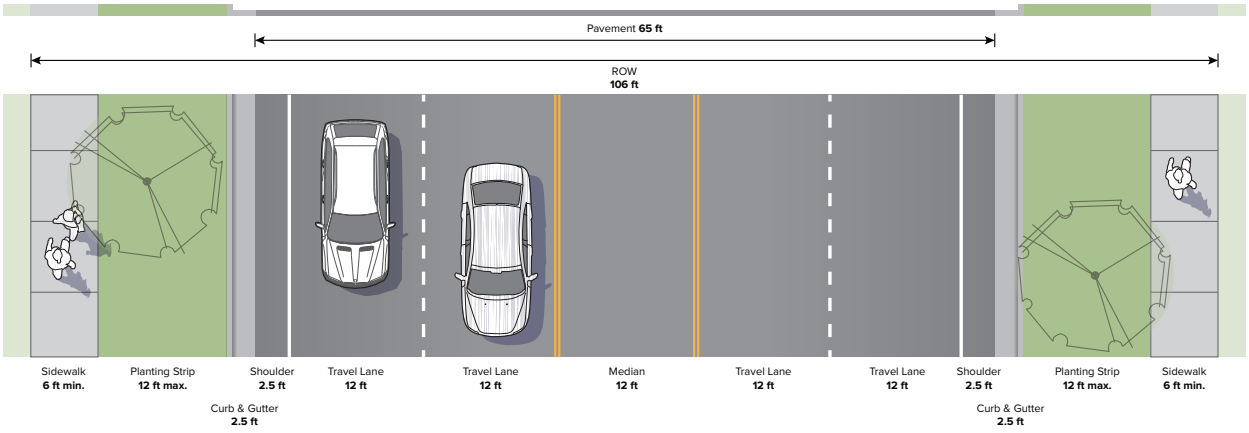
Additionally, Washington City should begin to require that sidewalks be at least five feet (5') wide (not including curb) per FHWA, U.S. Access Board/PROWAG, NACTO), regardless of land use or cross section. This new minimum will help to provide opportunities for accessible curb ramps, safe passing of mobility devices, and increased comfort for all users.

Major Arterial Cross Section

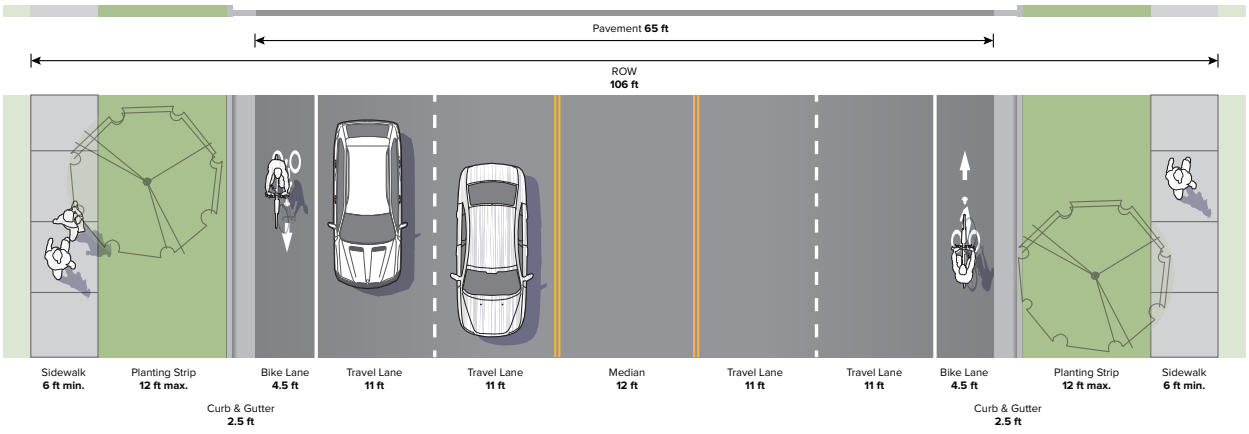
>20,000 cars per day (average)

The widest cross section accommodates the most vehicular traffic and is typically reserved for the busiest routes in the City (excluding highways and interstates). May require flaring at intersections.

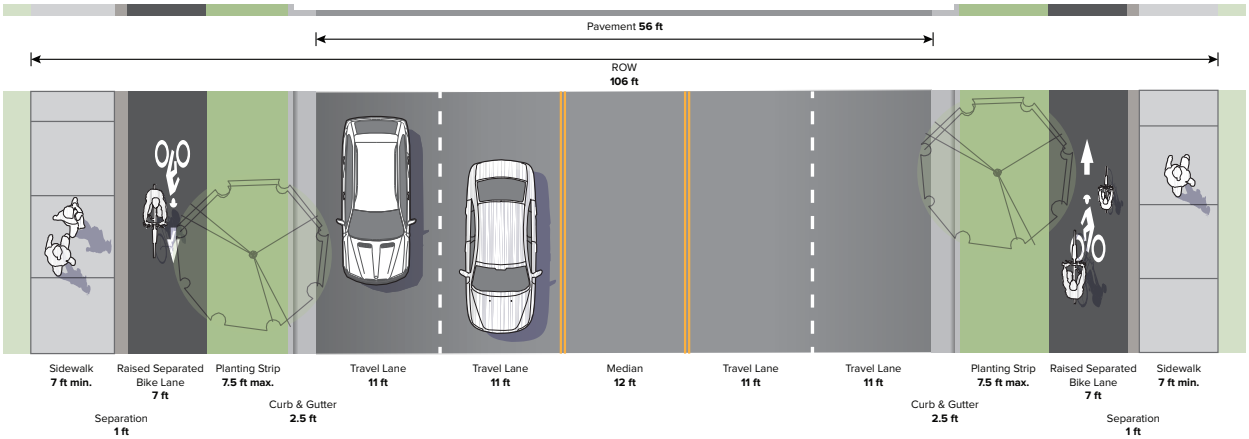
Existing



Restriping Existing



Modified Construction

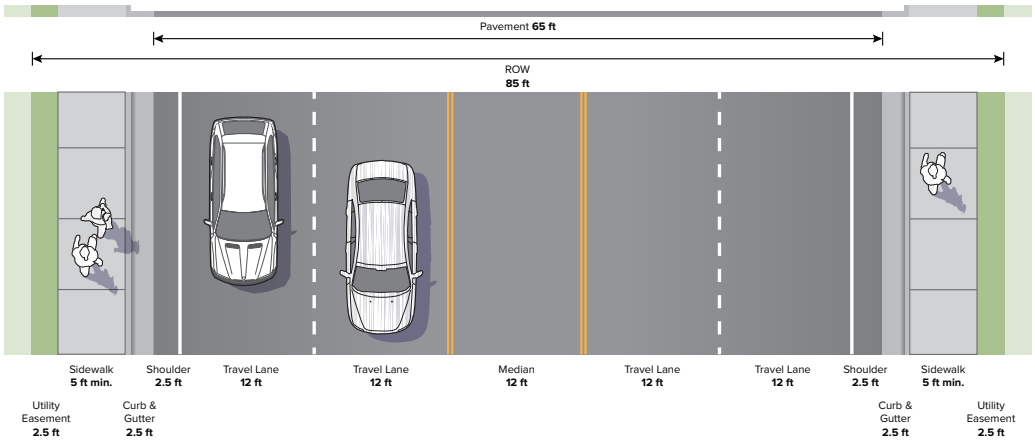


Minor Arterial Cross Section (page 1/2)

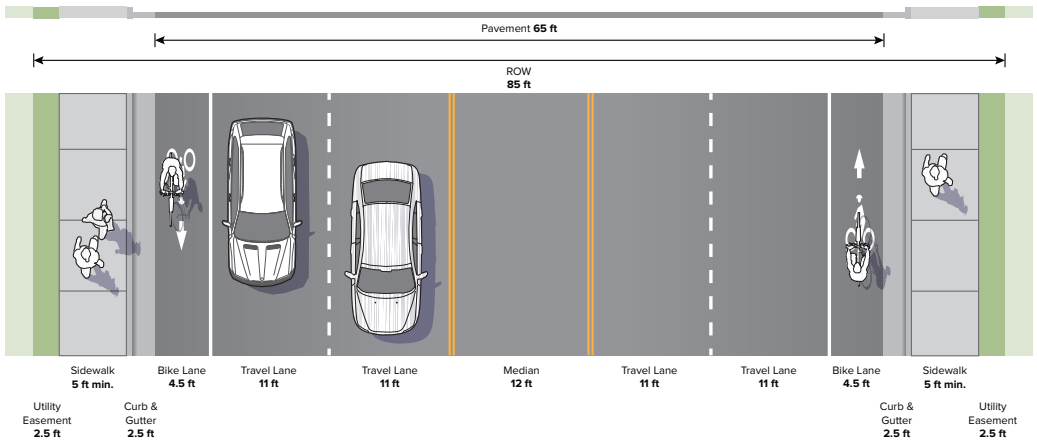
6,000 to 20,000 cars per day (average)

This cross section is a secondary arterial, similar to Washington Fields Road, that connects major arterials to collector streets in the street hierarchy system.

Existing



Restriping Existing

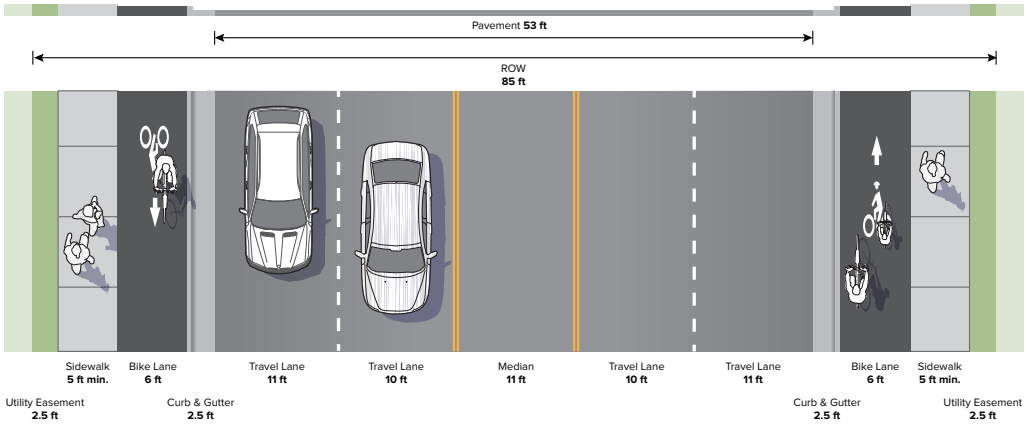


Minor Arterial Cross Section (page 2/2)

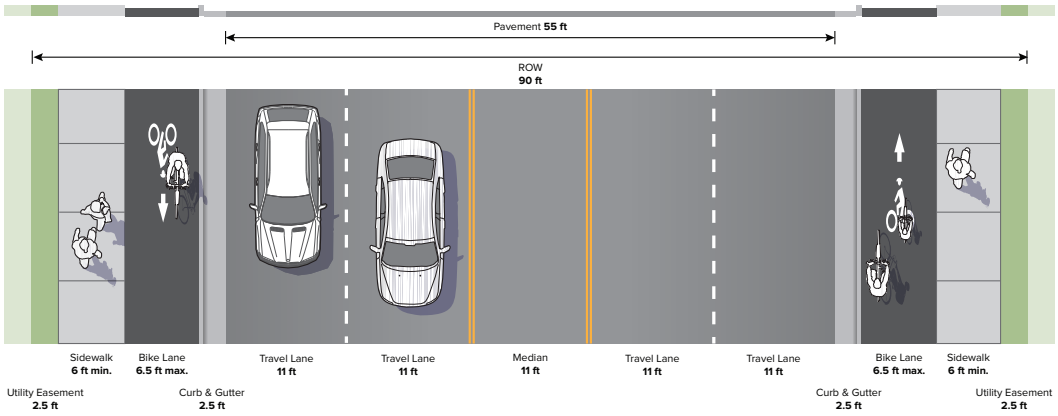
6,000 to 20,000 cars per day (average)

A wider, 90' overall right of way cross section (Option 2) may improve synergy with the City of St George's standard minor arterial cross section (which is also 90').

Modified Construction (Option 1)



Wider Right of Way Modified Construction (Option 2)

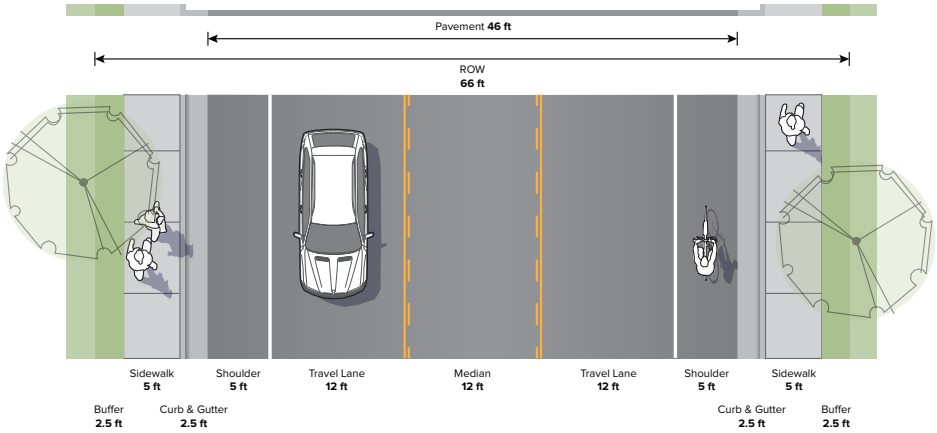


Major Collector Cross Section

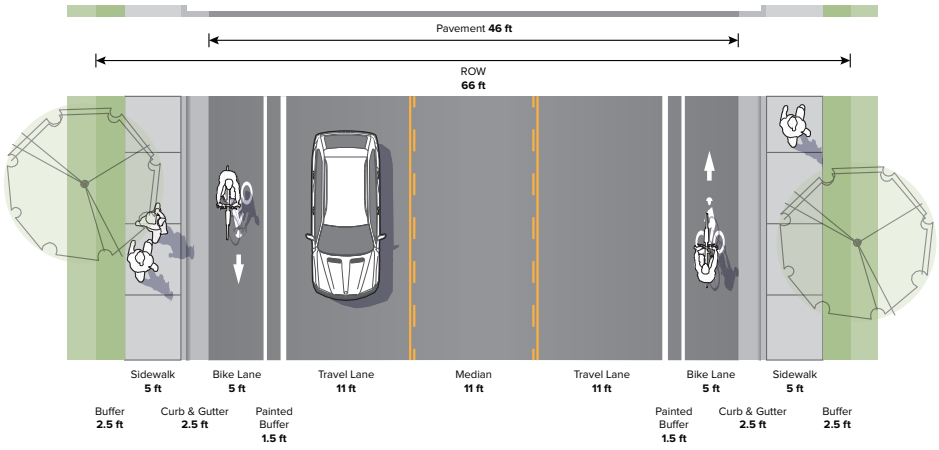
2,010 to 6,000 cars per day (average)

Collectors are designed to accommodate motor vehicle traffic between local, residential roads and busier, wider roads. An example in Washington City is 2000 South/Sandia Road.

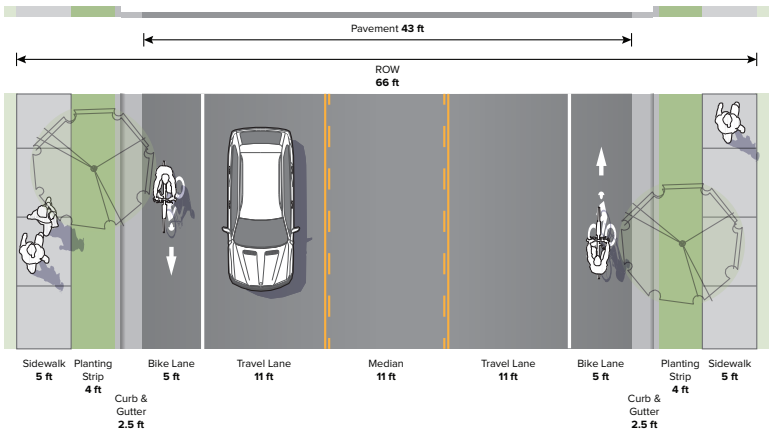
Existing

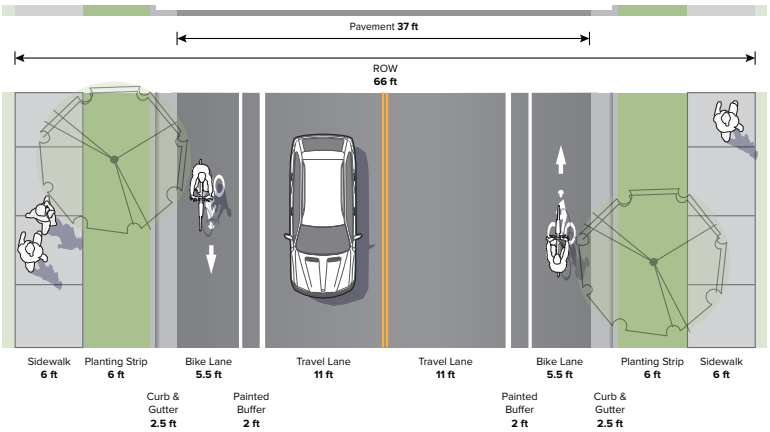


Restriping Existing



Modified Construction (Options 1 & 2)



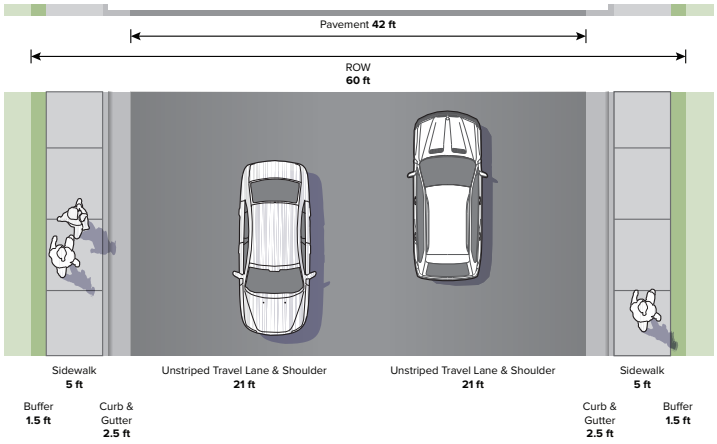


Residential Collector Cross Section

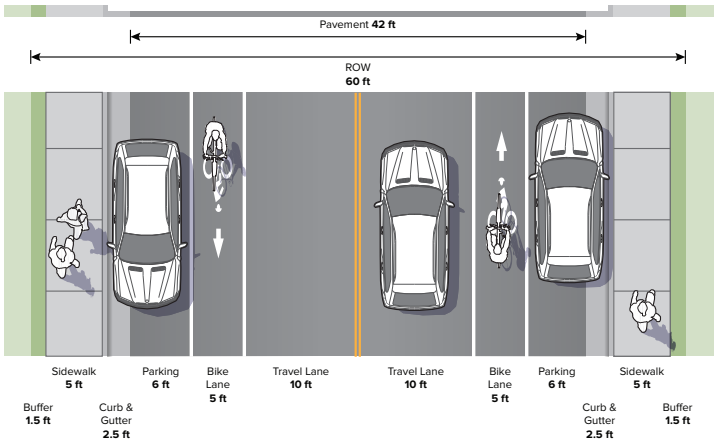
1,260 to 2,000 cars per day (average)

This cross section is typical of a principal road within a residential area. It connects narrower residential roads to major collectors. Advisory bike lanes require FHWA approval. Modified construction options 1 & 2 are suggested changes only to optional cross section alternatives that would allow developers to earn credits for higher density by improving the pedestrian realm through street trees and planting strips.

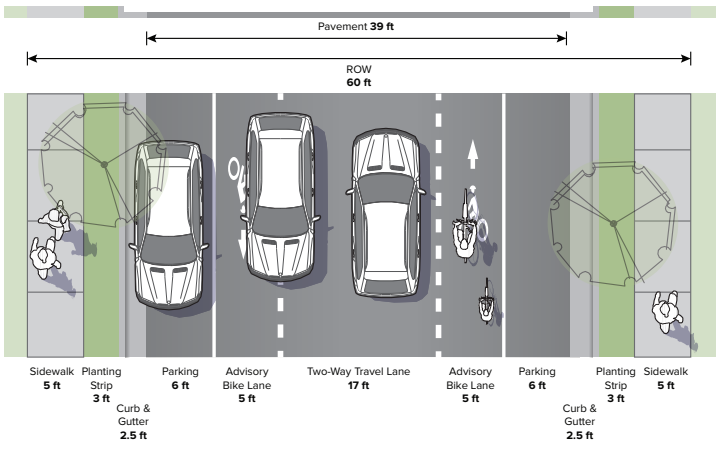
Existing

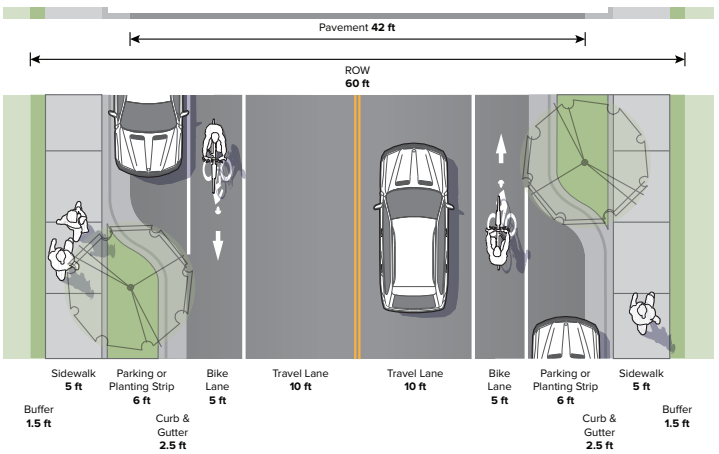


Restriping Existing



Modified Construction (Options 1 & 2) (Optional Changes)



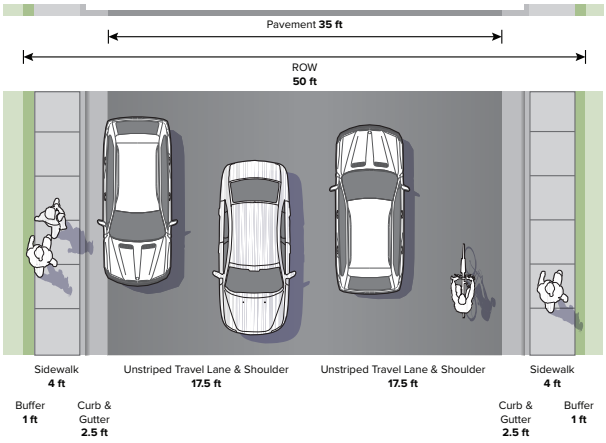


Residential Standard Cross Section

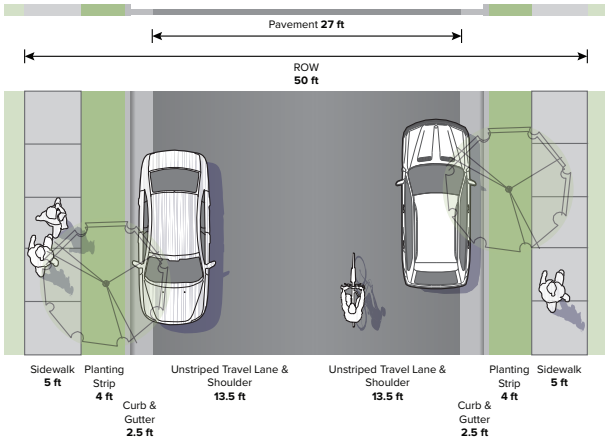
510 to 1,250 cars per day (average)

This represents the typical residential street. Lanes and parking areas are usually not delineated. Neighborhoods could be improved through wider sidewalks, green space and street trees, and less pavement. The modified cross section examples below are, however, suggested changes only to an optional cross section alternative that would allow development to earn increased density credits.

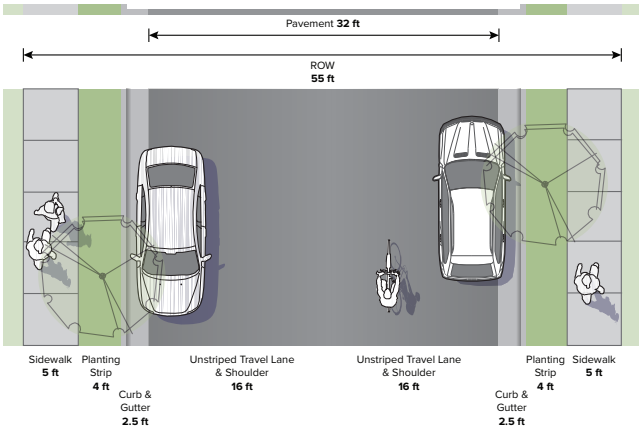
Existing



Modified Construction (Optional Changes)



Wider Right of Way Modified Construction (Optional Changes)



POLICIES

New Policy Recommendations

In addition to the City's existing policies, this section provides recommendations for new policies not yet implemented. These will help to foster smart growth, complete the active transportation system, encourage more residents and visitors to ride a bicycle or walk, monitor and report usage, and support the infrastructure and programmatic recommendations of this plan.

In addition to the recommended changes to the standards, details, codes, and cross sections discussed previously, the City should also seek additional ways to modify existing and introduce new land use policies, development processes, and standards that inherently encourage walking and bicycling.

All policies from this plan or those created in the future, should reflect a commitment to accommodating and encouraging people of all ages and abilities to walk and ride a bicycle.

Complete Streets Policy or Ordinance

The term "Complete Streets" refers to the practice of designing streets so that people of all ages and abilities can choose and use their travel mode safely (i.e. take transit, use a wheelchair or other mobility device, drive a car, walk, ride a bicycle) and not be confined to one choice. Washington City should adopt a Complete Streets policy or ordinance to ensure that all users are considered, if not accommodated, with each opportunity for changing streets within Washington City limits.

- **Desired Outcomes:** Ensure all user types are considered and/or accommodated when changes to streets can or do occur
- **Agencies or Departments:** Planning Commission and City Council
- **Examples & Resources:** Smart Growth America Resources Page; Salt Lake City, Utah's Ordinance; Salt Lake County, Utah' Ordinance; Wasatch Front Regional Council (WFRC) Vision, Mission, and Principles; Iowa Economic Development's Complete Streets Strategies to Increase Bicycling and Walking

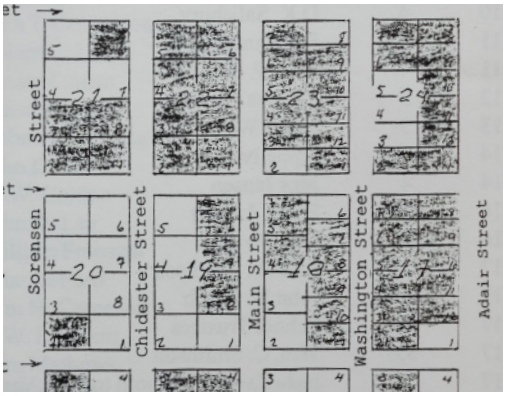
POLICIES

Sidewalk Infill Policy

Some existing neighborhoods and commercial areas in Washington City have missing or limited sidewalks, including many streets in the city's original plat. Completing missing sidewalk links can be challenging and expensive, especially in older or historic areas where residents and other property owners have developed fencing and landscaping within the public right-of-way. Washington City already utilizes a 50/50 cost sharing sidewalk policy, but may be able to utilize the following ideas for expansion of that program and acceleration of the development of the sidewalk network:

- Identify gaps during periodic inventories
- Develop strategies, prioritization criteria, and creative funding strategies (including those below) for completing gaps
- Coordinate and bid out sidewalk, crossing, and signal construction projects once a year at as high of a volume as can be accommodated for labor and cost efficiency
- Prioritize sidewalks near schools, followed by gaps that would greatly enhance the overall connectivity of the network
- Offer no-interest (for partly-financed repairs) and low-interest (for entirely-financed repairs) loans to property owners to replace, rehabilitate, or add new sidewalk that fronts their property
- Consider a "Health Insurance" model sidewalk replacement policy in which the financing model is based on the concept used in the health insurance industry. This policy allows property owners to pay in a fair amount regardless of property size or frontage length

- **Desired Outcomes:** Preserve historic or rural character of Washington City while improving pedestrian connectivity and accessibility
- **Agencies or Departments:** Planning and Public Works Departments
- **Examples & Resources:** Helena, Montana's Neighborhood Transportation and Volunteer Sidewalk Program; Missoula, Montana's Health Insurance Model Sidewalk Financing Program



POLICIES

Crosswalk Infill Policy

The City should adopt a crosswalk policy that establishes appropriate crosswalk types and associated traffic control for common roadway contexts (see Appendix D for examples and selection matrix). High-visibility, continental-style marked crosswalks (in concert with appropriate traffic control) should be installed at any marked school crossing per Utah's MUTCD supplement. Other styles (i.e. bricks, natural materials, or approved colors) of high-visibility crosswalks and traffic control should be prioritized at busy intersections, at well-used crossings along Telegraph St between 500 West and 300 East, and at mid-block crossings. Crosswalks are especially important where sidewalks are or will be present. ADA-compliant curb ramps should also be provided when crosswalks are installed (additional guidance is provided in Appendices B and D).

- **Desired Outcomes:** Improve and increase crossing opportunities and connectivity in Washington City
- **Agencies or Departments:** Planning and Public Works Departments; Washington County School District; Washington County; UDOT

Target Mode Share-Based Funding Policy

Funding for active transportation does not often keep pace with existing or projected bicycling and walking mode shares (6.8% of all trips in Washington City currently). Allocating or securing awarded funding directly correlated with a specific *target mode share* for bicycling and walking indicates a thoughtful and strategic approach to achieving those mode share goals. The City should base actual and target mode shares on data from the Utah Travel Study or local household travel surveys and not only on the American Community Survey.

- **Desired Outcomes:** Allocate funding for walking and bicycling commensurate with target mode shares
- **Agencies or Departments:** Planning and Public Works Departments; City Council; Washington County; Dixie MPO; UDOT
- **Examples & Resources:** San Luis Obispo Bicycle Funding Policy; Estimating Non-Automobile Mode Share (MNDOT)

POLICIES

Automated Counters in New Active Transportation Projects

Bicycle and pedestrian counters can provide valuable insights on long-term active transportation trends at location, corridor, and citywide levels. Like counts for motor vehicles, counting active transportation users can help bolster accuracy of mode share-based funding (see "Target Mode Share-Based Funding Policy" recommendation), improve context-sensitive facility design, and estimate benefits derived from active transportation. Automated bicycle and pedestrian counters that collect data year-round can often be included in roadway and active transportation project budgets for a nominal amount relative to overall costs. Traffic traffic control systems (i.e. Interis, GridSmart) can be configured to collect this data.

- **Desired Outcomes:** Consistent, year-round active transportation network usage data collection
- **Agencies or Departments:** Planning and Public Works Departments; Washington County; UDOT
- **Examples & Resources:** Innovation in Bicycle and Pedestrian Counts: A Review of Emerging Technology; FHWA Bicycle-Pedestrian Count Technology Pilot Project Summary Report; Bicycle and Pedestrian Detection Report (FHWA); NCHRP 797: Guidebook on Pedestrian and Bicycle Volume Collection (Phase 1); NCHRP 229: Methods and Technologies for Pedestrian and Bicycle Volume Data Collection(Phase 2)

Accommodating People Walking and Bicycling Near Schools in Low Density or Rural Areas

Washington City and Washington County School District should develop a policy to require pedestrian and bicycle facilities (linear and crossings) in undeveloped or rural areas that lack adequate facilities near and within school zones.

- **Desired Outcomes:** Provide safe access to and from schools for school-aged pedestrians and bicyclists, some of the most vulnerable users
- **Agencies or Departments:** Planning and Public Works Departments; Washington County School District; Washington County; UDOT
- **Examples & Resources:** FHWA Small Town and Rural Multimodal Networks Guide; Safe Routes to School National Partnership Rural Resources; Safe Routes to School Policies in Rural School Districts

POLICIES

Establish Routine & Capital Maintenance and Best Practice Policies for Active Transportation Facilities

The City, County, and other agencies have invested considerable resources in the construction of shared use paths, sidewalks, and other facilities in Washington City. Together with future recommended separated bike lanes, bike lanes, paths, and other facilities, the active transportation network does and will provide valuable recreational and transportation benefits to local residents and visitors. Maintaining these facilities will not only encourage greater use but also preserve capital investments and reduce future maintenance costs.

Maintenance activities are categorized into two types:

- Routine maintenance: Performed regularly; typically lower cost (i.e. sweeping and after-flood cleanup, striping, signs, pavement management, leveling, spot fixes, weed abatement, landscaping, and mowing)
- Major or capital maintenance: More intensive activity at a less than annual frequency (i.e. overlays, slurry seals, seal coats, or complete reconstruction)

Specific maintenance considerations for all bicycle and pedestrian facility types are included on almost every page of Appendix D.

- **Desired Outcomes:** Maintain the active transportation system so that it is safer and more enjoyable to use; Protect the City's and others' infrastructure investments
- **Agencies or Departments:** Planning and Parks Departments; Washington County; UDOT
- **Examples & Resources:** Washington City Active Transportation Plan Appendix D; Washington City Construction Design Standards; FHWA Guide for Maintaining Pedestrian Facilities for Enhanced Safety Research Report

POLICIES

Autonomous Vehicles Resolution, Policy, or Ordinance

Photo: City of Las Vegas

Autonomous vehicles (AVs) are programmed to navigate roadways without human operators. Though not yet approved for widespread use, AV technology could reduce traffic congestion and household transportation costs (through ridesharing) and improve safety for all users, especially people walking and bicycling (due to enhanced detection and aversion techniques).

At the same time, public awareness and policies regarding AVs should updated regularly and allow for the impending introduction of AVs into urban, suburban, and rural areas. Washington City should prepare a resolution, policy, or ordinance that addresses the benefits of this technology while aiming to limit associated risks. To ensure autonomous technology does not result in a second generation of planning solely for automobiles, Washington City can adopt a "People and Places First" framework for implementing transportation technology centered on people, rather than the vehicle itself (i.e. prioritizing pedestrian and bicycle infrastructure vs. adding additional parking or infrastructure encouraging more automobile use).

In general, a resolution, policy, or ordinance will (1) summarize why it is important to initiate activity, (2) establish locally important goals and time frames, and, (3) initialize a working group and public outreach program. Washington City can proactively plan for AVs through the following methods:

- Public Outreach: Sparking conversations on the status of technology, key priorities, and how transportation technology can enhance mobility and safety at the local level
- Scenario Planning: Developing potential scenarios of how technology advances might unfold, and how various policy levers can be used to lessen risks and shape benefits
- Smart Mobility Plans: Addressing the technological evolution of the transportation sector by integrating transportation, technology, and infrastructure into a coordinated plan.

- **Desired Outcomes:** Plan for risks and opportunities offered by AVs to ensure a safe and efficient transportation system.
- **Agencies or Departments:** Planning and Public Works Departments; Planning Commission; City Council; Dixie MPO
- **Examples & Resources:** Austin, Texas New Mobility Plan Resolution; Alta Planning + Design's "Preparing for New Mobility: Writing Effective Resoltuions" White Paper

PROGRAMS

Program Recommendations

These non-infrastructure program recommendations can encourage people to walk and ride more often by complementing the built infrastructure network and the adopted policies by educating, removing some of the common stigmas or barriers to walking and bicycling, and encouraging people to use the infrastructure provided by the City and regional partners.

Photo: Salt Lake City Police Department

Traffic Citation Diversion Education Classes

Other than one-time drivers' education courses, there are few formal opportunities for people to learn the legal rights and responsibilities specific to bicycling and walking. Washington City should work with regional and local partners on traffic citation diversion classes that allow transportation users (pedestrians, bicyclists, and/or motorists) who commit offenses known to endanger others to take a safety and diversion class in lieu of paying fines.

- **Desired Outcomes:** Fewer future violations and collisions while avoiding discouraging bicycling and walking
- **Agencies or Departments:** Washington County School District; Washington City Police Department
- **Examples & Resources:** Huntington Beach, CA's ticket diversion program; Marion County, OR's traffic safety and fine diversion program

PROGRAMS

Safe Routes to Schools

Encouraging more bicycling and walking to schools can be achieved through many of the recommended programs in this plan. In addition to the recommendations already listed, this section include more ideas for implementing Safe Routes to Schools (SRTS) activities.

Potential SRTS activities could include:

- Create awareness of SRTS at back to school nights
- School safety assemblies
- Host "Walk and Roll to School" events
- SRTS poster contests
- Classroom-to-classroom bicycle/walk to school competitions
- Create Walking School Bus and Bicycle Train programs
- Create a 'Caught Being Good' enforcement program where those who look both ways before crossing or follow crossing guard instructions are 'ticketed' with a prize

In addition, some schools within the Washington County School District are designated as "no wheel schools" to minimize issues with skateboards and bikes on school grounds. This prevents students from using bicycles or skateboards as transportation options and contributes to traffic congestion and poorer air quality. Schools should look for other ways to manage potential conflicts.

- **Desired Outcomes:** Increased awareness, education, and public engagement on active transportation topics near schools
- **Agency or Departments:** Washington County School District; Southwest Utah Public Health Department; Washington City Police Department; Southern Utah Bicycling Alliance; other non-profits
- **Examples & Resources:** UDOT's Safe Routes to School and SNAP (Student Neighborhood Access Program)

Photo: SUBA

PROGRAMS

Photo: WalltoWall.com

Photo: BikePGH

Awareness Media Campaigns

An awareness media campaign can be as large or small as necessary to fit the time constraints of the implementing staff, budget resources, and desired objectives and exposure. Campaigns can range from Public Service Announcements (PSAs) through local media outlets, billboards, and bus wraps, to fliers around the community, interactive booths at farmers markets, and announcements or notices through the schools.

Campaigns can focus on:

- Driver awareness of bicyclists and pedestrians (i.e. "...and I'm a Bicyclist" campaign)
- Bike safety
- Pedestrian education
- Rules of the road
- Safe Routes to School (SRTS)
- Health benefits of active transportation
- Sharing the road

- **Desired Outcomes:** Increased awareness, education, and public engagement on active transportation within the community
- **Agency or Departments:** St. George and Zion Area Tourism Office; Department of Public Safety; Washington County School District; Southwest Utah Public Health Department; Washington City Police Department; Southern Utah Bicycling Alliance; non-profits
- **Examples & Resources:** City of Pasadena, CA SRTS Media Campaign; BikePGH's "Rides a Bike" Campaign; Utah's Road Respect Media Campaign and Tour

PROGRAMS

Educational Courses

Educational courses are the cornerstone of an informed public. Like awareness media campaigns, educational courses should be selected for the appropriate audience and knowledge gap.

Types of courses to be considered:

- Safety and bicycle usage training courses for all ages
- In-class student education curriculum for SRTS
- Mechanical knowledge training for adults and youth
- "Trips for Kids" (promotes recreational mountain and city bike rides for youth)
- Drivers' education training
- Bike rodeos (participants ride a bike on a practice course)
- Bike commuting workshops
- Mobile active transportation tours

There are many curriculum and program resources available to implement these ideas, including the local bicycle collective, national bicycling and walking advocacy organizations, and the Safe Routes to Schools National Partnership.

- **Desired Outcomes:** Increased awareness, education, and public engagement on active transportation within the community
- **Agency or Departments:** Washington County School District; Southwest Utah Public Health Department; Washington City Police Department; Bicycle Collective of Southern Utah; Southern Utah Bicycling Alliance; other non-profits
- **Examples & Resources:** Cornell's Bicycle Rodeo Guide; Bicycle Collective Earn-a-Bike Program; League of American Bicyclists' "Our Classes" webpage; Bike Utah's Youth Bicycle Education and Safety Training (BEST) Program; Bike Utah's Mobile Active Transportation Tour webpage

Photo: SLUG Magazine and John Barkiple

Photo: Bicycle Collective

PROGRAMS

Photo: SUBA

Walking and Bicycling-Focused Community Events

Creating and hosting community-wide events that are focused on celebrating bicycling and walking is key to creating awareness, collecting public input, and communicating that these are fun, safe, and normal forms of transportation and recreation in Washington City. Doing so will encourage the less confident residents of the city to consider active transportation instead of driving in the future. These events could include or be organized in conjunction with activities based around previous programmatic recommendations, such as educational courses, media campaigns, and safe routes to schools events.

Additional event types could include:

- Ciclovia or Open Streets events
- "Walktober" and International Walk to School Day in October
- Bicycle film festivals
- Organized or adhoc walks or bike rides open to the public, such as the youth-focused "Kidical Mass", farmers market bike rides, Cotton Days rides, or other bike rides to or as part of other patriotic events

- **Desired Outcomes:** Awareness, education, and excitement within and encouragement of the community
- **Agency or Departments:** Cotton Days; Washington City Community Center; bike shops; St. George Area Chamber of Commerce; Washington County School District; Southwest Utah Public Health Department; Bicycle Collective of Southern Utah; Southern Utah Bicycling Alliance; other non-profits
- **Examples & Resources:** Pensacola, FL's Open Streets Event; Walktober Campaign; St. George 2016 Bicycle Film Festival; Kidical Mass

PROGRAMS

Biannual Bicycle and Pedestrian Infrastructure Condition Evaluation

Every two years, Washington City should collect data for and release a report on the condition of bicycle and pedestrian infrastructure (i.e. bicycle lanes, crosswalks, curb ramps, shared use paths, and sidewalks) within city limits. Facility conditions can include poor, good, and excellent conditions ratings or can be done on a 1-5 scale. The data should then be used to inform maintenance priorities in Public Works, Code Enforcement, and Parks and Recreation departments.

Surveyors should look for the following variables:

- **Pavement Condition:** Smooth pavement free of crumbling, rough, or heaving areas
- **Area Obstruction:** Bicycle and pedestrian facilities should be unobstructed and free of debris
- **System Completeness:** Analysis should include significant gaps, especially easy fixes, that should be filled in order to increase connectivity
- **Striping and Sign Maintenance:** Paint and signs should be maintained so as to increase predictability and not impede the safe travel of roadway, sidewalk, and path users
- **Construction:** Facilities should be constructed in compliance with the city's construction design details and standards as well as federal access standards, such as ADA and PROWAG (i.e. curb height, manhole flush with pavement grade, etc.)

Data gathering for the survey need not occur all at once. Staff and volunteers can check for bicycle and pedestrian infrastructure conditions during routine work and maintenance. Additionally, data gathering can be included in developers' post-project evaluations to ensure safe, cost-effective, and well-designed active transportation facilities after development. The existing active transportation facilities GIS data should also be updated to include infrastructure condition and most recent date surveyed.

- **Desired Outcomes:** Biannual report on the status and condition of the active transportation infrastructure network
- **Agency or Departments:** Washington City Public Works and Planning Departments; volunteer organizations; Southern Utah Bicycle Alliance; other non-profits
- **Examples & Resources:** Indiana's "Street, Sidewalk, Curb, and Alley Assessment"; NYCDOT Bicycle Lane and Trail Inventory Databases (2000)

"Washington City will improve its quality of life and collective health by creating and promoting an integrated bikeway, sidewalk, and trail system for transportation and recreation that will connect neighborhoods, places of work, and commercial centers."

- ACTIVE TRANSPORTATION PLAN VISION STATEMENT

Chapter Four:

Future Network Recommendations

- What could Washington City's network of trails, bike lanes, and sidewalks become in the future?
- Where do these recommendations come from?
- Which projects are high priorities and how much would they cost to build?
- Why would the community benefit from different types of facilities?
- Who benefits from the recommendations in this chapter and the plan?

Future Active Transportation System

*Washington City's 94.5 existing miles of walking & bicycling facilities are recommended to increase to **224 total miles.***

These total miles include existing facilities* in addition to newly recommended facilities (152.8 miles) within city limits from either this Active Transportation Plan (2017) or the Parks & Recreation Master Plan (2016).

Some of the recommended future facilities were proposed previously in the plans reviewed in Chapter 1, particularly the Dixie MPO Regional Active Transportation Plan and the Washington City Parks & Recreation Master Plan. Including these previous recommendations will enhance regional connectivity and consistency between planning efforts, agencies, and stakeholders. Many of the recommendations in this chapter came from the ideas contributed by Washington City residents (see Chapter 2).

The future system will provide meaningful and desired connections to destinations, like schools and businesses; improve perceived safety and comfort; and enhance transportation and recreation choices for all ages and abilities in Washington City.

Further information, including individual project costs, plan origin, location, and implementation considerations, can be found in several tables in Appendix F.

**All 23.5 miles of existing bike routes (or shared roadways) will be replaced by higher comfort facility types because the former do not currently accommodate potential active transportation users outside of the strong and fearless bicyclist (see Level of Traffic Stress Analysis for definition). Their mileage, 23.5 of the total existing 94.5 miles, are not included in future network mileages.*

All Ages & Abilities (AAA) Network

The vision and goals of this plan include making walking and bicycling normal, safe, everyday activities for people of all ages and abilities (AAA). Recommended walking and bicycling facilities like separated bike lanes, shared use paths, wide and/or landscaped sidewalks, and bicycle boulevards create a AAA network that is appropriate for the majority of Washington City residents. These facilities are considered high comfort because of physical protection, separation from traffic, or, in the case of bicycle boulevards, the use of low volume, low speed streets.

Physically separated bike lane in Russellville, Arkansas

Many Washington City residents would like to walk or ride bicycles more but are discouraged from doing so by perceived safety concerns, lack of facilities, lack of knowledge about where the appropriate facilities are located, or lack of connectivity to destinations. National surveys indicate that 50-60% of people say they would ride a bicycle more (or start riding if they do not already) if they had access to facilities that provided more separation from traffic, lower traffic speeds, and/or lower traffic volumes.[1]

A bicycle boulevard to bike lane transition and arterial roadway Toucan crossing in Fort Collins, Colorado

Separated or traffic-calmed on-street facilities for people riding bicycles also create a better pedestrian experience by reducing traffic speeds or, in the case of separated bike lanes, increasing the distance and physical separation between pedestrian areas and active motor vehicle travel lanes. Additionally, evidence has shown that communities with higher bicycling rates tend to have lower bicycle and all other modes crash rates, benefiting from the effect of "safety in numbers" and increased awareness.[2]

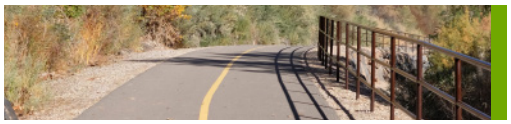
In addition to safety benefits, AAA facilities can improve retail sales in commercial areas, contribute to higher property values[3], and provide more transportation choices to the average person. The latter, in turn, often leads to a more balanced mode share between different transportation modes, contributing to improved air quality, improved health outcomes, more diversified transportation investment, and greater network resiliency and effectiveness.

1 Four Types of Cyclists. (2009). Roger Geller, City of Portland Bureau of Transportation: http://www.portlandonline.com/transportation/index.cfm?&a=237507.

2 Marshall, W., and N. Garrick, 2011 - Evidence on why bike-friendly cities are safer for all road users, Environmental Practice, 13, 1.

3 "Omaha Recreational Trails: Their Effect on Property Values and Public Safety". Rivers and Trails Conservation Assistance, National Park Service. Donald L. Greer, 2000; "Nebraska Rural Trails: Three Studies of Trail Impact". Rivers and Trails Conservation Assistance, National Park Service. Donald L. Greer, 2001.

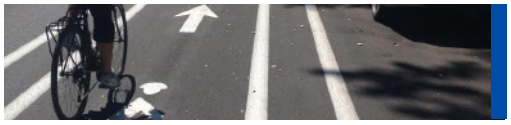
Recommended Facility Types and Mileages or Counts



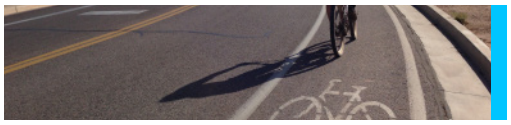
Shared Use Path (75.0 miles). Paved shared use paths are typically 8-12' wide, constructed of asphalt or concrete, and accommodate pedestrians and bicyclists on and off the street. **AAA**

Unpaved Trail (3.4 miles). Soft surface, unpaved trails are located in Washington City's periphery, especially to the north in the Red Cliffs Desert Preserve. AAA*

Separated Bike Lane (21.6 miles). Bike lanes that are physically separated from motor vehicle traffic, designed to create the feeling of a trail, but with on-street connectivity. **AAA**



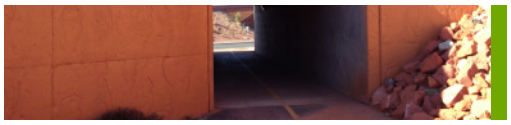
Buffered Bike Lane (21.2 miles). This type of bike lane is additionally visually separated from traffic and/or parking by striping, but lacks any physical separation. AAA



Bike Lane (28.8 miles). A common facility type in many cities; paint-striped bike lanes are typically located between parking or curb (to the right) and travel lanes (to the left). AAA

Bicycle Boulevard (2.7 miles). Low-speed, low-traffic streets that provide alternatives to busier streets and/or connections to destinations through neighborhoods. **AAA**

Sidewalk. Sidewalks should be comfortable for all ages and abilities, separated from traffic as much as possible, and given priority at intersections (see sidewalk policies in Chapter 3). AAA



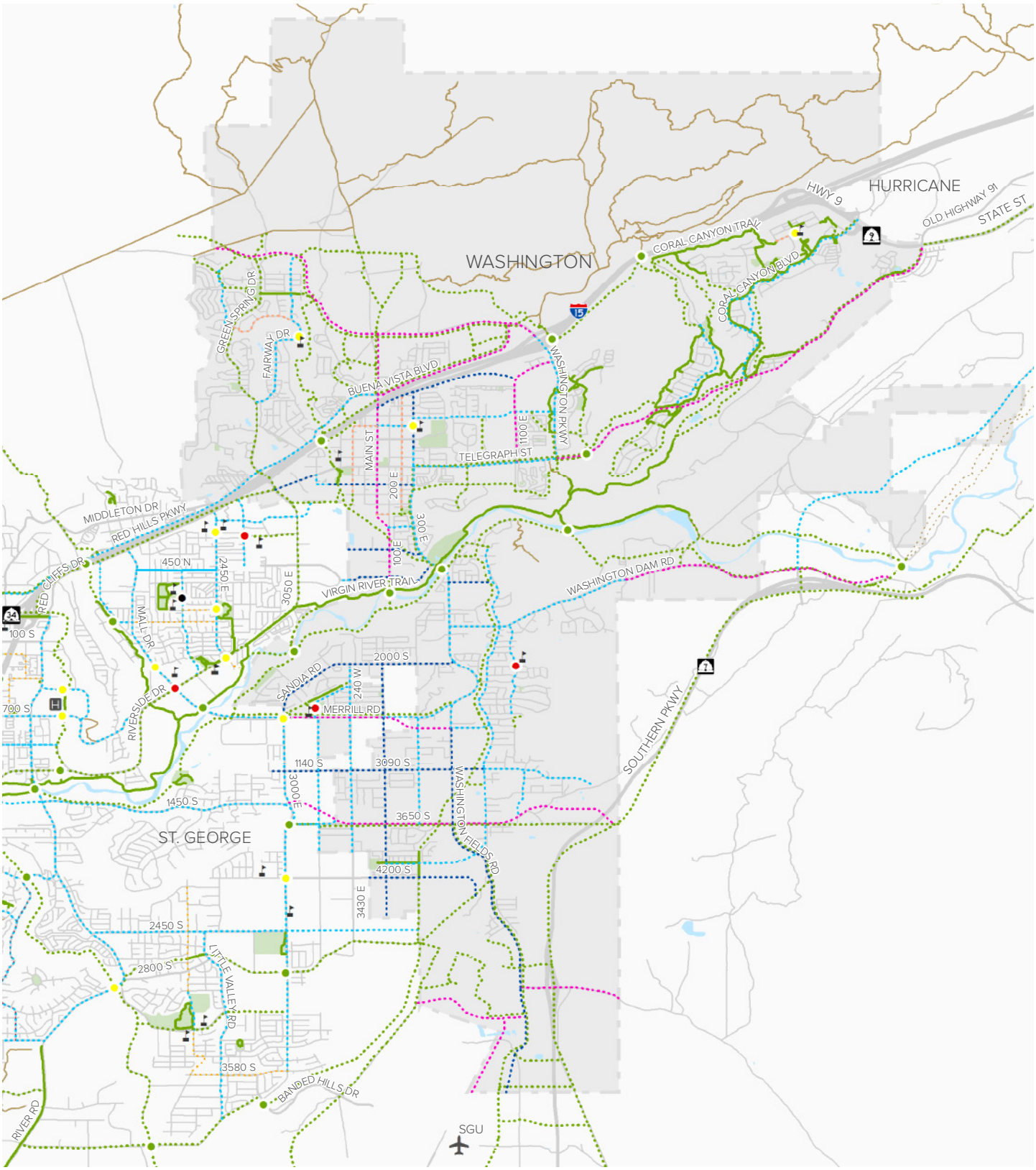
Overcrossing or Undercrossing (9). Grade-separated crossings of major roads or natural features are typically recommended only as shared use paths enhancements. **AAA**

Signal or Beacon (3). Changes to existing signals, addition of new signals or crossing beacons for pedestrians and bicyclists. Many more to be built together with linear facilities. AAA

Intersection Improvement (2). This category includes curb extensions, crosswalks at intersections, and lighting, but does not indicate all possible locations for improvements in the city. AAA

Misc Improvement. Miscellaneous spot improvements include small connections needed to make the network more viable, unsignalized trail crossings, & mid-block traffic calming. AAA

*Those with gray AAA (All Ages & Abilities) have the potential to be depending on context.



Map 4.1:

Recommended Future Facilities

Washington City Active Transportation Plan

Recommended Facilities

- Shared Use Path
- Unpaved Trail
- Separated Bike Lane
- Buffered Bike Lane
- Bike Lane
- Bicycle Boulevard
- Sidewalk
- Bridge or Undercrossing
- Crossing Beacon
- Intersection Improvement
- Misc. Improvement

Existing Facilities

- Shared Use Path
- Unpaved Trail
- Bike Lane

Base Data

- School
- Hospital
- Water
- Park
- Washington City Limits

MILES
0 1 2
3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

N

Data provided by Washington City, AGRC, City of St. George, UDOT, Dixie MPO. Map produced May 2017.

Future Roadway Network Suitability

Many of the newly recommended 152.8 miles of active transportation infrastructure will provide additional low-stress connectivity to and from Washington City's existing trail and sidewalk network and destinations. This low-stress connectivity, which is improved by shared use paths, separated bike lanes, and bicycle boulevards, is an important factor in encouraging people of all ages and abilities, especially children, to walk and ride a bicycle more in every part of the city.

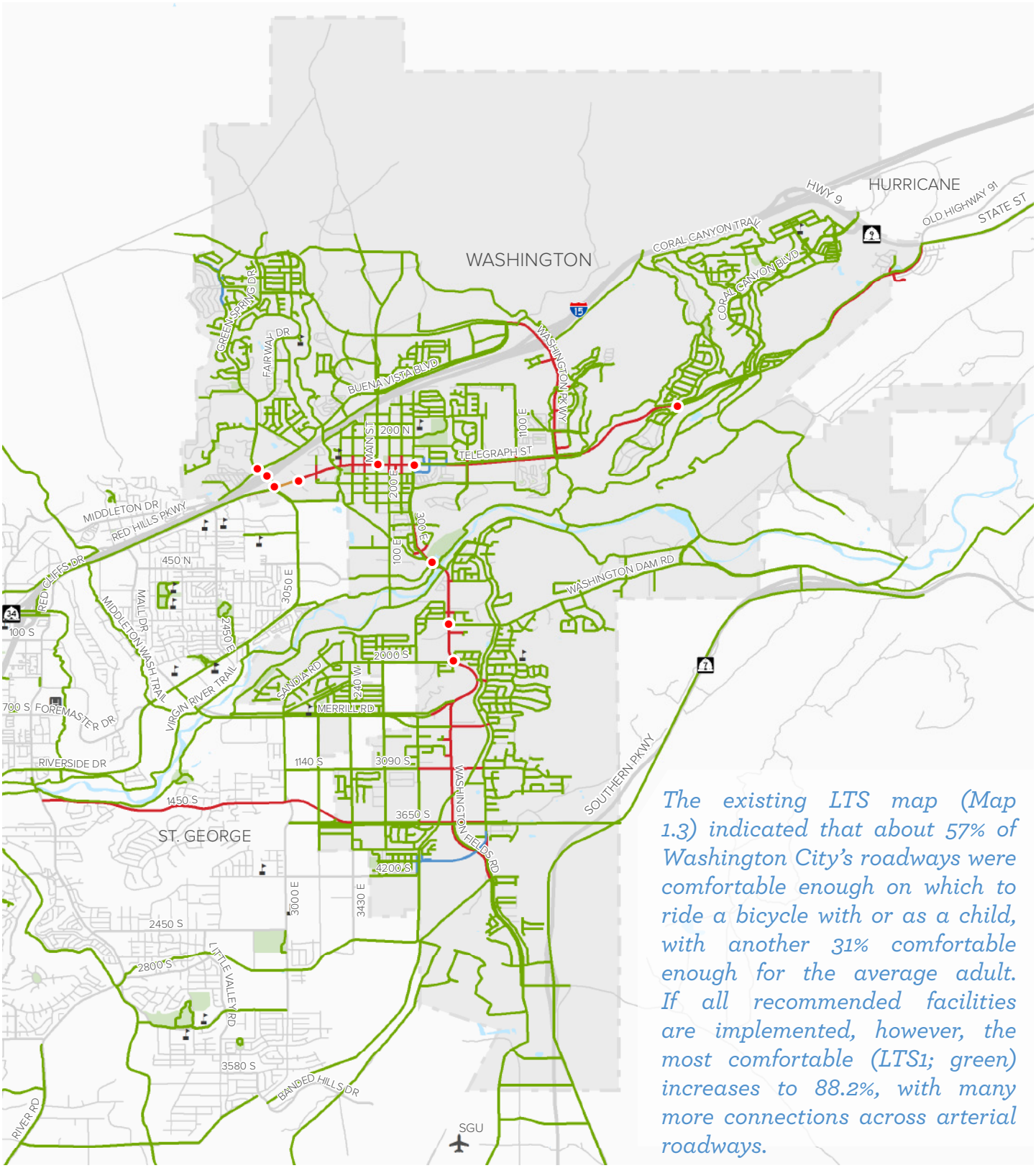
Methodology and Criteria

The methodology and criteria for the Level of Traffic Stress (LTS) analysis included in the following maps are included in Chapter 1. Essentially, LTS objectively assesses *only roadway* comfort for people riding bicycles. This section may be directly compared with p. 12-15 in order to see the difference between existing conditions and future conditions, assuming recommended infrastructure is implemented.

The combination of roadway data and LTS criteria creates four levels of traffic stress that indicate the comfort level of the future roadway network. The lower the number, the higher the level of comfort.

- **LTS 1 (88.2% of roadways).** The least stressful roadways, suitable for all ages and abilities; includes existing and future shared use paths
- **LTS 2 (1.4%).** Roadways that are comfortable enough that the mainstream adult population would ride a bicycle on them
- **LTS 3 (0.1%).** Roadways that would probably only be comfortable ridden by an experienced, confident bicyclist
- **LTS 4 (10.2%).** Roadways ridden only by strong or fearless bicyclists, typically arterials without high comfort infrastructure

High-stress roadway mileage will decrease by 37.4% while mileage of LTS 1 streets will increase from 57% to 88% of the overall network.



The existing LTS map (Map 1.3) indicated that about 57% of Washington City's roadways were comfortable enough on which to ride a bicycle with or as a child, with another 31% comfortable enough for the average adult. If all recommended facilities are implemented, however, the most comfortable (LTS1; green) increases to 88.2%, with many more connections across arterial roadways.

Map 4.2:

Future Level of Traffic Stress Analysis

Washington City
Active Transportation Plan

Future Level of Traffic Stress
- LTS 1 & Shared Use Paths
- LTS 2
- LTS 3
- LTS 4
- Streets w/o LTS Input Data
- Traffic Signals in Washington City

Base Data
- School
- Hospital
- Water
- Park
- Washington City Limits

MILES
0 1 2
3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

Data provided by Washington City, AGRC, UDOT, Dixie MPO.
Map produced January 2017.

The results of the existing LTS analysis helped inform the recommendations found in Map 4.1 and elsewhere in this chapter. Facilities that improved the comfort of a street and/or the crossing of a major roadway were developed first, along with connections to schools and parks.

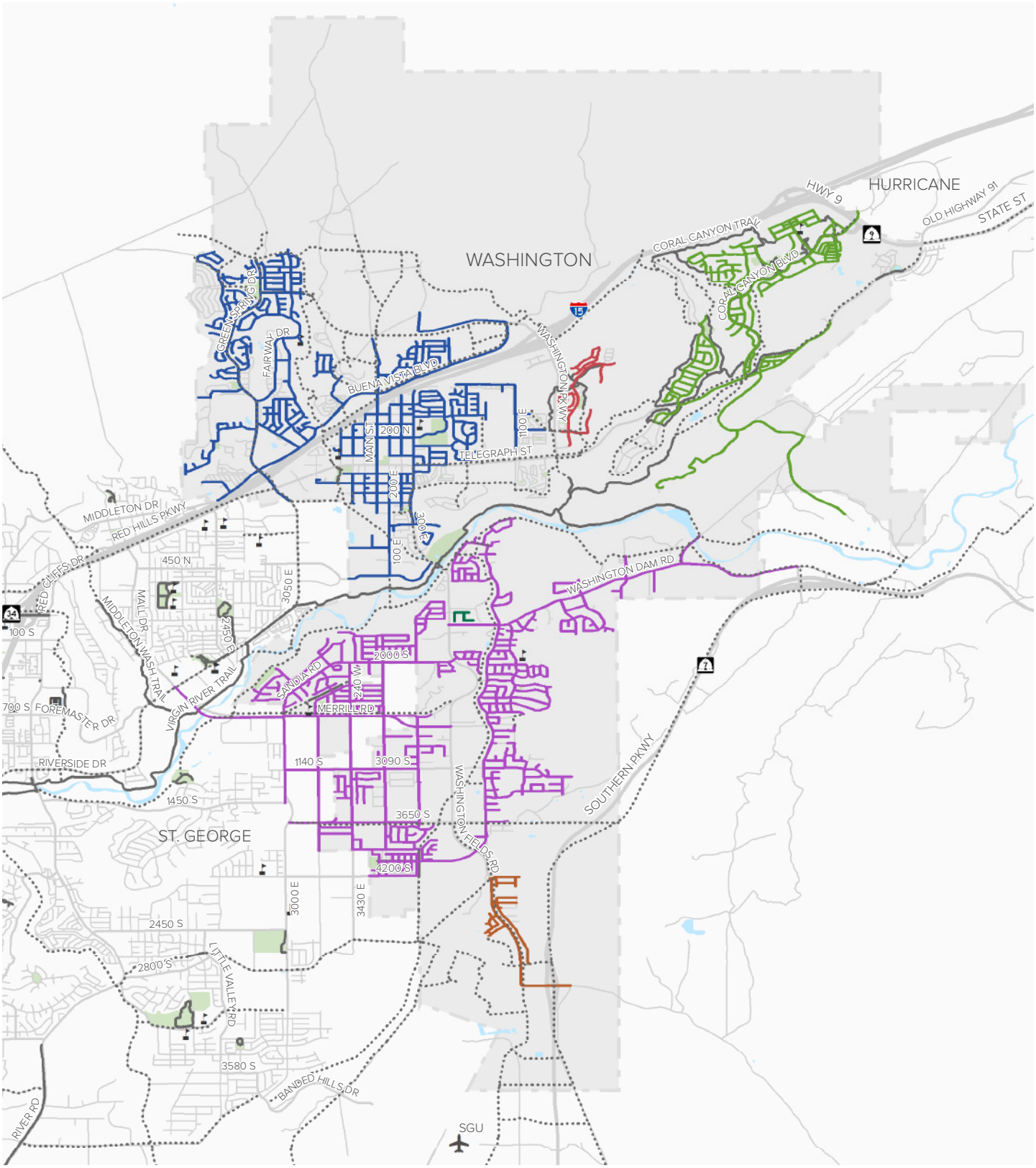
Islands of Connectivity

Map 4.3 includes only low-stress streets (LTS 1 and 2), displayed as "islands of connectivity", or, clusters of high comfort streets that are connected and accessible to each other.

If recommendations are implemented, there will be approximately 6 islands of low-stress streets, compared to 14 currently.

Private, unpaved, or other streets lacking adequate data were omitted from the analysis.

Fewer islands means increased low-stress connectivity, more active transportation mobility for people of all ages and abilities, and safer crossings of major barriers like major roadways and natural features.



Map 4.3:

Future Level of Traffic Stress Analysis & Islands of Connectivity

Washington City
Active Transportation Plan

Level of Traffic Stress

- Higher Stress Streets or Streets w/o LTS Input Data
- Existing Shared Use Paths (exempted from analysis)
- Recommended Shared Use Paths (exempted from analysis)

Base Data

- School
- Hospital
- Water
- Park
- Washington City Limits

MILES
0 1 2

3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

Data provided by Washington City, AGRC, UDOT, Dixie MPO.
Map produced January 2017.

Priority Projects

The following pages describe and depict four projects for which the City desires to provide additional detail, including design, context, benefits, and cost estimate information. These projects are not necessarily the first to be implemented nor are they intentionally ranked. Additional detail provided will be instrumental in pursuing future funding and grant opportunities and in building momentum for the plan's recommendations. These four projects were also among the most publicly-requested facilities from the plan's public involvement opportunities.

The recommendations may change as the City changes, priorities shift, and opportunities arise to complete projects. Realizing the recommended facility types is the ultimate goal; however, other treatments may need to be used in the interim in some instances.

More specific facility design guidance is found in Appendix D.

Project #1: Telegraph Street Buffered Bike Lanes (Green Spring Dr to 500 West)

Existing conditions on Telegraph Street between Green Spring Rd and 500 West

Project Description

Telegraph Street is the only east-west roadway south of I-15 in this area of Washington City, connecting downtown, residential, and commercial areas. The section between Green Spring Dr and 500 West (0.34 miles) is one of the widest, with approximately 88' of asphalt. This width can accommodate 5-6' bike lanes and 2-3' buffers in each direction by slightly narrowing the travel and turn lanes. Adding buffered bike lanes when the roadway is resurfaced provides a cost-effective opportunity. If Telegraph Street is reconstructed in the future, separated bike lanes may be the most appropriate facility type. For more project information, see project L-151 in Appendix F.

Context

Current conditions (high traffic volumes and speeds, lack of bike lanes, automobile-oriented land uses) make active transportation more difficult than in calmer parts of Washington. This proposed project is part of a larger east-west route and connects to a future buffered bike lane on

500 West and 100 South that will act as a bicycle bypass of the downtown section of Telegraph, where traffic volumes and existing roadway widths are not conducive to adding bike lanes.

Benefits

Improving this section of Telegraph Street will provide part of a continuous east-west bicycle corridor. The project will improve conditions to and from commercial areas, particularly, potentially reducing parking demand, increasing safety for people bicycling, and improving awareness of them by motorists. Buffered bike lanes increase the distance between people bicycling and people driving, which is especially important on higher speed roadways. Slightly narrower travel lanes may also calm traffic slightly, reducing crash severity.

Costs

Buffered Bike Lane Striping, Symbols, & Signs: $5,500 (paint); $37,500 (thermoplastic)

Green Conflict Zone Markings at two major driveways (optional): $2,500 (thermoplastic)

Total Project Costs: $5,500 - $40,000

Note: Costs do not include arterial roadway resurfacing ($2.50/square yard) and travel lane striping ($0.25/linear foot). These, however, highlight the relatively minimal investment for bicycle facilities.

Rendering of Telegraph Street with slight lane narrowing and addition of buffered bike lanes in both directions

The Canal Trail alignment as it exists today south of 3090 South.

Costs

Shared Use Path: $250,000 to $500,000/mile for 7 miles

Total Project Costs: $1,750,000 - $3,500,000

Note: Relatively low construction costs due to existing grading and crossings that exist currently. Costs do not include acquisition or easement costs, as they will vary by year and by property.

Project #2: Canal Trail

Project Description

The Canal Trail is a seven-mile, shared use path proposed to be constructed within the former Washington Canal (50' wide) alignment. Although much of the alignment is possible through easements granted by the Washington Canal Company and the Washington County Water Conservation District, several sections will only be possible by way of acquisition of or easements through private property.

Context

The Canal Trail will tie into the City of St. George's trail system near the South Block development (on the south and west) and the Virgin River Trail system (on the north and east).

Benefits

The Canal Trail, the most important project identified by the public in the Active Transportation Plan's online survey, will provide a low-stress, north-south active transportation network backbone. It will provide connects to and between schools, neighborhoods, parks, and existing trails.

Rendering of how the Canal Trail may look looking south from 3090 South. An equestrian trail is likely to be implemented to the side of the trail, as well.

10-12' Shared Use Path

Project #3: 200 East Bicycle Boulevard (Northern Terminus to Dogtown Park)

Project Description

Bicycle boulevards are low-volume, low-speed streets that enhance active transportation user comfort by using treatments such as signage, pavement markings, traffic calming, and intersection modifications (enhanced crossings may be required at the Telegraph Street and the 300 North intersections). For design guidance information on bicycle boulevard crossings, see p. D-32 and D-33 in Appendix D. For more project information, see project L-11 in Appendix F.

Context

1.05 miles of 200 East north of Dogtown Park will be converted to a bicycle boulevard (also known as a neighborhood greenway) in order to provide an alternative to the Washington Fields Road/300 East bike lane.

Benefits

The 200 East bicycle boulevard will connect people of all ages and abilities to and from parks, downtown, and schools. The design will allow through movements of people walking and bicycling while discouraging similar through-trips by non-local motorized traffic, helping to improve neighborhood safety and comfort for residents and transportation users alike.

Existing conditions on 200 East at the Telegraph Street intersection

Costs

Bicycle Boulevard Pavement Markings, Wayfinding, Minor Traffic Calming: $14,000 (paint); $50,000 (thermoplastic)

RRFB (300 North): $22,000

Traffic Diversion (Telegraph St, 300 North): $50,000

Toucan Signal (Telegraph St): $175,000

Total Project Costs: $260,000 - $300,000

Rendering of the 200 East & Telegraph Street intersection (looking north) with a bicycle boulevard crossing of the major, east-west arterial. Such a crossing would provide north-south connectivity through downtown as an alternative to 300 East.

Existing conditions on Washington Fields/300 East near 100 South

Costs

Bike Lane Striping, Symbols, & Signs: $22,000 (paint); $140,000 (thermoplastic)

Green Conflict Zone Markings at 18 intersection crossings (optional): $23,000 (thermoplastic)

Total Project Costs: $22,000 - $163,000

Note: Costs do not include arterial roadway resurfacing ($2.50/square yard) and travel lane striping ($0.25/linear foot). These, however, highlight the relatively minimal investment for bicycle facilities.

Project #4: Washington Fields Road/300 East Bike Lanes (Telegraph St to 2000 South)

Project Description

Originally recommended in the Dixie MPO Regional Active Transportation Plan, the City can add bike lanes to this 1.94 mile section by reducing travel and center turn lane widths and adding symbols, signs, and intersection markings to the widened shoulder. Like Project #1, a separated bike lane may be the most suitable facility type in the future if the roadway is reconstructed. For more project information, see project L-183 in Appendix F.

Context

As Telegraph is one of the only continuous east-west roadways, Washington Field Road/300 East is the principal north-south corridor in the city and would form part of the backbone of the city's active transportation network.

Benefits

Providing connectivity for bicycling will enable people to access Sullivan Park and the Virigin River Trail, schools, open space, downtown, the greater active transportation network, and residential areas without needing to drive. In addition, bike lanes also provide a buffer between people on the sidewalk and motor vehicles in the roadway.

Rendering of Washington Fields Road/300 East after lane narrowing and addition of bike lanes

Cost-Benefit Analysis (Appendix E)

Improving and expanding active transportation infrastructure will likely contribute to more people walking and bicycling. As expressed in Chapter 1, there are many benefits that can be derived from walking and bicycling (economic competitiveness, environmental sustainability, safety, quality of life, freedom of choice). Because an expanded network will require at least partial financial commitment from the City, this section and Appendix E seek to summarize and weigh the quantifiable costs and benefits based on approximate increased future usage.

Limitations

Even with extensive research, it is impossible to accurately predict the exact impacts of various factors. Accordingly, all benefit values are rounded, order of magnitude estimates. It should also be noted that because Washington City's bicycle commute mode share (ACS) is 0.0%, the derived benefits based on the mode shares of other communities likely differ slightly from actual future benefits. The cost-benefit analysis should be performed again once infrastructure buildout is progressing and/or when the data is more accurate.

Outcomes

If Washington City increased its rate of bicycling and walking to match communities with similar populations, land uses, and active transportation networks (existing networks similar to Washington City's proposed network), it could expect to reap the following net benefits (total benefits less capital and maintenance costs) by 2058.

36.4 to 58.1 million more bicycling and walking trips

22.1 to 43.7 million fewer vehicle miles traveled (VMT)

11,000 to 21,700 fewer metric tons of greenhouse gases and criteria pollutants (resulting in $2.2 to $4.4 million in avoided environmental damage or mitigation costs

Increased physical activity resulting in $2.4 to $6.8 million in healthcare savings

$13.9 million to $27.4 million in household transportation expenses, $1.2 million to $2.4 million in costs related to traffic congestion, and $87.9 million in costs related to collisions

At a 3% discount rate, the net cumulative value of the recommended projects ranges between $4,600,000 and $10,230,000 (in 2017 dollars).

Pedestrian Crossing Contextual Guidance and Recommended Facility Type Design Guidance (Appendix D)

Many of the needed and specific signal, beacon, and intersection improvement locations were not included in Map 4.1 due to the need for future transportation master planning, traffic modeling, and needs analysis. The City acknowledges, however, that these types of crossing improvements will be needed at some locations in the future in order to improve walking and bicycling comfort for all ages and abilities. These should reference the Pedestrian Crossing Contextual Guidance tool from Appendix D (p. D-11) and below when those projects are analyzed for implementation.

As mentioned in Chapter 3, additional design guidance, including user types, standards, additional research, resources, and maintenance and implementation considerations, for every facility type recommended in this plan, may be found in that appendix.

The design guidance appendix combines guidance from the NACTO *Urban Bikeway Design Guide*, the AASHTO *Guides for the Development of Bicycle and Pedestrian Facilities*, and other existing standards from FHWA, ADA, AASHTO, MUTCD, and PROWAG. This comprehensive set of guidelines represents contemporary practices studied, accepted, and utilized around the country.

PEDESTRIAN CROSSING CONTEXTUAL GUIDANCE at unsignalized locations	Local Streets 15-25 mph		Collector Streets 25-30 mph			Arterial Streets 30-45 mph							
FACILITY TYPE	2 lane	3 lane	2 lane	2 lane with median refuge	3 lane	2 lane	2 lane with median refuge	3 lane	4 lane	4 lane with median refuge	5 lane	6 lane	6 lane with median refuge
Crosswalk Only	✓	✓	EJ	EJ	X	EJ	EJ	X	X	X	X	X	X
Crosswalk with Warning Signage and Yield Lines	EJ	✓	✓	✓	✓	EJ	EJ	EJ	X	X	X	X	X
Active Warning Beacon (RRFB)	X	EJ	✓	✓	✓	✓	✓	✓	X	✓	X	X	X
Hybrid Beacon	X	X	EJ	EJ	EJ	EJ	✓	✓	✓	✓	✓	✓	✓
Full Traffic Signal	X	X	EJ	EJ	EJ	EJ	EJ	EJ	✓	✓	✓	✓	✓
Grade Separation	X	X	EJ	EJ	EJ	X	EJ	EJ	EJ	EJ	EJ	✓	✓

LEGEND	
Most Desirable	✓
Engineering Judgement	EJ
Not Recommended	X

Active Transportation Access to the Red Cliffs Desert Reserve

Recreation and open space access was one of the principal concerns of and requested recommendations from the public during the plan's public involvement process (Chapter 2). These destinations included trailheads at the Red Cliffs Desert Reserve and other existing parks and trails.

Washington City encourages the BLM, U.S. Fish and Wildlife, and the Red Cliffs Desert Reserve to provide and maintain trails, trailheads, and access to the Red Cliffs Reserve and other protected, natural areas in and near the city. The following strategies can be used to encourage appropriate use and access:

- **Property Owner and Trail User Outreach.** Some trailheads, especially those with parking, lack the ability to expand and may be located in proximity or accessed through neighborhoods. This can lead to friction between neighbors and trail users over issues including parked vehicles, noise, and trash. It may be beneficial to do outreach directly to neighbors and trail users to mitigate impacts to the neighborhood. (Reference: Rails-to-Trails Conservancy's "Developing Trails in Sensitive Areas" Guide)
- **Agency Partnerships.** Many existing facilities straddle boundaries between City, Reserve, and other state and federal lands. Partnerships are an efficient way to pool resources to provide facilities, messaging, or coordination across multiple jurisdictions. (Reference: FTA's Case Study on Alternative Transportation at Cape Cod National Seashore)
- **Active Transportation Encouragement.** The majority of trips to trailheads are currently vehicle-based. Attracting users to trailheads by bike or walking could allow greater use of the recreational facilities with the same or fewer private vehicles. Bike lanes or shoulders could help attract some users, but a separated paved path or unpaved trail will appeal to a wider range of potential recreation users. (Resource: Bozeman [MT] Area Recreational Alternative Transportation Study)
- **Trail and Access Improvement.** Maintaining trails, accesses, and trailheads can encourage use. Strategies should seek to increase active transportation access to the area first before increasing parking. Trailhead parking area expansions can be expensive and expand the footprint of human impact in sensitive lands. (Resource: Comprehensive Trail Management Plan and Mammoth Cave Trail Plan)

MOST POPULAR DESTINATIONS FOR PEOPLE CURRENTLY WALKING AND BICYCLING

Trailheads

Parks & Recreation Areas

Photo: Red Rock Bicycle Co.

“Dexter likes to look for lizards while we walk. I bring cheap bags from Wal-Mart to pick up after him. It helps to keep the trail looking nice and neat.”

- PAT AND DEXTER

Chapter Five:

Implementation, Evaluation, & Funding

- How and when are projects implemented?
- How will the City be able to pay to implement the recommendations from the plan?
- What types of projects are eligible for which types of funding?
- Are there ways to measure how well the infrastructure and programs perform over time?

Prioritization

Implementation strategies for active transportation projects require a blend of careful planning and opportunistic decision-making. On-street projects, like bike lanes, can often be implemented quickly and efficiently when coordinated with planned roadway projects or pavement preservation activities. Conversely, shared use path projects may, but not always, require more extensive easement negotiations, permitting, or fundraising to reach construction.

Methodology

The following project prioritization and phasing methodology should serve as a general guide for investment in the active transportation system. Flexibility in implementation is highly encouraged when opportunities arise to share resources, achieve cost savings, or partner with other agencies (i.e. UDOT, Washington County School District, Dixie MPO, City of St. George, Hurricane City).

Project Prioritization Criteria

For each project identified as part of the proposed system (Map 4.1; Appendix F), prioritization scoring was established based on vision and goals-based criteria and weighting (Table 5.1). For example, projects that helped improve walking and bicycling access to schools received the two points allotted to the recommendations that provide direct access to and/or are located within 1/4 mile of a school property. Not all goals were given criteria because not all goals affected the prioritization.

Table 5.1. *Project Prioritization Criteria and Scoring*

Criteria	Sub-Criteria	Score	Description
Safety	Crash Locations	5/2	Projects that directly address known safety issues and that are within 800 feet of the location of a severe (5 points) or minor (2 points) crash
	High Comfort Facility Type	3	High comfort facility types (separated bike lanes, shared use paths) that appeal to users of all ages and abilities
Funding	Cost-Sharing	3	Ability to share resources with or leverage near-term planned construction (1-5 year projects from TIP, Phase 1 projects from Parks & Trails Master Plan)
	Easy to Implement	2	Project requires a modest investment, has few barriers to implementation (paint only, no roadway redesign), and could be constructed within six months
Community-Driven Network Planning & Design	Public Support	2	Project received a high level of public support throughout the planning process
	School Connection	2	Project connects or improves a connection to school (within 1/4 mile)
	Park, Recreation, Trail Connection	2	Project connects or improves a connection to a park, recreation area, trail
	Regional Connection	1	Project supports or connects to existing facilities in other jurisdictions or to recommendations from other local and regional planning efforts
Connectivity	Network Gap	2	Project addresses a gap in the existing network

After all projects were assessed and assigned criteria-based score, a composite score was determined by adding all criteria scores together. The highest possible score was 22 and the highest-scored project received 17 total points.

Phasing

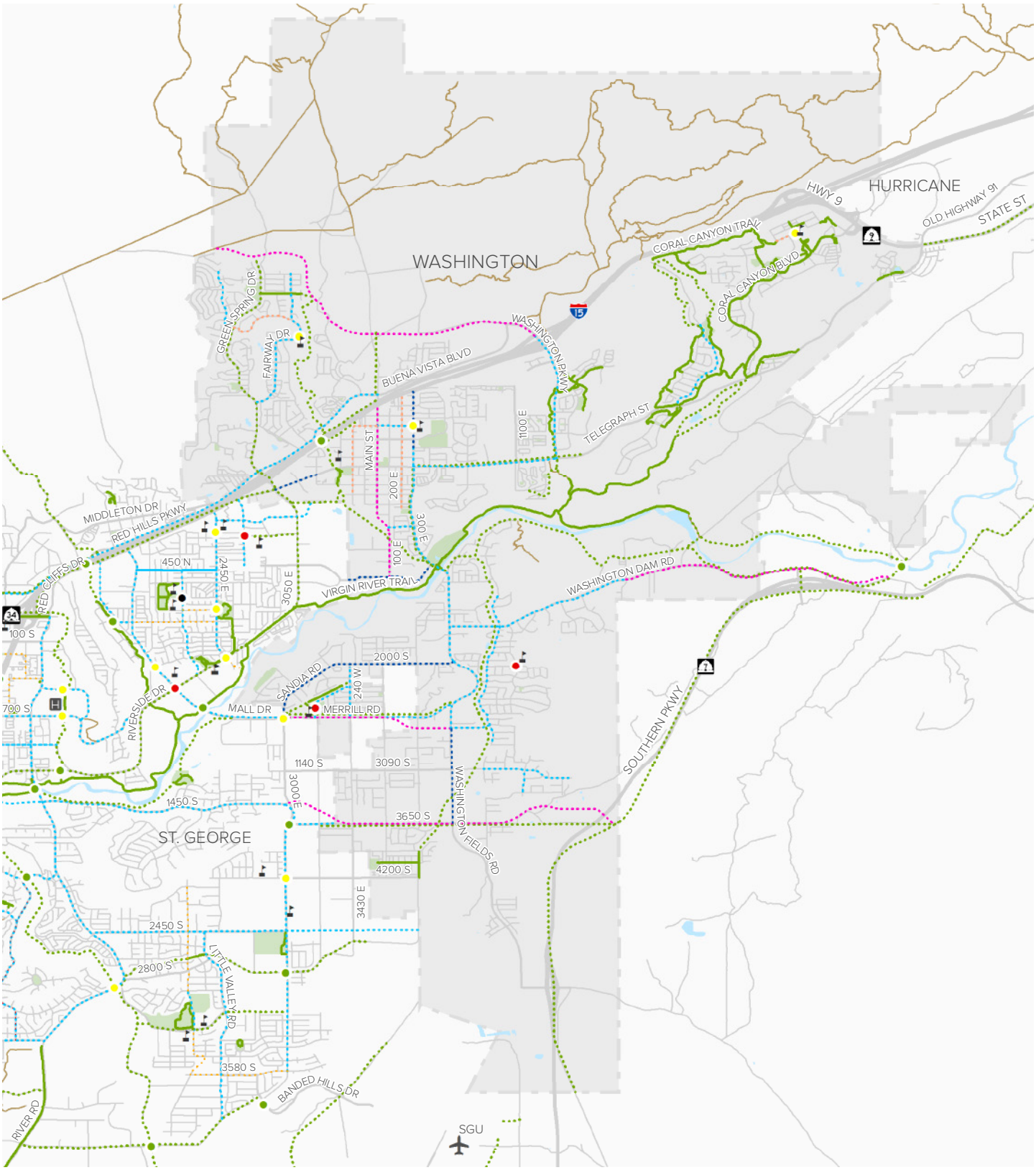
Projects were not phased purely according to their prioritization score (i.e. the highest scored project is not necessarily the project to be implemented first). Instead, many projects were phased according to the Transportation Improvement Program's phasing of several major roadway projects (1-5, 6-10, 11-20 year phases), depending on when new development is projected to occur, and according to the Parks & Recreation Master Plan's phasing (0-10 and 10+ years). High priority projects proposed in the latter plan are included in phases 1 and 2 of the Active Transportation Plan.

Projects were prioritized, for the most part, within the phase assigned to them.

The resulting phases were as follows:

- **Phase 1 (1-5 Years).** 70.7/152.8 miles and 7/14 spot improvements (see Map 5.1)
- **Phase 2 (6-10 Years).** 46.5/152.8 miles and 3/14 spot improvements (see Map 5.2)
- **Phase 3 (11-20 Years).** 35.6/152.8 miles and 4/14 spot improvements (see Map 5.3)

The maps on pages 82, 83, and 84 (Maps 5.1, 5.2, and 5.3) show the approximate active transportation network phasing according to implementability and the project prioritization scoring.



Map 5.1:

Phase 1 Recommended Facilities

Washington City Active Transportation Plan

Recommended Facilities

- Shared Use Path
- Unpaved Trail
- Separated Bike Lane
- Buffered Bike Lane
- Bike Lane
- Bicycle Boulevard
- Sidewalk
- Bridge or Undercrossing
- Crossing Beacon
- Intersection Improvement
- Misc. Improvement

Existing Facilities

- Shared Use Path
- Unpaved Trail
- Bike Lane

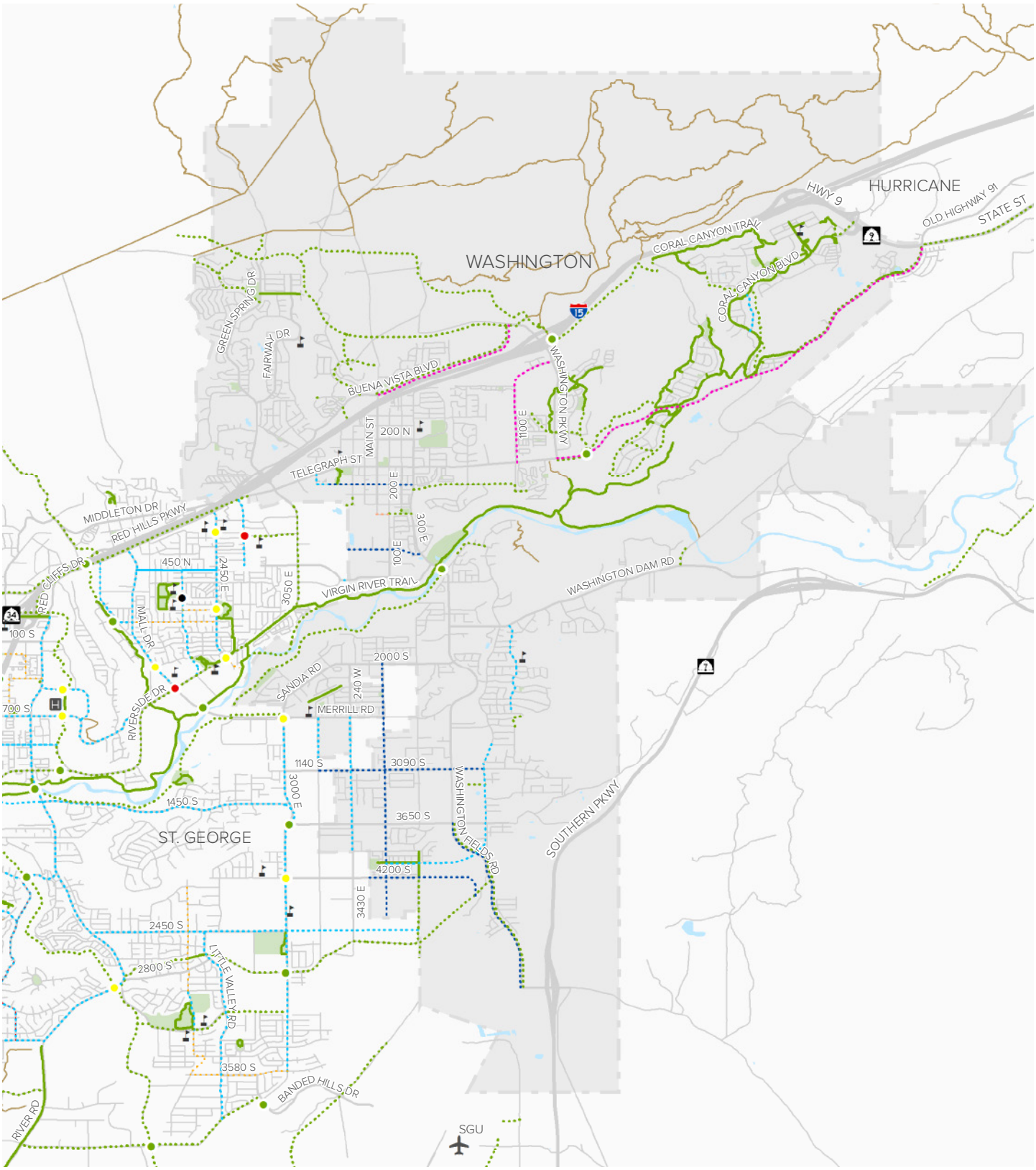
Base Data

- School
- Hospital
- Water
- Park
- Washington City Limits

MILES
0 1 2
3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

N

Data provided by Washington City, AGRC, City of St. George, UDOT, Dixie MPO. Map produced May 2017.



Map 5.2:

Phase 2 Recommended Facilities

Washington City Active Transportation Plan

Recommended Facilities

- Shared Use Path
- Unpaved Trail
- Separated Bike Lane
- Buffered Bike Lane
- Bike Lane
- Bicycle Boulevard
- Sidewalk
- Bridge or Undercrossing
- Crossing Beacon
- Intersection Improvement
- Misc. Improvement

Existing Facilities

- Shared Use Path
- Unpaved Trail
- Bike Lane

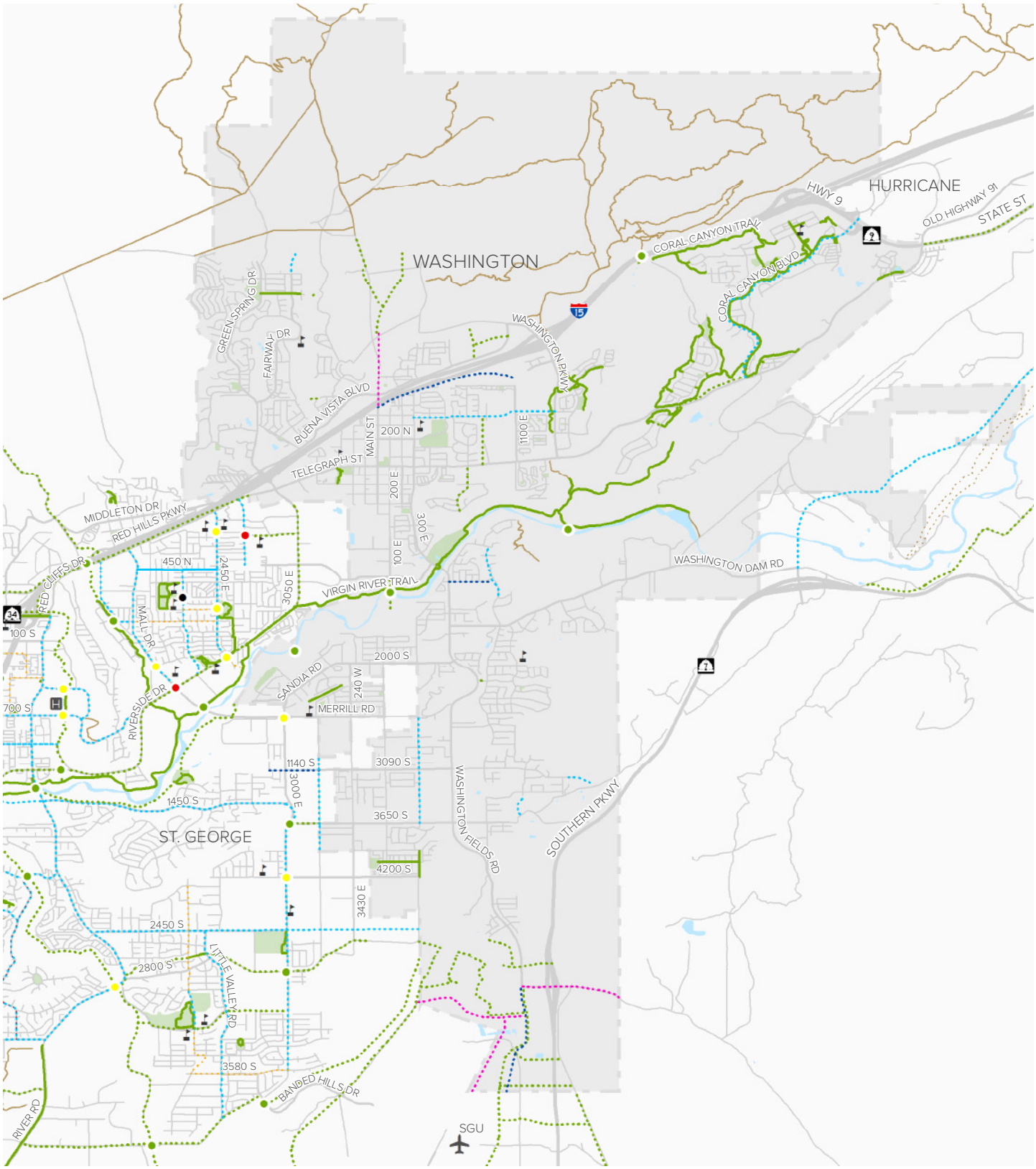
Base Data

- School
- Hospital
- Water
- Park
- Washington City Limits

MILES
0 1 2
3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

N

Data provided by Washington City, AGRC, City of St. George, UDOT, Dixie MPO. Map produced May 2017.



Map 5.3:

Phase 3 Recommended Facilities

Washington City Active Transportation Plan

Recommended Facilities

- Shared Use Path
- Unpaved Trail
- Separated Bike Lane
- Buffered Bike Lane
- Bike Lane
- Bicycle Boulevard
- Sidewalk
- Bridge or Undercrossing
- Crossing Beacon
- Intersection Improvement
- Misc. Improvement

Existing Facilities

- Shared Use Path
- Unpaved Trail
- Bike Lane

Base Data

- School
- Hospital
- Water
- Park
- Washington City Limits

MILES
0 1 2
3 MIN 6 MIN 12 MIN BIKE RIDE
10 MIN 20 MIN 40 MIN WALK

N

Data provided by Washington City, AGRC, City of St. George, UDOT, Dixie MPO. Map produced May 2017.

Maintenance

The City, County, and other agencies have invested considerable resources in the construction and maintenance of shared use paths along washes, through neighborhoods, and along riparian corridors like the Virgin River. These paved paths provide valuable recreational and transportation benefits to local residents and visitors. Guidance for improving the maintenance of the existing and the proposed on-street and off-street active transportation network in Washington City is included in this section.

Maintenance activities can generally be categorized into two types: *routine maintenance*, which is done annually or more frequently, and major or *capital maintenance*, which involves more intensive activity at a less than annual frequency.

Shared Use Path Maintenance

The following maintenance recommendations seek to establish a uniform approach to maintenance activities for existing and proposed paved, off-street bicycle and pedestrian facilities.

Routine Maintenance

Typical off-street facility maintenance activities include sweeping and after-flood cleanup, pavement management, weed abatement, landscaping, and mowing. Not every shared use path will have the same needs and levels of expenditure. It is estimated that for routine maintenance approximately $2,000 to $2,500 annually be budgeted per mile of shared use path (see Table 5.2).

Table 5.2. Recommended Routine Off-Street, Shared Use Path Maintenance Frequency and Estimated Costs

Maintenance Activity	Function	Frequency	Est. Annual Cost (per mi.)
Path Sweeping	Keep paved surfaces debris free	At least twice annually (once in spring and once in fall); more often if necessary due to flooding	$180 (x2)
Litter and Trash Removal	Keep path clean and maintain consistent quality of experience for users	Annually, or as needed	$70
Tree and Brush Trimming	Eliminate encroachments into path corridor and open up sight lines	Annually, or less frequently as needed	$100
Weed Abatement	Manage existence and/or spread of noxious weeds, if present	Twice annually, in late spring and mid to late summer	$350 (x2)
Safety Inspections	Inspect path tread, slope stability, and bridges or other structures	Annually	$20
Sign and Other Amenity Inspection/Replacement	Identify and replace damaged infrastructure	Annually (assume 2 sign replacements)	$100
Crack Sealing and Repair	Seal cracks in asphalt to reduce long term damage	Annually	$750
	Total		***$2,100***

Capital Maintenance

Major or capital maintenance activities typically involve more intensive maintenance repairs such as pavement seal coating, pavement overlays, pavement reconstruction, or other structural rehabilitations. Needs can vary widely based upon environmental factors, such as soil conditions, flood potential, drainage, and the quality of initial construction.

Any asphalt-paved path surface will deteriorate over time with asphalt surfaces dropping in quality rapidly after 10 years. Preservation efforts within 5-10 years, such as seal coating, extend the life of asphalt efficiently and at a lower cost than waiting for the surface to fail requiring expensive reconstruction. Overlays may be needed after multiple seal coats or at approximately 30 years after initial construction. A full reconstruction could be required when needed, typically at 50 years if the seal coat and overlay have been provided.

Concrete paths, which are a more significant upfront capital investment, will require significantly less ongoing maintenance than asphalt, are currently used in Washington City and throughout the region where paths and washes intersect, and, due to a lighter color, may reduce surface temperatures in the summer and the resulting damage from the sun. This paving method may be considered given the flooding potential of rivers and washes near Washington City's shared use paths.

Concrete paths may require isolated jacking or replacement, but generally limited maintenance expenditures should be expected for a life of upwards of 50 years.

Financial planning for major or capital maintenance can be challenging to budget for. Some jurisdictions stay focused on eventual reconstruction and treat this as a maintenance item to be budgeted for, whereas others treat this as a separate capital project to be considered at a later date in the future. Depending on the existing age and the level of effort major or capital maintenance can require an average budget of between $2,700 and $9,700 per mile per year. Some years may require more expensive maintenance with others requiring little to none.

Table 5.3. *Capital Off-Street, Shared Use Path Maintenance 50-Year Scenario*

Maintenance Activity	Time	Long Term Capital Costs					
Seal Coat	Year 2	SF	$0.19	LF	$1.90	Mile	$10,000
Seal Coat	Year 10	SF	$0.19	LF	$1.90	Mile	$10,000
Seal Coat	Year 20	SF	$0.19	LF	$1.90	Mile	$10,000
Overlay	Year 30	SF	$2	LF	$20	Mile	$105,000
Seal Coat	Year 40	SF	$0.19	LF	$1.90	Mile	$10,000
Reconstruction	Year 50	SF	$6.50	LF	$65	Mile	$343,000

Table 5.4. *Annual Capital Budgeting Requirements*

	Full Reconstruction	w/o Full Reconstruction	Before Overlay
Total Cost	$479,000	$136,000	$20,000
Cost/Year	$9,500	$2,700	$717

Sidewalk Maintenance

Sidewalks enable residents to safely access residences, commercial areas, community resources, other active transportation facilities, and other destinations on foot. Sidewalks are also integral to Washington City as they provide spaces to meet others, eat, and engage with the community. Maintaining sidewalks clear of debris and obstructions is essential to maintaining comfort and safety for pedestrians in Washington City and limiting liability.

The City should work with property owners to enforce regular sidewalk maintenance and to repair and reconstruct sidewalks where necessary because of tree root heaving, settling, deterioration, landslides, or other natural occurrences. Additional resources can be found in Chapter Three.

On-Street Facility Maintenance

Keeping on-street bikeways in good condition is equally as important as implementing them in the first place. Bikeways, or any on-street bicycle facility (i.e. bike lane, bicycle boulevard, separated bike lane) are typically maintained as part of standard roadway maintenance programs, and extra emphasis should be put on keeping bike lanes and roadway shoulders clear of debris as well as keeping vegetation overgrowth from blocking visibility or creeping into the roadway.

Maintenance activities could be driven by a regular schedule or by maintenance requests from the public. Typical maintenance costs for on-street bikeways are shown in Table 5.5.

Sweeping

Washington City maintains almost all non-interstate streets within city limits except for some UDOT-maintained intersections near interchanges as well as SR-7 and SR-9. Every street is swept about 4-5 times per year, with street sweeping occurring somewhere in the city every day.

When a bike lane becomes filled with debris, bicyclists are forced into the motor vehicle lane. Poor bikeway maintenance can contribute to crashes and deter potential bicyclists unwilling to risk flat tires. Street sweeping of on-street facilities should follow the following recommendations:

- Establish a seasonal sweeping schedule that prioritizes roadways with major bikeways
- Sweep bikeways whenever there is an accumulation of debris, and at least in the spring to clean debris left over from winter weather
- Coordinate with the management agency's roadway maintenance program to ensure that the roadway is cleared curb to curb
- Perform additional sweeping in the fall, after winter, and after major flooding events in areas where leaves and debris accumulates

Pavement Surface

People on bicycles are more sensitive to pavement quality than motorists because of reduced speeds, narrower tire widths, and, typically, lack of suspension or dampening

systems. Roadway resurfacing aggregate size (see Appendix A) should be of a small enough size so as to create a comfortable ride without risking lack of friction for all vehicles.

Compaction is also an important issue after trenches and other construction holes are filled. Uneven settlement after trenching can affect the roadway surface nearest the curb where bicycles travel. Sometimes compaction is not achieved to a satisfactory level, and an uneven pavement surface can result due to settling over the course of days or weeks.

- Maintain a smooth pothole-free surface
- Maintain pavement so that ridge buildup does not occur at the gutter-to-pavement transition
- Inspect the pavement 2 to 4 months after trenching construction activities are completed to ensure that excessive settlement has not occurred

Pavement Overlays

Pavement overlays represent good opportunities to improve conditions for on-street bikeways if done carefully. A ridge should not be left in the area where bicyclists ride (this occurs where an overlay extends part-way into a shoulder bikeway or bike lane). Overlay projects also offer opportunities to widen a roadway or to re-stripe a roadway with bike lanes where wide travel lanes previously prevented them.

- Extend the overlay over the entire roadway surface to avoid leaving an abrupt edge
- Ensure that inlet grates, and manhole and valve covers are within ¼ inch of the finished pavement surface and are made or treated with slip-resistant materials

Table 5.5. *Recommended On-Street Bikeway Maintenance Frequency and Cost Estimates*

Maintenance Activity	Material	Frequency	Estimated Cost
Pavement Sweeping	All	Monthly or as needed	Part of regular street sweeping activities and costs
Tree and Shrub Trimming	All	Every 5 to 12 months	Part of regular activities and costs
Sign Repair or Replacement	Signs and poles	Annually	$300/sign assembly
Bike Lane Restriping	Paint	Every 1 to 2 Years	$6,000/centerline mile
Buffered Bike Lane Restriping	Paint	Every 1 to 2 Years	$10,000/centerline mile
Bicycle Boulevard Maintenance	All	Every 1 to 2 Years	$500/centerline mile

Performance Measures

The recommended performance measures in this section will help Washington City assess the success of the plan and the implementation of its proposed facilities, programs, and policies. They will also highlight how well it is working to make bicycling and walking safe, normal, and popular choices; keep tabs on changing transportation demographics and safety citywide; and measure whether the City is meeting the plan's vision and goals over time. The City may choose to utilize any combination of suggested measures in a regular benchmarking report. These measures will highlight the need for adjustments and determine how effectively funding is being utilized. The outcomes of these measures can also help the City celebrate successes, small and large, and keep momentum for active transportation moving forward.

How to Measure Performance

As often as possible, performance measures should be based on rates rather than raw numbers in order to accurately and effectively show change over time (i.e. a 30% increase in walking trips rather than 20,000 new walking trips). While performance measures are focused on assessing progress over the long-term, data on these measures should be collected on a regular basis to help track continuing progress.

Trends

Tracking trends, like increases in the percentage of trips taken by walking and bicycling, miles of bicycling and walking facilities completed from the plan's recommended facilities, new or improved connections to downtown or parks, crosswalks added, or dollars spent on sidewalk replacement, are effective and positive performance measures. Some performance measures focus on downward trends like fewer crashes or lower speeds on selected roadways.

Tracking and reporting the progress of some performance measures over time will give the City more transparency while building more momentum and public support in the community. Measures can be evaluated either by meeting performance targets, trending in the desired direction, or both.

Responsibilities

Tracking and analyzing performance measures should not be restricted to one or two departments within the City. Washington City can collaborate with other organizations or departments within and outside the City government, such as the City Council, Dixie MPO, UDOT, Washington County, SUBA, St. George's and other cities' Active Transportation Committees, tourism and recreation organizations, Division of Air Quality, Southwest Utah Health Department, Dixie State University, SunTran, Washington County School District, regional and state law enforcement agencies, emergency responders, and others that will encourage higher level policy-related and programmatic changes.

Measure #1: Reduce Rate of Bicycle and Pedestrian Collisions

Gain access to and track the detailed information for crashes involving people walking and bicycling through UDOT's Numetric system (i.e. time of day, fault, vehicle speeds, location, intersection or crosswalk-related).

- **Desired Outcomes:** Reduce active transportation-related crashes by 10% annually
- **Desired Trend:** Decrease
- **Agencies or Departments:** Washington City Police Department, UDOT, DPS

Measure #2: Reduce Rate of Serious Injuries and Fatalities

Gain access to and track more detailed crash information (same as above) that will identify the severity of crashes and associated injuries for those involving people walking and bicycling.

- **Desired Outcomes:** Reduce severe active transportation-related crashes by 25% annually
- **Desired Trend:** Decrease
- **Agencies or Departments:** Washington City Police Department, UDOT, DPS

Measure #3: Mode Share Goal-based Funding for Bicycling and Walking Projects

Track past, existing, and future active transportation capital and maintenance expenditures in order to ensure that future funding applications (local and otherwise) are more robust and defensible. City Council should allocate funding to Public Works, Parks, and other departments equal to or greater than the desired combined rates of walking and bicycling.

- **Desired Outcomes:** Transportation, planning, and recreation budget spending and future allocations equal to or greater than the desired rates of walking and bicycling (i.e. 10% of funding for 10% walk and bike mode share by 2026).
- **Desired Trend:** Increase
- **Agencies or Departments:** City Council, Washington City Public Works, Washington City Parks and Recreation, Washington City Planning & Zoning

Measure #4: Increase Reach and Participation in Project-Specific Public Involvement Activities

Track and increase the number of people and responses acquired during project-specific public involvement events.

- **Desired Outcomes:** Increase public input on specific projects related to active transportation to help guide future planning and design
- **Desired Trend:** Increase
- **Agencies or Departments:** Washington City Public Works, Washington City Parks and Recreation, Washington City Planning & Zoning

Measure #5: Increase the Reach and Participation in Existing and Recommended Programs

Track and work to increase the number of people participating in existing and recommended, especially Safe Routes to School-related, programs.

- **Desired Outcomes:** Increased awareness and knowledge of walking and bicycling
- **Desired Trend:** Increase
- **Agencies or Departments:** Washington County School District, Southern Utah Bicycle Alliance, Washington City Public Works, Washington City Parks and Recreation, Washington City Planning & Zoning

Measure #6: Increase Awareness within Washington City Departments About Statutes, Standards, and Laws Pertaining to Active Transportation

Track number of Washington City staff that attended informational meetings about active transportation. Perform annual polls or surveys of all staff regarding City, state, and federal standards and laws regarding active transportation (i.e. City pavement quality standards, MUTCD).

- **Desired Outcomes:** Increased awareness and knowledge in order to improve capital and maintenance projects
- **Desired Trend:** Increase
- **Agencies or Departments:** All City Departments, UDOT

Measure #7: Percentage of the Recommended Bicycle and Pedestrian Network from the Active Transportation Plan Completed

Track the existing miles of the bicycle and pedestrian network in the City compared to the active transportation plan recommendations every year.

- **Desired Outcomes:** Implement the recommended active transportation network year after year following the phasing and prioritization plan
- **Desired Trend:** Increase
- **Agencies or Departments:** Washington City Public Works, Washington City Parks and Recreation, Washington City Planning & Zoning, UDOT

Measure #8: Biannual Bicycle and Pedestrian Infrastructure Condition Evaluation

By the end of at least every two years, Washington City should have performed an evaluation of all roads with bike lanes and sidewalks, as well as shared use paths, in order to determine the overall condition of the network and the immediate and planned, future maintenance needs (see final Program recommendation in Chapter Three).

- **Desired Outcomes:** Ensure that no more than 10% of bicycle and pedestrian infrastructure is within the "Poor" category.
- **Desired Trend:** Decrease
- **Agencies or Departments:** Washington City Public Works, Washington City Planning & Zoning, Washington City Parks and Recreation

Funding

Implementation of the proposed bicycle and pedestrian system will often require funding from local, regional, state, non-profit, and federal sources, as well as coordination with multiple agencies. The future active transportation network can largely be implemented as part of larger transportation and recreation projects, like roadway resurfacing and widening, new development, interchange redesigns, and planned parks and trails. It is recommended that, whenever possible, the proposed on and off-street facilities from Map 4.1 be constructed in the phases that align with associated planned and future capital and maintenance projects.

To facilitate funding efforts and so that local residents do not bear an unnecessary burden when funding is already available, this section presents a brief overview of different funding sources and strategies.

Strategies

The following strategies will help Washington City take advantage of existing and future funding sources:

- Subscribe to state and federal funding programs' communications and be prepared to respond proactively to grant availability by being informed about grant requirements and allocating money for matches
- Identify local funding sources for capital and non-infrastructure bicycle, pedestrian, and Safe Routes to School projects
- Develop diverse relationships with local partners, such as health, safety, economic development agencies, non-profits, and advocates to identify mutually supportive projects and develop grant proposals together
- Dedicate a funding source for active transportation projects in annual operations and capital improvement program budgets (i.e. a dedicated portion of general fund dollars, bond financing, special improvement districts, or specific local sales taxes)
- Coordinate Capital Improvement Program (CIP) project development and review so that planned roadway and maintenance projects include pedestrian and bicycle facilities, wherever possible

Sources

Most funding sources are competitive and require the preparation of applications. For multi-agency projects, applications may be more successful if prepared jointly with other local and regional agencies (see strategies).

The majority of non-local public funds for bicycle and pedestrian projects are derived through a core group of federal and state programs. In addition to federal, state, and regional funding sources, the City could develop a dedicated local funding source for active transportation improvements through a variety of measures. The City should also take advantage of private contributions, if available and appropriate (i.e. volunteer or in-kind labor during construction, right-of-way donations, outreach, planning and design, or monetary donations towards specific improvements).

Existing funding sources and their requirements and information are included in the following tables.

Table 5.6. *Municipal Funding Options*

Funding Opportunity	Eligible Projects	Qualifications	Lead Agency	Description
Bond Financing	Varies	Varies	Varies	Bonds are a financing technique and not a funding source. Money is borrowed against a source of revenue or collateral (i.e. parcel tax revenue). Bonds do not increase total funding, but rather shift investment from future to present. A successful precedent is the voter-approved Salt Lake County 2012 and 2016 Parks and Trails Bond, which authorized $47M and $90M to complete the Jordan River Parkway, Parley's Trail, acquire land, and build parks.
Special Assessment or Taxing Districts	Varies	Varies	Washington City	Local municipalities can establish special assessment districts to pay for improvements. Urbandale, IA, for example, established a special assessment program for building sidewalks in existing developments where they were missing. Exception clauses allowed residents to apply for hardship status or to allow residents to petition for sidewalks on one side of the street rather than both.
Development Impact Fees	Varies	Varies	Washington City	Development impact fees are one-time charges collected from developers for financing new infrastructure construction and operations and can help fund bicycle and pedestrian improvements. Impact fees are assessed through an impact fee program.
New Construction	Varies	Varies	Washington City	Future road widening and construction projects are methods of providing bicycle and pedestrian projects. To ensure that roadway construction projects provide infrastructure where needed, it is important that the review process includes a designated bicycle and pedestrian coordinator or similarly assigned liaison at the City. Planned roadway improvements in Washington City should include bikeways and walkways per the revised standard roadway cross sections.

Table 5.7. County Funding Options

Funding Opportunity	Eligible Projects	Qualifications	Lead Agency	Description
Sales Tax	Local roadways, transit, bicycle and pedestrian projects	Varies	Washington County	As permitted by Utah state legislation, voters can approve a 0.25 cent sales tax increase to fund local roadway, transit, bicycle, and pedestrian projects (Prop 1). More than 10 counties in Utah approved this proposition and sales tax in the November 2015 general election. Washington County's first attempts to pass Prop 1 failed, but future attempts may be successful and provide funding for walking and bicycling projects. http://tax.utah.gov/salestax/rate/17q2combined.pdf
Recreation, Arts, and Parks (RAP) Tax	Parks, trails, recreational facilities	Varies	Washington County	The Recreation, Arts, and Parks (RAP) tax is a local option sales tax approved by the voters administered by Washington County and municipalities. Funds generated support the development or improvement of parks, trails, and recreational facilities within the County's municipalities and unincorporated areas. Applications must be emailed to the Deputy County Clerk in September. It includes a form available online in which project description, merit, and budget are detailed. An additional budget worksheet also needs to be included which provides more information on the project's resource allocations. https://secure.washco.utah.gov/rap/

Table 5.8. State Funding Options

Funding Opportunity	Eligible Projects	Qualifications	Lead Agency	Description
Highway Safety Improvement Program (HSIP)	Infrastructure and program safety improvements	Public road with a correctable crash history, expected to reduce crashes, positive cost-benefit ratio, or, a systemic safety project	UDOT Traffic & Safety	Program purpose is to reduce fatalities and serious injuries on public roads through infrastructure and programs. Like SSIP, HSIP can fund low cost, systemic improvements if benefit-cost is met. The Traffic & Safety Division uses statewide hot spot and systemic modeling to pinpoint locations where crashes have occurred or where the models suggest crashes are likely to occur in the future. http://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:2933,
Spot Safety Improvement Program (SSIP)	Infrastructure and program safety improvements	Location is crash-frequent, similar quals to the HSIP	UDOT Traffic & Safety	Because SSIP is only state, and not federal, money, spending can be more flexible to fix crash-prone locations. http://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:575,
UDOT ADA Ramp Funding	ADA-related improvements	For missing ADA ramps on State routes only	UDOT	Title II regulations under the Americans with Disabilities Act (ADA) (1990) require the Utah Department of Transportation to apply the minimum design standards, developed by the U.S. Access Board, when constructing or altering pedestrian facilities. Applications are submitted to the Region Coordinator. Missing ramps can be found in the UDOT database from a recent survey of ramps. http://udot.utah.gov/main/uconowner.gf?n=13652716548952568
Safe Sidewalks Program	Sidewalks	Sidewalks on State routes only	UDOT	The Safe Sidewalks Program provides a legislative funding source for construction of new sidewalks adjacent to state routes where sidewalks do not currently exist and where major construction or reconstruction of the route, at that location, is not planned for ten or more years. (1) Located adjacent to a State highway; (2) Located within an urban area or an area where the immediate environment of the project is of an urban nature; (3)Significant pedestrian traffic; and (4) 25% local government match. https://www.udot.utah.gov/main/f?p=100:pg:0::::V,T:,583
State-Administered Community Development Block Grants (CDBG)	Street improvements	Best if project benefits low or moderate-income populations and part of a consolidated plan	HUD, State, and Local Gov't	The Grantee cannot be a principal city of a metropolitan statistical area, a city with more than 50,000 population, or a county with a population with more than 200,000 (which would qualify Washington City and County to apply). http://www.jobs.utah.gov/housing/cdbg

Table 5.8 (cont.). *State Funding Options*

Funding Opportunity	Eligible Projects	Qualifications	Lead Agency	Description
Surface Transportation Block Grant Program (STBGP)	Bicycle and pedestrian improvements, recreational trails	Project activities to be funded should be included in a federally approved statewide transportation improvement program (STIP) for capital projects or a unified planning work program (UPWP) for planning projects	DMPO, UDOT	In the new 2016 federal transportation act (FAST), the former Surface Transportation Program is now known as the Surface Transportation Block Grant Program (STBGP) and includes the Transportation Alternatives Program (TAP) in the form of set-aside funds. The Transportation Alternatives (TA) set-aside funds authorizes funding for projects and programs that include pedestrian and bicycle facility improvements, non-driver access to transportation, safe routes to school projects, recreational trail projects (former Recreational Trails Program) among others. Dixie MPO (DMPO) accepts concept reports for consideration of programming funds. This program has a state and an MPO component. The application process can include submitting a letter of intent containing project name, project limits, a brief project description, the type of funds being sought, and an estimated cost. Letters of intent usually need to be signed by town officials such as the Mayor, Commissioner, or executive director of the sponsoring agency. https://www.udot.utah.gov/main/uconowner.gf?n=32453816442886810
State Legislation	Legislation dependent	Legislation dependent	State Legislature	State legislation can create laws that have dedicated bicycle funding components. Two examples of this are the Oregon “bike bill” which requires including bicycle and pedestrian facilities when any road, street or highway is built or rebuilt (http://oregon.gov/ODOT/HWY/BIKEPED/Pages/bike_bill.aspx) and the California Active Transportation Program grants, which provide state funds to cities and counties wishing to improve safety and convenience for bicyclists and pedestrians (http://www.dot.ca.gov/hq/LocalPrograms/atp). Contact state legislators and/or reach out to local smart growth organizations to draft bill or initiatives that can foster active transportation.
Utah Outdoor Recreation Grant	Trails and recreational amenities	For building of infrastructure (not for planning). Projects must offer economic opportunities for the community and be of public access	Utah Governor's Office of Economic Development	The goal of this grant is to help communities create trails and recreational amenities to boost local economies. Recreational opportunities attract visitors and help increase residents' quality of life. Applications include an online form and submittal of maps, and design plans, timeline, letters of support, financial documentation, environmental analysis and special permits. Grant application workshops are offered throughout the year. http://business.utah.gov/programs/office-of-outdoor-recreation/office-of-outdoor-recreation-grant-program
B&C Road Funds	Projects on Class B & C roadways	Construction, maintenance and highway related purposes on eligible and public B & C roads	UDOT	The Class B & C road system with a funding program was established by the Utah Legislature as a means of providing assistance to counties and incorporated municipalities for the improvement of roads and streets throughout the state. The B & C Regulations Document designates those regulations which are acceptable to the Utah Department of Transportation (UDOT) in the administration of funds for counties, cities, and towns provided for by the Utah Legislature. The Appendix includes the Statutory Provisions relating to "B" & "C" Road Funds. Washington City has used B&C road funds to maintain roughly 450,000 square feet of pavement in the city within the last five years. https://www.udot.utah.gov/main/f?p=100:pg:0::::V,T:,134
Statewide Transportation Improvement Program (STIP)	Highway and transportation projects	Projects that address pavement/bridge conditions, safety needs and capacity needs	UDOT	The Statewide Transportation Improvement Program (STIP) is a plan of highway and transit projects for Utah which compiles transportation projects happening around the state and ensures compliance with the FAST Act. A STIP plan is produced each year with recommendations from various groups such as UDOT, transit groups, MPOs, RPOs and others. In order to apply for Surface Transportation Block Grants (STBPG) established by the FAST Act, the projects must be identified in the STIP plan. Active transporation projects funded through this process include trails and alternative transportation, safe routes to school, and rails to trails. Coordinate with MPO for proposing projects to be included in the STIP plan before the region workshops in January. https://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:40,

Table 5.9. Federal Funding Options

Funding Opportunity	Eligible Projects	Qualifications	Lead Agency	Description
Transportation Infrastructure Finance and Innovation Act (TIFIA) Loans	Highway, transit, freight, rural infrastructure and TOD projects	Varies according to the eligible project type	USDOT	These loans are not a funding source but do provide financing options, including credit assistance in the form of direct loans, loan guarantees, and standby lines of credit for large surface transportation projects of national or regional significance, as well as public-private partnerships. Begin process with submission of a Letter of Interest, determine eligibility. https://www.transportation.gov/buildamerica/programs-services/tifia/applications
BLM Challenge Cost Share (CCS) Grant Program	Recreation projects or projects that protect resources	Helps manage cultural, recreation, and wildlife resources; enhances recreation experiences	BLM, Dep't of Interior	Grants up to $200,000. Program's goal is to promote cost-share partnerships with non-federal entities that would benefit public land management; can fund construction or maintenance. https://www.grants.gov/web/grants/view-opportunity.html?oppId=283135
Land and Water Conservation Fund (LWCF)	Bicycle and pedestrian paths and trails, or acquisition of land for paths and trails	Projects that create outdoor recreation facilities, or land acquisition for public outdoor recreation	DNR	Provides matching grants to state and local governments for the acquisition and development of public outdoor recreation areas and facilities. The program is intended to create and maintain a nationwide legacy of high quality recreation areas and facilities and to stimulate non-federal investments in the protection and maintenance of recreation resources. 50/50 match is required and the grant recipient must be able to fund the project completely while seeking reimbursements for eligible expenses. Applications are evaluated on how the project addresses outdoor recreation needs from the Utah State Comprehensive Outdoor Recreation Plan, application completeness, technical merits, previous recreation program performance, project readiness, availability of local funding, and site visit/inspection. The Washington City Park and Pool were funded under this grant. http://stateparks.utah.gov/resources/grants/land-and-water-conservation-fund
Rivers, Trails, and Conservation Assistance Program (RTCA)	Planning assistance for bicycle and pedestrian projects	Staff support for facilitation and planning	National Park Service	Projects related to conservation and recreation, with broad community support, and supporting the NPS's mission. Applicants must submit application, including basic information as well as letters of support, by August 1 annually. Nearby funded projects: Panguitch Trailhead Kiosks. https://www.nps.gov/orgs/rtca/index.htm
Transportation Investments Generating Economic Recovery (TIGER)	Shovel ready, surface transportation projects	Positive estimated cost-benefit ratio meeting federal transportation goals, benefiting country as a whole	USDOT, State and Local Gov'ts	Projects involving highways, bridges, bicycle and pedestrian facilities, transit, rail, and intermodal are eligible. Applicants must also include a project information form detailing the specifics of the project. https://www.transportation.gov/tiger
Partnership for Sustainable Communities Grants	Based on five Livability Principles, including bicycling/walking infrastructure	Varies	PSC	Joint project of the EPA, HUD, and USDOT. Aims to "improve access to affordable housing, more transportation options, and lower transportation costs while protecting the environment in communities nationwide". https://www.sustainablecommunities.gov/partnership-resources
Enhanced Mobility of Seniors and Individuals with Disabilities	Bicycle infrastructure, sidewalks, curb-ramps, wayfinding	Bicycle and pedestrian improvements that provide access to an eligible public transportation facility and meet the needs of the elderly and individuals with disabilities	FTA	This program is intended to enhance mobility for seniors and persons with disabilities by providing funds for programs to serve the special needs of transit-dependent populations beyond traditional public transportation and paratransit services. https://www.transit.dot.gov/funding/grants/enhanced-mobility-seniors-individuals-disabilities-section-5310
Federal Lands Access Program (FLAP)	Bicycle and pedestrian projects connecting to public lands	Projects must connect to federal land	FHWA	Priority is given to projects accessing high-use Federal recreation sites or Federal economic generators. Next call will be on January 13, 2020. To get started, meet with federal land managers who might have projects in mind, then call state FLAP contacts to learn more about the process. https://flh.fhwa.dot.gov/programs/flap/

Table 5.10. *Private, Non-Profit, and Corporate Funding Options*

Funding Opportunity	Eligible Projects	Qualifications	Lead Agency	Description
Cambia Health Foundation Children's Health Program	Programs and possibly infrastructure	Projects must improve access to healthy foods, recreation facilities, and encourage healthy behavior in families	Cambia Health Foundation	Grants are typically $50,000-$100,000, focusing on programs. http://www.cambiahealthfoundation.org/programs/childrens-health
People for Bikes Community Grants	Paths, rail trails, mountain bike trails, bike parks, BMX, advocacy	Project funding should leverage federal funding and build momentum for bicycling	People for Bikes	People for Bikes have awarded more than $2.9 million in grants, leveraging nearly $670 million in public & private funding. This grant program is funded by partners in the bicycle industry. http://www.peopleforbikes.org/pages/community-grants http://www.peopleforbikes.org/pages/apply-now
REI Grants	Preservation and restoration	Non-profit, partner with local store (SLC)	REI Foundation	REI has awarded $4.2 million in grants to more than 300 non-profits for preservation and restoration projects in 650 locations. After a store/ non-profit relationship is established, REI asks the non-profit to apply for grant funding. Unsolicited grant applications are usually not considered. https://www.rei.com/stewardship/community/non-profit-partnerships-and-grants.html
Community Fundraising	All	Small dollar amounts	Local Gov't, agency, or non-profit	Lead agency manages the details, marketing, and range of community fund raising campaign. Successful examples include use of volunteer labor for path construction near Zion National Park in Springdale, Utah. http://www.pedbikeinfo.com/data/library/details.cfm?id=2805
IRONMAN Foundation Grants	Bicycle lanes and paths, trails (especially near IRONMAN race locations)	Projects must meet identified needs specific to that race community	The IRONMAN Foundation	IRONMAN reaches a variety of worldwide charitable organizations through several programs of the IRONMAN Foundation. Through the community fund, the IRONMAN Foundation provides funding opportunities as a way of leaving the IRONMAN legacy behind in race communities. Identify local non-profits (like SUBA) for potential parternships and grant application. Local IRONMAN Foundation-funded projects include bicycle-friendly speed humps in Snow Canyon State Park and bike racks at Sunset Elementary School in St. George. http://ironmanfoundation.org/grants/community


Washington City
Where Dixie Begins

Appendix A:

Recommended Changes to the Washington City Construction Design Standards

Because of the length of the original Construction Design Standards document, only the pages with recommended changes (in red) are included in this Appendix. Page numbering (centered) is shown for reference only.

FINAL INSPECTION: An inspection of the work, which is conducted by the City's Representative(s) and other necessary parties after said work is fully completed.

FIRE CHIEF: The officially appointed person designated as the City Fire Chief for the City of Washington or his designated representative.

FLOOD PLAIN: That area of a channel, river or other watercourse and the adjacent land areas, which are inundated during abnormally high water (flooding) generally associated with a 100-year or 500-year flood event.

FLOOD WAY: The area of the flood plain that is or must be reserved in order to pass the 100-year flood event in accordance with applicable regulations and which shall not be encroached upon by construction, fill or other development.

GEOTECHNICAL ENGINEER: That Professional Engineer registered with the Utah State Department of Business Regulation and licensed to practice as a Professional Engineer in the State of Utah specializing in geotechnical investigations, which has been retained to investigate soil and other similar conditions and submit recommendations and/or reports concerning said conditions.

HILLSIDE DEVELOPMENT STANDARDS: The standards as noted in the City of Washington Hillside Ordinance used in all hillsides overlay zones.

INSPECTION PUNCH LIST: A written list of work discrepancies and deficiencies compiled by the City's Representatives and others during a final or other inspection.

I.T.E.: The Institute of Transportation Engineers.

JOINT UTILITY COMMITTEE (JUC): A formal group of representatives from public and private utility companies in the Washington area that meet as needed to review and approve utility plans as required.

LAWS AND /OR REGULATIONS: Any federal, state, county, city, or local jurisdiction's laws, rules, regulations, ordinances, codes, and orders.

MAXIMUM DRY DENSITY: The Maximum Dry Density as determined by ASTM Standard D-1557.

NACTO: The National Association of City Transportation Officials, publishers of the "Urban Bikeways Design Guide", "Urban Street Design Guide", and "Urban Transit Design Guide".

MUTCD: "The Manual of Uniform Traffic Control Devices", latest edition and revisions as published by the U.S. Department of Transportation, Federal Highway Administration.

Local access shall be maintained to all properties on the project at all times. When local access cannot be maintained, the Contractor must notify the affected property owner at least twenty-four hours in advance. Access shall be restored the same day of completion of work which caused loss of access.

A temporary traffic lane shall not be open to traffic unless it is paved with hot mix or cold mix asphalt or is graded reasonably smooth and maintained dust free as directed by the City's Representative.

Arrangements for partial or complete street closure permits shall be obtained through the City Engineer or his designated representative. An advance notice of forty-eight hours for major streets and twenty-four hours for local streets and alleys is required. The Contractor shall be required to notify all emergency services (ambulance, fire, etc.) and all other necessary parties as dictated by the City's Representative.

The Contractor is responsible for all barricading, 24-hours a day, 7-days a week. In the event of inclement weather conditions, such as windstorms, rainstorms, etc. the Contractor (or his authorized representative) shall immediately inspect his work area and take all necessary actions to insure that public access and safety are maintained. In general trenches and excavations shall not be left open or uncovered over night. Special conditions may be given consideration by the City's designated representative.

The Contractor shall maintain all existing, STOP, YIELD, street name signs and other traffic control devices until such time as construction requires their removal. At that time the Contractor shall obtain authorization from the City to remove said signs and posts without damage and deliver them to a storage site as directed by the City Representative. When required, the Contractor may need to install temporary signs (i.e., regulatory signs) until such time as permanent signs can be reinstalled, and the City will reinstall all traffic signs.

If at any time project construction shall require the closure or disruption of traffic in any roadway or alley such that normal refuse collection will be interfered with, the Contractor shall, prior to causing such closure or disruption, make arrangements with the appropriate refuse removal service in order that collection service can be maintained.

The Contractor shall provide the City's Representative with a 24-hour emergency phone number of his representative(s) responsible for maintenance of barricades, warning signs and other traffic control devices.

2.5.2 BICYCLE AND PEDESTRIAN CONSIDERATIONS. Efforts should be made to accommodate the needs of all road users (motorists, bicyclists, and pedestrians, including those with disabilities or visual impairments) within all work zones. If accommodation is not possible or practical, effective alternative routes must be provided and comply with the current *Americans with Disabilities Act* (ADA) and Part 6 of the MUTCD.

The placement of additional temporary signing and Traffic Control Devices (TCD) for the control of non-motorized vehicles and pedestrians should be considered where a reasonable volume of users is expected and where work is expected to last longer than one hour.

The contractor should make every practical effort to satisfy the following:
1. Match the level of accommodation to the existing facilities available prior to the work.
2. Use appropriate TCD to keep bicycles and pedestrians outside active work spaces and away from work equipment.
3. Avoid placing bicycles and pedestrians in conflict with traffic, work site vehicles, materials, or operations.
4. If using an alternate route, provide sufficient and appropriate advance warning and detour signing for bicycles and pedestrians.
5. If a bicycle facility exists, maintain a 4-foot minimum width for bicycles, unless an alternate route is provided.
6. If the work will impact the sidewalk or pedestrian path, the pedestrian shall be provided a safe and accessible path that replicates, as nearly practical, the characteristics of existing facilities.
7. If work closes a sidewalk or sidewalk ramp, close sidewalks at a point where there is an alternate way to proceed or provide an alternate route for pedestrians.
8. Steel plates shall be discouraged, so as to maintain a safe route for bicycles and mobility devices.

Refer to Chapter 6D of the MUTCD for additional pedestrian safety information.

2.6 COOPERATION WITH UTILITIES. The Contractor will notify the City and other private and public utility companies and or other parties affected. And endeavor to have all necessary adjustments of the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction, made as soon as practicable.
The Contractor shall comply with the requirements of the Blue Stake one call system, in notification to the interested utility owners prior to start of construction. The Contractor shall resolve all problems with the utility owners concerned.

Where water users' association facilities obstruct construction of the work, the Contractor shall contact officials of the association relative to the shutdown of irrigation water and shall acquaint him with and conform to the requirements of the association.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cable ways, signals and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted by or under the direction of the facility owners at no expense to the City.

2.7 COOPERATION BETWEEN CONTRACTORS. The City reserves the right at any time to contract for and perform other or additional work on or near the work being done.

When separate contracts are let within the limits of any one project, each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being

Contractor to hire a licensed Surveyor to properly reference the monument, unless otherwise directed.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, defective work or materials, or misconduct in his manner or method of executing the work, or in consequence of the non-execution thereof by the Contractor, he shall restore, at his expense and at no cost to the City, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or he shall make good such damage or injury in an acceptable manner. Said responsibility shall not be released until the project has been completed and accepted. The Contractor shall not dump spoil or waste material on private property without first obtaining written permission from the property owner. All such dumping shall be in strict conformance with the Grading and Drainage Ordinances.

Prior to any construction in front of driveways the Contractor shall notify the property owner twenty-four hours in advance. Inconvenience caused by construction across driveways and sidewalks shall be kept to a minimum by restoring the serviceability within twenty-four hours, or as otherwise approved by City's Representative. If it is necessary to leave open excavation for a longer period of time the Contractor shall provide structurally adequate steel plates to bridge the excavation. Construction zone guidelines for safe accommodation of bicyclists and pedestrians is found in 2.5.

2.11 SURVEY MONUMENTS. Class I or Class II survey control monuments (as shown in the standard drawings of these specifications) shall be installed on all dedicated and private streets. All survey control monuments shall be installed in strategic locations (as determined by the City's Representative) so as to insure adequate survey control required for subsequent resurvey in the area.

All Class I monuments shall be cross tied and referenced to permanent features and mapped sufficiently for future use in relocation and replacement. All cross tie information shall be submitted to the City Surveyor and should also be kept in a permanent record by the Professional Surveyor doing the work.

Any section, witness or reference corners which fall within roadway or parking lot construction areas shall be reset with a Class I type monument with appropriate cap (as shown in the standard drawings). All corners being replaced shall be referenced in a manner as to accurately reset the corner. A copy of the field notes shall be submitted to the appropriate public agency surveyors for approval before corners are destroyed. The appropriate public agency surveyors (City or county) shall give direction on requirements for referencing of corner(s) to be replaced and the method of reinstallation prior to corner(s) being destroyed.

2.12 HAZARDOUS MATERIALS DISCOVERIES. If suspected hazardous materials (including chemicals, petroleum products, etc.) are encountered, construction operations shall be immediately stopped in the vicinity of the discovery and the proper authority shall be notified of the nature and exact location of the findings. The Contractor shall secure the site of the discovery and shall provide written confirmation of the discovery and proper notification to the City's

SECTION 3

DESIGN STANDARDS

3.1 GENERAL. This section defines design requirements for public improvements. It is not the intent of these standards to restrict professional judgment, but rather to serve as a guide and to establish consistency in design. As determined by the City Engineer, all existing improvements related to the project or within the boundaries of the project shall be brought up to current standards.

These standards are the minimum required and should be considered as such.

It is recommended that the Engineer in charge review each project on its own merit and impose a higher professional standard as necessary for each project.

3.2 STREET DESIGN. All streets shall be designed to conform to the standards and technical design requirements contained within this sub-section. The latest editions of AASHTO, a policy on geometric design of highways and streets, shall, and AASHTO, Guide for the development of bicycle facilities, and AASHTO, Guide for the Planning, Design, and Operation of Pedestrian Facilities should be used as a supplement to these guidelines. In cases of conflict, a determination shall be made by the City, which determinations shall be final.

3.2.1 STREET CROSS-SECTION STANDARDS. Requirements for the street cross-section configurations are shown in Table 3.1. These requirements are based on traffic capacity, design speed, projected traffic, system continuity and overall safety.

All new developments shall use street cross-sections with fifty feet (50) or more of right-of-way for public streets and a minimum of thirty-four (34) feet for private. Access to multi-family or commercial developments, shall use street cross-sections with sixty (60) feet or more of right-of-way.

Alternate road cross-sections incorporating the use of a planting strip may be permitted, if applicable safety and traffic standards are met and approved by the City Council.

3.2.2 ROADWAY NETWORK DESIGN. New roadway networks shall be designed in accordance with the general planning concepts, guidelines, and objectives provided within this sub-section.

- The "Quality of Life" for residential occupants shall be a primary concern when designing a residential roadway network.
- An emphasis on proper street hierarchy should be adhered to, namely, local streets should access residential collectors; residential collectors should access major collectors; major collectors should access minor.

- An emphasis on access management should provide control of the location, design, and operation of all driveways, median openings, and street connections to a roadway. (See access management guidelines)
- Substantial increases in average daily traffic, due to development of adjacent property on established streets not originally designed to accommodate such increases should be avoided.
- Drainage methods should concentrate on meeting the drainage needs while not impeding the movement of traffic (see drainage guidelines).
- Roads should be designed to lie within existing topographic features without causing unnecessary cuts and fills.
- A reduction in the use of cul-de-sacs should be emphasized in order to provide greater traffic circulation and less volume on collector roads. Circulation is of the up most importance, long blocks and excessive dead end streets should be avoided.
- Stopping sight distance must be considered at all intersections and curves to ensure the safety of the public, in accordance with AASHTO standards.
- Pedestrians and bicycle traffic should be considered in the planning and design of all developed streets.
- Gaps in pedestrian and bicycle facilities are discouraged, particularly when development is capable of completing or filling existing gaps. Sidewalks, trails, and bicycle facilities should be included in improvements whenever possible.

[Modifications to Table 3.1 are recommended in Chapter 3 of the Active Transportation Plan but are not reflected in these revisions. Those changes may be adopted and reflected in the table below as part of the update of the Washington City Transportation Master Plan at a later date.]

Table 3.1
Street Cross-section Configurations

Classification	Minimum ADT or [D.U.=s]	Traffic Index	Maximum Grade (%)	Right of Way (feet)	Pavement Width [1] (feet)	Sidewalk Width (contiguous (feet)
Private	<100[2 to 10]	5	15	34	30	4' minimum on at least 1-side
Residential[8] Access	<100 [2 to 10]	5	15	36	27	4
Residential Standard	510 to 1,250 [51 to 125]	5	15	50 [2]	35	4
Residential Collector	1,260 to 2,000 [126 to 200]	5.5	15	60 [2]	42	5
Major Collector [5]	2,010 to 6,000 [201 to 600]	6	12	66	46	5[3]
Minor Arterial [5]	6,000 to 20,000	7	10	80	65	6[4]
Arterial Major [5]	>20,000	8	8	>100	as req.	6 (min)
Commercial Local	NA	10	8	60 [6]	45	5[7]
Industrial Local	NA	10	6	66 [6]	45 [6]	5[7]

1 Pavement width measured from lip of curb to lip of curb.
2 A four-foot wide or wider planter strip may be placed within right-of-way widths shown. For residential roads use a four -foot sidewalk when planter strips is used.
3 A planter strips may be placed between back of sidewalk and any wall, fence, hedge, etc. This area can be private or public. If public, a 72-foot right-of-way will be required. Alternate sections with meandering sidewalks may be proposed.
4 Same as note (3) except no additional right-of-way dedication will be required.
5 Configuration of major collector and higher classifications may be adjusted with proper justification and approval of City Engineer.
6 The minimum right-of-way and pavement width is shown. Each may be increased when required by a traffic impact study.
7 Same as note (3) except a minimum of 66foot right-of-way for commercial with a 5 foot sidewalk local and 7 foot right-of-way for industrial local will be required.
8. In special circumstances (hillside road serving less than 10 single family dwelling units, and cul-de-sac street less than 600 feet in length AND serving less than 10 single family dwelling units), a cross-section of 36 feet may be acceptable or residential access streets at the discretion of the City Engineer. The pavement width for this special circumstance shall be 27 feet (measured lip of curb to lip of curb) and the sidewalk width shall be 4 continuous feet on 1 side.

3.2.3 IMPROVEMENT REQUIREMENTS. All improvements including, but not limited to the following, shall be constructed in accordance with the standard specifications and drawings unless otherwise approved.

3.2.3.1 CURB, GUTTER AND SIDEWALK. Required curb, gutter and sidewalk shall be constructed.

3.2.3.2 DRIVEWAYS. Driveways shall be constructed in approved locations in reference to the Current Access Management Plan.

3.2.3.3 PAVEMENT. All streets, public or private, shall be surfaced to grade, with asphalt concrete pavement, to the required minimum width and thickness in accordance with these specifications.

3.2.3.4 STREET LIGHTING. Street lighting shall be provided on all streets. The construction on public streets shall be in accordance with the standard drawings and these specifications. Standard Public street lights may be installed on private streets upon agreement with the City and the local power agency when applicable. Cobra Head type streets lights shall be placed on all collector and arterial roadway and at all intersections. Pole spacing shall not be less than 200ft or more than 300ft. Street lights installed within a subdivision shall be placed at each intersection, ends of cul-de-sacs and knuckles. Spacing shall be approximately 300ft. Other lighting may be required as determined by the City. Approved decorative lighting will be allowed within a project as approved by the City.

3.2.3.5 CROSS GUTTERS. No cross gutters shall be allowed across major collector or major and minor arterial streets. On commercial and industrial streets, cross gutters are generally not allowed and require approval by the City Engineer for their use. The City Engineer may prohibit construction of cross gutters on any street deemed necessary.

3.2.3.6 ~~HANDICAP~~ ACCESSIBLE CURB RAMPS. When new construction occurs ~~handicap~~ accessible curb ramps shall be constructed at all street intersections, in accordance with current ADA standards. In addition, when a project occurs where existing improvements are in place, ~~handicap~~ curb ramps shall be upgraded to meet current ADA standards. On collector and arterial roadways, perpendicular curb ramps, rather than diagonal, shall be constructed whenever feasible. These are recommended, but not required, on residential roadways.

3.2.3.7 PAVED ROADWAY MEDIANS. Medians on public roadways may be allowed when approved by the City Engineer. Design and construction shall be in accordance with applicable standards.

3.2.3.8 MINIMUM ACCESS. Proposed developments shall have only the required number of accesses to adequately address the needs of the development and only at approved locations. Too many access points or access on major routes hinder the safety and efficient travel of pedestrians, bicyclists, and vehicles using these routes. In addition, too few accesses can stifle circulation and unnecessarily concentrate traffic at selected locations.

3.2.3.9 DRAINAGE. Adequate drainage facilities shall be installed to properly conduct runoff from the roadway. Sub-drains and surface drainage facilities shall be designed in accordance with the approved drainage study. Cross gutters shall be used sparingly to maintain the public's driving comfort and in accordance with these specifications. Drainage facilities shall be installed out of bicycle and pedestrian travel ways (i.e. bicycle-friendly drainage grates in gutter pan; curb inlets that do not project into shoulder) to maintain consistent travel surfaces.

3.2.3.10 TRAFFIC CONTROL DEVICES. Appropriate traffic control devices and street signs, as required by the City Engineer, shall be installed in accordance with the MUTCD.

3.2.3.11 PAVEMENT MARKINGS. Appropriate pavement markings, as required by the City shall be installed in accordance with the MUTCD.

3.2.3.12 OTHER IMPROVEMENTS. The above required improvements are not all inclusive. Other improvements needed to complete the development in accordance with current engineering and planning standard practice may be required by the City Engineer.

3.2.4 TECHNICAL DESIGN REQUIREMENTS. The following requirements apply to public streets.

3.2.4.1 STREET GRADES

A. All street grades shall have a maximum grade as shown in Table 3.1

B. A written request to increase the maximum street grades shown in Table 3.1 may be considered upon submittal of a request and information justifying such a request to the City Engineer. Request for approval must be based upon and in accordance with the latest edition of AASHTO's "Policy on Geometric Design of Highways and Streets" guidelines. Any approvals for increased grades must be consistent with access requirements of fire apparatus as defined by the Fire Department. The City Engineers decision will be final. Cost of construction will not be justification for approval.

3.2.4.2 INTERSECTIONS

A. All street intersections should intersect at ninety degree angles.

order or classification of street.

K. Residential and commercial developments are generally required to provide at least two improved accesses to the development depending upon the forecasted traffic volumes. Adjacent developments may be required to combine or share driveway access to public roadways. Projected traffic volumes shall be calculated using the criteria outlined within the Transportation Master Plan.

L. Covered driveways will not be allowed unless approved by the City Engineer.

M. The minimum effective radius allowed for a residential street at the PC shall be 20 feet. Roads with asphalt width of more than 35 feet, or roads connecting to a road with more than 35 feet of asphalt in width, shall have a minimum radius as determined by the City and which are sensitive to type of street, lane configuration, parking, and/or or bike lanes. In all cases, the chosen radii length shall improve safety and comfort for non-motorized users by encouraging predictable turning movements and speeds. All ~~radiuses~~ radii are measured at the TBC (top back of curb).

3.2.4.3. INTERSECTION SPACING. Reference Access Management Plan. The City Engineer shall review and give final approval to any intersection request on arterials.

3.2.4.4 MAXIMUM DESIGN VOLUME

A. The maximum design volume shown on Table 3.1 shall be used unless otherwise approved by the City Engineer. A request to increase these volumes may be submitted for consideration to the City Engineer. This request shall include all necessary and required information including support and justification from the Traffic Impact Study.

Conditions which must be considered when reviewing a request for an increase in maximum design volume include hillsides, safety, parking, traffic studies, access requirements, etc.

3.2.4.5 CUL-DE-S~~E~~AC STREETS

A. Such streets shall not exceed six hundred (600') feet in length as measured from center of cross street to center of Cul-de-sac. The turn-around pavement radius shall not be less than forty-two and one-half feet (42 1/2') (50 feet at property line). Commercial pavement radii shall be no less than forty-seven and one-half feet (47 1/2') (55 feet at property line). No road shall be ended without a properly designed cul-de-sac turnaround unless otherwise approved by the City Engineer. Major collectors and higher order roads shall not be permanently dead-ended.

3.2.4.6 SIDEWALKS

A. Pedestrian Access shall be required in all residential and commercial developments. See Table 3.1.

B. For developments which are within hillside areas, see the City of Washington Hillside Ordinance.

C. Sidewalks in areas of high pedestrian traffic may require greater width as determined by the City Engineer.

3.2.4.7 ~~MEANDERING~~ SIDEWALKS (CONT.). Minimum sidewalk width shall be not less than 4 5 feet. Meandering ~~and/or elevated~~ sidewalks may be approved on a case by case basis, but are discouraged because they create unnecessary changes of direction of travel for users of mobility assistance devices, are costlier for developers to build and for the City or homeowner to maintain, and are often superfluous to a safe and efficient pedestrian network. All sidewalks shall conform to the materials, practices and designs as stated within this Construction Design Standards.

Additional design standards and requirements for ~~the meandering and /or elevated~~ sidewalks are as follows:

~~A. "Meandering/elevated" sidewalks are those that are not connected to any other street improvements (e.i. i.e. curb & gutter); this shall include any sidewalks parallel to the road, straight or curving meandering.~~

~~B. For a fifty foot (50') or less road cross-section a minimum width for his meandering sidewalk shall be four feet (4').~~

~~C~~ A. ~~For roads larger than fifty foot (50')~~ ~~r~~Road cross section ~~a~~ minimum width for ~~meandering~~ sidewalk shall be five feet (5').

~~D~~ B. A maximum grade change of five percent (5%) will be allowed along the running length of a~~n elevated~~ sidewalk.

~~E~~ C. ~~The meandering~~ ~~s~~Sidewalk shall not be greater than eighteen (18) inches above or below the top back of curb, with a maximum slope to the curb of 4:1.

~~F~~ D. At the project boundaries the sidewalk must connect to the back of the curb, or align with connecting sidewalk on adjacent property, if present.

~~G~~ E. Where any sidewalk connects with any trails, paths and/or other sidewalks that are larger or smaller in width, a 10:1 transitional area will be required.

~~H. The minimum centerline radius of the meandering sidewalk on straight runs shall be no less than two hundred feet (200').~~

~~I~~ F. Adequate pedestrian access must be provide for ingress and egress to the sidewalks from the streets.

~~J~~ G. Additional easements may be required for the placement of meandering sidewalks outside ROW.

~~K~~ H. All pedestrian accesses shall conform to ADA standards.

3.2.4.8 TRAILS All trails must be constructed and designed to the current AASHTO Standards. All trails within 30' (thirty) of a roadway that runs parallel with the roadway, shall be constructed using Portland cement type V concrete material. All other trails shall be constructed with asphalt or concrete. Saw cut joints shall be used on concrete trail surfaces. Other construction materials will require prior approval from the City.

3.2.4.9 CURB AND GUTTER All public and private streets shall have curb and gutter. All public streets shall have HB30-7 curb and gutter. For private streets, the developer may request an optional type of curb and gutter at the time of construction drawing submittal. Approval by the City Engineering is required for any curbing except HB30-7. Depending on the type and location of the curb and gutter requested modifications to the base course and sidewalk thickness maybe required.

3.2.4.10 PLANTER STRIPS

A. Planter strip areas in road right-of-way must be landscaped with at least fifty percent (50), by area, of live vegetation.

B. Xeriscape landscaping must be approved by City's Representative.

C. Planter strips ~~shall not be filled with concrete or other hard surfaces~~ may be paved when narrower than 3' or in commercial areas to allow for greater

pedestrian circulation and flow and to facilitate construction of driveway aprons.

D. Special drainage requirements may be imposed by the City's Representative to protect pavement and curb and gutter from damage due to irrigation of planter strips.

3.2.4.11 DESIGN SPEED

A. The design of geometric features such as horizontal and vertical alignment will depend on the design speed selected for each street. The design speed is primarily determined by the street function and classification, and is the maximum speed for safe and comfortable operation of a vehicle. The use of design speeds other than those listed below must be approved by the City Engineer who may decide that the speed provided in this sub-section be changed to that which is reasonable and prudent under the conditions and having due regard to the actual and potential hazards.

be required in connection with the results of a Traffic Impact Study or by the City Engineer.

E. Where a deceleration lane crosses a driveway, the driveway should be fitted with an abrupt driveway apron to warn vehicles entering and exiting the driveway to look for turning cars and crossing pedestrians.

F. Where a deceleration lane crosses a bike lane or sidewalk, appropriate advance warning signage shall be placed to warn vehicles to be aware of and yield to crossing bicycle and pedestrian traffic.

3.2.4.18 DRIVEWAY PROFILES. The slope of a driveway can dramatically influence its operation. Usage by large vehicles can have a tremendous effect on operations if slopes are severe. The profile, or grade, of a driveway should be designed to provide a comfortable and safe transition for those using the facility, and to accommodate the storm water drainage system of the roadway. Where a driveway crosses a sidewalk, the driveway shall be designed to meet accessibility guidelines (see Design Details for more information).

Suggested treatments of driveway grades are illustrated in below. While 8 percent should be the maximum allowable initial grade (see G1 on figure), maximum grades of 1 to 3 percent are preferable for high-volume driveways and 3 to 6 percent for low-volume driveways.

Driveway Type and Adjacent Street Classification	**Maximum Range for G2**
Low Volume Driveway** on Local Street	-8% to 14%
Low Volume Driveway** on Collector Street	-4% to 8%
Low Volume Drive** on Arterial Street	-1% to 5%
High Volume Driveway*** on Any Street	-1% to 5%
* The preferable grade of G1 is 3% to 6% for low volume driveways and 1% to 3% for high volume driveways. ** Low Volume Driveway - defined as a driveway with less than 100 vehicles in the peak hour in the peak direction. *** High Volume Driveway - defined as a driveway with more than 100 vehicles in the peak hour in the peak direction.	
Maximum suggested change in Grade: G1 - G2 = 12% for any 10 feet of distance without a vertical curve.	

TABLE 3.6
SANITARY SEWER LATERALS

TYPE OF UNIT OR RESIDENCE	MINIMUM SEWER LATERAL SIZE (Diameter)	MINIMUM SLOPE	MAXIMUM SLOPE
Single Family Residences	4 inches	2%	5%
Townhomes (each unit)	4 inches	2%	5%
Multi-family Condominiums	6 inches	1%	5%
Commercial establishments	6 inches	1%	5%
Mobile Homes	4 inches	2%	5%
Apartments	**4 inches minimum (see note below)**		5%

NOTE:
1) Lateral size and slope shall be based on the number of fixture units in the apartment, in accordance with the Uniform Plumbing Code.

3.5.5 MANHOLES. Manholes shall be installed at all changes in grade, direction, pipe size or at all intersections; and at distances no greater than four hundred feet apart. All manholes shall be accessible to maintenance vehicles, and all sewer easements shall provide at least twelve feet of unobstructed width. Drop manholes shall be provided for a sewer line entering a manhole at an elevation of two feet, or more, above the manhole invert. Floor troughs shall be furnished for all sewers entering manholes, and shall be at least as deep as the full diameter of the sewer main in the manhole.

A sewer main or service eight inches or larger connecting to an existing sewer main shall require a manhole at the point of connection. Where the junction consists of the same size sewers, a 0.2 foot drop shall be provided between the branch and main sewer. When a smaller sewer main joins a larger sewer main in a manhole, the top of pipe elevations shall match.

All manholes shall have eccentric manhole cones conforming to the detailed dimensions, construction details and materials as shown in the standard drawings.

Sewer manholes for all sewer mains of less than twelve (12) inches in diameter shall be a minimum four feet inside diameter. For sewers mains twelve inches in diameter or larger or over twelve (12) feet in depth, the manholes shall be not less than five feet in inside diameter. When the sum of all pipe sizes connecting to the manhole totals 24 inches or greater the manhole diameter shall be five feet or greater.

Manhole covers shall conform to the details and specifications shown in the Construction Design Details and shall, where feasible, be placed outside of any bicycle or pedestrian travel way. Manhole covers shall be constructed flush with the roadway surface.

(2) At minimum intervals of five hundred (500) feet in commercially zoned areas.

(3) In residential areas to isolate a maximum of thirty services (approximately six hundred (600) feet).

(4) A maximum of five valves will be required to isolate any location.

(5) Valves shall not be located in street gutters, valley gutters, or in driveways.

(6) Valves should be located outside of bicycle and pedestrian travel ways, wherever possible or feasible.

(7) Valves shall be constructed flush with the roadway surface.

~~(6)~~(8) A valve is required at the end of all temporarily dead-ended mains.

~~(7)~~(9) Valved outlet(s) for future service laterals six (6) inches in diameter and larger may be installed when approved by the City Engineer. (Valved outlet installation approval does not constitute a water commitment.)

~~(8)~~(10) A shut off valve immediately adjacent to the water main shall be provided for all service laterals greater than two (2) inches in diameter and for all fire hydrant laterals.

~~(9)~~(11) The City Engineer may require additional valves as deemed necessary.

3.6.9 NETWORK HYDRAULIC ANALYSIS. Must be preformed in accordance with this section. It shall be the responsibility of the design engineer to have flow tests performed on the existing system for use in the analysis. These flow tests must be performed only by qualified personnel and must be witnessed by the City Engineer.

3.6.9.1 DESIGN. The consulting engineer shall perform a fire flow test as required to satisfy the requirements of this section.

3.6.9.2 SUBMITTAL FOR REVIEW AND APPROVAL. The network hydraulic analysis shall be submitted with the project design for review.
For larger projects, such as a major subdivision, obtaining network hydraulic analysis approval prior to submitting the water plan is preferred. The City Engineer shall, upon request, make a determination as to which submittal method must be followed.

The network hydraulic analysis submittal shall include two copies of the following items:

Asphalt mix shall be deposited in a mass into the haul truck or loading hopper from the silo. The gates on the bottom of the silo cone shall open and close quickly. To prevent segregation, it is also necessary for the gates to open completely so that the flow of mix is unrestricted. The mix shall be delivered in evenly divided drops into the length of the truck bed. In no case shall the truck be loaded continuously by the truck driver moving forward under the silo as the mix is being discharged. Multiple drops of small quantities or dribbling mix into the haul vehicle at the end of the main delivery should be avoided to prevent segregation.

4.5.16 SURFACE PREPARATION FOR ASPHALT OVERLAYS. Prior to placing asphalt overlays, all manholes, utility covers, monuments and other items affected by the paving operations shall be located, referenced and protected. The existing asphalt surface shall be thoroughly cleaned of all deleterious materials and brought to a uniform grade by spot leveling or by the application of a bituminous leveling course to the surface. A bituminous tack coat shall be applied to the existing prepared surface immediately prior to placing the finish asphalt course in accordance with Section 4.5.9 of these specifications. It may be required to remove a section of pavement at each end of the overlay to create a smooth transition onto existing asphalt. A minimum eight foot wide section must be removed. Edges of the section must be saw cut prior to removal. Feathering of the overlay onto existing asphalt will not be permitted. Tolerance between cover and existing roadway surface shall not exceed ½".

4.5.17 ADJUSTMENT OF MANHOLE AND OTHER UTILITY COVERS. Prior to paving and after road base is placed, all manholes shall be brought to finish asphalt grade using concrete and/or expanded polypropylene (EPP) grade rings. Concrete grade rings shall be "wet set" in a bed of non-shrink grout, EPP grade rings shall be installed per manufacturer's recommendations, including adhesives. All other utility covers shall be brought to the base grade. Damaged valve boxes, covers, grade rings, cones, flattops, risers, etc. shall be replaced at this time. Manhole cones or flattops that are more than eighteen inches below finish grade shall be raised by using risers under the cone or flattop. Existing road base shall not be contaminated with soil or sub base. Backfill material around adjusted manholes and utilities shall comply with road base standards meeting Section 4.5.7 of these specifications, and be compacted to ninety five percent as determined by ASTM D-1557-78 or AASHTO T-180 Method D. When paving is complete, all utility covers shall be raised to finished grade, including concrete collars, in accordance with standard requirements.

4.5.18 ASPHALT PAVING EQUIPMENT. A self-propelled paver with a screed unit that provides a smooth, steady pull on the screed arms shall be used. The screed unit shall strike off, partially compact, and iron the surface of the mat at least twelve feet (3.7 m) wide. The screed unit shall be equipped with automatic controls and heaters and vibrators. The screed plate must be smooth and not excessively worn. All screed extensions shall be ridged, or hydraulically extendable. The screed extensions shall maintain the proper elevation and angle of attack to the main screed at all times and shall also be heated and provide vibration. Augers shall adequately feed all areas of the extended screed.

The allowable maximum deviations from the approved Marshall Mix design shall be as follows:

Asphalt content	+/- 0.46%
½" (12.5 mm)	+/- 6.3%
3/8" (9.5 mm)	+/- 5.9%
No. 4 (4.75 mm)	+/- 5.7%
No. 8 (2.36 mm)	+/- 4.8%
No. 200 (.075 mm)	+/- 2.0%

4.5.24.6 ASPHALT PAVEMENT SURFACES.
The completed surfacing shall be thoroughly compacted, smooth and free from ruts, humps, depressions, rock pockets or slick spots. Any ridges, indentations or other objectionable marks left in the pavement's finished surface shall be corrected prior to acceptance.

The paving contractor shall provide adequate quality control during spreading and finishing procedures to meet or exceed the following longitudinal and transverse profiles:

- Longitudinal deviations shall not exceed ± 0.025 foot in 25 feet when checked by a taut string line.
- Transverse deviations shall not exceed ± 0.01 foot in 10 feet when checked with a ten foot straight edge.
- Longitudinal construction joint deviations shall not exceed ± 0.01 foot when checked with a ten foot straight edge.
- he completed pavement surfaces shall be constructed to the required grades and cross sections. When pavement surfaces contact concrete structures such as drainage structures, curbs & gutters, utility vaults, or manholes, the pavement surfaces shall be flush with or above the concrete structures by not more than 0.02 foot.

  All deviations exceeding the specified profile tolerances shall be corrected prior to final rolling.

4.6 BITUMINOUS SEAL COAT (CHIP SEAL). Bituminous surface treatments (chip seals) shall be applied to the road surface only when required, or approved by the City Engineer. The bituminous surface treatment shall consist of an application of bitumen covered with mineral aggregate and rolled to a smooth surface presenting an even texture. If the chip alone is not sufficient to create a smooth and uniform surface with minimal chip migration, a top seal or fog coat should be applied after the chip is spread on the roadway. The materials used in the application of the bituminous surface treatment shall be bituminous mineral and mineral aggregate, as specified below.

The crushed aggregate shall conform to the gradation requirements shown in following table. Crushed aggregate smaller than 3/8" is recommended; ¼" aggregate is ideal to create a smooth and uniform surface.

TABLE 4.11
GRADATION OF AGGREGATE FOR CHIP SEAL COATS

SIEVE SIZE	PERCENT BY WEIGHT PASSING (Ideal)	IDEAL GRADATION TOLERANCE (Percent)
1/2 Inch	100	0
3/8 Inch	95	+/- 5
No. 4	15-10	+/- 5
No. 8	2	+/- 2
No. 200	0.5	+/- 0.5

The initial mineral aggregate used for the production of chips shall be retained on a one-inch sieve prior to being crushed to the gradation specified.

4.6.2 AGGREGATE QUALITY CONTROL. Prior to delivery to the project site the designated wear test, striping test, sodium sulfate test, fracture face count, and gradation tests shall be performed on the crushed aggregate. Each time a source changes said tests will be repeated.

All aggregate (chips) shall be tested for compliance with the gradation and fracture face count during the production of the chips. There shall be no less than one test performed for every five hundred tons of material produced or one day's production, whichever is less. One gradation test and fracture face count test shall be defined as the average results of tests taken on three different samples taken at one particular time.
All material produced shall be stockpiled in designated stockpile site(s).

When chips are delivered to the project stockpile site there shall be one gradation test conducted for every five hundred tons of material. If the gradation test requirements are not met, the City's Representative may require that the failed material be removed from the stockpile. Chips shall be considered to be out of specification if one test (as defined herein above) fails.

The City's Representative will not accept any chips which do not meet all the designated specifications. No reduction in pay or other remedial terms will be allowed or negotiated.

In addition to the random acceptance samples taken at the stockpile, the City's Representative may sample the aggregate from any portion of stockpile which exhibits a non-uniform appearance.

All sewer manhole lids, water valve covers and survey monument covers shall be protected from the application of the seal coat by placing building paper over the lids (cut to the exact dimensions of the lids or collars as directed) prior to the application of the seal coat. At the completion of the sealing operations, all protective coverings shall be removed from said survey monument covers, manhole lids and valve covers. Transitions between covers and new roadway surface shall be made smooth, to ensure safe travel by vehicles, bicycles, and pedestrians. Tolerance between covers and new surface shall not exceed ½".

At the edges of all passes which will form longitudinal joints in the surface treatment (chip seal) the edge of the pass shall be swept clean of all chips for a distance of from four to six-inches back from the edge prior to the application of the adjacent pass to allow for overlap without chip buildup (humps) in the previous pass. Building paper shall be laid on all cross gutters (concrete waterways) to prevent the chip seal from being applied to said gutters. The Contractor shall place building paper at the beginning of all chip passes. Immediately after the chip application, the building paper shall be removed and destroyed.

4.6.4.2 ASPHALT APPLICATION. Application of the bituminous material shall not be permitted until the loaded aggregate trucks, rollers, and chip-spreader are in place and ready to apply, and roll, the cover aggregate. No surface will be chip sealed until authorization to do so have been obtained from the City's Representative. The asphalt material shall be applied at 0.32 to 0.40 gallons per square yard or as determined by the City's Representative and at a temperature between 125 degrees to 185 degrees Fahrenheit. The exact temperature used to apply the bituminous material shall be determined by the City's Representative.

The bituminous material shall be applied by an asphalt distributor, as described above, so that uniform distribution in the quantities specified is obtained over all points of the surface to be treated. All lightly-coated areas and spots missed by the distributor shall be properly treated with bituminous material applied by hand. No more asphalt shall be applied than can be covered with aggregate in sixty seconds or less. Distances between the distributor and chip-spreader shall be as close as possible, but in no case shall the chip-spreader be greater than fifty feet behind the distributor during the chipping operations.

4.6.4.3 AGGREGATE SPREADING. Immediately following the application of the bituminous material, the aggregate shall be evenly spread over the surface at a uniform quantity of twenty-five to thirty (25-30) pounds per square yard of surface area. Upon commencement of the work, and during its progress, the individual quantities of bitumen and aggregate may be varied to meet specific field conditions, as directed by the City's Representative. An adequate supply of aggregate shall be available on the job site to permit continual spreading operations. Aggregate shall be damp (not wet) prior to being spread on the surface. The aggregate shall be spread by using a self-propelled spreader machine (Flarity or equal). The aggregate shall be spread evenly by hand on all areas missed by the aggregate spreader. Back-

spotting or sprinkling of additional aggregate over the areas having insufficient cover shall be done by hand and shall be continued during the operations whenever necessary.

As the distributor moves forward to spray the asphalt, the aggregate spreader shall start right behind it, spreading the damp chips uniformly and at the specified rate. The asphalt distributor shall travel at the same rate of speed as the chip spreader and in no case shall the two machines be separated by more than fifty feet during the sealing process. Operating the chip spreader at speeds that cause the chips to roll over after striking the bituminous-covered surface will not be permitted.

Excess aggregate deposited in localized areas shall be immediately removed with square-end shovels, and in areas where application is insufficient, additional aggregate shall be added by hand prior to the time the asphalt "breaks".

The resulting surface should consist of smooth, longitudinal joints and shall be smooth enough for safe and comfortable bicycle travel.

4.6.4.4 AGGREGATE COMPACTION. The treated surface shall be rolled with rubber-tired rollers immediately after the distribution of the cover aggregate, and rolling shall continue until the aggregate is properly seated in the binder. Rollers shall proceed in the longitudinal direction, working across the treated surface until the entire width and length of the treated surface has been rolled at least four times. All rolling shall be completed within one hour after the application of the cover aggregate. Rollers and gravel trucks shall not be operated at speeds great enough to kick up chips, and in no case shall rollers be operated above ten miles per hour. In all places not accessible to the rollers, the aggregate shall be adequately compacted with pneumatic type hand tampers. Any aggregate that becomes coated, or mixed with dirt or any other foreign material shall be removed, replaced with clean aggregate over a newly-sprayed surface, and then re-rolled as directed by the City's Representative.

Bituminous material and chips shall not be spread more than one hundred feet ahead of completion of initial rolling operations.

No aggregate will be allowed to be swept into the gutters, onto the sidewalks, or thrown onto private property. The Contractor shall be responsible for the clean up of any and all aggregate swept into these areas.

Prior to placing the second chip seal course on streets designated for double chip seals, the first course shall be thoroughly rolled to set the chips, then no less than 24 hours later the excess chips shall be removed. Upon removal of the excess chips, the second course may be applied.

4.6.4.5 LOOSE AGGREGATE REMOVAL. Upon completion of rolling, traffic will be allowed to use the streets at a speed not to exceed fifteen miles per hour for a

Fiber-mesh shall be added only at the concrete batch plant to assure uniform and complete dispersion of the collated-fibrillated fiber bundles into single mono-filaments within the concrete.

4.8.1.3 CURB, GUTTER, SIDEWALK AND BASE MATERIALS. Concrete and base materials shall conform to the following requirements.

A. **GENERAL.** This subsection defines materials, practices and designs to be used in the construction of all public curb, gutter and sidewalk.

All curb, gutter and sidewalk shall consist of air-entrained Type V Portland Cement Concrete and shall be constructed on a prepared sub grade in accordance with these specifications, as well as all trails within 30' (thirty) of a roadway per Section 3.2.4.8 of these standards. All work shall conform to the lines and grades, thickness, and typical cross sections shown on the approved plans or established by the City's Representative.

B. **SUB GRADE.** The sub grade shall be excavated and filled with suitable material, as specified in Section 4.3.2.3 of these standards. All soft, yielding and otherwise unsuitable material shall be removed and replaced with suitable materials as outlined above. Filled sections shall be compacted and extend to a minimum of one (1) foot outside the form lines according to Section 4.3.2.3 of these standards.

C. **GRAVEL BASE COURSE.** A gravel base course consisting of crushed road base gravel shall be placed under all curbs, gutters, driveways, waterways, sidewalks and other miscellaneous flatwork. The gravel base material shall conform to the requirements contained in Section 4.5.7 of these specifications. Where the foundation material is found to be unstable, the Contractor shall furnish and place sufficient additional gravel or other suitable material as directed by the City's Representative to provide an adequate foundation upon which the concrete will be placed.

4.8.2 CONSTRUCTION METHODS AND EQUIPMENT. The methods employed in performing the work, all equipment, tools and machinery, and other appliances used in handling the materials and executing the work shall be the responsibility of the Contractor. The Contractor shall make such changes in the methods employed and in the equipment used as are necessary whenever the concrete being installed does not meet the specifications herein established. These methods shall include, but are not limited to the following:

4.8.2.1 GENERAL CONCRETE PLACEMENT. Generally, concrete shall be placed as follows.

A. **FORMS.** Forms shall be properly built and adequately braced to withstand the liquid weight of concrete being placed in the forms. All linings,

C. **FINISHING.** The concrete shall be finished smooth, by a wood or magnesium float and then given a final surface texture using a light broom or burlap drag unless otherwise specified or directed. Concrete that is adjacent to forms and formed joints shall be edged with a standard jointer or edging tool as shown in the standard drawings. The top, face, and flow-line of the curb, and the top of driveway apron, shall be finished true to line and grade without any noticeable surface irregularities.

The Contractor shall be responsible for neatly stamping an "S" in the curb pan at all sewer lateral locations, a "W" in the curb pan at all water lateral locations along the curb, and an "I" in the curb pan at all irrigation lateral locations along the curb.

The gutter shall not pond water. The surface of the curb and gutter shall not exceed more than one fourth (1/4) of an inch in ten (10) feet. No part of the exposed surface shall present a wavy appearance.

D. **JOINTING.**

D.1 Contraction Joints. Transverse weakened-plane contraction joints shall be constructed at right angles to the curb line at intervals not exceeding the values in accordance with standard drawings. Where the sidewalk abuts the curb and gutter, joints should align unless otherwise approved by the City's Representative. Joint depth shall at least be one quarter (1/4) of the cross section depth of the concrete. Generally, surface areas shall not exceed fifty square feet without contraction joints unless otherwise approved by the City's Representative.
Contraction joints may be sawed, hand-formed, or made by placing division plates in the form-work. For saw-cut joint specifications on trails, see Section 3.2.4.8). Sawing shall be done within twenty four hours after the concrete has set to prevent the formation of uncontrolled cracking. The joints may be hand-formed either by using an appropriate jointing tool, or a thin metal blade to impress a plane of weakness into the plastic concrete, or by inserting one eighth (1/8) inch thick steel strips into the plastic concrete temporarily. Steel strips shall be withdrawn before final finishing of the concrete. Where division plates are used to make contraction joints, the plates shall be removed after the concrete has set while the forms are still in place.

D.2 Expansion Joints. Expansion joints for curb and gutter shall be constructed at right angles to the curb line at no greater than one hundred fifty (150) foot intervals, at immovable structures and at points of curvature for short-radius curves. Spacing for sidewalk expansion joint shall not exceed twenty (20) feet. Filler material for

expansion joints shall conform to requirements of ASTM D-994, D-1751, or D-1752 and shall be furnished in a single one half inch thick piece for the full depth and width of the joint.

Expansion joints in a slip formed curb and gutter shall be constructed with an appropriate hand tool by raking or sawing through partially set concrete for the full depth and width of the section. For saw-cut joint specifications on trails, see Section 3.2.4.8). The cut shall be only wide enough to permit a snug fit for the joint filler. After the filler is placed, open areas adjacent to the filler shall be filled with concrete and then trowel and edged. Contaminated concrete shall be discarded.

Alternately, an expansion joint may be installed by removing a short section of freshly extruded curb and gutter, immediately installing temporary holding forms, placing the expansion joint filler, and replacing and reconsolidating the concrete that was removed. Contaminated concrete shall be discarded.

D.3 Other Jointing. Construction joints may be either butt or expansion-type joints. Curbs and gutters constructed adjacent to existing concrete shall have the same type of joints as in the existing concrete with similar spacing; however, contraction joint spacing shall not exceed ten feet.

A silicone joint sealer as defined in ASTM C 962 shall be applied to all form-plate expansion joints. The silicone joint sealer shall be applied under pressure to a depth of not less than two inches from the outside surface of the curb and gutter.

E. **PROTECTION.** At all times during the construction of the project, the Contractor shall have materials available at the site to protect the surface of the plastic concrete against rain or other detrimental elements. These materials shall consist of waterproof paper, plastic sheeting or other approved material. For slip-form construction, materials to protect the edges shall also be required.

When concrete is being placed in cold weather and the temperature is expected to drop below 35 degrees F., suitable protection shall be provided to keep the concrete from freezing until it is at least seven (7) days old. Concrete damaged by frost action shall be removed and replaced.

F. **CURING.** Concrete shall be cured for at least three days after placement to protect against loss of moisture, rapid temperature change, and mechanical damage. Liquid membrane curing compound, or other approved methods, or a combination thereof may be used as the curing

SECTION 5

5.1 INTRODUCTION. This section covers street signing and pavement markings.

5.2 SIGNING MATERIALS, FABRICATION AND PLACEMENT. All traffic, street name and other roadside signage shall follow the requirements for materials, fabrication and installation outlined in the standard drawings and these specifications.

5.2.1 STREET NAME SIGNS. The sign face materials shall consist of reflective "high intensity" grade sheeting ("engineer" or similar grade materials shall not be used). The sign face colors shall be green for public streets and blue for private streets. The street sign blanks shall consist of high tensile, degreased aluminum in accordance with the standard drawings. The street name sign face layout detail, as shown on standard drawings, shall be followed. The "Street Name Sign Designation Form" found in the standard drawings shall be completed and approved by the City Address Coordinator prior to the fabrication and installation of any new street name signs. All street name signs shall include address coordinates.

The street name signs shall be installed on galvanized steel posts that conform to the requirements contained in the standard drawings. The installation method and location shall be in accordance with the standard drawings and the MUTCD.

5.2.2 STREET SIGNS. Street signs shall be installed on separate, individual posts. Signs should be placed on opposite corners of the placement of stop signs.

5.2.3. TRAFFIC SIGNS. All traffic signs shall conform to the requirements relating to color, face, size, markings, lettering and location of installation found in the Manual of Uniform Traffic Control Devices for Streets and Highways (MUTCD). Traffic sign face material shall consist of reflective "high intensity" grade sheeting (FP-85 Type IIIA). Pedestrian wayfinding signs should not be reflective, in order to minimize confusion to vehicular traffic during nighttime conditions (Chapter 2D.50.11, MUTCD, 2009).

Traffic sign blanks shall consist of 0.1 inch thick high tensile degreased aluminum alloy in, accordance with 6061-T6, with alodine 1200 finish.

All traffic signs shall be installed on galvanized steel posts in accordance with the standard drawings.

5.2.4 VISIBILITY. All street name and traffic signs shall be installed in such a manner as to provide adequate advance visibility for an approaching driver in accordance with MUTCD and other approved standards.

5.3 PAVEMENT MARKINGS. Pavement markings shall include all traffic lane striping, pavement words and symbols, and other traffic oriented street markings.

Appendix B:

Recommended Changes to the Washington City Construction Design Details

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MEMORANDUM

To: Bronson Bundy and Mike Shaw, Washington City Public Works

From: Tom Millar, Senior Planner, Alta Planning + Design

Date: March 25, 2017

Re: Washington City Construction Design Details Recommendations

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The memo provides revisions that the consultant for the Washington City Active Transportation Plan, Alta Planning + Design, recommends making to the standard drawings from the Washington City Construction Design Details (Ordinance No. 2016-06, Adopted: February 24, 2016) in order to enhance bicycle and pedestrian safety as well as provide increased consistency with national accessibility and design standards within the built environment in Washington City.

Driveway Apron Details – Standard Drawing No. 111

The driveway shown in the drawing does not meet accessibility guidelines as it is currently detailed. Additionally, improvements to this detail can improve perceived pedestrian comfort. The best narrow sidewalk driveway designs will widen the sidewalk at the driveway and wrap around a clearly defined driveway apron. Generally, the apron is 4' deep, adjacent to a 4' sidewalk (Option C WSDOT ADA Field Guide 2011, p. 28). However, the preferred design is to widen the sidewalk (to 5' minimum), allowing for driveway aprons that can be fully contained by the paved sidewalk area and furnishing zone. This also creates a continuous route for pedestrians, increasing safety and comfort (Option A/B WSDOT ADA Field Guide 2011, p. 28).

We recommend that the City require an 8-foot (minimum) sidewalk area along collector and above roadway classifications (recommended below collector classification), with a minimum 5-foot paved sidewalk and a minimum 3-foot furnishing zone. This furnishing zone would generally be unpaved (expect in some circumstances in commercial areas) and planted with context-sensitive, drought-resistance, low-water plantings. This zone can be utilized for constructing driveway aprons and allowing more pedestrian capacity and/or furnishing uses in commercial areas.

Standard Sidewalk Details – Standard Drawing No. 120

The current City Standards show the standard sidewalk as 4 to 5 feet wide, without a furnishing zone, depending on the roadway classification cross section. 4-foot sidewalks require a 5x5-foot passing area every 200 feet. While this passing area requirement is often met by adjacent driveway areas (assuming they meet level landing requirements of 2% cross slope) and ADA and PROWAG-compliant, it is easier and more desirable to set a 5-foot minimum sidewalk width. This 5-foot minimum also automatically meets ADA passing area requirements.

We recommend that the City require a minimum sidewalk width of 5 feet, with a 3-foot furnishing zone (required on collectors and above; recommended below collectors), totaling a minimum sidewalk area of 8 feet.

Handicap [Accessible Curb] Ramp Design – Standard Drawing No. 121

The current diagonal ramp detail meets accessibility guidelines. However, the diagonal ramp design is the least preferred orientation. Diagonal ramps offer poor clarity for users with vision disabilities, and can interfere with bicycle left turn positioning while making a two-stage left turn. Similar to the issue with driveways, it is difficult to create preferred curb ramp designs (perpendicular ramps [see Figure 1 at right]) with narrow sidewalks. In order to create perpendicular curb ramps, a total sidewalk width of 10 feet at the intersection is required, to allow for at least a 4-ft x 4-ft landing above the ramp, and a 6-foot ramp to the roadway (Figure 16, WSDOT ADA Field Guide 2011, p. 18).

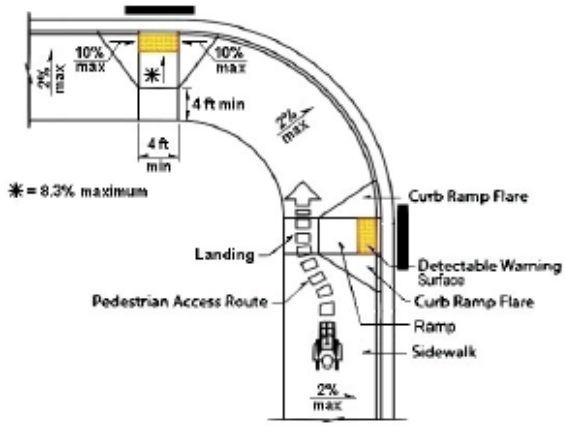

Figure 1: Perpendicular Curb Ramps

It is possible to create perpendicular curb ramps with a narrow sidewalk by using parallel ramps (Figure 17, WSDOT ADA Field Guide 2011, p. 19). However, it should be noted that this ramp design combined with wide corner radii may create undesirable interaction or make pedestrians less visible to turning motorists. Another option to create space for perpendicular curb ramps is to incorporate curb extensions at intersections. Extending the curb line toward the center of the roadway at crossings not only provides adequate space for landings and accessible ramps, but also creates a shorter and more visible crossing for pedestrians. Curb extensions can use the space within the roadway cross section at mid-block dedicated to parking lanes, shoulders, or deceleration lanes.

To create a safer crossing environment, we recommend that the City require perpendicular curb ramps on collector and above roadways. To allow for more desirable designs, the City should also require a minimum sidewalk area of 10 feet at ramp approaches to provide room for landings above curb ramps on collector and above roadways. These requirements may be softened to recommendations on roadways below the collector classification. We also recommend considering renaming the detail to "Accessible Curb Ramp Design".

Standard Road Cross Sections – Standard Drawing No. 140

We recommend that Standard Drawing No. 140 be revised to reflect the recommended changes to Table 3.1 in the Construction Design Standards (changes found in Chapter 3 of the ATP, not in Appendix A where the Construction Design Standards recommended revisions are located).

Roadway Details Rural – Standard Drawing No. 141

The current detail does not show sidewalks as part of the rural roadway cross section.

In order to prioritize and improve pedestrian connectivity, we recommend that the City require 5' minimum width sidewalks on rural roadways, where feasible.

Standard 4′ Cross Gutter – Standard Drawing No. 150 & Standard 6′ Cross Gutter – Standard Drawing No. 151

The current cross gutter details depict corners that would accommodate diagonal accessible curb ramps. However, perpendicular curb ramps are the preferred design. Successful designs have been implemented that incorporate perpendicular curb ramps and cross gutters, maintaining the intended drainage and flow. It should be noted that curb extensions often help with the placement of perpendicular curb ramps and maintaining flow lines.

We recommend the cross gutter details be revised to reflect the preferred perpendicular curb ramps, mentioned above. Details showing the use of curb extensions should also be considered.

Class I Standard Monument Details – Standard Drawing No. 160 & Concrete Water Valve Collar – Standard Drawing No. 172

Some design standards provide guidance recommending that utility covers be located outside of bike lanes, sidewalks, or paths in order to maintain a consistent bicycling surface, minimize detours during utility work, and increase safety during slippery conditions (MassDOT Separated Bike Lane Planning and Design Guide 2015, p. 48).

We recommend the City require, where feasible, that utilities and covers be located outside of existing or future potential bikeways, walkways, trails, or paths. Where this is not possible, the City should require covers to be flush with the bike lane, sidewalk, or path surface and placed such that avoidance maneuvers are minimized or eliminated altogether.

Standard Catch Basin Grate - Bicycle Safe – Standard Drawing No. 205E

The Florida DOT has developed drainage standards which specifically take into account whether a drainage inlet is compatible with bicycles or acceptable in the pedestrian way (Figure 3-11 and 3-12, FDOT Drainage Handbook Storm Drains 2014, p. 36-37). Tables, like Figure 2 (next page), in the standards list a variety of curb and gutter inlets, ditch bottom and median inlet applications, and specify if the facility is acceptable to be used in a bike or pedestrian way, with exceptions and reasoning behind the designation. FDOT also provided examples of well- and poorly-placed drainage infrastructure within bicycle and pedestrian ways in the *Drainage Considerations for Bicycle and Pedestrian Facilities, 2012* publication. The VTA Bicycle Technical Guidelines stress bicycle-minded drainage design, and even recommend grateless roadway design (Bicycle Technical Guidelines, p. 3-4). Guidance is given for the placement of drainage grates so that bicycles do not have to traverse or go out of their way to avoid them (p. 3-5).

We recommend that Washington City create similar standards which include City-approved drainage facilities and provide relevant information regarding their compatibility with bicycle and pedestrian accessibility. Guidance for placement of grates out of the bicycle way is also recommended.

DITCH BOTTOM AND MEDIAN INLET APPLICATION GUIDELINES

Index No.	Inlet Type	Location	Traffic	Bicycle Compatible	Acceptable in Pedestrian Way	Acceptable in Areas of Occasional Pedestrian Traffic [5]
230	A	Limited Access Facilities	Heavy Wheel Loads	No	No	No
231	B	Inside Clear Zone	Heavy Wheel Loads	No	No	Yes
232	C [3]	Outside Clear Zone [4]	Infrequent Traffic	Yes [6]	No	Yes [4]
	D	Outside Clear Zone [4]	Infrequent Traffic	Yes [6]	No	Yes [4]
	E	Outside Clear Zone [4]	Infrequent Traffic	Yes [6]	No	Yes [4]
	H	Outside Clear Zone	Infrequent Traffic	Yes	No	Yes
233	F	Inside Clear Zone	Heavy Wheel Loads	Yes	No	Yes
	G	Inside Clear Zone	Heavy Wheel Loads	Yes	No	Yes
234	J	Inside Clear Zone	Heavy Wheel Loads	No	No	Yes
235	K	Outside Clear Zone	N/A	N/A	No	N/A

[1] Alternate G grates should be specified when in salt-water environment.
[2] Inlets with slots are more debris tolerant than inlets without slots. Debris may buildup on Type B fence of Type K Inlet.
[3] For Back of Sidewalk Location See Index No. 282.
[4] Type C, D, & E Inlets without slots or inlets with traversable slots may be located within the Clear Zone. Slotted inlets located within the Clear Zone or in areas accessible to pedestrians shall have traversable slots.
[5] Areas subject to occasional pedestrian traffic are pavement, grassed, or landscaped areas where pedestrians are not directed over the inlet and can walk around the inlet.
[6] Inlets with traversable slots shall not be used in areas subject to bicycle traffic.

Figure 2: FDOT Drainage Handbook Inlet Application Guidelines

Manhole Frame & Cover Details – Standard Drawing No. 222

Many design standards, including MassDOT and VTA, provide guidance for placing utility covers outside of bike zones to maintain a consistent bicycling surface, minimize detours during utility work, and increase safety during slippery conditions. Some specify surface tolerances for cover step or groove dimensions (Table 3-3, VTA Bicycle Technical Guidelines, p. 3-7).

Table 3-3 Bikeway Surface Tolerances

Direction of Travel	Step	Groove
Parallel	No more than 1/2" wide	No more than 3/8" high
Perpendicular	-	No more than 3/4" high

Source: Caltrans HDM 2006, Table 1003.6

Figure 3: Bikeway Surface Tolerances, VTA Bicycle Technical Guidelines

Manhole cover manufacturers such as SlipNOT produce manhole and vault covers that are slip resistant, providing high-traction surfaces for walking and biking across.

We recommend that the City require manholes to be placed outside of bicycle zones. If manholes must be placed in the bike zone, they should be flush with the roadway and monitored with future surface improvements. We also recommend that the City require specific design characteristics for manhole covers, such as surface tolerances and/or slip resistance, discouraging using covers with large ridges or grooves.

Typical Sign Placement Details – Standard Drawing No. 412

The current drawing shows sign placement as 10′ from the curb, maximum. This could cause overhang problems for pedestrians, wheelchair users, and bicycles on sidewalks with a planting strip or trails that are 10′ wide.

To allow adequate space for pedestrians, wheelchairs, and bicycles on trails, signs should be placed no less than 2′ from the edge of pavement to the inside edge of the sign (Figure 5-1, AASHTO Bike Guide, p. 5-4).

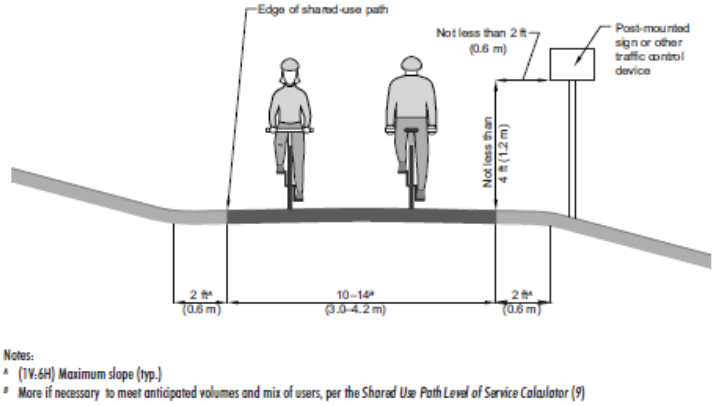

Figure 4: Sign Placement along Trails and Sidewalks

Appendix C:

Recommended Changes to the Washington City Code

Because of the length of the City Code, only the sections or parts of sections with recommended changes (in red) are included in this Appendix. Some ordinances and code section numbering may need to be modified as some or all of the changes are adopted.

TITLE 5 CHAPTER 2. OFFENSES, CRIMES AND TRAFFIC CODES

5-2-3: PARKING REGULATIONS:

E. Stopping Or Parking Prohibited In Specified Places: No person shall stop, stand or park a vehicle, except when necessary to avoid conflict with other traffic or in compliance with law or the directions of a police officer or traffic control device, in any of the following places:

1. On a sidewalk.

2. In front or within two feet (2') of a private driveway.

3. Within an intersection.

4. Within five feet (5') of a fire hydrant.

5. Within twenty feet (20') of a crosswalk at an intersection.

6. Within thirty feet (30') upon the approach to any flashing beacon or traffic control device located at the side of a roadway.

7. Between a safety zone and the adjacent curb or within thirty feet (30') of points on the curb immediately opposite the ends of a safety zone, unless authorized signs or markings indicate a different length.

8. Within fifty feet (50') of the nearest rail or railroad crossing.

9. Within twenty feet (20') of the driveway entrance to any fire station and on the side of a street opposite the entrance when properly signposted.

10. Alongside or opposite any street excavation or obstruction when stopping, standing or parking would obstruct or be hazardous to traffic.

11. Upon any bridge or culvert structure upon a street or within a street tunnel or underpass.

12. At any place where official signs or traffic markings prohibit stopping, standing or parking.

13. With the left hand side of the vehicle to the curb, except as otherwise permitted on one-way streets.

14. In any bike lane or path defined visually or physically for the use of bicycles or all non-motorized users, respectively.

(1989 Code § 11-340-5; amd. 2007 Code)

ARTICLE E. MINI-MOTORCYCLES, MOTOR ASSISTED SCOOTERS, PERSONAL MOTORIZED MOBILITY DEVICES, MOTORIZED CARTS AND GO-CARTS

5-2E-4: PERSONAL MOTORIZED MOBILITY DEVICES:

E. A person may not operate a personal motorized mobility device:

~~1. On a highway consisting of a total of four (4) or more lanes designated for regular vehicular traffic;~~

~~2. On a highway with a posted speed limit greater than twenty five (25) miles per hour; or~~

1. That has been structurally or mechanically altered from the original manufacturer's design.

TITLE 6 CHAPTER 1. STREETS, SIDEWALKS AND PUBLIC WAYS

6-1-2: REGULATIONS GENERALLY:

H. Placing Goods For Sale Or Show: No goods, wares or merchandise shall be placed, maintained or permitted for sale or show in or on any parking area, street or sidewalk beyond two feet (2') from the front line of the lot, without first obtaining the written approval of the governing body. Such approval shall be granted ~~only~~ when such sale or show shall be a promotional activity not exceeding forty eight (48) hours and when participated in by a majority of firms seeking approval in their business areas, or when street dining and other permanent public space installations in front of businesses fit within existing available sidewalk space while still allowing an accessible pedestrian travel way. The governing body's written approval shall specifically provide that no goods, wares or merchandise shall be placed in such a manner as to leave less than ~~a six foot (6') passageway~~ at least the minimum sidewalk space as required by the roadway classification cross section for pedestrians. (1989 Code § 11-368)

TITLE 8 CHAPTER 5. CONSTRUCTION DEBRIS.

8-5-3: CONSTRUCTION ZONE GUIDELINES FOR BICYCLISTS AND PEDESTRIANS

All construction zones will adhere to the guidelines for safely accommodating bicyclists and pedestrians as specified in Section 2.5.2 of the Washington City Construction Design Standards (revised 2017).

TITLE 9 CHAPTER 14. SUPPLEMENTARY AND QUALIFYING REGULATIONS

9-14-14: CURBS, GUTTERS AND SIDEWALKS

The installation of curb, gutter and sidewalks of a type approved by the city shall be required on any existing or proposed street adjoining a lot on which a new use is to be established in any commercial, residential, administrative and professional, or mobile home zoning district, unless specifically waived by the city council or deferred by the mayor. Such curb, gutter and sidewalk shall be required as a condition of building or use approval.

A. Waiver Procedure: Any landowner who wishes to request a waiver of the installation of curb, gutter and/or sidewalk must submit a written request for waiver of curb, gutter and/or sidewalk to the public works department. Such request may be in the form of a letter which describes the unique circumstances which justify such a waiver. The request will be placed on the next regular city council agenda. The city council shall use the following standards in determining whether or not to grant the waiver:

1. The density and ~~pedestrian circulation pattern~~ existing pedestrian facilities of the immediate area do not require curb, gutter and/or sidewalks to facilitate orderly drainage and safe pedestrian access (i.e. where a path or other facility pedestrian or shared use facility already exists; where rural or very low densities, like agriculture, may only necessitate sidewalk on one or neither side; and/or where posted and 85th-percentile speeds are 20 mph and below on a street with total pavement width of less than 25 feet);

2. The proposed drainage plan for the subject parcel has been reviewed by the public works department, and the public works department provides a written statement concurring with the finding that curb~~,~~ and gutter ~~and/or sidewalk~~ are not necessary to provide orderly drainage; (Ord. 93-18, 10-27-1993; amd. 2007 Code)

3. In the case of curb and gutter, ~~N~~no city developed drainage ~~and/or circulation~~ plans are available for the public streets in the immediate vicinity; and

4. The landowner agrees to file a written statement with the city recorder in which the landowner and any successors or assigns agree not to oppose any special improvement district which may be proposed to install curb, gutter and/or sidewalk in the future. In cases requesting to waive curb and gutter only, the construction of sidewalks or sidepaths should be encouraged, to maintain and improve safe pedestrian access and connectivity, especially in currently underserved areas.

B. Deferral Procedure: Such curb, gutter and/or sidewalk improvements may be deferred when deemed appropriate by the mayor. Deferral may be allowed when the mayor finds that:

1. The construction is impractical due to physical constraints, such as inadequate slopes or land use types which do not allow installation of such improvements as a feasible element of the new use;

2. The ~~neighborhood is absent similar improvements, and the city has no plans for the installation of such~~ site will not create or maintain a gap in improvements within two (2) years of the establishment of the new use; and

~~3. The public works director has reviewed the request and has submitted a recommendation.~~

C. Deferral Agreement: When deferred, the owner of land requesting the deferral shall enter into an agreement with the city for the installation of curb, gutter and/or sidewalk ~~at a future date~~ whenever facilities are improved or installed on at least one side of the property by adjacent property owner(s); as determined by the mayor, upon the advice of the public works director and city attorney. This agreement shall provide for the following:

1. The agreement shall be acceptable to the public works director and city attorney;

2. Construction of required improvements shall begin within ninety (90) days of any future receipt of notice to proceed from the city;

3. In the event of default by the owner or successors, the city is authorized to cause the construction to be done and charge the entire expense to the owners or successors, including interest from the date of notice of the cost until paid;

4. The agreement shall be recorded in the office of the county recorder at the expense of the owner and shall constitute notice to all successors of title to the real property of the obligation set forth, and also a lien in the amount to fully reimburse the city, including interest;

5. In the event of litigation caused by any default of the owner or successors, the owner or successors agree to pay all costs involved, including reasonable attorney fees, which shall become a part of the lien against the real property;

6. The term "owner" shall include not only the present owner, but also heirs, successors, assigns, executors and administrators, with the intent that the obligations undertaken shall run with the real property and constitute a lien against it;

7. The landowner agrees to file a written statement with the city recorder in which the landowner and any successors or assigns agree not to oppose any special improvement district which may be proposed to install curb, gutter and/or sidewalk in the future; and

8. Any other provisions deemed necessary by the mayor or city attorney. (Ord. 93-18, 10-27-1993)

TITLE 9 CHAPTER 16. OFF STREET PARKING

9-16-1: OFF STREET PARKING REQUIRED:

At the time any building or structure is erected or enlarged or increased in capacity or any use is established, there shall be provided off street parking spaces for automobiles and bicycles in accordance with the requirements set forth in this chapter. (Ord. 89-5, 3-1-1989)

9-16-5: NUMBER OF PARKING SPACES:

The number of off street vehicle and bicycle parking spaces required shall be as follows:

Land Use	**Vehicle Spaces Required**	**Short Term Bicycle Spaces Required**	**Long Term Bicycle Spaces Required**	**Long Term Bicycle Spaces Recommended**
Business or professional offices	1 parking space for each 250 square feet of floor area.	1 space per 5,000 sq. ft., minimum of 4 total	1 space per 2,500 sq. ft., minimum of 5 total	
Churches with fixed seats	1 parking space for each 3.5 fixed seats, or 1 parking space for each 7 feet of linear pew, whichever is greater.	Spaces to accommodate 8% of maximum expected attendance		1 space per 20 employees/clergy, minimum of 2 total
Churches without fixed seats, sports arenas,	1 parking space for each 3.5 seats of maximum seating capacity.	1 space per 2,000 sq. ft., minimum of 4 total		1 space per 10,000 sq. ft., minimum of 2 total

auditoriums, theaters, assembly halls, meeting rooms				
Furniture and appliance stores	1 parking space for each 60 square feet of floor area.	1 per 5,000 sq ft, minimum of 2 total		1 per 12,000 sq ft, minimum of 2 total
Hospitals	2 parking spaces for each bed.	1 per 20,000 sq ft, minimum of 2 total	1 per 20 employees or 1 per 70,000 sq ft, whichever is greater, minimum of 4 total	
Hotels, motels, motor hotels, and apartment houses	1.1 parking spaces for each living unit, plus 1 parking space for each 2 employees working on the largest shift, plus parking space for all accessory uses as herein specified, except for apartment houses with units containing 2 or more bedrooms, which shall have 2 parking spaces for each living unit, or as determined by the planning commission.	0.05 per bed, minimum of 2 total		0.05 per bed, minimum of 2 total
Nursing homes	1 parking space for each employee working on the highest employment shift, plus 1 parking space for each 5 beds.	0.05 per bedroom, minimum of 2 total		0.05 per bedroom, minimum of 1 total
Restaurants, taverns, private clubs and all other similar dining and drinking establishments	1 parking space for each 4 seats or 1 parking space for each 150 square feet of floor area (excluding kitchen, storage or other areas which will not accommodate customers), whichever is greater.	1 space per 1,000 sq. ft., minimum of 4 total		1 space per 2,000 sq. ft., minimum of 2 total
Retail stores and shops, except as provided in "furniture and appliance stores" above	1 parking space for each 250 square feet of retail floor space.	1 space per 2,000 sq. ft., minimum of 5 total	1 space per 10,000 sq. ft., minimum of 2 total	
Shopping centers or other groups of uses not listed	As determined by the planning commission, based on the nearest comparable use standards, including standards for individual uses within	As determined by the planning	As determined by the planning commission, based on the	

above	a mix of uses.	commission, based on the nearest comparable use standards, including standards for individual uses within a mix of uses.	nearest comparable use standards, including standards for individual uses within a mix of uses.	
Single-family dwellings	2 off street parking spaces, and except for dwelling units located in the DM zone, 1 of which shall be enclosed in a garage or carport. The additional required parking space shall be constructed of concrete or asphalt and be a minimum of 9 feet by 19 feet in size. Both parking spaces required by this section shall comply with the front yard setback requirements of the zone in which the lot is located. Except for the mobile home-recreational vehicle (MH) zone, locating 1 parking space immediately in front of the other required parking space (tandem parking) is specifically prohibited. Any single-family dwelling which is converted to a two-, three-, four- or multiple-family dwelling in compliance with the provisions of this title must provide 2 off street parking spaces for each dwelling unit constructed. Each parking space must meet the provisions of this chapter.	No spaces required	No spaces required	
Multi-family (3+) dwellings	[CITY TO PROVIDE REQUIREMENT]	0.2 per bedroom, minimum of 8 total	1 space per bedroom, minimum of 2 per dwelling unit; with private garage or private locked storage unit for each	

			unit, minimum 1 per dwelling unit	
Wholesale establishments, warehouses, manufacturing establishments, and all industrial uses	1 parking space for each 1,000 square feet of gross floor area, or 1 parking space for each employee working on the largest shift, whichever is greater, plus 1 parking space for each 200 square feet of office or sales area.	1 space per 20,000 sq. ft., minimum of 2 total	1 space per 12,000 sq. ft., minimum of 2 total	

[New ordinance number here.]

9-16-14: DEFINITION OF BICYCLE PARKING TYPES:

1. Required off-street, short term bicycle parking areas shall be outside of a building, made available for employees, patrons, and other visitors; located at the same grade as the sidewalk or walkway, or at a location that can be reached by an accessible pedestrian route; and, placed within 50 feet of that entrance as measured along the most direct pedestrian access route. For buildings with more than one main entrance, bicycle parking must be along all facades with a main entrance. For sites with more than one primary building, bicycle parking must be distributed to serve all primary buildings.
2. Required off-street, long term bicycle parking areas should be covered and located on site indoors or, if outdoors, within 200 feet of the main building entrance. The main building entrance is defined as publicly accessible entrances and shall exclude gated private garage entrances, trash room entrances, and other building entrances that are not publicly accessible.

9-16-15: DIMENSIONS OF BICYCLE PARKING TYPES:

The dimensions and definitions of bicycle parking spaces shall conform to the standards in this section of the code.

1. Definition. “Bicycle parking facility” or “bicycle parking space” means a space exclusively for the storage of bicycles. All bicycle parking facilities shall be dedicated for the exclusive use of bicycle parking and shall not be intended for the use of motorized two-wheeled or similar vehicles.
2. Provided For New and Existing Uses. Bicycle parking shall be provided for new development projects, additions to existing buildings, and new living units in existing buildings. Bicycle parking as prescribed hereafter shall be provided for activities occupying buildings, or portions of, which are constructed, established, wholly reconstructed, or moved onto a new lot after the effective date of the bicycle parking requirements, except to the extent that existing bicycle parking exceeds such requirements for any existing facilities. The required amount of new bicycle parking shall be based on the cumulative increase in floor area, or other applicable unit of measurement prescribed hereafter, after said effective date. If an existing building is altered or changed in occupancy so as to

result in an increase in the number of residential living units, bicycle parking as prescribed hereafter shall be provided for the new units. A minimum 5% reduction in the minimum amount of motor vehicle parking will be permitted by providing bicycle parking and showering and changing facilities (latter two referring to long term parking) on the site that are additional to the requirements found in this section. Any reduction above 5% should be scalable. Developers and building owners may, with approval from the Planning Commission, propose more bicycle parking and less motor vehicle parking beyond a 5% reduction. Existing parking may be converted to take advantage of this provision as well.

3. Types of Bicycle Parking.

   A. Required. Short-term Bicycle Parking. Short-term bicycle parking shall consist of a bicycle rack or racks and is meant to accommodate visitors, customers, and others. Although short-term parking users do not typically park more than two hours, spaces can be used and should be designed to accommodate day-long parking as well.

   B. Required for all commercial, office, and multi-family residential; recommended for all other uses. Long-term Bicycle Parking. Each long-term bicycle parking space should consist of a locker or a rack located within a locked enclosure, such as a secure room or controlled access area, providing protection for each bicycle from theft, vandalism, and weather. Long-term bicycle parking is meant to accommodate employees, students, residents, commuters, and others expected to park more than two hours.

4. Short Term Bicycle Racks and Spacing. Bicycle parking and racks shall meet the following standards:

   A. Definition. A bicycle parking space is the space that one bicycle typically occupies (e.g. a U-shaped bicycle rack has two bicycle parking spaces, one on either side of the rack).

   B. Each required bicycle parking space must be at least 2.5 feet in width (5 feet between parallel racks) by 6 feet in length to allow sufficient space between parked bicycles.

   C. The rack supports the bicycle frame at two contact points on the frame and allows the bicycle frame and one wheel to be locked to a bicycle rack with a high security, U-shaped shackle lock if both wheels are left on the bicycle.

   D. A bicycle six feet long can be securely held with its frame supported so that the bicycle cannot be pushed or fall in a manner that will damage the wheels or components.

   E. The rack must be securely anchored.

   F. Each required bicycle parking space must be accessible without moving another bicycle.

   G. There must be an aisle at least 4 feet wide behind all required bicycle parking to allow room for bicycle maneuvering. Where the bicycle parking is adjacent to a sidewalk, the maneuvering area may extend into the sidewalk right-of- way.

   H. The area devoted to bicycle parking must be made of concrete.

   I. The racks shall be located with at least 30 inches clearance in all directions from any obstruction, including but not limited to other racks, walls, and landscaping. Large retail uses such as supermarkets and grocery stores are encouraged to locate racks with a 36 inch clearance in all

directions from any vertical obstruction, including but not limited to other racks, walls, and landscaping.

J. Bicycle parking facilities shall not impede pedestrian or vehicular circulation.

K. Bicycle parking racks located on sidewalks should be kept clear of the pedestrian through zone and should maintain the sidewalk's ADA (Americans with Disabilities Act) compliance for wheelchairs and other mobility assistance devices.

L. Bicycle parking facilities within auto parking facilities shall be protected from damage by cars by a physical barrier such as curbs, wheel stops, poles, bollards, or other similar features capable of preventing automobiles from entering the designated bicycle parking area.

M. Short-term bicycle parking facilities serving community activity centers such as libraries and community centers should incorporate weather-protective enclosures (either overhang from the roof or a separate structure) shielding the designated bicycle area from typical inclement weather when feasible.

N. Bicycle parking facilities shall be located in highly visible, well-lighted areas. In order to maximize security, whenever possible short-term bicycle parking facilities shall be located in areas highly visible from the street and from the interior of the building they serve (i.e. placed adjacent to windows). Where lighting does not already exist, it shall be provided.

O. The location and design of required bicycle parking shall be of a quality, character and color that harmonize with adjoining land uses. Required bicycle parking shall be incorporated whenever possible into building design or street furniture.

P. If required bicycle parking is not visible from the street or main building entrance, a sign must be posted at the main building entrance indicating the location of the bicycle parking.

5. Long Term Bicycle Racks and Spacing. Locations wishing to install long term bicycle parking should install bicycle parking spaces and associated bicycle racks as follows:

A. Include a variety of rack types to accommodate different bicycle sizes, styles, and users.

B. Meet site specific requirements as indicated by the public works or planning director.

Any deviation from these standards must be recommended by the public works or planning director and approved by the planning commission.

TITLE 9 CHAPTER 18. SIGNS

9-18-20: SPECIAL STANDARDS FOR COMMERCIAL SIGNS ON TELEGRAPH ROAD, WASHINGTON PARKWAY, AND 300 EAST

3. Location: Permanent and/or long-term ~~S~~signs must be located on private property and not within any existing or planned public right of way as identified in the city transportation master plan. Temporary signs, i.e. sandwich boards, may be located within sidewalk or planting space as long as a clear and unobstructed pedestrian travel way of at least 4' wide is maintained. Signs shall not obstruct visibility at

driveway entrances and exits, intersections and other points along the roadway. Signs in the downtown mixed use zone shall be outside of the front yard and street side yard setbacks and shall ~~not interfere with any sidewalk or~~ maintain a clear pedestrian way of at least 4' wide. (Ord. 2008-33, 11-12-2008; amd. Ord. 2009-14, 10-14-2009)

TITLE 9 CHAPTER 10: COMMERCIAL ZONES - ARTICLE D. DOWNTOWN MIXED USE (DM) ZONE

9-10D-1: PURPOSE

The purpose of the downtown mixed use zone is to provide appropriate locations for the development and operation of a variety of uses in the downtown area that will be pedestrian oriented by fronting buildings adjacent to the sidewalks and providing parking at the rear of buildings. The design for new development and the remodeling of existing development is to be of a traditional nature by utilizing the ground level of buildings for predominantly retail, restaurant and service businesses and utilizing the upper levels of buildings for predominantly professional offices and residential units with medium high densities. (Ord. 2009-14, 10-14-2009)

9-10D-3: SITE DESIGN REGULATIONS

3. Sidewalk In Front Yard Setback: In addition to the public right of way sidewalk, a minimum ~~five foot (5')~~ seven foot (7') wide sidewalk and a minimum five foot (5') wide furnishing zone shall be installed within the front yard setback adjacent to the public right of way.

Appendix D:

Design Guidance for the Implementation of Active Transportation Facilities

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Table of Contents

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1: Context and Guidance

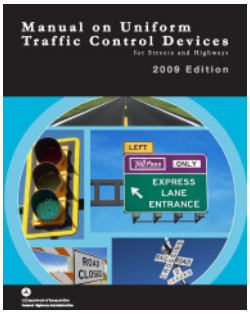
Introduction

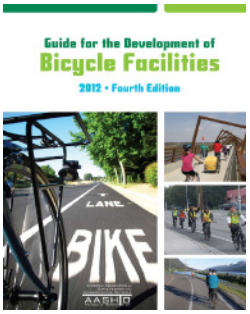
This technical handbook is intended to assist Washington City in the selection and design of bicycle and pedestrian facilities. The following sections combine best practices and design guidance provided by a number of national sources including ITE, NCHRP, FHWA, and NACTO. Within the design chapters, treatments are covered within a single or double sheet format relaying important design information and discussion, example photos, schematics (if applicable), and existing summary guidance from current or upcoming draft standards. Existing local, state, and national standards are referenced throughout and should be the first source of information when seeking to implement any of the treatments featured here.

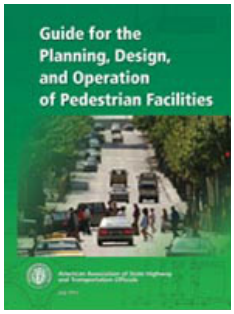
Guiding Principles

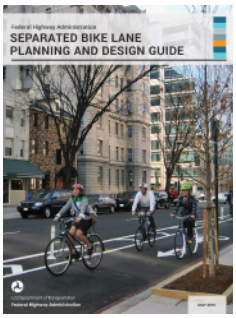
The following are guiding principles for these bicycle and pedestrian design guidelines:

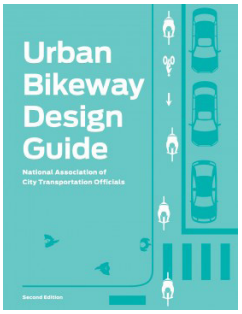
- The walking and bicycling environment should be safe and comfortable. Safe means minimal conflicts with external factors, such as noise, vehicular traffic and protruding architectural elements. Safe also means routes are clear and well marked with appropriate pavement markings and directional signage.
- The trail and bicycle network should be accessible. Shared use paths, bike routes, and crosswalks should permit the mobility of residents of all ages and abilities. The trail and bicycle network should employ principles of universal design. Bicyclists have a range of skill levels, and facilities should be designed with a goal of providing for inexperienced/recreational bicyclists (especially children and seniors) to the greatest extent possible.
- Trail and bicycle network improvements should be economical. Trail and bicycle improvements should achieve the maximum benefit for their cost, including initial cost and maintenance cost, as well as a reduced reliance on more expensive modes of transportation. Where possible, improvements in the right-of-way should stimulate, reinforce and connect with adjacent private improvements.
- The trail and bicycle network should connect to places people want to go. The trail and bicycle network should provide continuous direct routes and convenient connections between destinations such as homes, schools, shopping areas, public services, recreational opportunities and transit. A complete network of on-street bicycling facilities should connect seamlessly to existing and proposed shared use paths to complete recreational and commuting routes.
- The walking and bicycling environment should be clear and easy to use. Shared use paths











and crossings should allow all people to easily find a direct route to a destination with minimal delays, regardless of whether these persons have mobility, sensory, or cognitive disability impairments. All roads are legal for the use of pedestrians and bicyclists (except freeways, from which each is prohibited unless a separate facility on that right of way is provided). This means that most streets are bicycle facilities and should be designed, marked and maintained accordingly.

- The walking and bicycling environment should be attractive and enhance community livability. Good design should integrate with and support the development of complementary uses and should encourage preservation and construction of art, landscaping and other items that add value to the community. These components might include open spaces such as plazas, courtyards and squares, and amenities like street furniture, banners, art, plantings and special paving. These along with historical elements and cultural references, should promote a sense of place.
- Design guidelines are flexible and should be applied using professional judgment. This document references specific national guidelines for bicycle and trail facility design, as well as a number of design treatments not specifically covered under current guidelines. Statutory and regulatory guidance may change. For this reason, the guidance and recommendations in this document function to complement other resources considered during a design process, and in all cases sound engineering judgment should be used.

National Standards

The Federal Highway Administration's **Manual on Uniform Traffic Control Devices** (MUTCD) defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic. The MUTCD is the primary source for guidance on lane striping requirements, signal warrants, and recommended signage and pavement markings.

To further clarify the MUTCD, the FHWA created a table of contemporary bicycle facilities that lists various bicycle-related signs, markings, signals, and other treatments and identifies their official status (e.g., can be implemented, currently experimental). See **Bicycle Facilities and the Manual on Uniform Traffic Control Devices**.

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 on this website.

American Association of State Highway and Transportation Officials (AASHTO) **Guide for the Development of Bicycle Facilities**, updated in June 2012 provides guidance on dimensions, use, and layout of specific bicycle facilities. The standards and guidelines presented by AASHTO provide basic information, such as minimum sidewalk widths, bicycle lane dimensions, detailed striping requirements and recommended signage and pavement markings.

The National Association of City Transportation Officials' (NACTO) 2012 **Urban Bikeway Design Guide** offers guidance on the current state of the practice designs. The NACTO Urban Bikeway Design Guide is based on current practices in the best cycling cities in the world. The intent of the guide is to offer substantive guidance for cities seeking to improve bicycle transportation in places where competing demands for the use of the right of way present unique challenges. All of the NACTO Urban Bikeway Design Guide treatments are in use internationally and in many cities around the US.

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 separated bike lanes, presents a suite of design recommendations based on corridor context, and highlights notable case studies from across the US.

Some of these treatments 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.

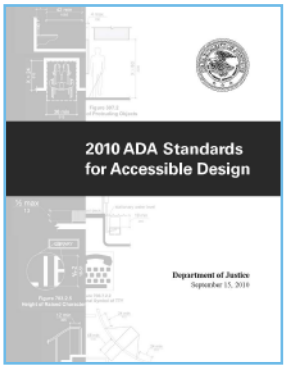
Local Standards

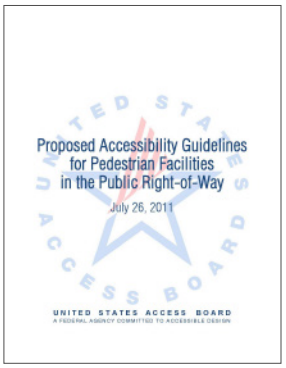
The Utah Department of Transportation's (UDOT) **Pedestrian and Bicycle Guide** provides design guidance and maintenance best practices for pedestrian and bicycle facilities. It also includes resources on funding, education and enforcement, and UDOT's project development process.

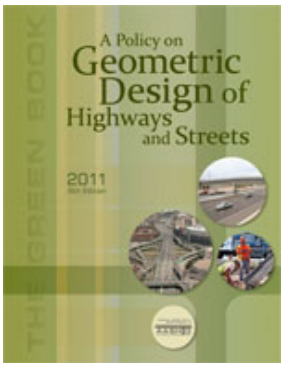
Additional US Federal Guidelines

Meeting the requirements of the Americans with Disabilities Act (ADA) is an important part of any bicycle and pedestrian facility project. The United States Access Board's proposed **Public Rights-of-Way Accessibility Guidelines** (PROWAG) and the **2010 ADA Standards for Accessible Design** (2010 Standards) contain standards and guidance for the construction of accessible facilities. This includes requirements for sidewalk curb ramps, slope requirements, and pedestrian railings along stairs.

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





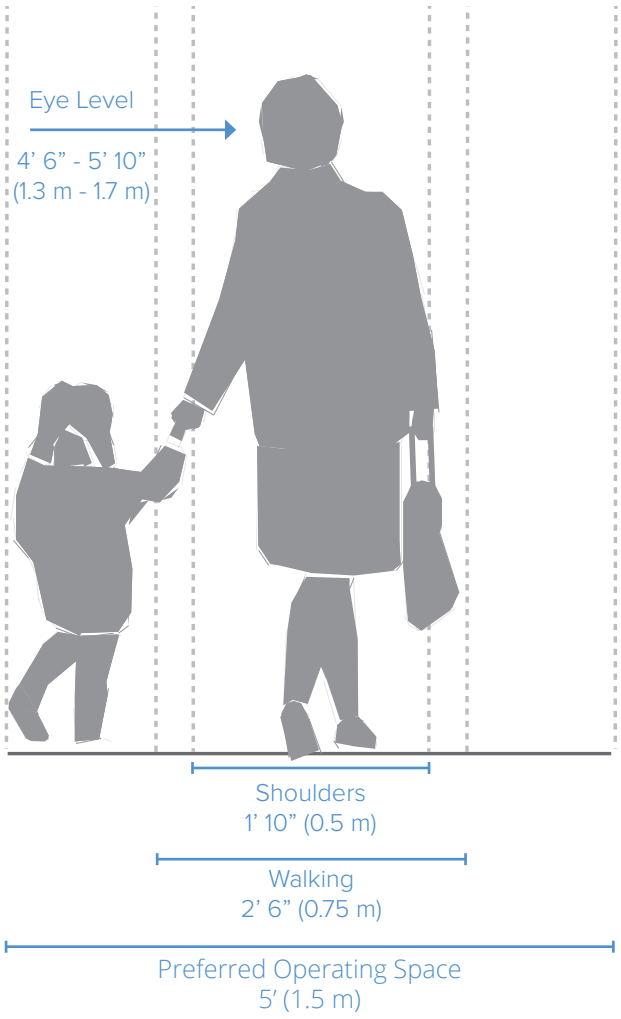


Design Needs of Pedestrians

Types of Pedestrians

Pedestrians have a variety of characteristics and the transportation network should accommodate a variety of needs, abilities, and possible impairments. Age is one major factor that affects pedestrians' physical characteristics, walking speed, and environmental perception. Children have low eye height and walk at slower speeds than adults. They also perceive the environment differently at various stages of their cognitive development. Older adults walk more slowly and may require assistive devices for walking stability, sight, and hearing. The table below summarizes common pedestrian characteristics for various age groups.

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



Pedestrian Characteristics by Age

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

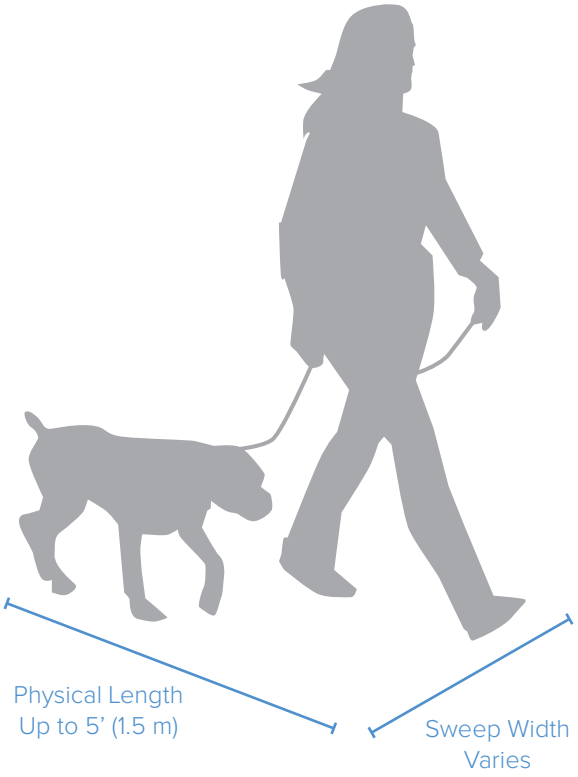
Source: AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, Exhibit 2-1. 2004.

Design Needs of Pedestrians

Design Needs of Dog Walkers

Dog walking is a common and anticipated use, especially on shared use paths. Dog sizes vary largely, as does leash length and walking style, leading to wide variation in possible design dimensions.

Shared use paths designed to accommodate wheelchair users are likely to provide the necessary dimensions for the average dog walker. Amenities such as dog waste stations may enhance conditions for dog walkers.

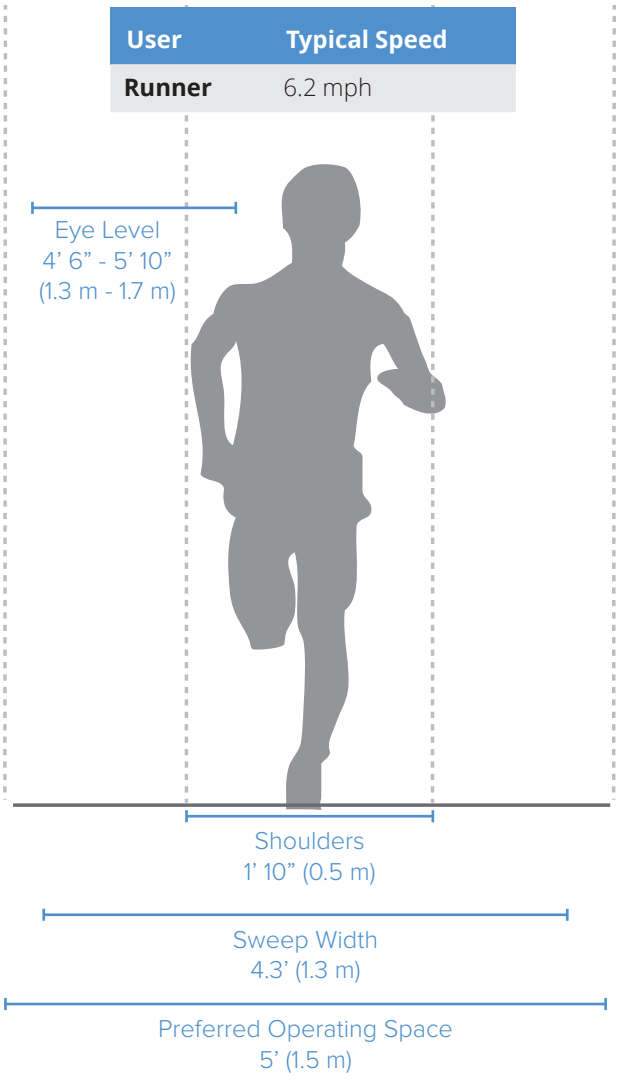


Design Needs of Runners

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

Runner Typical Speed

User	Typical Speed
Runner	6.2 mph



Source: FHWA. *Characteristics of Emerging Road and Trail Users and Their Safety.* (2004).

Design Needs of Pedestrians

Design Needs of Wheelchair Users

As the American population ages, the number of people using mobility assistive devices (such as manual wheelchairs, powered wheelchairs) increases.

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

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

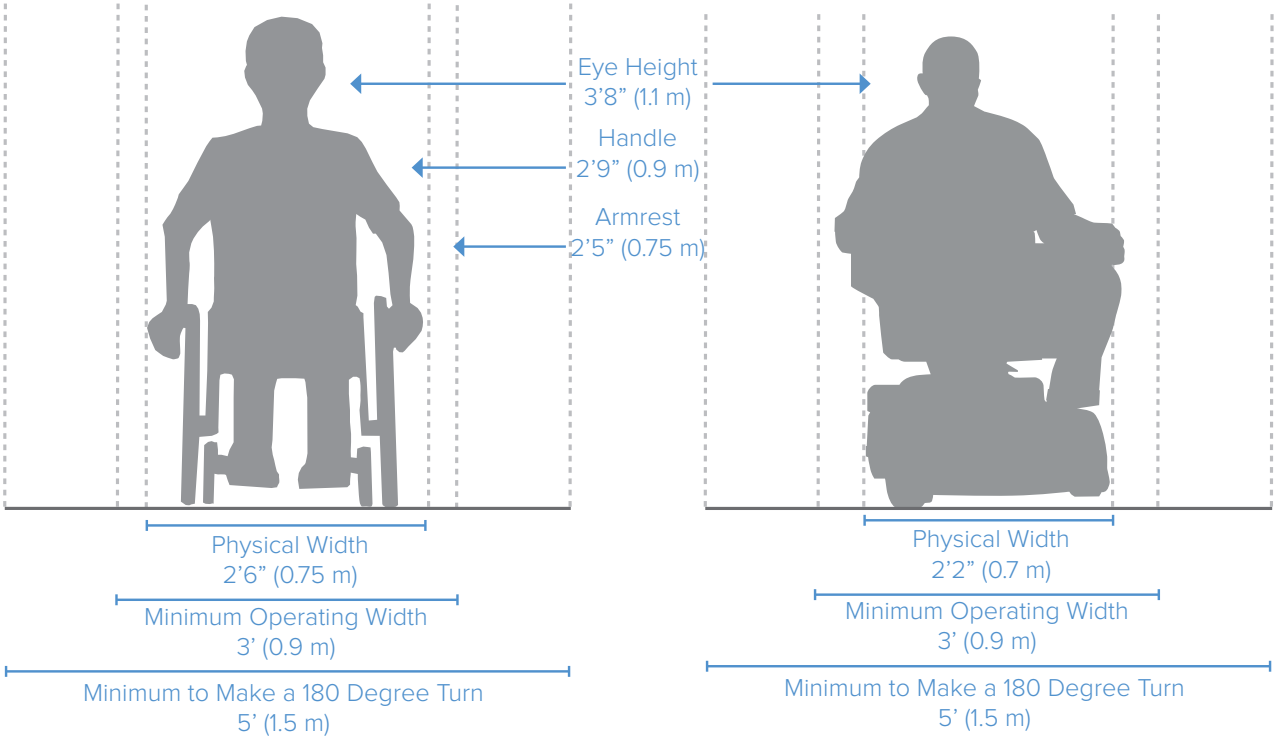
Maneuvering around a turn requires additional space for wheelchair devices. Providing adequate space for 180 degree turns at appropriate locations is an important element for accessible design.

Wheelchair User Typical Speed

User	Typical Speed
Manual Wheelchair	3.6 mph
Power Wheelchair	6.8 mph

Design Considerations

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



Source: FHWA. *Characteristics of Emerging Road and Trail Users and Their Safety.* 2004.
USDOJ. *2010 ADA Standards for Accessible Design.* 2010.

Pedestrian Crossing Location and Facility Selection

Mid-block Crossings

Mid-block crossings are an important street design element for pedestrians. They can provide a legal crossing at locations where pedestrians want to travel, and can be safer than crossings at intersections because traffic is only moving in two directions. Locations where mid-block crossings should be considered include:

- Long blocks (longer than 600 ft) with destinations on both sides of the street.
- Locations with heavy pedestrian traffic, such as schools, shopping centers.
- At mid-block transit stops, where transit riders must cross the street on one leg of their journey.

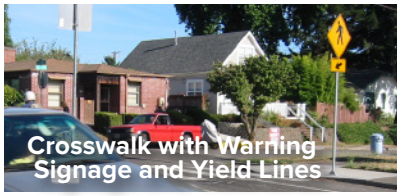
Crossing Treatment Selection

The specific type of treatment at a crossing may range from a simple marked crosswalk to full traffic signals or grade separated crossings. Crosswalk lines should not be used indiscriminately, and appropriate selection of crossing treatments should be evaluated in an engineering study should be performed before a marked crosswalk is installed. The engineering study should consider the number of lanes, the presence of a median, the distance from adjacent signalized intersections, the pedestrian volumes and delays, the average daily traffic (ADT), the posted or statutory speed limit or 85th-percentile speed, the geometry of the location, the possible consolidation of multiple crossing points, the availability of street lighting, and other appropriate factors.

PEDESTRIAN CROSSING CONTEXTUAL GUIDANCE at unsignalized locations	Local Streets 15-25 mph		Collector Streets 25-30 mph			Arterial Streets 30-45 mph							
FACILITY TYPE	2 lane	3 lane	2 lane	2 lane with median refuge	3 lane	2 lane	2 lane with median refuge	3 lane	4 lane	4 lane with median refuge	5 lane	6 lane	6 lane with median refuge
Crosswalk Only	✓	✓	EJ	EJ	X	EJ	EJ	X	X	X	X	X	X
Crosswalk with Warning Signage and Yield Lines	EJ	✓	✓	✓	✓	EJ	EJ	EJ	X	X	X	X	X
Active Warning Beacon (RRFB)	X	EJ	✓	✓	✓	✓	✓	✓	X	✓	X	X	X
Hybrid Beacon	X	X	EJ	EJ	EJ	EJ	✓	✓	✓	✓	✓	✓	✓
Full Traffic Signal	X	X	EJ	EJ	EJ	EJ	EJ	EJ	✓	✓	✓	✓	✓
Grade Separation	X	X	EJ	EJ	EJ	X	EJ	EJ	EJ	EJ	EJ	✓	✓

LEGEND	
Most Desirable	✓
Engineering Judgement	EJ
Not Recommended	X


Crosswalk Only


Crosswalk with Warning Signage and Yield Lines


Active Warning Beacon (RRFB)

Hybrid Beacon


Full Traffic Signal

Grade Separation

Design Needs of Bicyclists

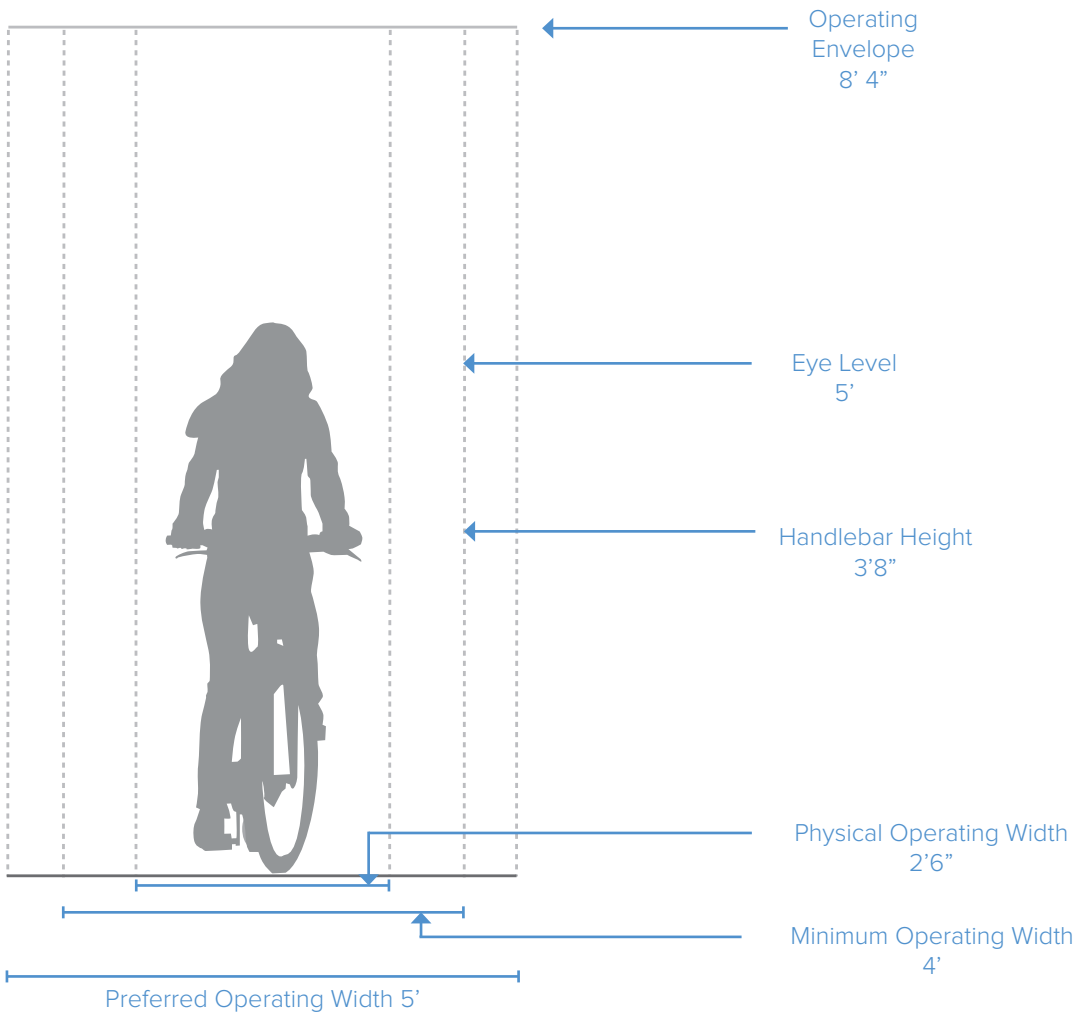
The purpose of this section is to provide the facility designer with an understanding of how bicyclists operate and how their bicycle influences that operation. Bicyclists, by nature, are much more affected by poor facility design, construction and maintenance practices than motor vehicle drivers. Bicyclists lack the protection from the elements and roadway hazards provided by an automobile's structure and safety features. By understanding the unique characteristics and needs of bicyclists, a facility designer can provide quality facilities and minimize user risk.

Bicycle as a Design Vehicle

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

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

Standard Bicycle Rider Dimensions



Source: AASHTO *Guide for the Development of Bicycle Facilities*, 4th Edition. 2012.

Design Needs of Bicyclists

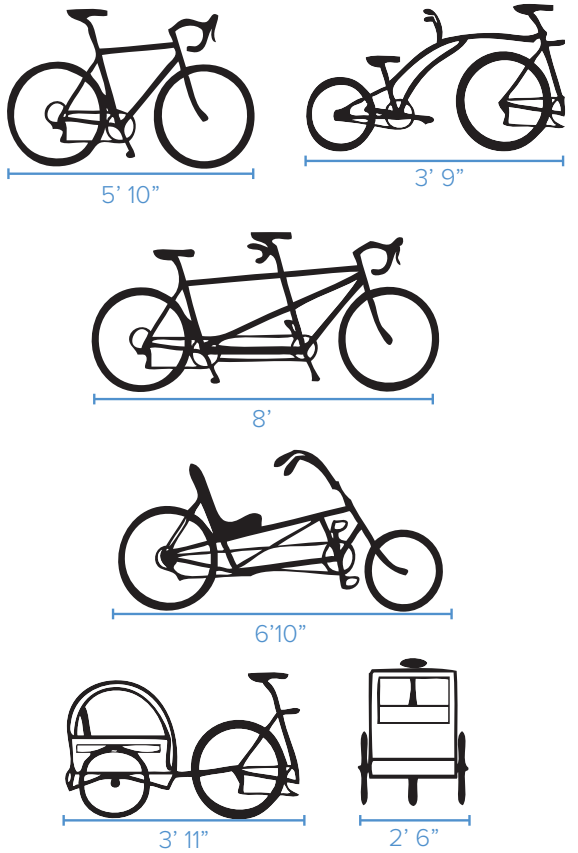
In addition to the design dimensions of a typical bicycle, there are many other commonly used pedal-driven cycles and accessories to consider when planning and designing facilities. The most common types include tandem bicycles, recumbent bicycles, and trailer accessories. The figure below and table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

Design Speed Expectations

The expected speed that different types of bicyclists can maintain under various conditions also influences the design of facilities such as shared use paths. The table at right provides typical bicyclist speeds for a variety of conditions.

Types of Bicyclists

It is important to consider bicyclists of all skill levels when creating a non-motorized plan or project. Bicyclist skill level greatly influences expected speeds and behavior,



Bicycle as Design Vehicle - Typical Dimensions

Source: AASHTO *Guide for the Development of Bicycle Facilities*, 4th Edition
*AASHTO does not provide typical dimensions for tricycles.

Bicycle as Design Vehicle - Design Speed Expectations

Bicycle Type	Feature	Typical Speed
Upright Adult Bicyclist	Paved level surfacing	15 mph
	Crossing Intersections	10 mph
	Downhill	30 mph
	Uphill	5 -12 mph
Recumbent Bicyclist	Paved level surfacing	18 mph

*Tandem bicycles and bicyclists with trailers have typical speeds equal to or less than upright adult bicyclists.

Bicycle as Design Vehicle - Typical Dimensions

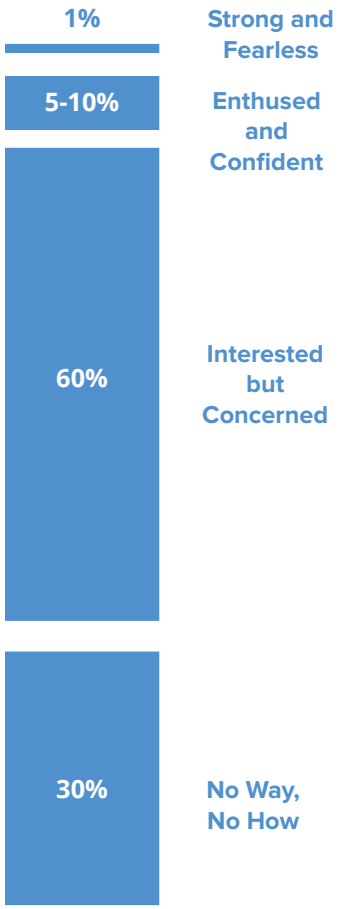
Bicycle Type	Feature	Typical Dimensions
Upright Adult Bicyclist	Physical width	2 ft 6 in
	Operating width (Minimum)	4 ft
	Operating width (Preferred)	5 ft
	Physical length	5 ft 10 in
	Physical height of handlebars	3 ft 8 in
	Operating height	8 ft 4 in
	Eye height	5 ft
	Vertical clearance to obstructions (tunnel height, lighting, etc)	10 ft
	Approximate center of gravity	2 ft 9 in - 3 ft 4 in
Recumbent Bicyclist	Physical length	8 ft
	Eye height	3 ft 10 in
Tandem Bicyclist	Physical length	8 ft
Bicyclist with child trailer	Physical length	10 ft
	Physical width	2 ft 6 in

Design Needs of Bicyclists

both in on-street bikeways and on shared roadways. Bicycle infrastructure should accommodate as many user types as possible, with decisions for separate or parallel facilities based on providing a comfortable experience for the greatest number of people.

The bicycle planning and engineering professions currently use several systems to classify the population which can assist in understanding the characteristics and infrastructure preferences of different bicyclists. The current AASHTO Guide to the Development of Bicycle Facilities encourages designers to identify their rider type based on the trip purpose (Recreational vs. Transportation) and on the level of comfort and skill of the rider (Causal vs. Experienced). A more detailed framework for understanding of the US population's relationship to transportation focused bicycling is illustrated in the figure at right. Developed by planners in Portland, OR[1] and supported by research[2], this classification provides the following alternative categories to address varying attitudes towards bicycling in the US:

Typical Distribution of Bicyclist Types



- Strong and Fearless (approximately 1% of population) – Characterized by bicyclists that will typically ride anywhere regardless of roadway conditions or weather. These bicyclists can ride faster than other user types, prefer direct routes and will typically choose roadway connections -- even if shared with vehicles -- over separate bicycle facilities such as shared use paths.
- Enthused and Confident (5-10% of population) - This user group encompasses bicyclists who are fairly comfortable riding on all types of bikeways but usually choose low traffic streets or shared use paths when available. These bicyclists may deviate from a more direct route in favor of a preferred facility type. This group includes all kinds of bicyclists such as commuters, recreational riders, racers and utilitarian bicyclists.
- Interested but Concerned (approximately 60% of population) – This user type comprises the bulk of the cycling population and represents bicyclists who typically only ride a bicycle on low traffic streets or shared use paths under favorable weather conditions. These bicyclists perceive significant barriers to their increased use of cycling, specifically traffic and other safety issues. These people may become "Enthused & Confident" with encouragement, education and experience.
- No Way, No How (approximately 30% of population) – Persons in this category are not bicyclists, and perceive severe safety issues with riding in traffic. Some people in this group may eventually become more regular cyclists with time and education. A significant portion of these people will not ride a bicycle under any circumstances.

1 Roger Geller, City of Portland Bureau of Transportation. Four Types of Cyclists. http://www.portlandonline.com/transportation/index.cfm?&a=237507. 2009.
2 Dill, J., McNeil, N. *Four Types of Cyclists? Testing a Typology to Better Understand Bicycling Behavior and Potential.* 2012.

Bicycle Facility Selection Guidelines

The specific bicycle facility type that should be provided depends on the surrounding environment (e.g. auto speed and volume, topography, and adjacent land use) and expected bicyclist needs (e.g. bicyclists commuting on a highway versus students riding to school on residential streets).

Facility Selection Guidelines

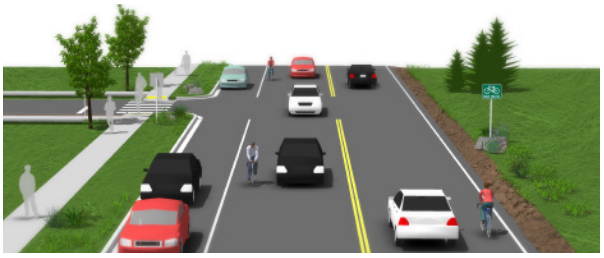
There are no 'hard and fast' rules for determining the most appropriate type of bicycle facility for a particular location – roadway speeds, volumes, right-of-way width, presence of parking, adjacent land uses, and expected bicycle user types are all critical elements of this decision. Studies find that the most significant factors influencing bicycle use are motor vehicle traffic volumes and speeds. Additionally, most bicyclists prefer facilities separated from motor vehicle traffic or located on local roads with low motor vehicle traffic speeds and volumes. Because off-street pathways are physically separated from the roadway, they are perceived as safe and attractive routes for bicyclists who prefer to avoid motor vehicle traffic. Consistent use of treatments and application of bikeway facilities allow users to anticipate whether they would feel comfortable riding on a particular facility, and plan their trips accordingly. This section provides guidance on various factors that affect the type of facilities that should be provided.

Facility Classification

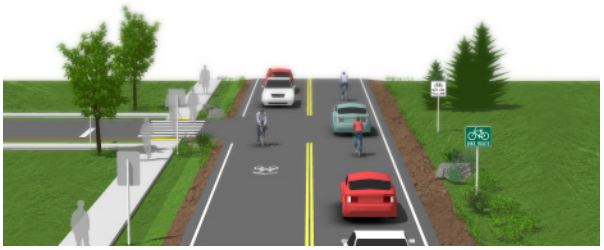
Description

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 Roadways 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.



Shared roadways may also be designated by pavement markings, signage and other treatments including directional signage, traffic diverters, chicanes, chokers and /or other traffic calming devices to reduce vehicle speeds or volumes. Such treatments often are associated with **Bicycle Boulevards**.



On-Street Bikeways, 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 Bike Lanes** which are exclusive bike facilities that combine the user experience of a separated path with the on-street infrastructure of conventional bike lanes.

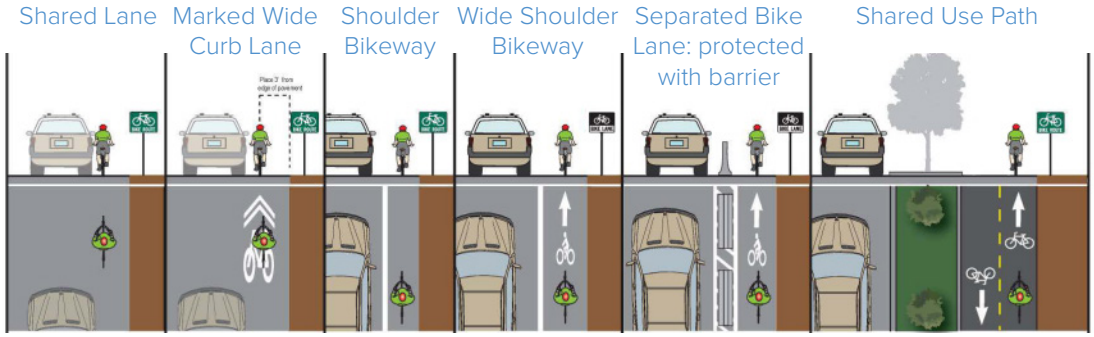
Shared Use Paths are facilities separated from roadways for use by bicyclists and pedestrians.

Facility Continua

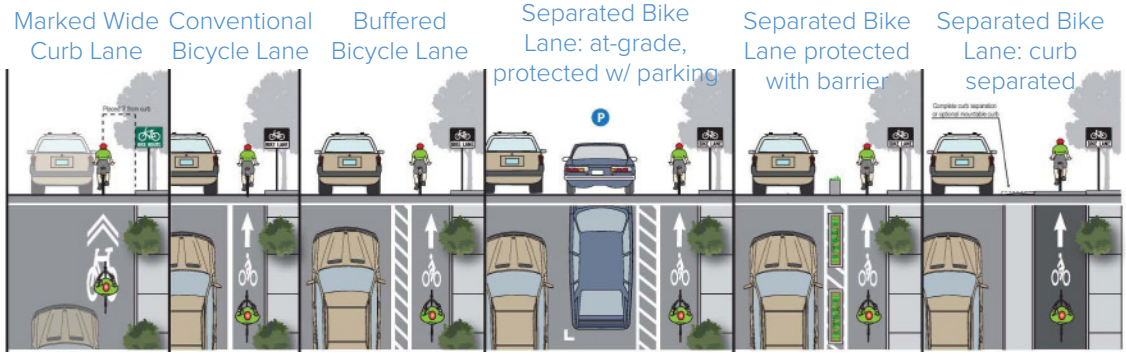
The following continua illustrate the range of bicycle facilities applicable to various roadway environments, based on the roadway type and desired degree of separation. Engineering judgment, traffic studies, previous municipal planning efforts, community input and local context should be used to refine criteria when developing bicycle facility recommendations for a particular street. In some corridors, it may be desirable to construct facilities to a higher level of treatment than those recommended in relevant planning documents in order to enhance user safety and comfort. In other cases, existing and/or future motor vehicle speeds and volumes may not justify the recommended level of separation, and a less intensive treatment may be acceptable.

Least Protected → Most Protected

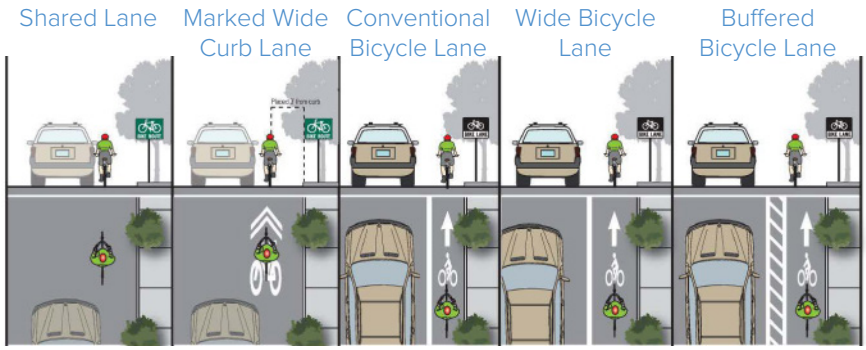
Arterial/Highway Bikeway Continuum (without curb and gutter)



Arterial/Highway Bikeway Continuum (with curb and gutter)

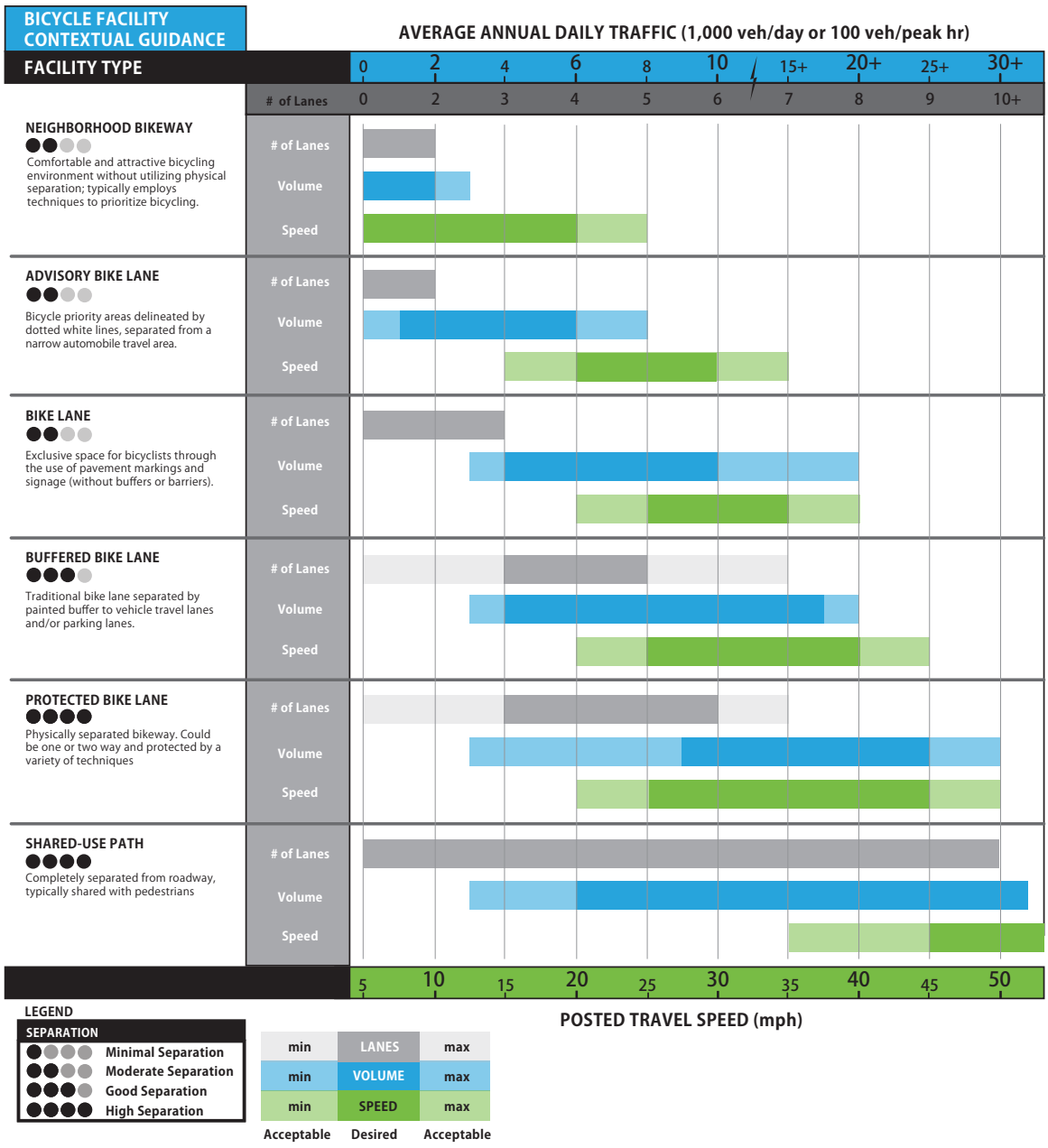


Collector Bikeway Continuum



Bicycle Facility Contextual Guidance

Due to the range of factors that influence bicycle users' comfort and safety, selecting the best bicycle facility type for a given roadway can be challenging. There is a significant impact on cycling comfort when the speed differential between bicyclists and motor vehicles is high and when traffic volumes and speeds are also high. The chart below can help to determine the type of bikeway best suited for particular configurations, speeds, and volumes. To use this chart, identify the number of lanes, daily traffic volume, and travel speed, and locate the facility types indicated by those key variables. Other factors beyond speed and volume that are not included in the chart below but that still affect facility selection include traffic mix of heavy vehicles, on-street parking, intersection density, surrounding land use, and roadway sight distance. These additional factors should be considered in the facility selection and design process.



2: Pedestrian Crossing Treatments

Introduction

Attributes of pedestrian-friendly intersection design include:

Clear Space: Corners should be clear of obstructions. They should also have enough room for curb ramps, for transit stops where appropriate, and for street conversations where pedestrians might congregate.

Visibility: It is critical that pedestrians on the corner have a good view of vehicle travel lanes and that motorists in the travel lanes can easily see waiting pedestrians.

Legibility: Symbols, markings, and signs used at corners should clearly indicate what actions the pedestrian should take.

Accessibility: All corner features, such as curb ramps, landings, call buttons, signs, symbols, markings, and textures, should meet accessibility standards and follow universal design principles.

Separation from Traffic: Corner design and construction should be effective in discouraging turning vehicles from driving over the pedestrian area. Crossing distances should be minimized.

Lighting: Adequate lighting is an important aspect of visibility, legibility, and accessibility.

These attributes will vary with context but should be considered in all design processes. For example, suburban and rural intersections may have limited or no signing. However, legibility regarding appropriate pedestrian movements should still be taken into account during design.

Crossing beacons and signals facilitate crossings of roadways for pedestrians. Beacons make crossing intersections safer by clarifying when to enter an intersection and by alerting motorists to the presence of pedestrians.

Flashing amber warning beacons can be utilized at unsignalized intersection crossings. Signage and pavement markings may be used to highlight these facilities for pedestrians, bicyclists and motorists.

Determining which type of signal or beacon to use for a particular intersection depends on a variety of factors. These include speed limits, traffic volumes, lane configuration, presence of a median or refuge, and the anticipated levels of pedestrian and bicycle crossing traffic.

An intersection with crossing beacons may reduce stress and delays for a crossing users, and discourage illegal and unsafe crossing maneuvers.

Unmarked Crossings

Description

Crosswalks exists at the corners of roadway intersections, whether they are marked or unmarked. An unmarked crosswalk is the area defined by the edges of the sidewalk. This area is absent of crosswalk markings, though other related traffic control markings may be present.

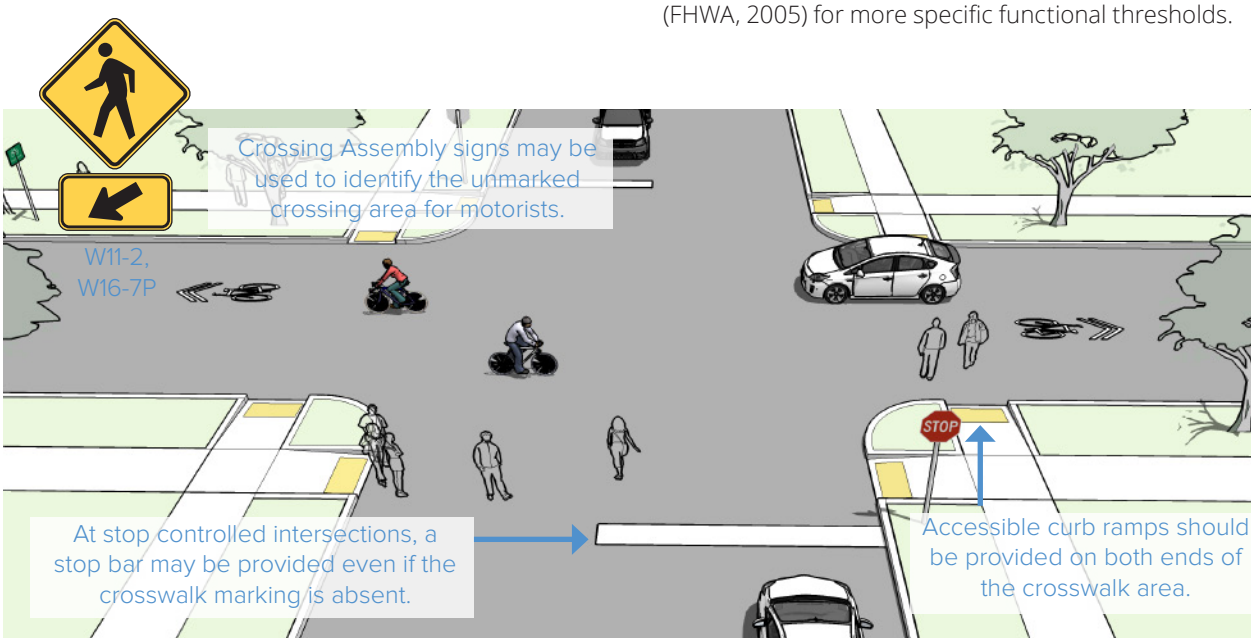
Unmarked crosswalks area not applicable at mid-block locations. Crosswalk pavement markings must be used to formally establish the crosswalk in these areas.

Guidance

Unmarked crosswalks are most comfortable on streets with:

- One lane in each direction
- Motor vehicle speeds of 25 mph or lower
- Motor vehicle volumes of 3,000 ADT or lower

Unmarked crosswalks may operate safely at locations with higher speeds and volumes than noted above, but may result in uncomfortable conditions and discourage pedestrian activity. See Safety Effects of Marked Vs. Unmarked Crosswalks at Uncontrolled Locations (FHWA, 2005) for more specific functional thresholds.



Discussion

The Uniform Vehicle Code requires that motorists yield right-of-way to pedestrians in marked and unmarked crosswalks. The UVC is ambiguous about whether an unmarked crosswalk exists at intersections where no sidewalk are present.

If a pedestrian is 700 feet or farther from a formal pedestrian crossing they may cross mid-block at any location, but they must yield to motor vehicles. At mid-block crossings, a yield line may be provided even if the crosswalk marking itself is absent.

Additional References and Guidelines

AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* 2004.
FHWA. *Safety Effects of Marked Vs. Unmarked Crosswalks at Uncontrolled Locations.* 2005.

Materials and Maintenance

Unmarked crosswalks should be maintained free of debris. Surrounding landscaping should be maintained to not negatively impact sight lines.

Marked Crosswalks at Intersections

Description

A marked crosswalk signals to motorists that they must stop for pedestrians and encourages pedestrians to cross at designated locations. Installing crosswalks alone will not necessarily make crossings safer especially on multi-lane roadways.

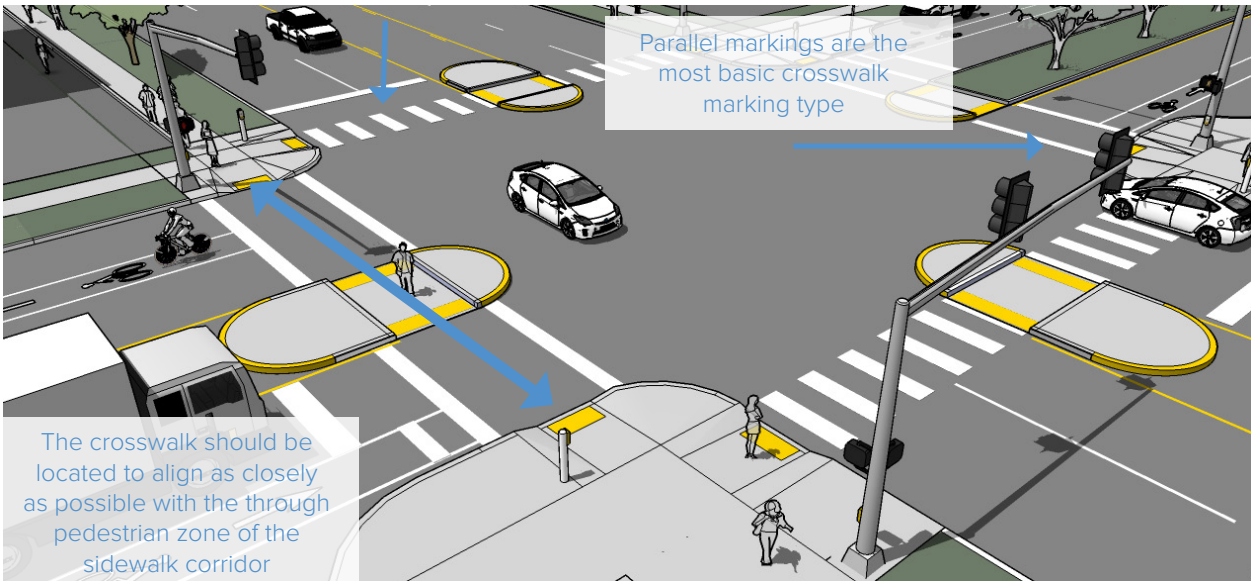
At mid-block locations, crosswalks can be marked where there is a demand for crossing and there are no nearby marked crosswalks.

Guidance

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

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

Continental markings provide additional visibility



Discussion

Continental crosswalk markings should be used at crossings with high pedestrian use or where vulnerable pedestrians are expected, including: school crossings, across arterial streets for pedestrian-only signals, at mid-block crosswalks, and at intersections where there is expected high pedestrian use and the crossing is not controlled by signals or stop signs. See intersection signalization for a discussion of enhancing pedestrian crossings.

Additional References and Guidelines

FHWA. *Manual on Uniform Traffic Control Devices. (3B.18).* 2009.
AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* 2004.
FHWA. *Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations.* 2005.
FHWA. *Crosswalk Marking Field Visibility Study.* 2010.
NACTO. *Urban Street Design Guide.* 2013.

Materials and Maintenance

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

Marked/Unsignalized Mid-Block Crossings

Description

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 can improve user safety by providing pedestrians and bicyclists space to perform the safe crossing of one side of the street at a time.

Guidance

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

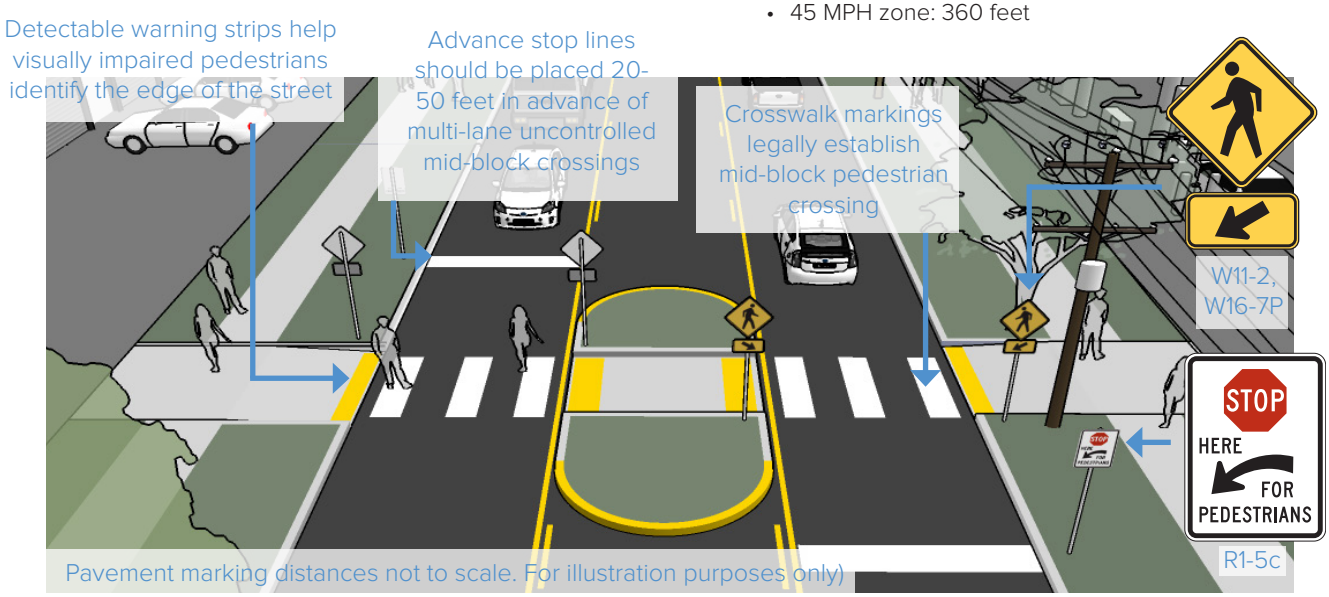
- 35 MPH

Maximum number of lanes

- 3 lanes with a refuge

Minimum line of sight

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



Discussion

Unsignalized crossings of multi-lane arterials over 15,000 ADT may be possible with features such as sufficient crossing gaps (more than 60 per hour), median refuges, and/or active warning devices like rectangular rapid flash beacons or in-pavement flashers, and excellent sight distance. For more information see the discussion of active warning beacons. On roadways with low to moderate traffic volumes (<12,000 ADT) and a need to control traffic speeds, a raised crosswalk may be the most appropriate crossing design to improve pedestrian visibility and safety.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities*. 2012.
FHWA. *Manual on Uniform Traffic Control Devices*. 2009.

Materials and Maintenance

Locate markings out of wheel tread when possible to minimize wear and maintenance costs.

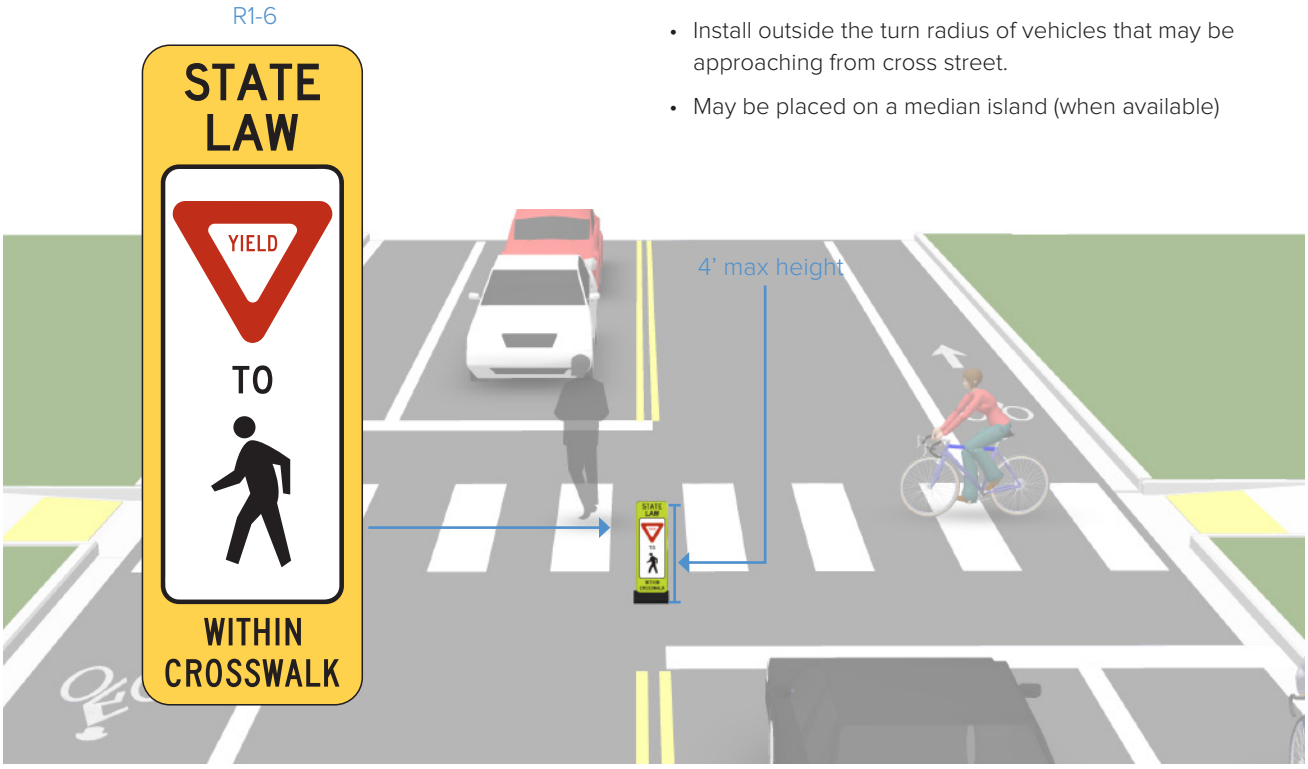
In Street Pedestrian Crossing Signs

Description

In-street pedestrian crossing signs are attached to a flexible plastic bollard on the center line of the roadway. They are used to reinforce the presence of crosswalks and remind motorists of their legal obligation to yield for pedestrians in marked or unmarked crosswalks. This signage is often placed at high-volume pedestrian crossings that are not signalized.

Guidance

- 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.
- The signs perform better on narrow roadways, where the visibility of the signs is maximized
- Install in a manner that does not impede pedestrian flow.
- Install outside the turn radius of vehicles that may be approaching from cross street.
- May be placed on a median island (when available)



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 moveable base. This allows for day-time only applications. On multi-lane roadways, consider active warning beacons for improved yielding compliance.

Additional References and Guidelines

UDOT. *Utah Manual on Uniform Traffic Control Devices.* 2011.
Redmon, Tamara. *Evaluating Pedestrian Safety Countermeasures. Public Road.* 2011.
Hua, Jenna. *San Francisco PedSafe II Project Outcomes and Lessons Learned.* TRB Annual Meeting. 2009.

Materials and Maintenance

Unless the In-Street Pedestrian Crossing sign is placed on a physical island, the sign support shall be designed to bend over and then bounce back to its normal vertical position when struck by a vehicle.

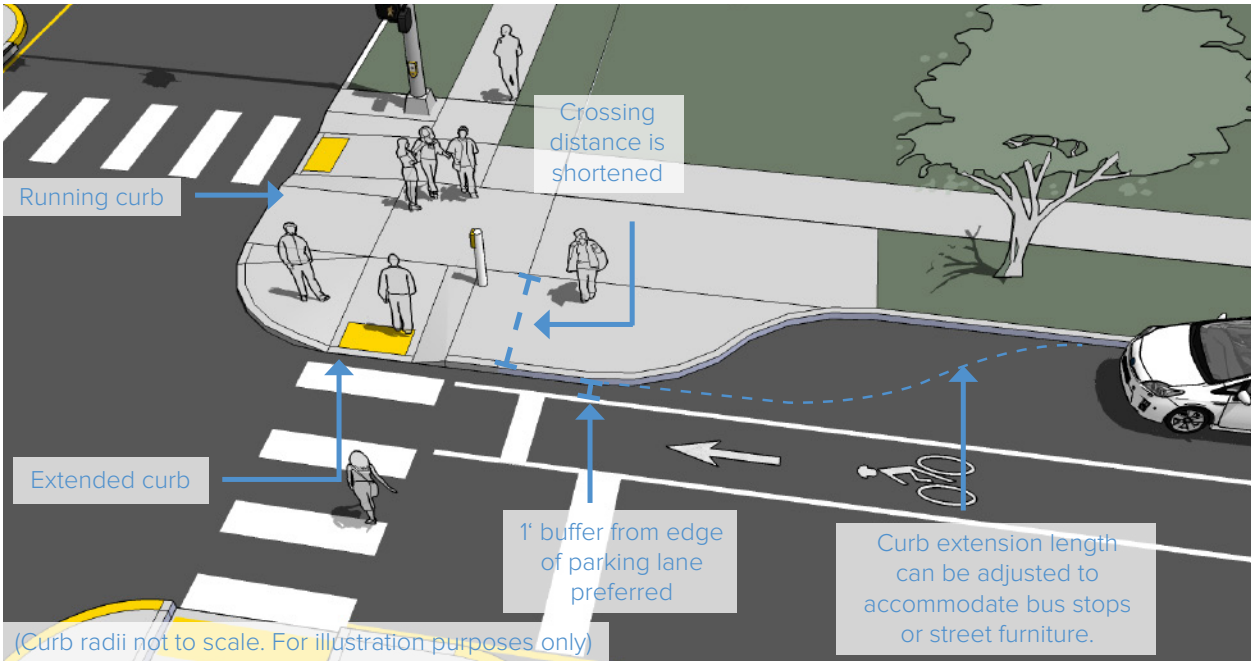
Curb Extensions

Description

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.

Guidance

- 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.



Discussion

If there is no parking lane, adding curb extensions may be a problem for bicycle travel and truck or bus turning movements. Additional traffic calming tools can be found in Chapter 8 of this appendix.

Additional References and Guidelines

AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* 2004.
AASHTO. *A Policy on Geometric Design of Highways and Streets.* 2004. NACTO. *Urban Street Design Guide.* 2013.

Materials and Maintenance

Planted curb extensions may be designed as a bioswale, a vegetated system for storm water management.

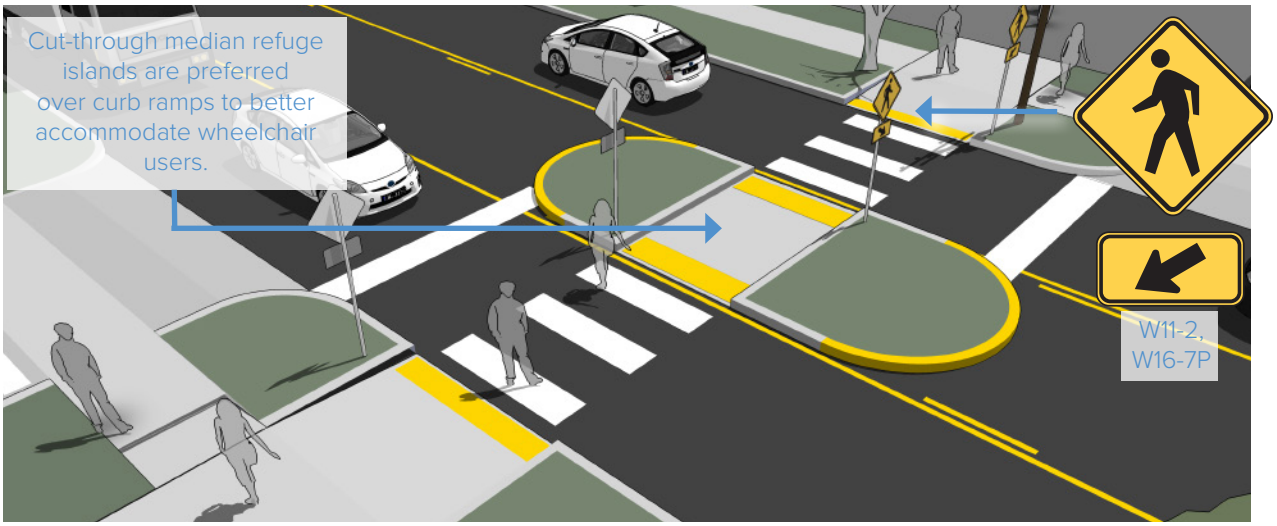
Median Refuge Islands

Description

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

Guidance

- Can be applied on any roadway with a left turn center lane or median that is at least 6' wide.
- Appropriate at signalized or unsignalized crosswalks
- The refuge island must be accessible, preferably with an at-grade passage through the island rather than ramps and landings.
- The island should be at least 6' wide between travel lanes (to accommodate bikes with trailers and wheelchair users) and at least 20' long.
- On streets with speeds higher than 25 mph there should also be double center line marking, reflectors, and "KEEP RIGHT" signage.



Discussion

If a refuge island is landscaped, the landscaping should not compromise the visibility of pedestrians crossing in the crosswalk. Shrubs and ground plantings should be no higher than 1 ft 6 in. On multi-lane roadways, consider configuration with active warning beacons for improved yielding compliance. Additional traffic calming tools can be found in Chapter 8 of this appendix.

Additional References and Guidelines

FHWA. *Manual on Uniform Traffic Control Devices.* 2009.
AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* 2004.
NACTO. *Urban Bikeway Design Guide.* 2012.
NACTO. *Urban Street Design Guide.* 2013.

Materials and Maintenance

Refuge islands may collect road debris and may require somewhat frequent maintenance. Refuge islands should be visible to snow plow crews and should be kept free of snow berms that block access.

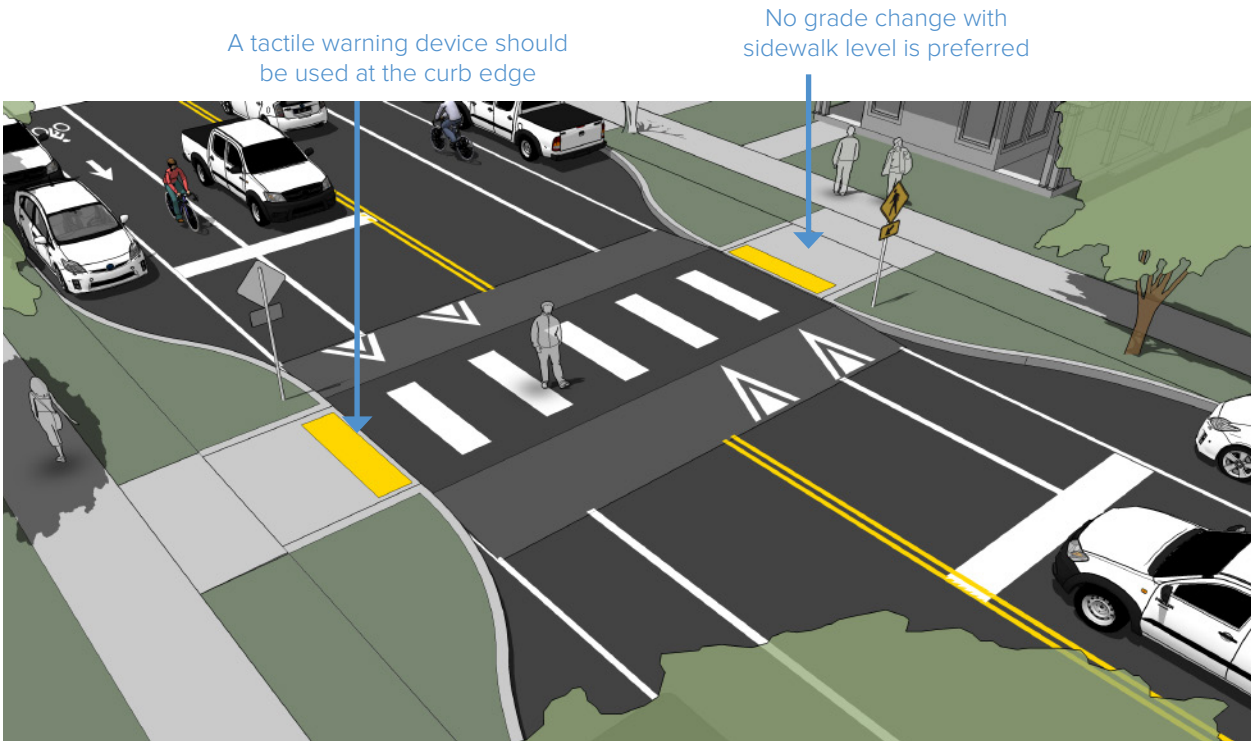
Raised Crosswalks

Description

A raised crosswalk or intersection can eliminate grade changes from the pedestrian path and give pedestrians greater prominence as they cross the street. Raised crosswalks should be used only in very limited cases where a special emphasis on pedestrians is desired; review on case-by-case basis.

Guidance

- Use detectable warnings at the curb edges to alert vision-impaired pedestrians that they are entering the roadway.
- Approaches to the raised crosswalk may be designed to be similar to speed humps.
- Raised crosswalks can also be used as a traffic calming treatment.



Discussion

Like a speed hump, raised crosswalks have a traffic slowing effect which may be unsuitable on emergency response routes. Additional traffic calming tools can be found in Chapter 8 of this appendix.

Additional References and Guidelines

FHWA. *Manual on Uniform Traffic Control Devices. (3B.18).* 2009.
AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* 2004.
USDOJ. *ADA Standards for Accessible Design.* 2010.
NACTO. *Urban Street Design Guide.* 2013.

Materials and Maintenance

Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority.

Pedestrians at Signalized Crossings

Description

Pedestrian Signal Head

Pedestrian signal heads indicate to pedestrians when to cross at a signalized crosswalk. Pedestrian signal indications are recommended at all traffic signals except where pedestrian crossing is prohibited.

Countdown pedestrian signals are particularly valuable for pedestrians, as they indicate whether a pedestrian has time to cross the street before the signal phase ends. Countdown signals should be used at all new and rehabbed signalized intersections

Signal Timing

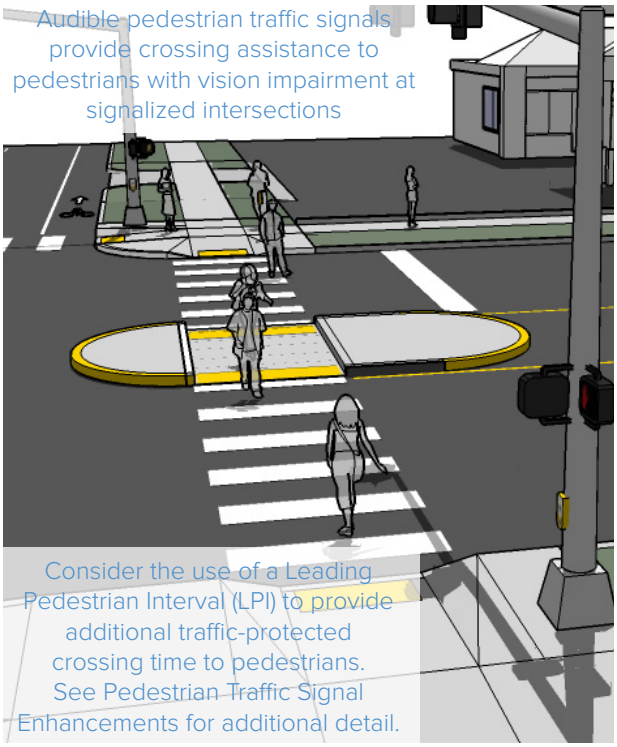
Adequate pedestrian crossing time is a critical element of the walking environment at signalized intersections. The length of a signal phase with parallel pedestrian movements should provide sufficient time for a pedestrian to safely cross the adjacent street. The MUTCD recommends a walking speed of 3.5 ft per second.

At crossings where older pedestrians or pedestrians with disabilities are expected, crossing speeds as low as 3 ft per second should be assumed. Special pedestrian phases can be used to provide greater visibility or more crossing time for pedestrians at certain intersections (See Pedestrian Traffic Signal Enhancements).

Large pedestrian crossing distances can be broken up with median refuge islands. A pedestrian push-button can be provided on the median to create a two-stage pedestrian crossing if the pedestrian phase is actuated. This ensures that pedestrians are not stranded on the median, and is especially applicable on large, multi-lane roadways with high vehicle volumes, where providing sufficient pedestrian crossing time for a single stage crossing may be an issue.

Additional References and Guidelines

United States Access Board. *Proposed Accessibility Guidelines for Pedestrian Facilities in the Public-Right-of-Way (PROWAG).* 2011.
AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* 2004.
NACTO. *Urban Street Design Guide.* 2013.



Discussion

Push-buttons should be located so that someone in a wheelchair can reach the button from a level area of the sidewalk without deviating significantly from the natural line of travel into the crosswalk. Push-buttons should be marked (for example, with arrows) so that it is clear which signal is affected. In areas with very high pedestrian volumes, consider an all-pedestrian signal phase, also known as a Pedestrian Scramble or Barnes Dance, to give pedestrians free passage in the intersection when all motor vehicle traffic movements are stopped, including diagonally in some cases. This greatly reduces pedestrian and vehicle conflicts, but does make for a longer signal cycle length. Right turns on red must not be permitted in conjunction with an exclusive pedestrian phase.

Materials and Maintenance

It is important to repair or replace traffic control equipment before it fails. Consider semi-annual inspections of controller and signal equipment, intersection hardware, and loop detectors.

Pedestrian Traffic Signal Enhancements

Description

Pedestrian-vehicle conflicts can occur when drivers performing turning movements across the crosswalk do not see or yield to pedestrians who have the right-of-way. Pedestrians may also arrive at an intersection late, or may not have any indication of how much time they have to safely cross the intersection. Pedestrian traffic signal enhancements can be made to provide pedestrians with a safe crossing environment.

Guidance

Pedestrian recall is a traffic signal controller setting that automatically provides a pedestrian walk phase during every cycle. Since Pedestrian recall does not require detection or actuation, it eliminates the need for push buttons or other costly detection equipment. This makes pedestrian crossings predictable, minimizes unnecessary pedestrian delay, and does not leave pedestrians wondering whether they have been detected or not. The most appropriate use of pedestrian recall is in locations and/or times of day with high pedestrian volumes.

Push buttons can be configured to provide additional crossing time when pedestrians arrive at the crossing during the flashing don't walk interval. The MUTCD requires signage indicating the walk time extension at or adjacent to the push button (R10-32P).

Passive pedestrian detection devices save pedestrians the trouble of having to locate a push button. They are also capable of tracking pedestrians as they cross the intersection, and can be configured to extend the walk/flashing don't walk interval when pedestrians are still in the intersection, and/or not dedicate walk time in the absence of pedestrians.

Leading Pedestrian Intervals (LPI) are used to reduce right turn and permissive left turn vehicle and pedestrian conflicts. The through pedestrian interval is initiated first, in advance of the concurrent through/right/permissive left turn interval. The LPI minimizes vehicle-pedestrian conflicts because it gives pedestrians a 3-10 second head start into the intersection, thereby making them more visible, and reducing crossing exposure time.

Accessible Pedestrian Signals (APS) are designed to be accessible by individuals with visual disabilities. They provide audible tones or verbal messages to convey when it is appropriate to walk, when they must wait, and feedback when the signal has been actuated via push-button. This eliminates the need for pedestrians to rely entirely on the audible cues provided by moving cars, which may be deceiving depending on the complexity of traffic signal operations at the intersection.

Pedestrian Traffic Signal Enhancements

Leading Pedestrian Interval

Passive Infrared Pedestrian Detector

Push-buttons will require regular inspection

Materials and Maintenance

Detection and actuation equipment will require regular maintenance. As a result, fixed operations require less maintenance than actuated operations. Intersections employing split phasing, right turn overlaps, or protected-permitted left-turn signals should be monitored to ensure that conflicting pedestrian and vehicle movements do not occur.

Additional References and Guidance

FHWA. *Signal Timing Manual.* 2008.
FHWA. *Signalized Intersections: Informational Guide. 2nd Edition.* 2013.
UDOT. *Utah Manual on Uniform Traffic Control Devices.* 2011.
NACTO. *Urban Street Design Guide.* 2013.

Active Warning Beacons (RRFB)

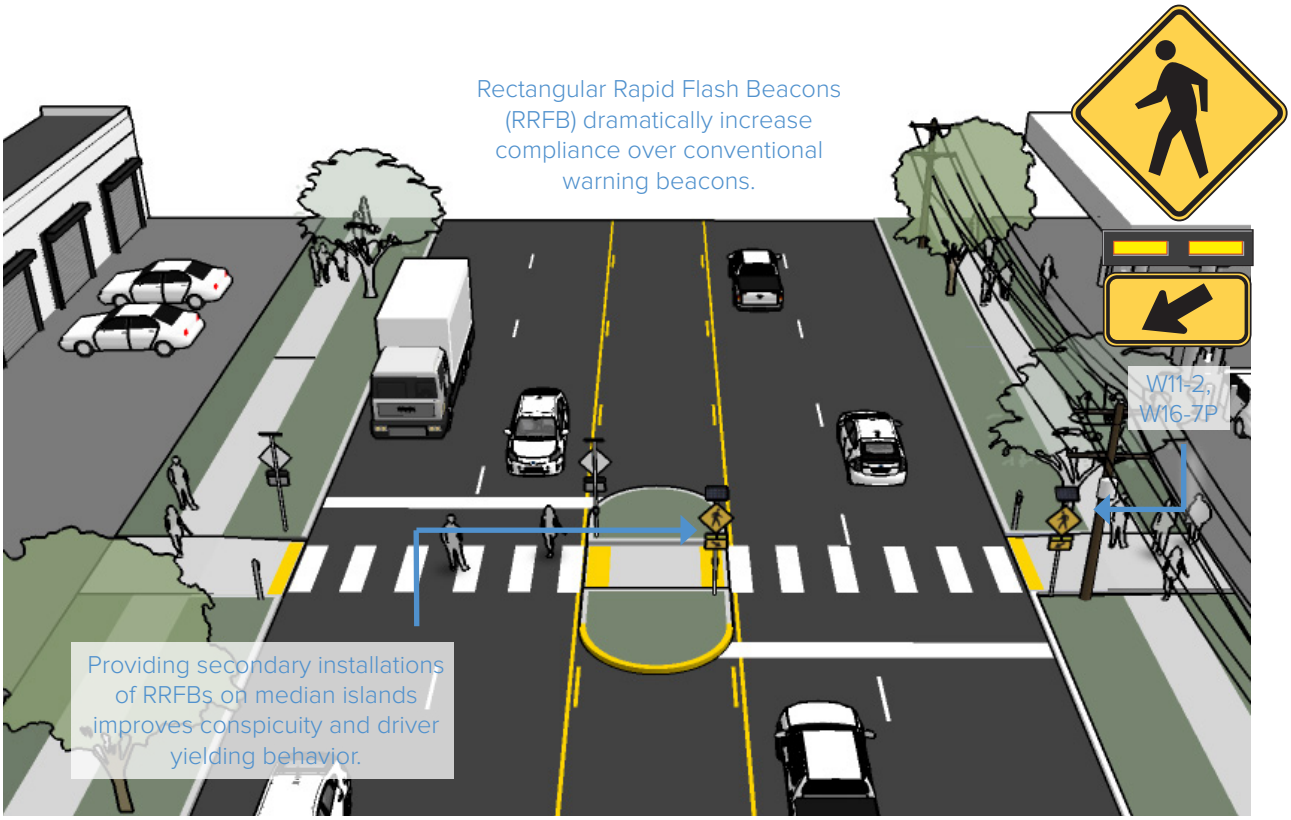
Description

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).

Guidance

- 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.



Discussion

Rectangular rapid flash beacons have the most increased 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 (according to a 2009 FHWA study). Additional studies over long term installations show little to no decrease in yielding behavior over time.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide*. 2012.
FHWA. *Manual on Uniform Traffic Control Devices*. 2009.
FHWA. *MUTCD - Interim Approval for Optional Use of Rectangular Rapid Flashing Beacons (IA-11)*. 2008.

Materials and Maintenance

Depending on power supply, maintenance can be minimal. If solar power is used, RRFBs should run for years without issue.

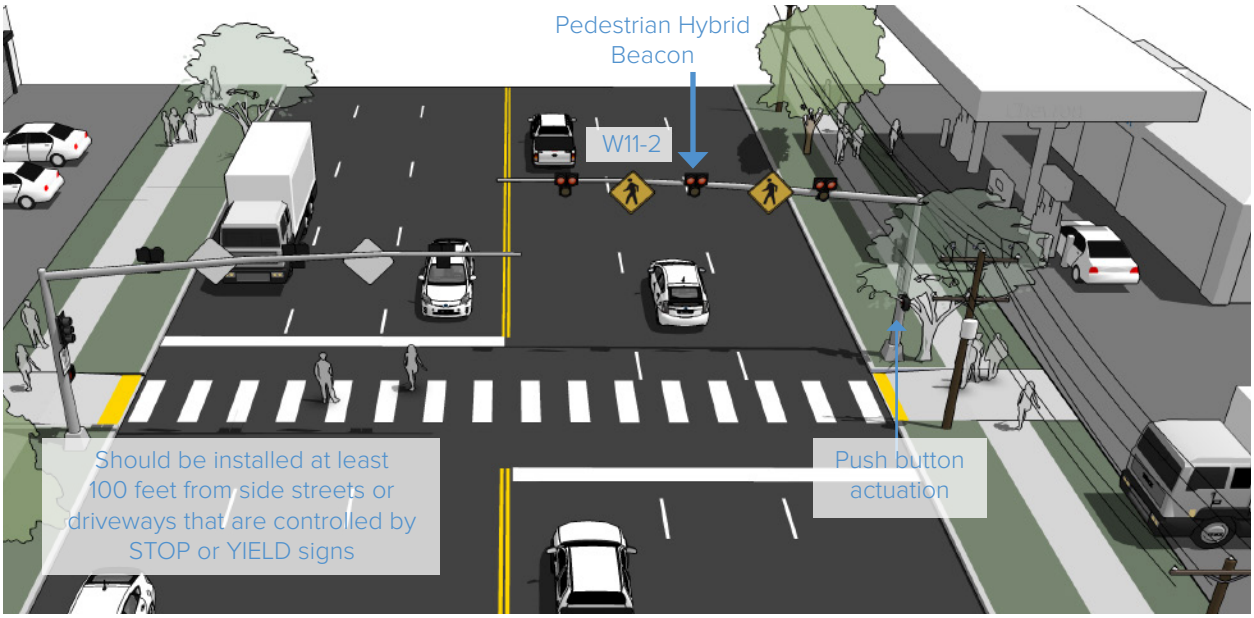
Hybrid Beacons

Description

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.

Guidance

- 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.



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.

Additional References and Guidelines

FHWA. *Manual on Uniform Traffic Control Devices.* 2009.
NACTO. *Urban Bikeway Design Guide.* 2012.

Materials and Maintenance

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

Toucan Signals

Description

"Toucan" crossings of streets are a type of signal configuration that provides minor street or mid-block signal indication for bicyclists and pedestrians, but not for motor vehicles, so that "two can" cross the major street.

Typical Application

- Appropriate at mid-block or carefully designed intersection locations.
- Across higher traffic streets where pedestrians and bicyclists are crossing together.
- Across higher traffic streets where a conventional traffic signal or pedestrian hybrid beacon is considered to assist in pedestrian and bicyclist crossings.

Design Features

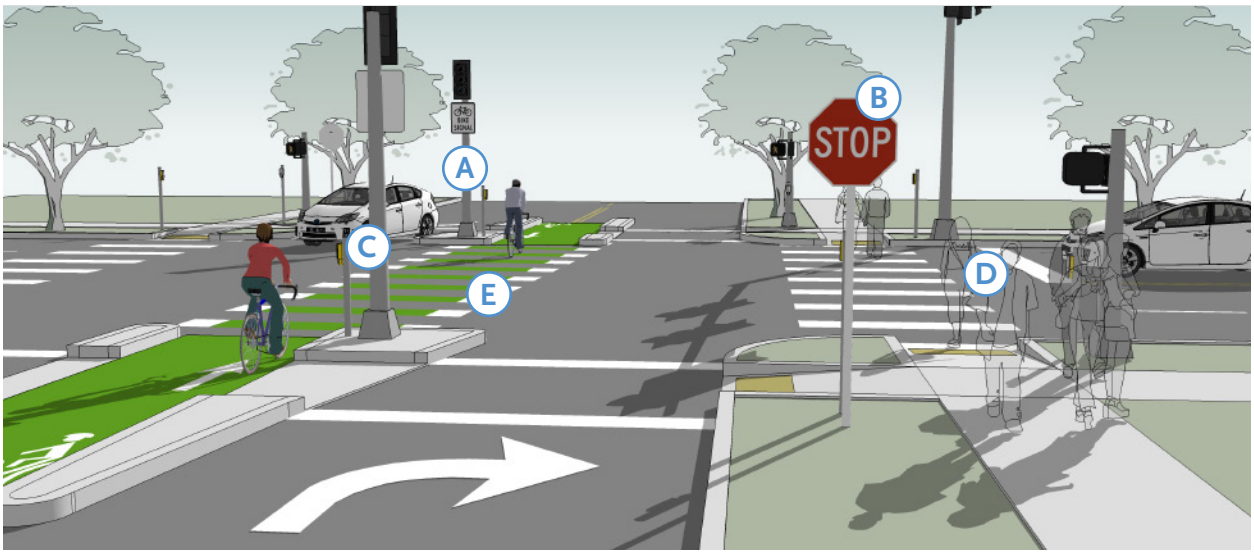
(A) A toucan signal assembly may be created by pairing a bicycle signal head with a pedestrian signal head.

(B) If located at an intersection, the major street receives standard traffic signal control, and the minor cross street has STOP sign to control motor vehicle traffic. The design may be paired with access management or other measures to reduce potential conflicts.

(C) The pedestrian/bike phase is typically activated by a push button or passive detection.

(D) Stop lines, high visibility crosswalk markings and bicycle lane dotted line extensions should be used to clarify crossing expectations.

(E) Green colored pavement may be used to highlight the bike lane crossing.



Additional References and Guidelines

NCHRP 562: Improving Pedestrian Safety at Unsignalized Crossings. 2006.

FHWA Interim Approval 16 (I.A. 16). (Note: Because this is an unconventional configuration at intersections, it is important to operate all Toucan signals consistently across the city for maximum safety and understanding. (NCHRP 562). FHWA has approved bicycle signals for use, if they comply with requirements from F.C. Interaction Approval 16 (I.A. 16).

Implementation & Costs

Cost will depend on the complexity and size of the intersection, but in general, costs are comparable to the installation of conventional traffic signals (i.e. controller boxes, detection devices, mast arms, etc.).

Toucan Signals

Toucan signal with channelized crossing island

This central island also functions as a right-out channelization island for motor vehicles. (Tucson, AZ)

Toucan signal at mid-block location

A mid-block toucan signal uses high visibility crossing markings to separate user types. (Berkeley, CA)

Further Considerations

- MUTCD guidance discourages installation of half signals at intersection locations. However, based on an engineering study or engineering judgment, a jurisdiction can decide to install the device at such an intersection if it determines that is the best location for it, considering all pertinent factors, and/or there are mitigating measures.
- Pedestrians typically need more time to travel through an intersection than bicyclists. Signal timing and recall phases may be configured to be responsive to the detection and actuation by different user types with different signal and clearance intervals.
- Bicycle detection and actuation systems include loop detectors, video detection, microwave, radar, or other technologies that trigger the activation of the bicycle signal when a bicycle is detected.
- Toucan signals operate in a similar fashion to Pedestrian Hybrid Beacons (PHB). PHBs have shown a crash reduction of 29% for all crash types (CMF ID: 2911) and 15% for fatal or serious injury crashes (CMF ID: 2917).

Full Traffic Signal

Description

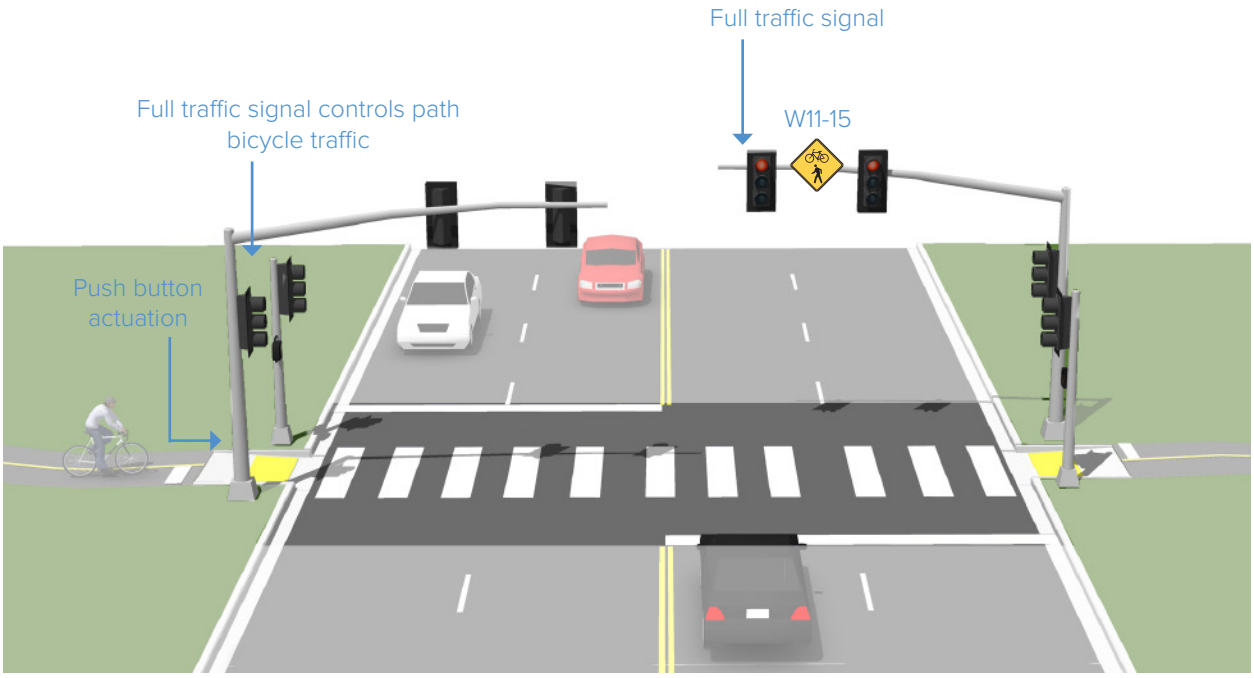
Signalized crossings provide the most protection for crossing path users through the use of a red-signal indication to stop conflicting motor vehicle traffic.

A full traffic signal installation treats the path crossing as a conventional 4-way intersection and provides standard red-yellow-green traffic signal heads for all legs of the intersection.

Guidance

Full traffic signal installations must meet MUTCD pedestrian, school or modified warrants. Additional guidance for signalized crossings:

- Located more than 300 feet from an existing signalized intersection
- Roadway travel speeds of 40 MPH and above
- Roadway ADT exceeds 15,000 vehicles



Discussion

Shared use path signals are normally activated by push buttons but may also be triggered by embedded loop, 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.

Additional References and Guidelines

FHWA. *Manual on Uniform Traffic Control Devices*. 2009.
NACTO. *Urban Bikeway Design Guide*. 2012.

Materials and Maintenance

Traffic signals require routine maintenance. Signing and striping need to be maintained to help users understand any unfamiliar traffic control.

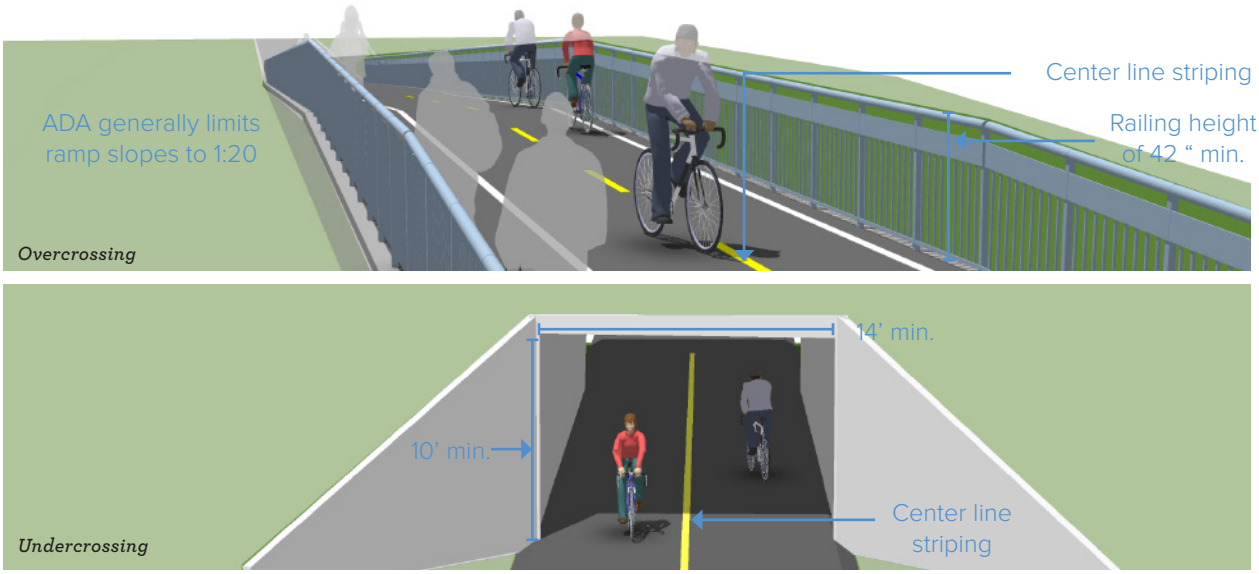
Grade-Separated Crossings

Description

Grade separated crossings provide critical non-motorized system links by joining areas separated by barriers such as railroads, waterways and highway corridors. In most cases, these structures are built in response to user demand for safe crossings where they previously did not exist. There are no minimum roadway characteristics for considering grade separation. Depending on the type of facility or the desired user group, grade separation may be considered in many types of projects.

Guidance

Overcrossings require a minimum of 17 feet of vertical clearance to the roadway below versus a minimum elevation differential of around 12 feet for an undercrossing. This can result in greater elevation differences and much longer ramps for bicycles and pedestrians to negotiate. Overcrossings should be at least 8 feet wide with 14 feet preferred and additional width provided at scenic viewpoints. Undercrossings should be designed at minimum 10 feet height and 14 feet width.



Discussion

Overcrossings for bicycles and pedestrians typically fall under the Americans with Disabilities Act (ADA), which strictly limits ramp slopes to 5% (1:20) with landings at 400 foot intervals, or 8.33% (1:12) with landings every 30 feet. Overcrossings pose potential concerns about visual impact and functional appeal, as well as space requirements necessary to meet ADA guidelines for slope. Safety is a major concern with undercrossings. Shared use path users may be temporarily out of sight from public view and may experience poor visibility themselves. To mitigate safety concerns, an undercrossing should be designed to be spacious, well-lit, equipped with emergency cell phones at each end and completely visible for its entire length from end to end.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* 2004.

Materials and Maintenance

14 foot width allows for maintenance vehicle access. Potential problems include conflicts with utilities, drainage, flood control and vandalism. Overcrossings can be more difficult to clear of snow than undercrossings.

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3: Shared Use Paths

Introduction

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. These facilities are frequently found in parks, along rivers, beaches, and in greenbelts or utility corridors where there are few conflicts with motorized vehicles. Path facilities can also include amenities such as lighting, signage, and fencing (where appropriate).

Key features of shared use paths include:

- Frequent access points from the local road network.
- Directional signs to direct users to and from the path.
- A limited number of at-grade crossings with streets or driveways.
- Terminating the path where it is easily accessible to and from the street system.
- Separate treads for pedestrians and bicyclists when heavy use is expected.

Path Crossings

In most cases, at-grade path crossings can be properly designed to provide a reasonable degree of safety and can meet existing traffic and safety standards. Path facilities that cater to bicyclists can require additional considerations due to the higher travel speed of bicyclists versus pedestrians.

Consideration must be given to adequate warning distance based on vehicle speeds and line of sight, with the visibility of any signs absolutely critical. Directing the active attention of motorists to roadway signs may require additional alerting devices such as a flashing beacon, roadway striping or changes in pavement texture (see Chapter 2 of this appendix). Signing for path users may include a standard "STOP" or "YIELD" sign and pavement markings, possibly combined with other features such as bollards or a bend in the pathway to slow bicyclists. Care must be taken not to place too many signs at crossings lest they begin to lose their visual impact.

A number of striping patterns have emerged over the years to delineate path crossings. A median stripe on the path approach will help to organize and warn path users. Crosswalk striping is typically a matter of local and state preference, and may be accompanied by pavement treatments to help warn and slow motorists. In areas where motorists do not typically yield to crosswalk users, additional measures may be required to increase compliance.

General Design Practices

Description

Shared use paths can provide a desirable facility, particularly for recreation, and users of all skill levels preferring separation from traffic. Bicycle paths should generally provide directional travel opportunities not provided by existing roadways.

Guidance

Width

- 8 feet is the minimum allowed for a two-way bicycle path and is only recommended for 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. A separate track (5' minimum) can be provided for pedestrian use.

Lateral Clearance

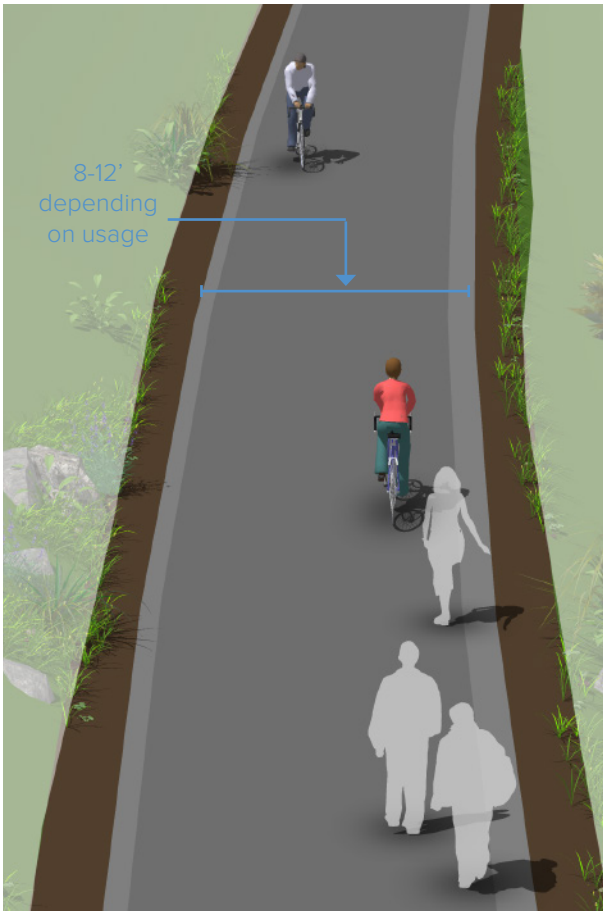
- A 2 foot or greater shoulder on both sides of the path should be provided. An additional foot of lateral clearance (total of 3') is required by the MUTCD for the installation of signage or other furnishings.
- If bollards are used at intersections and access points, they should be colored brightly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

Overhead Clearance

- Clearance to overhead obstructions should be 8 feet minimum, with 10 feet recommended.

Striping

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



Discussion

Terminate the path where it is easily accessible to and from the street system, preferably at a controlled intersection or at the beginning of a dead-end street.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
FHWA. *Manual on Uniform Traffic Control Devices.* 2009.
Flink, C. *Greenways: A Guide To Planning Design And Development.* 1993.

Materials and Maintenance

Asphalt is the most common surface for bicycle paths. The use of concrete for paths has proven to be more durable over the long term. Saw cut concrete joints rather than troweled improve the experience of path users.

Shared Use Paths Along Roadways

Description

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.

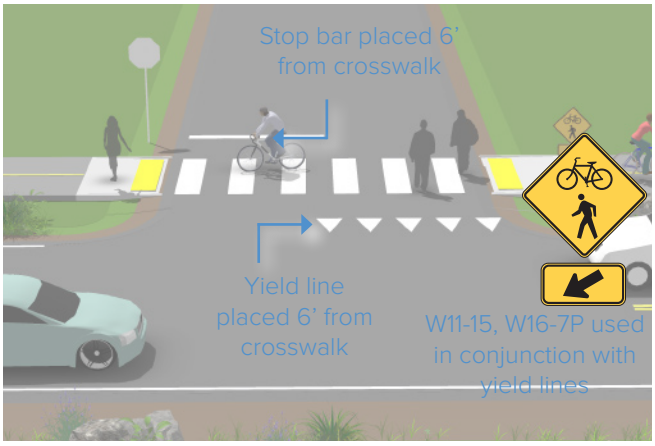
Along roadways, these facilities create a situation where a portion of the bicycle traffic rides against the normal flow of motor vehicle traffic and can result in wrong-way riding where bicyclists enter or leave the path. The AASHTO Guide for the Development of Bicycle Facilities cautions practitioners of the use of two-way sidepaths on urban or suburban streets with many driveways and street crossings.

In general, there are two approaches to crossings: adjacent and setback crossings, illustrated below.

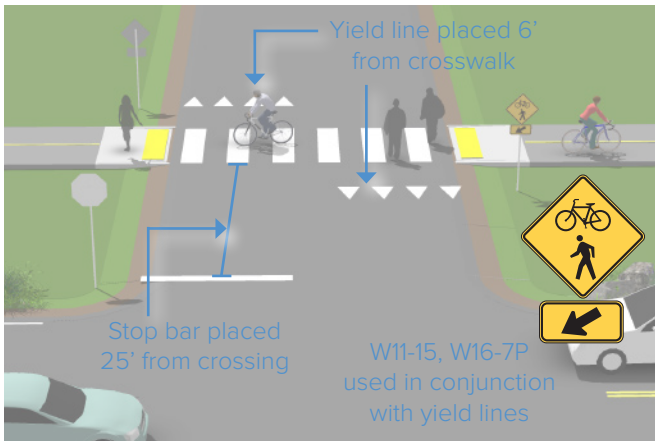
Guidance

- Guidance for sidepaths should follow that for general design practises of shared use paths.
- A high number of driveway crossings and intersections create potential conflicts with turning traffic. Consider alternatives to sidepaths on streets with a high frequency of intersections or heavily used driveways.
- Where a sidepath terminates special consideration should be given to transitions so as not to encourage unsafe wrong-way riding by bicyclists.
- Crossing design should emphasize visibility of users and clarity of expected yielding behavior. Crossings may be STOP or YIELD controlled depending on sight lines and bicycle motor vehicle volumes and speeds.

Adjacent Crossing - A separation of 6 feet emphasizes the conspicuity of riders at the approach to the crossing.



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.



Discussion

The provision of a shared use path adjacent to a road is not a substitute for the provision of on-road accommodation such as paved shoulders or bike lanes, but may be considered in some locations in addition to on-road bicycle facilities. To reduce potential conflicts in some situations, it may be better to place one-way sidepaths on both sides of the street.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
NACTO. *Urban Bikeway Design Guide.* See entry on Raised Cycle Tracks. 2012.

Materials and Maintenance

Asphalt is the most common surface for bicycle paths. The use of concrete for paths has proven to be more durable over the long term. Saw cut concrete joints rather than troweled improve the user experience.

Local Neighborhood Accessways

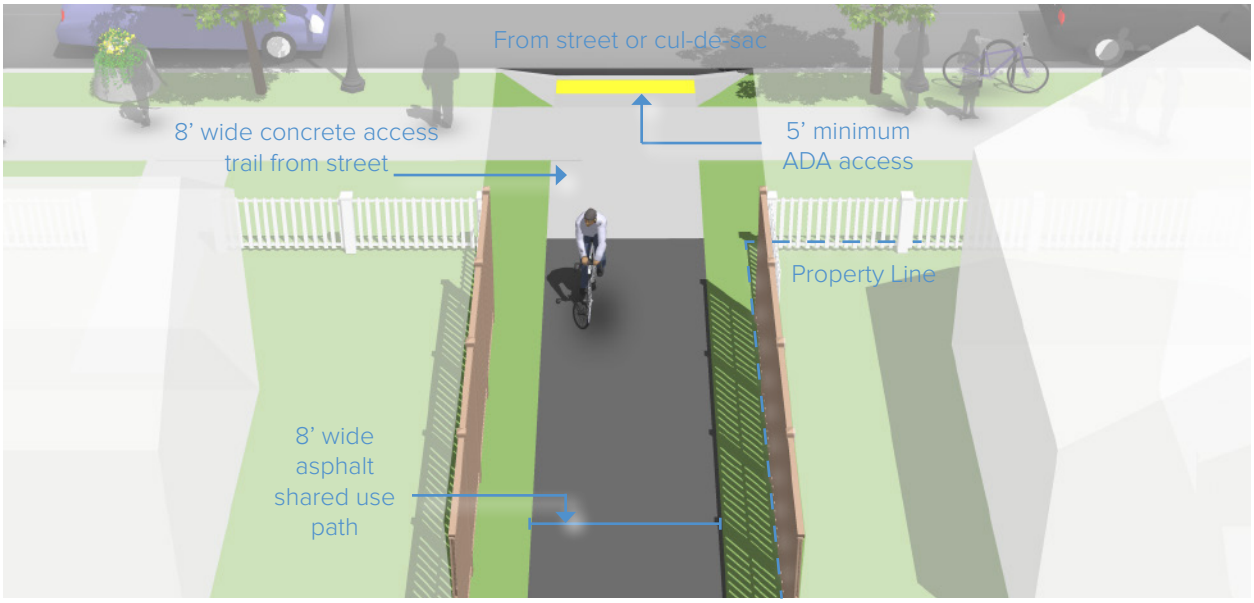
Description

Neighborhood accessways provide residential areas with direct bicycle and pedestrian access to parks, shared use paths, green spaces, and other recreational areas. They most often serve as small shared use path connections to and from the larger shared use path network, typically having their own rights-of-way and easements.

Additionally, these smaller shared use paths can be used to provide bicycle and pedestrian connections between dead-end streets, cul-de-sacs, and access to nearby destinations not provided by the street network.

Guidance

- Neighborhood accessways should remain open to the public.
- Shared use path pavement shall be at least 8' wide to accommodate emergency and maintenance vehicles, meet ADA requirements and be considered suitable for multi-use.
- Shared use path widths should be designed to be less than 8' wide only when necessary to protect large mature native trees over 18" in caliper, wetlands or other ecologically sensitive areas.
- Access trails should slightly meander whenever possible.



Discussion

Neighborhood accessways should be designed into new subdivisions at every opportunity and should be required by City/County subdivision regulations. For existing subdivisions, Neighborhood and homeowner association groups are encouraged to identify locations where such connects would be desirable. Nearby residents and adjacent property owners should be invited to provide landscape design input.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
FHWA. *Manual on Uniform Traffic Control Devices.* 2009.
FHWA. *Federal Highway Administration University Course on Bicycle and Pedestrian Transportation. Lesson 19: Greenways and Shared Use Paths.* 2006.
NACTO. *Urban Bikeway Design Guide.* 2012.

Materials and Maintenance

Asphalt is the most common surface for bicycle paths. The use of concrete for paths has proven to be more durable over the long term. Saw cut concrete joints rather than troweled improve the experience of path users.

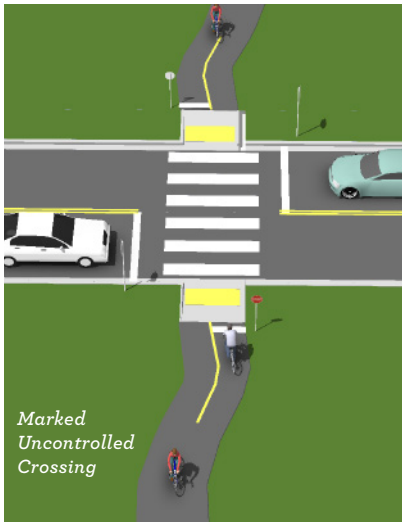
Shared Use Path Crossings

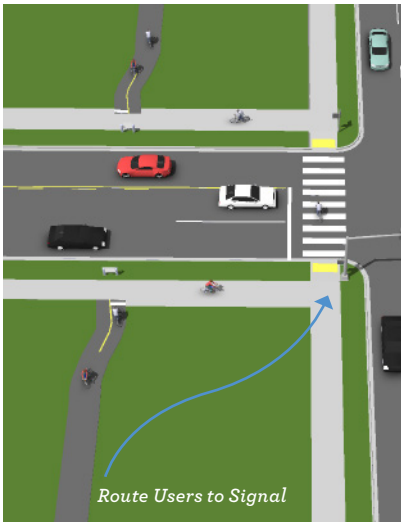
Description

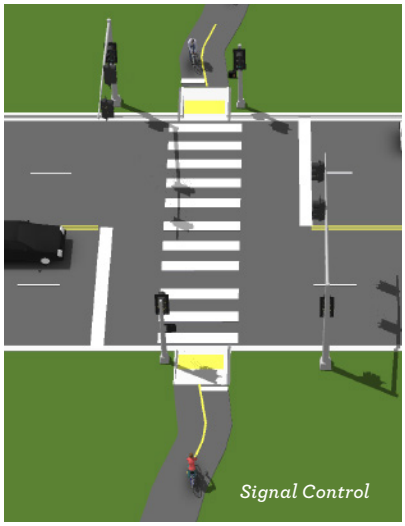
At-grade roadway crossings can create potential conflicts between path users and motorists, however, well-designed crossings can mitigate many operational issues and provide a higher degree of safety and comfort for path users.

Guidance

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.







Discussion

Marked Crossings are appropriate on a two lane road with ≤9,000-12,000 Average Daily Traffic (ADT) volume, and speeds below 35 mph. Crossings of streets with higher speeds, higher volumes, and additional lanes require additional enhancements such as median islands or active warning beacons.

Path crossings should not be provided within approximately 400 feet of an existing signalized intersection. If possible, **route the path directly to the signal**. Barriers and signing may be needed to direct shared use path users to the signalized crossings

At **signal-controlled crossings**, full traffic signal installations must meet MUTCD pedestrian, school or modified warrants. Signalized crossings should be located more than 300 feet from an existing signalized intersection, and include push button actuation for shared use path users. The maximum delay for activation of the signal should be two minutes.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
AASHTO. *Guide for the Planning, Design, and Operation of Pedestrian Facilities.* 2004.
FHWA. *Manual on Uniform Traffic Control Devices.* 2009.
FHWA. *Pedestrian Hybrid Beacon Guide - Recommendations and Case Study.* 2014.
FHWA. *MUTCD - Interim Approval for Optional Use of Rectangular Rapid Flashing Beacons (IA-11).* 2008.
NACTO. *Urban Bikeway Design Guide.* 2012.

Materials and Maintenance

Locate markings out of wheel tread when possible to minimize wear and maintenance costs. Signing and striping need to be maintained to help users understand any unfamiliar traffic control. If a sidewalk is used for crossing access, it should be kept clear of snow and debris and the surface should be level for wheeled users. Traffic signals and hybrid beacons require routine maintenance.

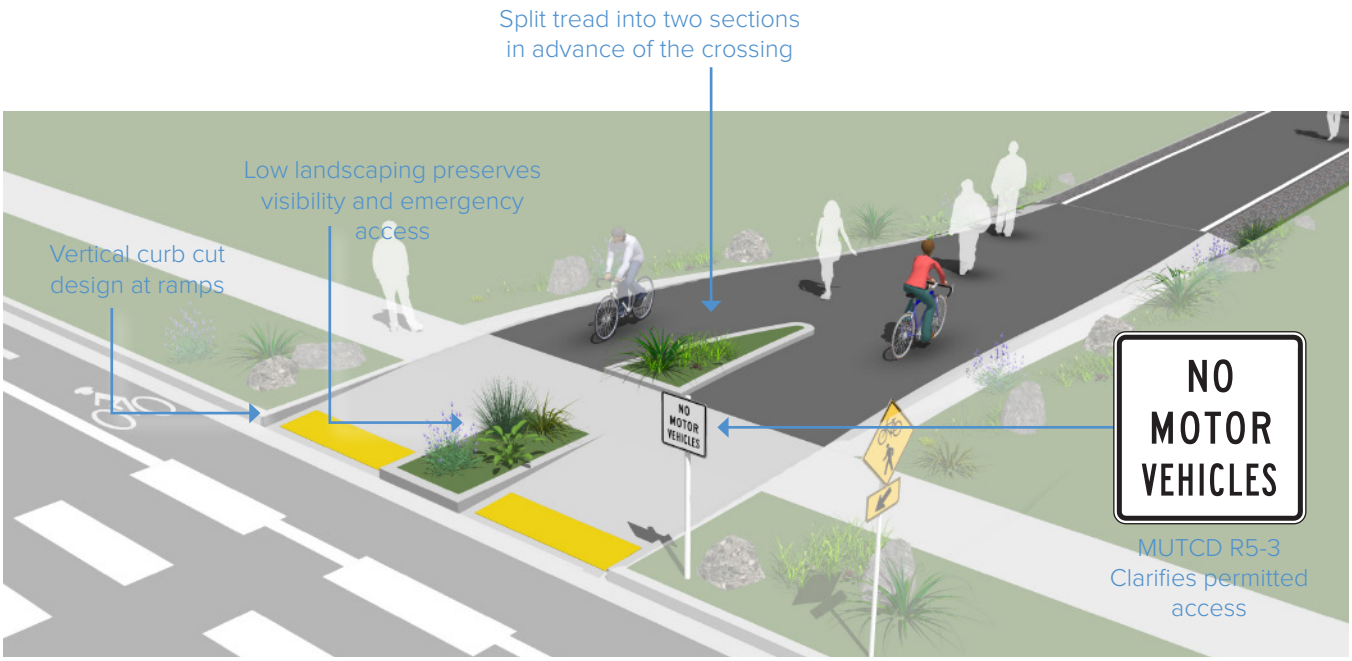
Bollard and Gate Alternatives at Shared Use Path Crossings

Description

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

Guidance

- Bollards or other barriers should not continue to be used unless there is a documented history of unauthorized intrusion by motor vehicles.
- "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



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.

Additional References and Guidelines

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

Materials and Maintenance

Landscaping separation between treads should be maintained to a height easily straddled by emergency vehicles.

4: Bicycle Facilities

On-Street Bikeways

Designated exclusively for bicycle travel, on-street bikeways are segregated from vehicle travel lanes by striping, and can include pavement stencils and other treatments. On-street bikeways are most appropriate on arterial and collector streets where higher traffic volumes and speeds warrant greater separation.

On-street bikeways can increase safety and promote proper riding by:

- Defining road space for bicyclists and motorists, reducing the possibility that motorists will stray into the bicyclists' path.
- Discouraging riding on the sidewalk.
- Reducing the incidence of wrong way riding.
- Reminding motorists that bicyclists have a right to the road.

Shared Roadways

On shared roadways, bicyclists and motor vehicles use the same roadway space. These facilities are typically used on roads with low speeds and traffic volumes, however they can be used on higher volume roads with wide outside lanes or shoulders. A motor vehicle driver will usually have to cross over into the adjacent travel lane to pass a bicyclist, unless a wide outside lane or shoulder is provided.

Shared roadways employ a large variety of treatments from simple signage and shared lane markings to more complex treatments including directional signage, traffic diverters, chicanes, chokers, and/or other traffic calming devices to reduce vehicle speeds or volumes.

Bicycle boulevards are a special class of shared roadways designed for a broad spectrum of bicyclists. They are low-volume local streets where motorists and bicyclists share the same travel lane. Treatments for bicycle boulevards are selected as necessary to create appropriate automobile volumes and speeds, and to provide safe crossing opportunities of busy streets. See the Bicycle Boulevards section on Page A-40 for more information.

Bicycle Boulevards

Description

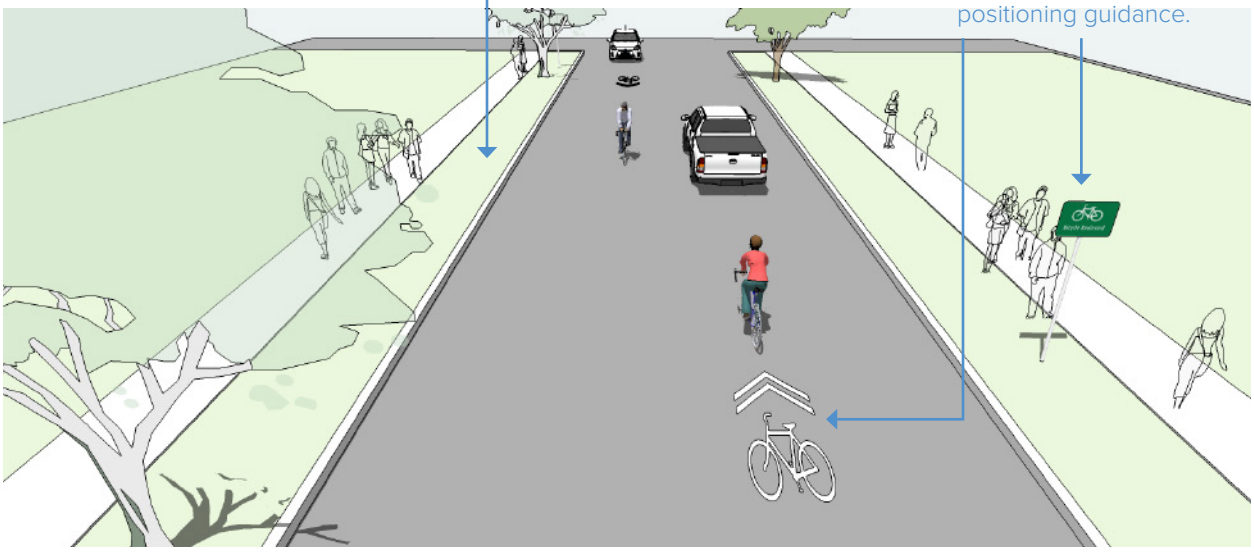
Bicycle boulevards are low-volume, low-speed streets modified to enhance bicyclist comfort by using treatments such as signage, pavement markings, traffic calming and/or traffic reduction, and intersection modifications. These treatments allow through movements of bicyclists while discouraging similar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

Guidance

- 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 22 mph.
- Implement volume control treatments based on the context of the bicycle boulevard, using engineering judgment. Target motor vehicle volumes range from 1,000 to 3,000 vehicles per day.
- Intersection crossings should be designed to enhance safety and minimize delay for bicyclists.

Wayfinding signage provides directions, distance and estimated travel time to nearby destinations.

Signs and Pavement Markings identify the street as a bicycle priority route and provide positioning guidance.



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. Anticipate and monitor vehicle volumes on adjacent streets to determine whether traffic calming results in inappropriate volumes. Traffic calming can be implemented on a trial basis.

Additional References and Guidelines

Alta Planning + Design and IBPI. *Bicycle Boulevard Planning and Design Handbook.* 2009.
BikeSafe. *Bicycle countermeasure selection system.*
Ewing, Reid. *Traffic Calming: State of the Practice.* 1999.
Ewing, Reid and Brown, Steven. *U.S. Traffic Calming Manual.* 2009.

Materials and Maintenance

Vegetation should be regularly trimmed to maintain visibility and attractiveness.

Conventional Bicycle Lanes

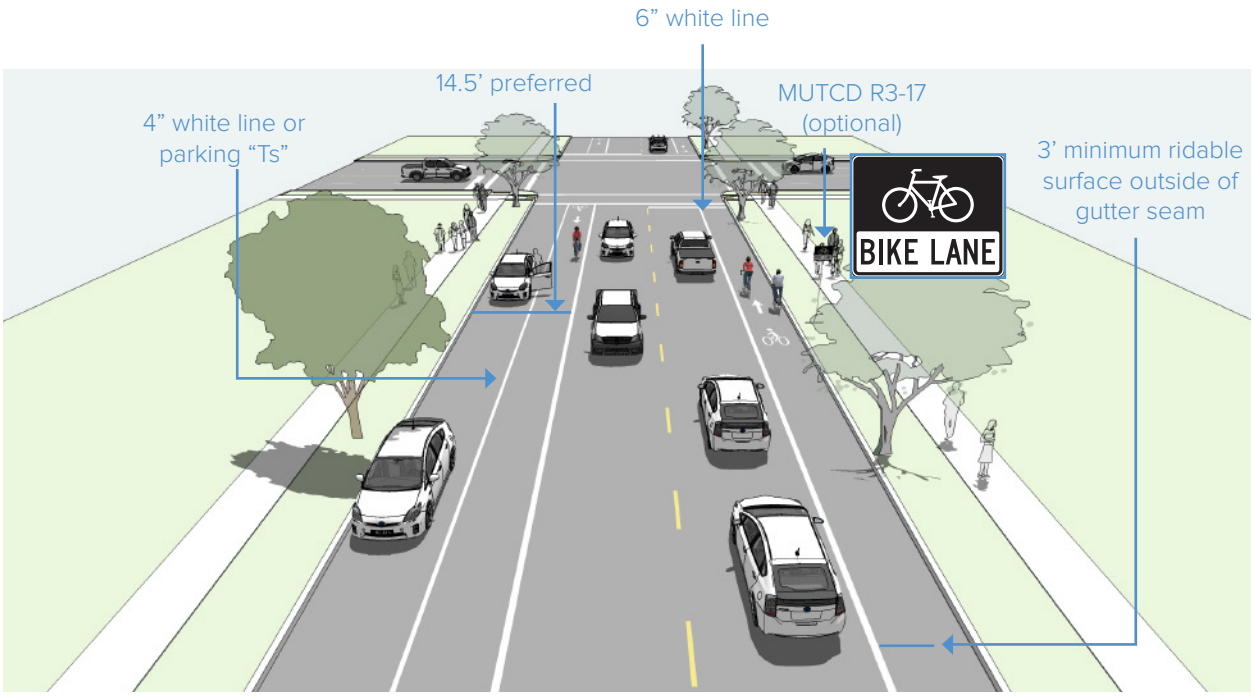
Description

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

Many bicyclists, particularly less experienced riders, are more comfortable riding on a busy street if it has a striped and signed bikeway than if they are expected to share a lane with vehicles.

Guidance

- 4 foot minimum when no curb and gutter is present.
- 5 foot minimum when adjacent to curb and gutter or 3 feet more than the gutter pan width if the gutter pan is wider than 2 feet.
- 14.5 foot preferred from curb face to edge of bike lane. (12 foot minimum) when adjacent to parallel parking.
- 7 foot maximum width for use adjacent to arterials with high travel speeds. Greater widths may encourage motor vehicle use of bike lane.



Discussion

Wider bicycle lanes are desirable in certain situations such as on higher speed arterials (45 mph+) where use of a wider bicycle lane would 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. Consider buffered bike lanes when further separation is desired.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
FHWA. *Manual on Uniform Traffic Control Devices.* 2009.
NACTO. *Urban Bikeway Design Guide.* 2012.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates. Bicycle lanes should be cleared of snow through routine snow removal operations.

Advisory Bicycle Lanes

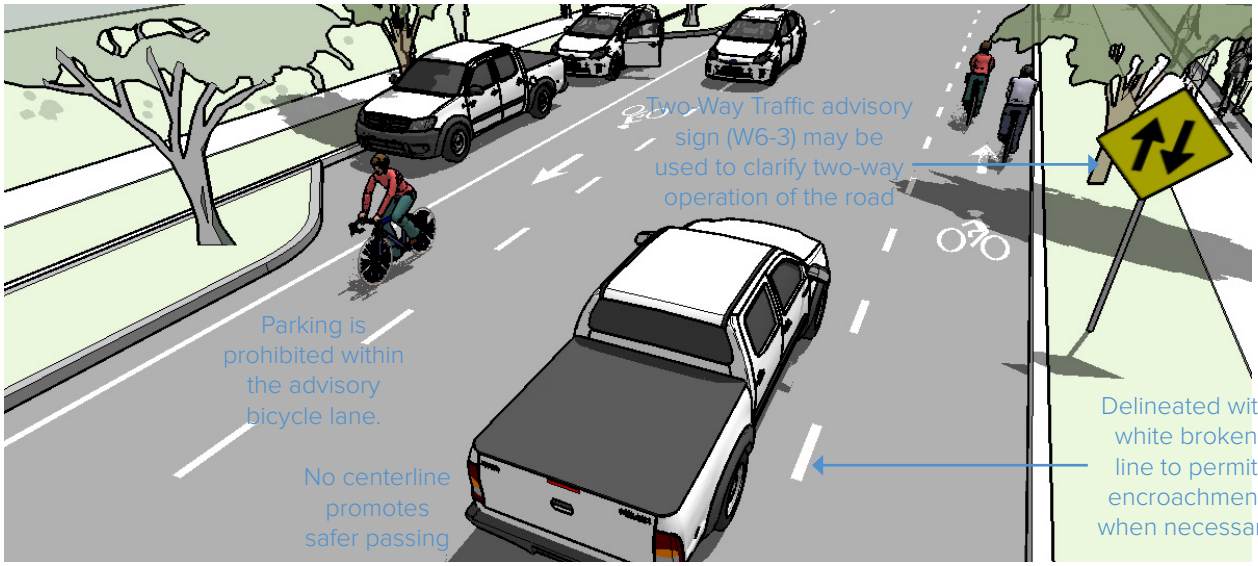
Description

Advisory bicycle lanes (also called dashed bicycle lanes) provide a bicycle-priority space 5-7 feet wide with bicycle lane markings on a roadway 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.

Benefits of advisory bicycle lanes include creating priority for people bicycling in what would otherwise be a shared-roadway condition, increasing predictability and clarifying positioning between people bicycling and people driving, and encouraging increased separation while passing.

Guidance

- This treatment is most appropriate on narrow (20-30 feet), two-lane roadways where there is insufficient space for conventional bicycle lanes and that have low volumes. Streets with travel area wider than 30 feet can support conventional bike lanes.
- Motor vehicle traffic volumes are low-moderate (1,500-4,500 ADT), but may function on streets with as high as 6,000 ADT.
- The roadway is preferably straight with few bends, inclines or sightline obstructions.
- Should not be implemented in areas where parking demand is high enough that parked cars would obstruct the advisory bicycle lanes.
- Recommended two-way motor vehicle travel lane width of 16 ft, though some are as narrow as 10 ft.



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 any experimentation requirements. Advisory bicycle lanes may be appropriate on low volume streets in freight districts. Required passing widths for truck or emergency vehicles should be considered on routes where such vehicles are anticipated.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities and A Policy on Geometric Design of Highways and Streets.* 2012.
FHWA. *Manual on Uniform Traffic Control Devices.* 2009.
NACTO. *Urban Bikeway Design Guide.* 2012.

Materials and Maintenance

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

Buffered Bike Lanes

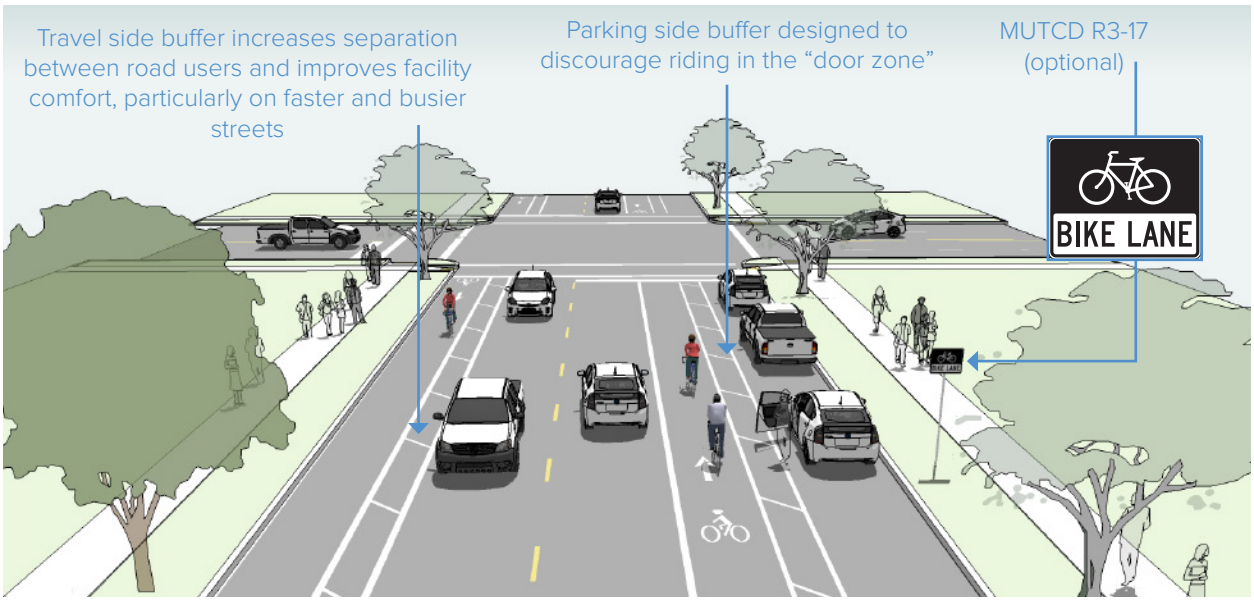
Description

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 follow general guidance for buffered preferential vehicle lanes as per MUTCD guidelines (section 3D-01).

Buffered bike lanes are designed to increase the space between the bike lane and the travel lane and/or parked cars. 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.

Guidance

- 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 dashed line for the inside buffer boundary where cars are expected to cross.
- Buffered bike lanes can buffer the travel lane only, or parking lane only depending on available space and the objectives of the design.



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.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
FHWA. *Manual on Uniform Traffic Control Devices. (3D-01).* 2009.
NACTO. *Urban Bikeway Design Guide.* 2012.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates. Bicycle lanes should be cleared of snow through routine snow removal operations.

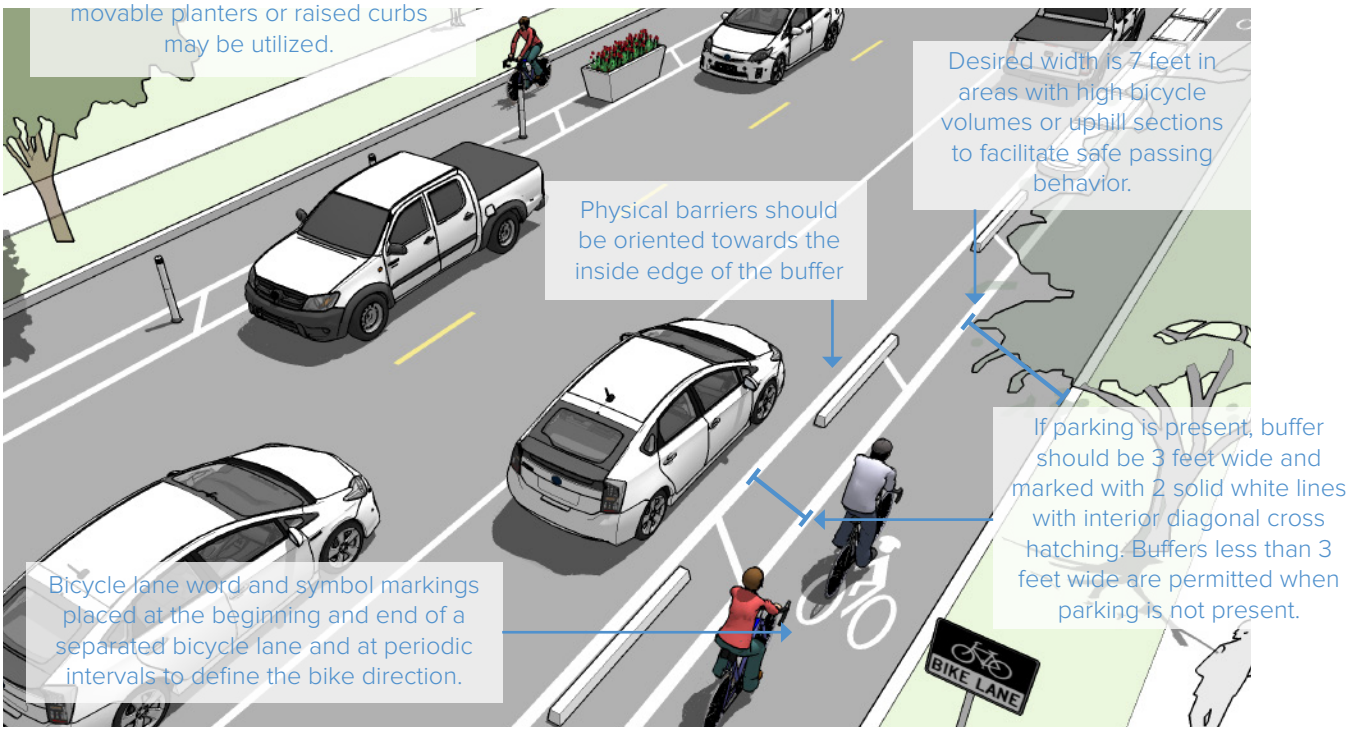
One-Way Separated (or Protected) Bike Lanes

Description

One-way separated bike lanes, also known as cycle tracks or protected bike lanes, are physically protected from motor traffic and distinct from the sidewalk. Separated bike lanes are either raised or at street level and use a variety of elements for physical protection from passing traffic.

Guidance

- 7 foot recommended minimum to allow passing.
- 5 foot minimum width in constrained locations.
- When placed adjacent to parking, the parking buffer should be three feet wide to allow for passenger loading and to prevent door collisions.
- When placed adjacent to a travel lane, one-way raised bike lanes may be configured with a mountable curb to allow entry and exit from the bicycle lane for passing other bicyclists or to access vehicular turn lanes.



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. If configured as a raised separated bike lane, the crossing should be raised so that the sidewalk and separated bike lane maintain their elevation through the crossing.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide*. 2012.

Materials and Maintenance

In cities with winter climates, barrier separated and raised bike lanes may require special equipment for snow removal.

Two-Way Separated (or Protected) Bike Lanes

Description

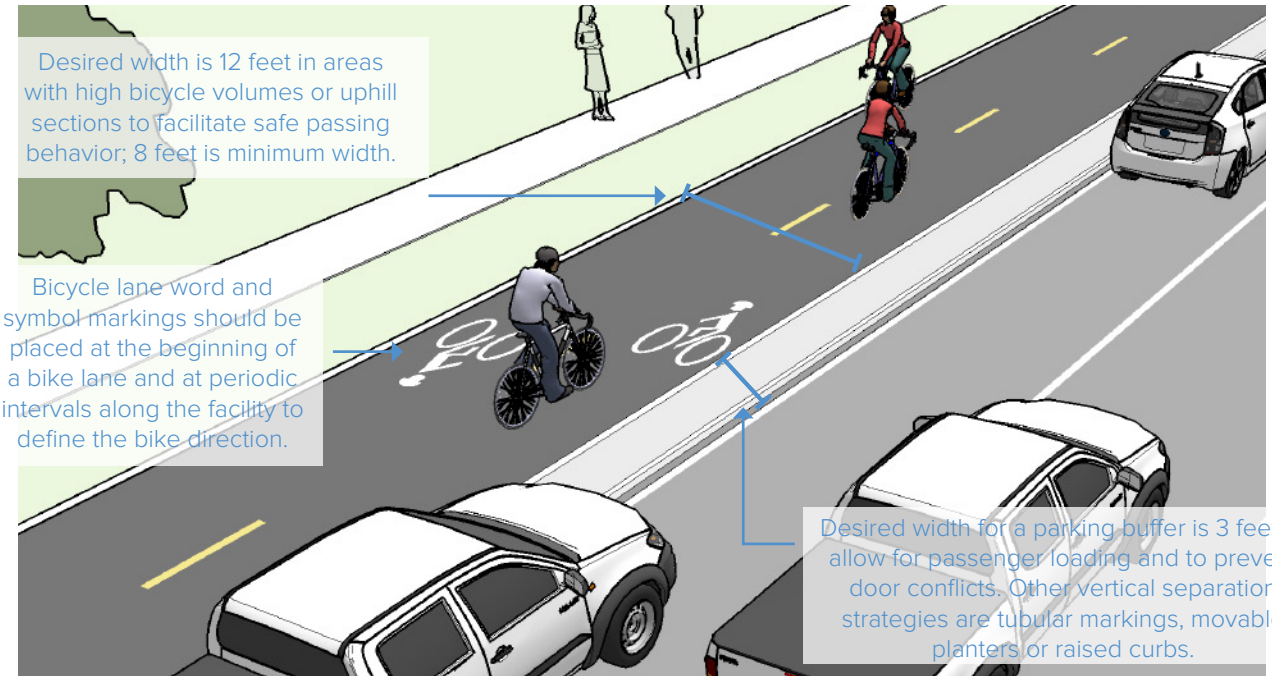
Two-way separated bike lanes, also known as cycle tracks or protected bike lanes, are physically separated facilities that allow bicycle movement in both directions on one side of the road. Two-way bike lanes share some of the same design characteristics as one-way facilities, but may require additional considerations at driveway and side-street crossings.

A two-way separated bike lanes may be configured as a protected facility at street level with a parking lane or other barrier between the bike lane and the motor vehicle travel lane and/or as a raised bike lane to provide vertical separation from the adjacent motor vehicle lane.

Guidance

- 12 foot recommended minimum for two-way facility
- 8 foot minimum in constrained locations
- When placed adjacent to parking, the parking buffer should be three feet wide to allow for passenger loading and to prevent door collisions.

Two-way separated bike lanes work best on one-way streets. Single direction motor vehicle travel minimizes potential conflict with bicyclists.



Discussion

Two-way separated bike lanes require a higher level of control at intersections to allow for a variety of turning movements. These movements should be guided by separated signals for bicycles and motor vehicles. Transitions into and out of two-way bike lanes should be simple and easy to use to deter bicyclists from continuing to ride against the flow of traffic. At driveways and minor intersections, bicyclists riding against roadway traffic in two-way bike lanes may surprise pedestrians and drivers not expecting bidirectional travel. Appropriate signage is recommended.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide*. 2012.

Materials and Maintenance

In cities with winter climates barrier, separated and raised separated bike lanes may require special equipment for snow removal.

Separated Bike Lane Protection Methods

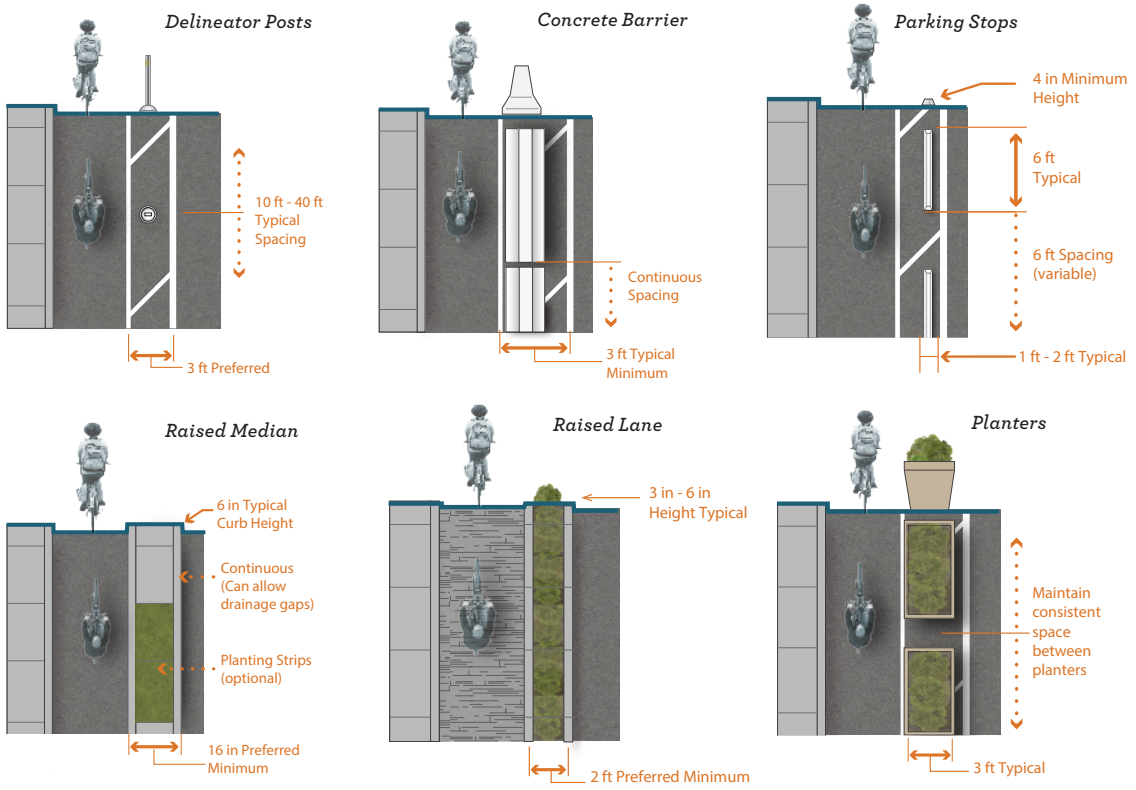
Description

Protection is provided through physical barriers and can include bollards, parking, a planter strip, an extruded curb, or on-street parking. Separated bike lanes using these protection elements typically share the same elevation as adjacent travel lanes.

Raised separated bike lanes may be at the level of the adjacent sidewalk or set at an intermediate level between the roadway and sidewalk to distinguish the separated bike lane from the pedestrian area.

Guidance

- Separated bike lanes should ideally be placed along streets with long blocks and few driveways or mid-block access points for motor vehicles. Separated bike lanes located on one-way streets have fewer potential conflict areas than those on two-way streets.
- In situations where on-street parking is allowed, separated bike lanes shall be located between the parking lane and the sidewalk (in contrast to bike lanes).



Source: FHWA Separated Bike Lane Planning and Design Guide. 2015.

Discussion

Sidewalks or other pedestrian facilities should not be narrowed to accommodate the separated bike lane as pedestrians will likely walk on the separated bike lane if sidewalk capacity is reduced. Visual and physical cues (e.g., pavement markings & signage) should be used to make it clear where bicyclists and pedestrians should be travelling. If possible, distinguish the separated bike lane and pedestrian zone with a furnishing zone.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide*. 2012.

Materials and Maintenance

In cities with winter climates, barrier protected and raised separated bike lanes may require special equipment for snow removal.

5: Bicycle Signs and Markings

Introduction

Signage helps to regulate traffic, indicate to bicyclists and other users that a particular roadway is suitable or preferred (or not) for travel by bicycle, and may also indicate nearby destinations accessible by bicycle.

The ability to navigate through a city is informed by landmarks, natural features and other visual cues. Signs throughout the city should indicate to bicyclists:

- Direction of travel
- Location of destinations
- Travel time/distance to those destinations

These signs will increase users' comfort and accessibility to the bicycle systems.

Signage can serve both wayfinding and safety purposes including:

- Helping to familiarize users with the bicycle network
- Helping users identify the best routes to destinations
- Helping to address misconceptions about time and distance
- Helping overcome a "barrier to entry" for people who are not frequent bicyclists (e.g., "interested but concerned" bicyclists)

A community-wide bicycle wayfinding signage plan would identify:

- Sign locations
- Sign type – what information should be included and design features
- Destinations to be highlighted on each sign – key destinations for bicyclists
- Approximate distance and travel time to each destination

Bicycle wayfinding signs also visually cue motorists that they are driving along a bicycle route and should use caution. Signs are typically placed at key locations leading to and along bicycle routes, including the intersection of multiple routes. Too many road signs tend to clutter the right-of-way, and it is recommended that these signs be posted at a level most visible to bicyclists rather than per vehicle signage standards.

Wayfinding Sign Types

Description

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

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.

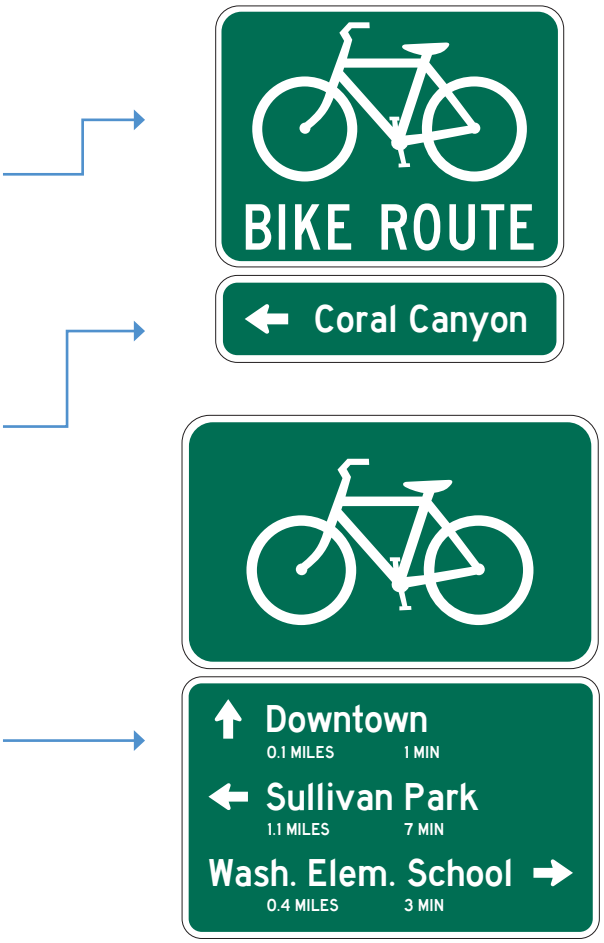
Include destinations and arrows.

Decisions Signs

Mark the junction of two or more bikeways.

Inform bicyclists of the designated bike route to access key destinations. Includes destinations and arrows and distances.

Travel times are optional but recommended.



Discussion

There is no standard color for bicycle wayfinding signage, though wayfinding should not use regulatory or advisory colors like red or yellow, respectively. 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.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities*. 2012.
FHWA. *Manual on Uniform Traffic Control Devices*. 2009.
NACTO. *Urban Bikeway Design Guide*. 2012.

Materials and Maintenance

Maintenance needs for bicycle wayfinding signs are similar to other signs and will need periodic replacement due to wear.

Wayfinding Sign Placement

Guidance

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.

Decisions Signs

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

Along a route to indicate a nearby destination.

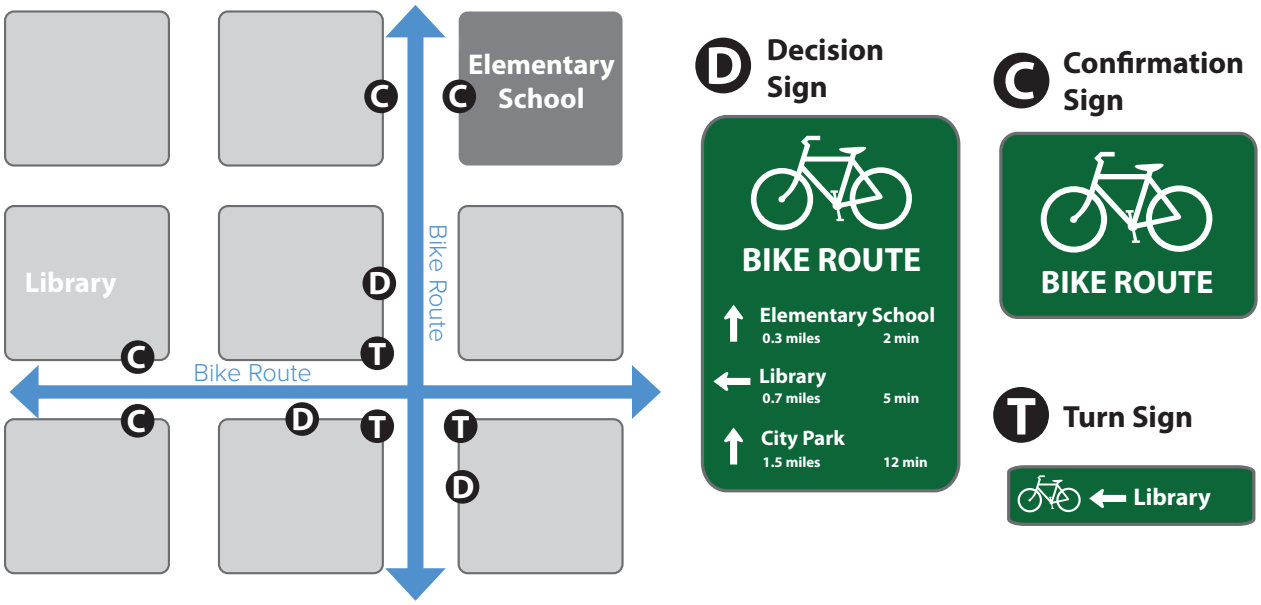
Description

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.



Discussion

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 ranking in the hierarchy can be used to determine the 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.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities*. 2012.
FHWA. *Manual on Uniform Traffic Control Devices*. 2009.
NACTO. *Urban Bikeway Design Guide*. 2012.

Materials and Maintenance

Maintenance needs for bicycle wayfinding signs are similar to other signs and will need periodic replacement due to wear.

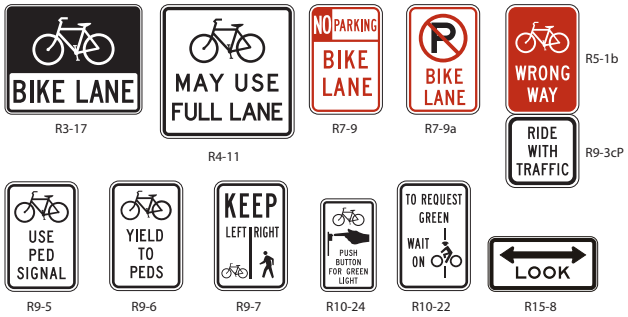
Regulatory and Warning Signs

Description

Regulatory signs give a direction that must be obeyed, and apply to intersection control, speed, vehicle movement and parking. They are usually rectangular or square with a white background and black, white or colored letters. Regulatory signs with a red background are reserved for STOP, YIELD, DO NOT ENTER or WRONG WAY messages. Red text indicates a restricted parking conditions, and a circle with a line through it means the activity shown is not allowed.

Warning signs call attention to unexpected conditions on or adjacent to a street, and to situations that might not be readily apparent to road users. Warning signs alert users to conditions that might call for a reduction of speed or an action in the interest of safety and efficient traffic operations. They are usually diamond-shaped or square with a retroreflective yellow or fluorescent yellow-green background with black letters.

Common Bicycle Oriented Regulatory Signs

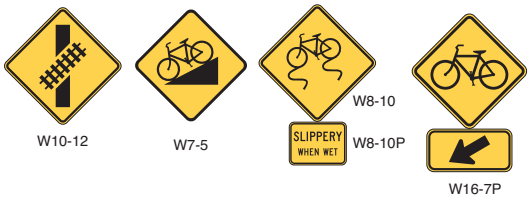


Guidance

- Small-sized signs or plaques may be used for bicycle-only traffic applications, such as along shared use paths.
- See the MUTCD 9B for a detailed list of regulatory sign application and guidance.
- Fieldwork and engineering judgment are necessary to fine-tune the placement of signs.
- The SHARE THE ROAD plaque (W16-P) shall not be used alone, and must be mounted below a W11-1 vehicular traffic warning sign. It is typically placed along roadways with high levels of bicycle usage but relatively hazardous conditions for bicyclists. The sign should not be used to designate a preferred bicycle route, but may be used along short sections of designated routes where traffic volumes are higher than desirable.

Additional Bicycle-Oriented Warning Signs

Bicycle Crossing Assembly



Additional warning are available to call attention to unexpected conditions for people riding bicycles, such as steep grades, rail crossings, and slippery conditions. A Bicycle Crossing Assembly using W11-1 and W16-7P arrow plaque may be used at the location of a bikeway crossing to warn other road users.

Share the Road Sign

The sign serves to make motorists aware that bicyclists might be on the road, and that they have a legal right to use the roadway.

Discussion

Signs for the exclusive use of bicyclists should be located so that other road users are not confused by them. Installation of "Share the Road" signs is an ongoing process. Each new route system that is developed is assessed for "Share the Road" signing needs. Periodic field inspections of existing routes should identify areas where changing traffic conditions may warrant additional "Share the Road" signs. The mixing of standard yellow and fluorescent yellow-green backgrounds within a zone or area should be avoided.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
FHWA. *Manual on Uniform Traffic Control Devices.* 2009.

Materials and Maintenance

Maintenance needs for regulatory and warning signs are similar to other signs and will need periodic replacement due to wear.

6: Bicyclists at Intersections and Crossings

Introduction

Intersections are junctions at which different modes of transportation meet and facilities overlap. An intersection facilitates the interchange between bicyclists, motorists, pedestrians and other modes in order to advance traffic flow in a safe and efficient manner. Designs for intersections with bicycle facilities should reduce conflict between bicyclists (and other vulnerable road users) and vehicles by heightening the level of visibility, denoting clear right-of-way and facilitating eye contact and awareness with other modes. Intersection treatments can improve both queuing and merging maneuvers for bicyclists, and are often coordinated with timed or specialized signals.

The configuration of a safe intersection for bicyclists may include elements such as color, signage, medians, signal detection and pavement markings. Intersection design should take into consideration existing and anticipated bicyclist, pedestrian and motorist movements. In all cases, the degree of mixing or separation between bicyclists and other modes is intended to reduce the risk of crashes and increase bicyclist comfort. The level of treatment required for bicyclists at an intersection will depend on the bicycle facility type used, whether bicycle facilities are intersecting, and the adjacent street function and land use.

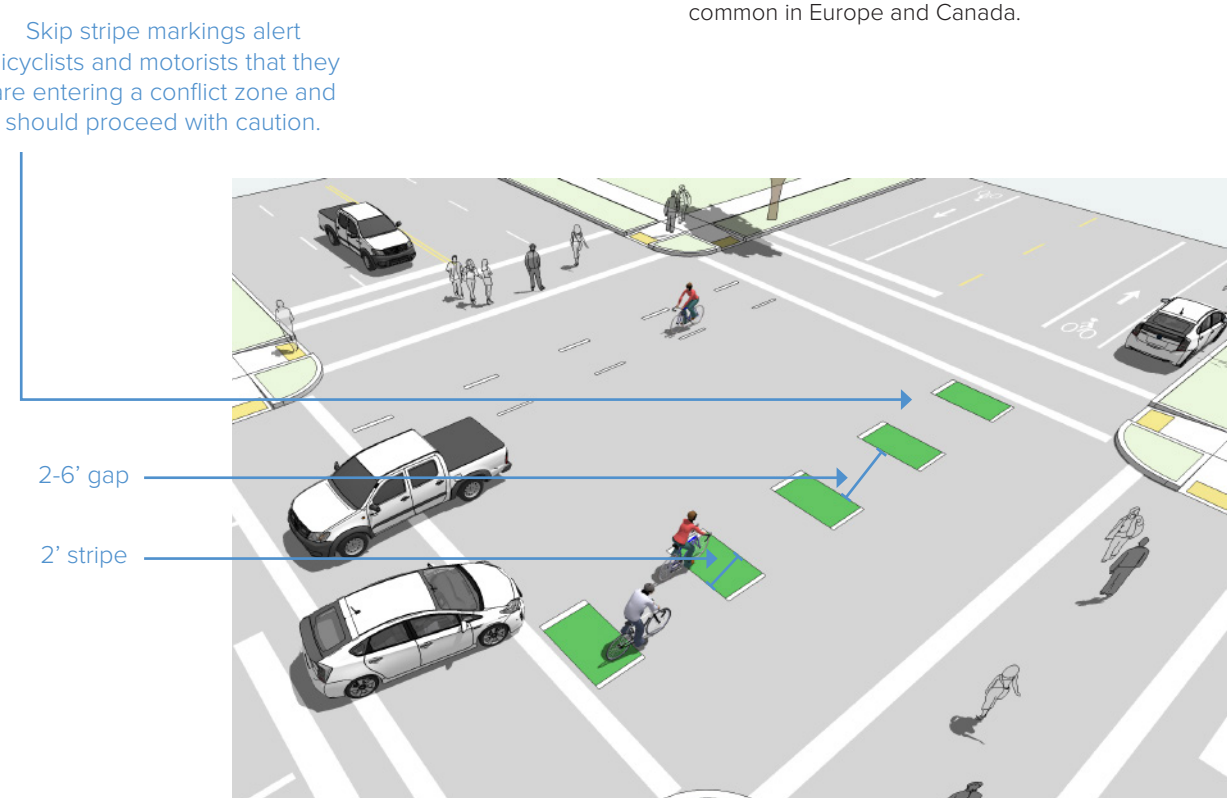
Intersection Crossing Markings

Description

Bicycle pavement markings through intersections indicate the intended path of bicyclists through an intersection or across a driveway or ramp. They guide bicyclists on a safe and direct path through the intersection and provide a clear boundary between the paths of through bicyclists and either through or crossing motor vehicles in the adjacent lane.

Guidance

- See MUTCD Section 3B.08: "dotted line extensions"
- Crossing striping shall be at least six inches wide when adjacent to motor vehicle travel lanes. Dashed lines should be two-foot lines spaced two to six feet apart.
- Chevrons, shared lane markings, colored bike lanes, or skip striping in conflict areas may be used to increase visibility within conflict areas or across entire intersections. Elephant's Feet markings are common in Europe and Canada.



Discussion

Additional markings such as chevrons, shared lane markings, or colored bike lanes in conflict areas are strategies currently in use in the United States and Canada. Cities considering the implementation of markings through intersections should standardize future designs to avoid confusion.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
FHWA. *Manual on Uniform Traffic Control Devices. (3A.06).* 2009.
NACTO. *Urban Bikeway Design Guide.* 2012.

Materials and Maintenance

Because the effectiveness of marked crossings depends entirely on their visibility, maintaining marked crossings should be a high priority.

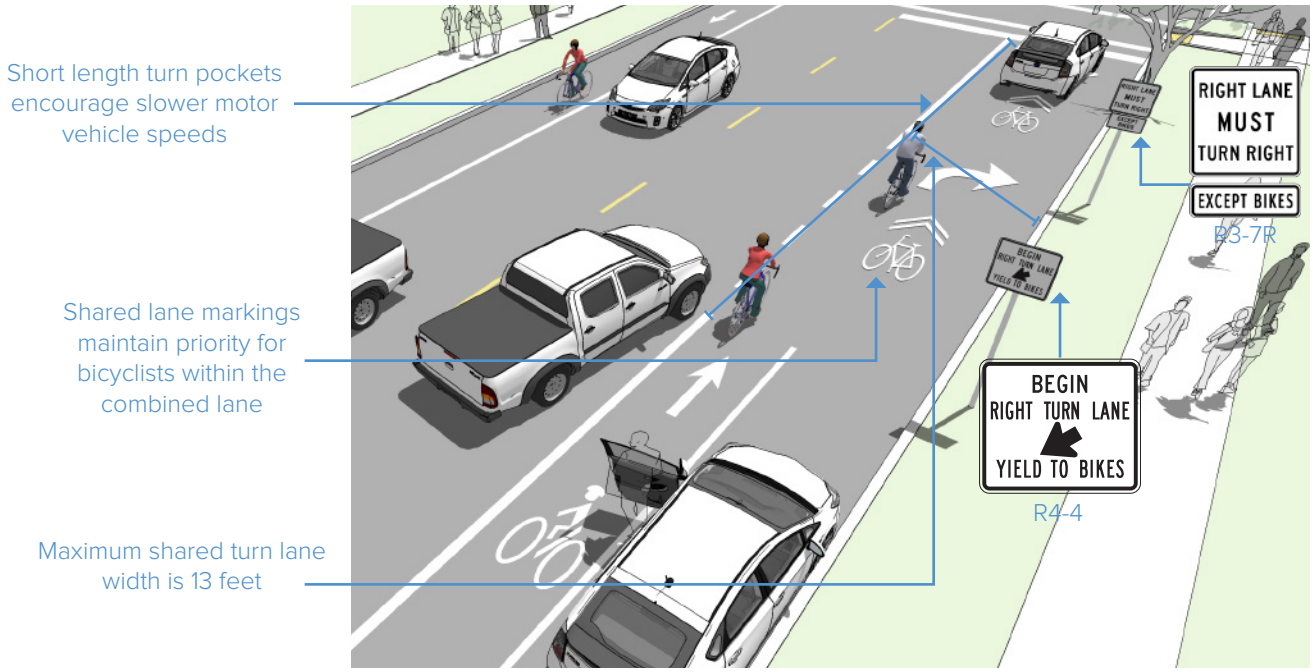
Combined Bike Lane / Turn Lane

Description

The combined bike lane/turn lane places shared lane markings within a right turn only lane. A dashed 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.

Guidance

- Maximum shared turn lane width is 13 feet; narrower widths promote single file operation.
- 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.



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. May not be appropriate for intersections with large percentages of right-turning heavy vehicles.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide*. 2012.

Materials and Maintenance

Locate markings out of tire tread to minimize wear. Because the effectiveness of markings depends on their visibility, maintaining markings should be a high priority.

Bike Lanes at Right Turn Only Lanes

Description

The appropriate treatment at right-turn lanes is to place the bike lane between the right-turn lane and the right-most through lane or, where right-of-way is insufficient, to use a shared bike lane/turn lane.

The design (right) illustrates a bike lane pocket, with signage indicating that motorists should yield to bicyclists through the conflict area.

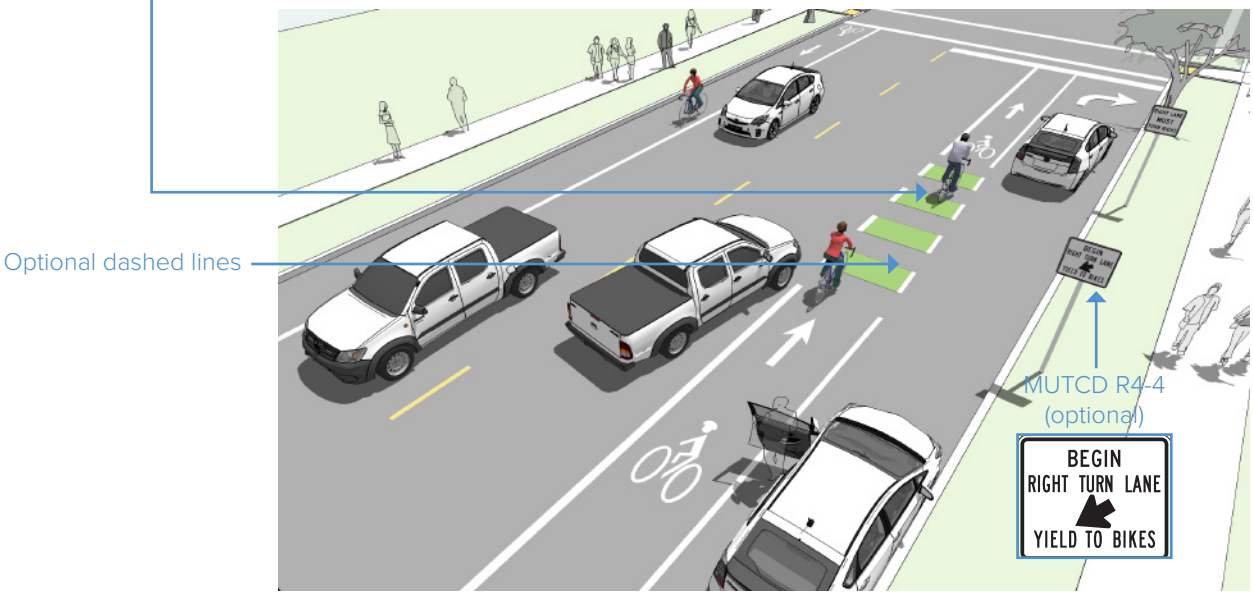
Guidance

At auxiliary right turn only lanes (add lane):

- Continue existing bike lane width; standard width of 5 to 6 feet or 4 feet in constrained locations.
- Use signage to indicate that motorists should yield to bicyclists through the conflict area.
- Consider using colored conflict areas to promote visibility of the mixing zone.

Where a through lane becomes a right turn only lane:

- Do not define a dashed line merging path for bicyclists.
- Drop the bicycle lane in advance of the merge area.
- Use shared lane markings to indicate shared use of the lane in the merging zone.
- For additional information, see NACTO's *Urban Bikeway Design Guide* under "Intersection Treatments"



Discussion

For other potential approaches to providing accommodations for bicyclists at intersections with turn lanes, please see guidance on shared bike lane/turn lane, bicycle signals, and colored bike facilities.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
FHWA. *Manual on Uniform Traffic Control Devices.* 2009.
NACTO. *Urban Bikeway Design Guide.* 2012.

Materials and Maintenance

Because the effectiveness of markings depends entirely on their visibility, maintaining markings should be a high priority.

Bike Box

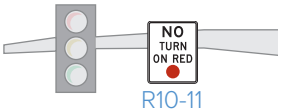
Description

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.

Guidance

- 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.

No Turn on Red restriction for motorists



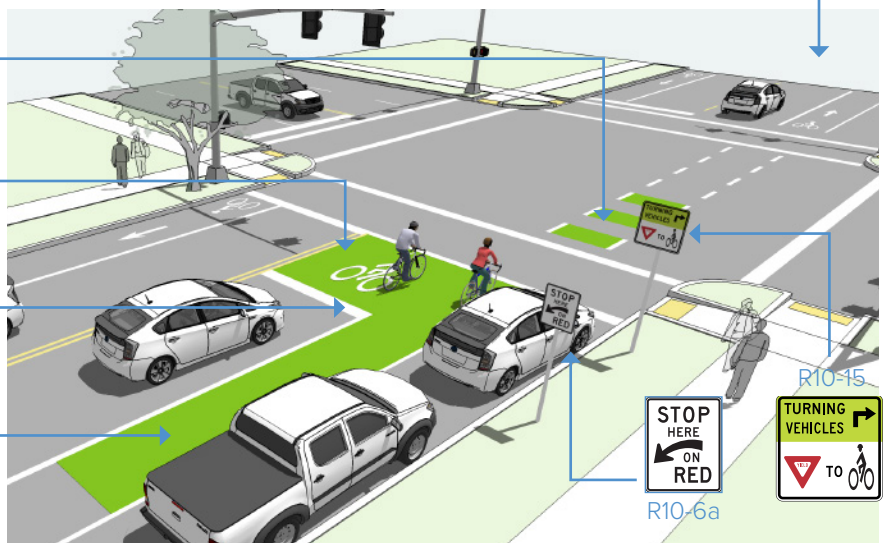
R10-11

May be combined with intersection crossing markings and colored bike lanes in conflict areas

Colored pavement can be used in the box for increased visibility

Wide stop lines used for increased visibility

If used, colored pavement should extend 50' from the intersection



R10-15

R10-6a

Discussion

Bike boxes are considered experimental by the FHWA. Bike boxes 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.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide.* 2012.
FHWA. Interim Approval (IA-14) has been granted. Requests to use green colored pavement need to comply with the provisions of Paragraphs 14 through 22 of Section 1A.10. 2011.

Materials and Maintenance

Because the effectiveness of markings depends entirely on their visibility, maintaining markings should be a high priority.

Two-Stage Turn Boxes

Description

Two-stage turn queue boxes offer bicyclists a safe way to make left turns at multi-lane signalized intersections from a right side separated or conventional bike lane.

On right side separated bike lanes, bicyclists are often unable to merge into traffic to turn left due to physical separation, making the provision of two-stage left turn boxes critical. Design guidance for two-stage turns apply to both conventional and separated bike lanes.

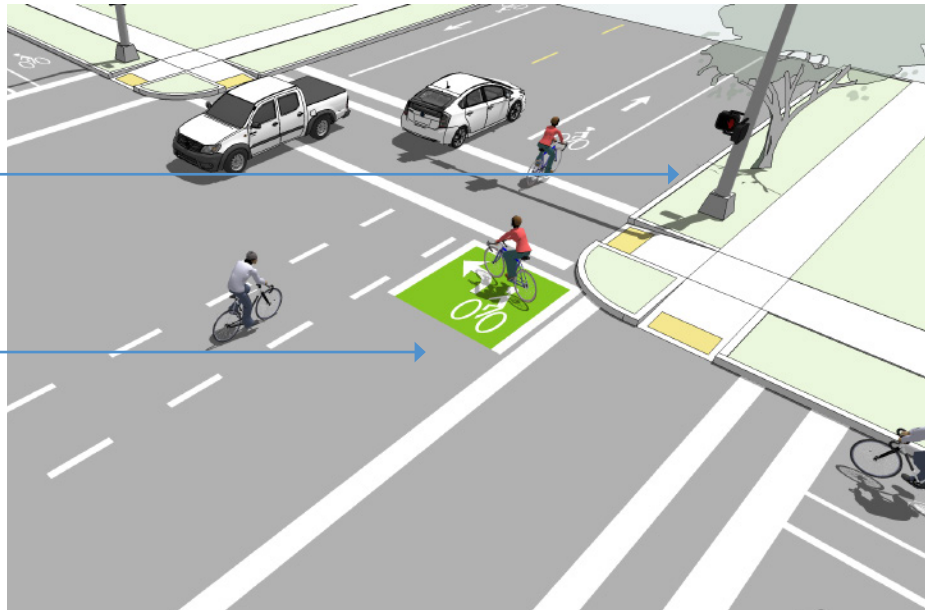
Guidance

- 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.
- 6.5' 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 separated bike lanes 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



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.

Additional References and Guidelines

NACTO. *Urban Bikeway Design Guide*. 2012.

Materials and Maintenance

Paint can wear more quickly in high traffic areas or in winter climates.

Bicycle Signal Heads

Description

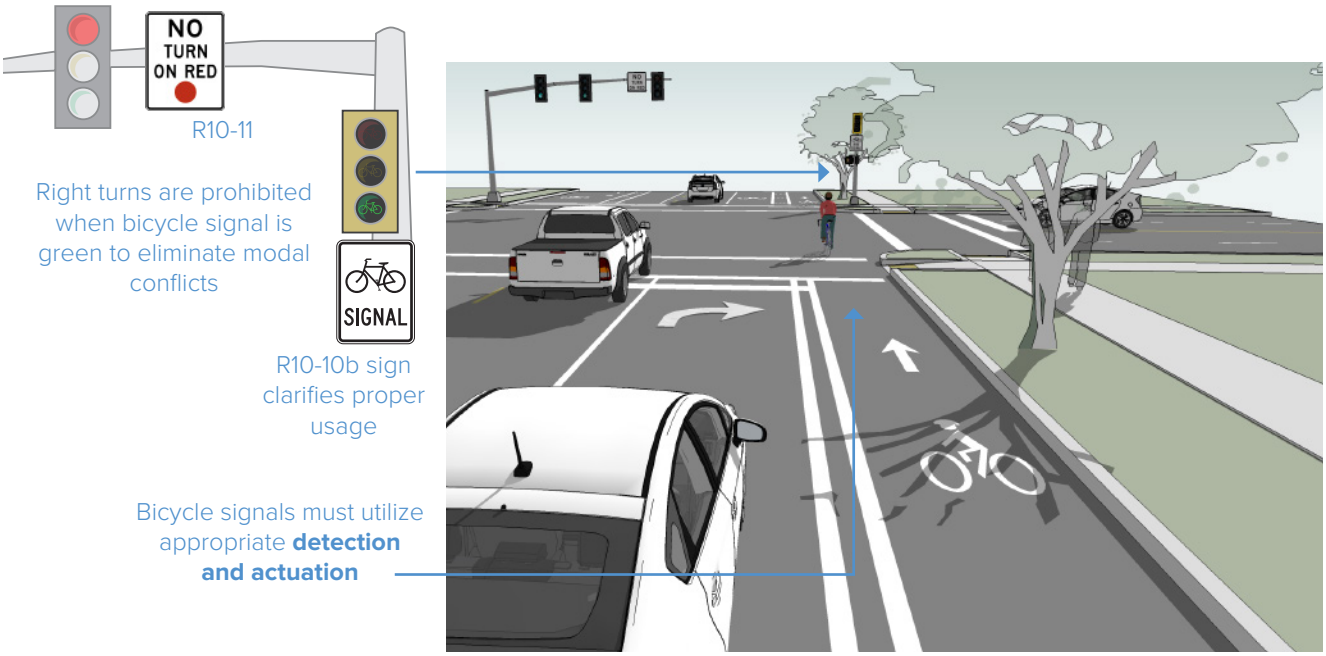
A bicycle signal is an electrically powered traffic control device that should only be used in combination with an existing traffic signal. Bicycle signals are typically used to improve identified safety or operational problems involving bicycle facilities. Bicycle signal heads may be installed at signalized intersections to indicate bicycle signal phases and other bicycle-specific timing strategies. Bicycle signals can be actuated with bicycle sensitive loop detectors, video detection, or push buttons.

Bicycle signals are typically used to provide guidance for bicyclists at intersections where they may have different needs from other road users (e.g., bicycle-only movements).

Guidance

Specific locations where bicycle signals have had a demonstrated positive effect include:

- Those with high volume of bicyclists at peak hours
- Those with high numbers of bicycle/motor vehicle crashes, especially those caused by turning vehicle movements
- At T-intersections with major bicycle movement along the top of the "T"
- At the confluence of an off-street bike path and a roadway intersection
- Where separated bike paths run parallel to arterial streets



Discussion

Local municipal code should be checked or modified to clarify that at intersections with bicycle signals, bicyclists should only obey the bicycle signal heads. For improved visibility, smaller (4 inch lens) near-sided bicycle signals should be considered to supplement far-side signals.

Additional References and Guidelines

FHWA. *MUTCD - Interim Approval for Optional Use of a Bicycle Signal Face (IA-16).* 2013.
NACTO. *Urban Bikeway Design Guide.* 2012.

Materials and Maintenance

Bicycle signal heads require the same maintenance as standard traffic signal heads, such as replacing bulbs and responding to power outages.

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7: Bicyclists and Pedestrians at Interchanges

Introduction

Interchanges are grade-separated crossings where one roadway, typically a higher-order facility such as a limited-access freeway, is connected to another highway or surface street by high-speed ramps. In communities bisected by freeways, interchanges often provide the sole access point for several miles, but the presence of ramps often do not allow for safe or comfortable connections for bicycles or pedestrians.

The safest interchange configurations are those where motorists must slow down or stop before entering or exiting the highway, such as where the ramp intersects the cross-street at a 90 degree angle and is either signal or stop-controlled at the intersection. This design provides maximum priority for bicycle riders and pedestrians crossing the ramps and reduces impact severity in case of a collision because of slower vehicle speeds.

Interchanges that have free-flow slip ramps encourage turning movements at high speeds and can cause conflicts with pedestrians and bicyclists wishing to cross. This configuration creates major access barriers and can deter all but the most confident bicyclists. The most vulnerable road users, such as the elderly, children or people with disabilities, will particularly have difficulty with navigating through these facilities.

In these situations, crossings should be clearly marked and signed, and designed as perpendicular as possible to the ramp to increase visibility and safety for pedestrians and bicycles.

Channelized Turn Lanes

Description

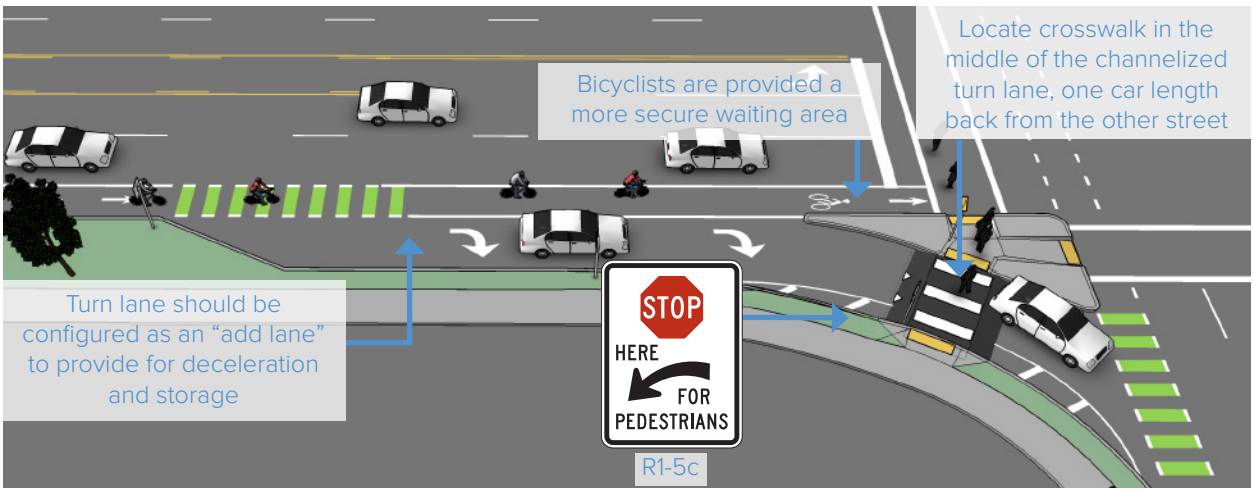
In some intersections of arterials streets, design vehicle requirements or intersection angles may result in wide turning radii at corners. Configuring the intersection as a channelized (or free-right) turn lane with a raised refuge island can improve conditions for pedestrians trying to cross the street.

Similar to a median refuge island, the raised refuge island can reduce crossing distances, allow staged crossing of the roadway, and improve visibility of pedestrians crossing the roadway.

To improve safety and comfort for pedestrians, measures to slow traffic at the pedestrian crossing are recommended such as provision of a raised crosswalk, signalized pedestrian walk phase, high visibility crosswalk, and/or pedestrian crossing signage.

Guidelines

- The preferred angle of intersection between the channelized turn lane and the roadway being joined is no more than 15 degrees to allow for simultaneous visibility of pedestrians and potential roadway gaps.
- Design with a maximum 30-35 foot turning radius.
- Signing: Pedestrian crossing sign assembly (W11-2) or Yield (R1-2) to encourage yielding. Yield to Bikes (R4-4) or similar if bike lanes are present.
- Raised crossings in the channelized turn lane may slow driver speed through the turning area.



Discussion

This design requires trucks to turn into multiple receiving lanes, and may not be appropriate on the approach to streets with one through lane. Channelized turn lanes can be very challenging for blind pedestrians. NCHRP 674 identified the use of sound strips (a full lane rumble strip-like device) in conjunction with flashing beacons to increase yielding compliance.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
TRB. *NCHRP 674 Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities.* 2011.
ITE. *Designing Walkable Urban Thoroughfares.* 2010.

Materials and Maintenance

Signage and striping require routine maintenance.

Bike Lanes at Entrance Ramps

Description

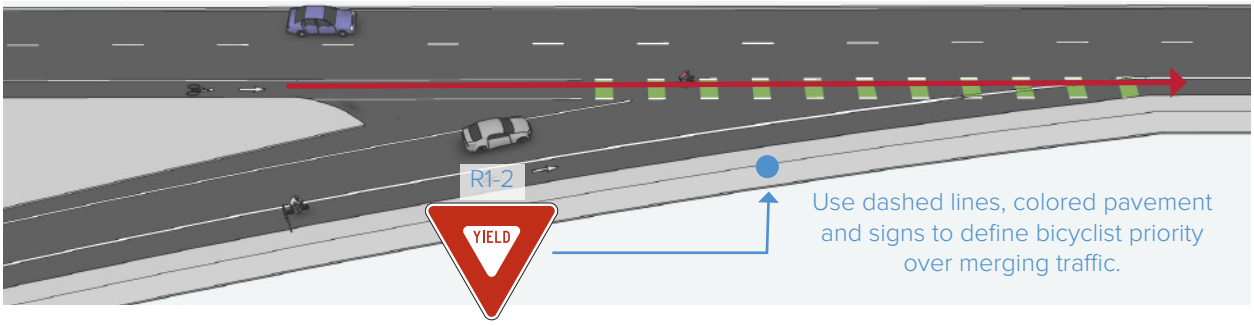
Arterials may contain high speed freeway-style designs such as merge lanes which can create difficulties for bicyclists. The entrance lanes typically have intrinsic visibility problems because of low approach angles and feature high speed differentials between bicyclists and motor vehicles.

Guidance

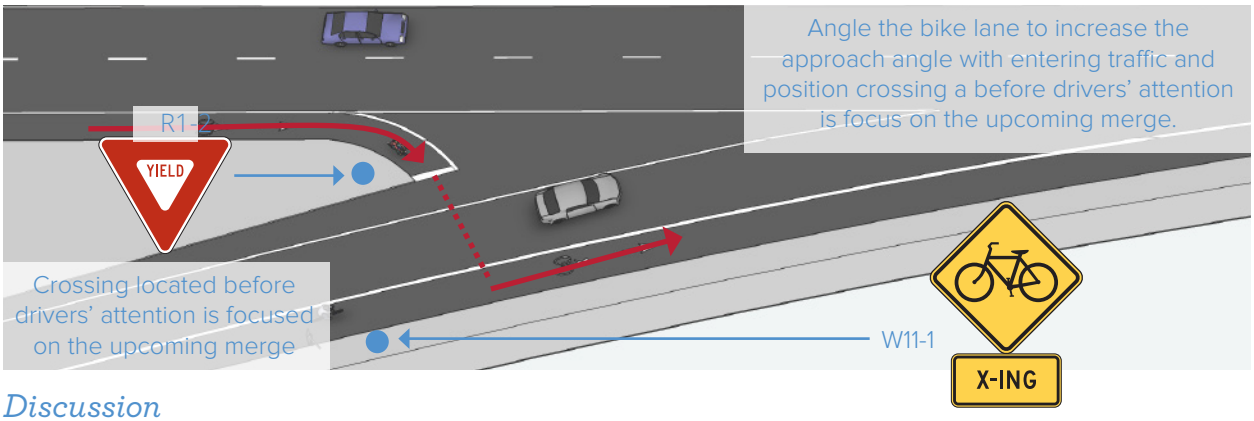
These treatments are typically found on streets with high speed freeway style merge lanes and where users are likely to be skilled adult riders.

Design strategies differ for low-speed and high-speed configurations. The bike lane should be angled to increase the approach angle with entering traffic, and the crossing positioned before drivers' attention is focused on the upcoming merge.

Low Speed Entrance Ramp (Bicycle Priority)



High Speed Entrance Ramp (Motor Vehicle Priority)



Discussion

On low-speed entrance ramps (≤ 40 mph) the bike lane should travel straight through the merge area. At high-speed entrance ramps (≥ 35 mph), with dedicated receiving lanes, bicyclists should be encouraged to yield to merging traffic and cross when safe. Even with signage and striping improvements, free-flow ramps present significant challenges for pedestrians and bicyclists; reconfiguring the intersection is the preferred treatment. While the jug-handle approach is the preferred configuration at entrance ramps, provide the option for through bicyclists to perform a vehicular merge and proceed straight through under safe conditions.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
Caltrans. *Complete Intersections. Chapter 9: Interchanges.* 2010.
FHWA. *Manual on Uniform Traffic Control Devices.* 2009.
FHWA. *Bicycle and Pedestrian Transportation. Lesson 15: Bicycle Lanes.* 2006.

Materials and Maintenance

Locate crossing markings out of wheel tread when possible to minimize wear and maintenance costs.

Bike Lanes at Exit Ramps

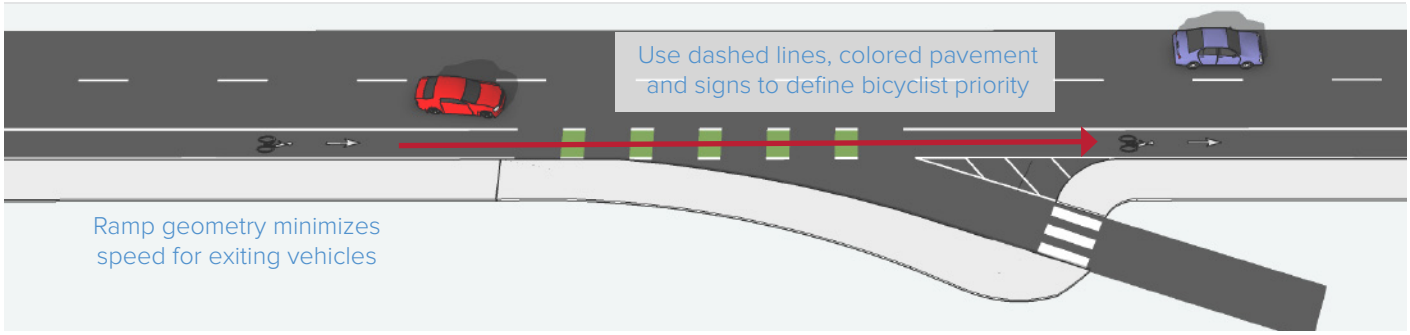
Description

Arterials with freeway-style exit ramps can create difficulties for bicyclists. Exit lanes typically have intrinsic visibility problems because of low approach angles and feature high speed differentials between bicyclists and motor vehicles.

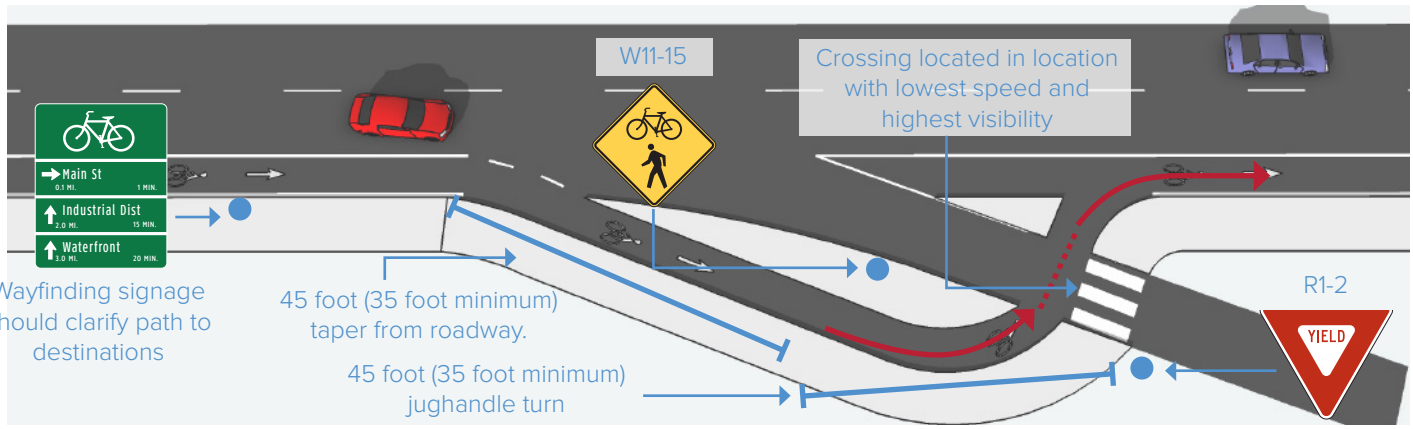
Guidance

These treatments are typically found on streets with bicycle lanes where there are freeway-style exit ramps and where users are likely to be skilled adult riders. A jug handle turn should be used to bring bicyclists to increase the approach angle with exiting traffic, and add yield striping and signage to the bicycle approach.

Low Speed Exit Ramp (Bicycle Priority)



High Speed Exit Ramp (Motor Vehicle Priority)



Discussion

On low-speed exit ramps (≤ 40 mph), the bike lane should travel straight through the merge area. On high-speed exit ramps (≥ 45 mph), use a jug handle turn to bring bicyclists to a visible location with exiting traffic. Grade separated crossings are preferred over at-grade crossings to offer low-stress crossings of high-speed interchange ramps. Grade separation designs utilizing a bicycle path could be used if the approach ramp elevations are appropriate, and if bicycle volumes are fairly high and motor traffic volumes are high. Standard bicycle path geometric guidelines would be applied to the approaches to a grade separated crossing for a bikeway.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
Caltrans. *Complete Intersections. Chapter 9: Interchanges.* 2010.
FHWA. *Manual on Uniform Traffic Control Devices.* 2009.
FHWA. *Bicycle and Pedestrian Transportation. Lesson 15: Bicycle Lanes.* 2006.

Materials and Maintenance

Locate crossing markings out of wheel tread when possible to minimize wear and maintenance costs.

8: Traffic Calming

Introduction

Motor vehicle speeds affect the frequency at which automobiles pass bicyclists as well as the severity of collisions that can occur. Maintaining motor vehicle speeds closer to those of pedestrians and bicyclists greatly improves comfort for pedestrians, bicyclists, and other vulnerable road users on a street. Slower vehicular speeds also improve motorists' ability to see and react to pedestrians and bicyclists and minimize conflicts at driveways and other turning locations.

Traffic calming can be applied on streets where a reduction of vehicle speeds and/or volumes is desired. Traffic calming measures may reduce the design speed of a street and can be used in conjunction with reduced speed limits to reinforce the expectation of lowered speeds. In short, traffic calming is a physical means of reducing speeds, whereas a speed limit sign is only a regulatory means of doing so.

All traffic calming operates on the principle of deflecting the direction of motor vehicles and interfering with the ability to travel a straight, level path. Vertical deflection such as speed humps, maintains a vehicles straight path, but requires a sudden, brief elevation change. Horizontal shifts, such as chicanes, require vehicles to travel a tightly meandering path and can narrow the visual field to reduce travel speeds.

Vertical Traffic Calming

Description

High motor vehicle speeds affect pedestrians and bicyclists by decreasing comfort for vulnerable users, decreasing motorists' reaction times, and increasing the severity of crashes that can occur. Reducing the speed differential between modes greatly improves safety and comfort for all users. Vertical speed control measures are slight rises in the pavement, on which motorists (and occasionally bicyclists) must reduce speed to cross.

Speed Hump

Offset Speed Hump

Temporary Speed Cushion

Raised Crosswalk

Guidelines

- Bicycle boulevards should have a maximum posted speed of 25 mph and traffic calming can be used to maintain an 85th percentile speed below 22 mph.
- Speed humps are 14' long raised areas usually placed in a series across both travel lanes, though they can also be offset to accommodate emergency vehicles. Gaps can be provided in the center or by the curb for bicyclists, depending on where bicyclists are operating on a particular facility. Speed tables are longer than speed humps and flat-topped. Raised crosswalks are speed tables that are marked and signed for a pedestrian crossing.
- Speed cushions have gaps to accommodate the wheel tracks of emergency vehicles.
- Slopes of vertical traffic calming should not exceed 1:10 or be less steep than 1:25. In order to reduce the risk of bicyclists losing their balance, tapers should be no greater than 1:6. The vertical lip should be no more than a 1/4" high.

Discussion

Emergency vehicle response times should be considered where vertical deflection is used. Because emergency vehicles have a wider wheel base than passenger cars, speed lumps/cushions allow them to pass unimpeded while slowing most other traffic. Alternatively, speed tables are recommended because they cannot be straddled by a truck, decreasing the risk of bottoming out. Traffic calming can also be used to deter motorists from driving on a street prioritized for other modes, however, monitoring vehicle volumes on adjacent streets will help to determine whether traffic calming results in inappropriate volumes elsewhere. Traffic calming can be implemented on a trial basis.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
Alta Planning + Design and IBPI. *Bicycle Boulevard Planning and Design Handbook.* 2009.
BikeSafe. *Bicycle countermeasure selection system.*
Ewing, Reid. *Traffic Calming: State of the Practice.* 1999.
Ewing, Reid and Brown, Steven. *U.S. Traffic Calming Manual.* 2009.
NACTO. *Urban Street Design Guide*. 2013.

Materials and Maintenance

Traffic calming should be designed to minimize impacts to snowplows. Vegetation should be regularly trimmed to maintain visibility and attractiveness.

Horizontal Traffic Calming

Description

Horizontal traffic calming devices cause drivers to slow down by constricting the roadway space or by requiring careful maneuvering.

Such measures may reduce the design speed of a street, and can be used in conjunction with reduced speed limits to reinforce the expectation of lowered speeds.

Temporary Curb Extension

Pinchpoint, Choker, or Neckdown

Chicane

Pinchpoint with Bicycle Access

Guidelines

- Maintain a minimum clear width of 20 feet (or 28 feet with parking on both sides), with a constricted length of at least 20 feet in the direction of travel.
- Pinchponts are curb extensions placed on both sides of the street, narrowing the travel lane and encouraging all road users to slow down. When placed at intersections, pinchpoints (or curb extensions) are known as chokers or neckdowns. They reduce curb radii, further lower motor vehicle speeds, and shorten pedestrian crossing distances.
- Chicanes are a series of raised or delineated curb extensions, edge islands, or parking bays on alternating sides of a street forming an "S"-shaped curb, which reduce vehicle speeds by requiring motorists to shift laterally through narrowed travel lanes.
- Pinchpoints allow for traffic to exit one-way from a local street while restricting entrance to the street from one of its entrances. This treatment diverts traffic, reduces volumes on local streets, improves the quiet feel of local streets, while still allowing two-way bicycle and pedestrian traffic.

Discussion

Horizontal speed control measures should not infringe on bicycle or pedestrian space. Where possible, provide a bicycle route outside of the element so bicyclists can avoid having to merge into traffic at a narrow pinch point. This technique can also improve drainage flow and reduce construction and maintenance costs. Traffic calming can also deter motorists from driving on a street. Monitor vehicle volumes on adjacent streets to determine whether traffic calming results in inappropriate volumes elsewhere. Traffic calming can be implemented on a trial basis.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
Alta Planning + Design and IBPI. *Bicycle Boulevard Planning and Design Handbook.* 2009.
BikeSafe. *Bicycle countermeasure selection system.*
Ewing, Reid. *Traffic Calming: State of the Practice.* 1999.
Ewing, Reid and Brown, Steven. *U.S. Traffic Calming Manual.* 2009.
NACTO. *Urban Street Design Guide*. 2013.

Materials and Maintenance

Traffic calming should be designed to minimize impacts to snowplows. Vegetation should be regularly trimmed to maintain visibility and attractiveness.

Traffic Diversion

Description

Motor vehicle traffic volumes affect the operation of a bicycle boulevard or a quiet, local street. Higher vehicle volumes reduce bicyclists' and pedestrians' comfort and can result in more conflicts. Implement volume control treatments, if necessary, based on the context of the bicycle boulevard, using engineering judgment. Target motor vehicle volumes range from 1,000 to 3,000 vehicles per day, either occurring naturally or accomplished with diversion or calming, above which the road should be striped as a bike lane or considered a signed and/or marked shared roadway.

Guidelines

- Traffic diversion treatments reduce motor vehicle volumes by completely or partially restricting through traffic on a bicycle boulevard or other local street that requires calming.
- Partial closures allow full bicycle passage while restricting vehicle access to one way traffic at that point. Pedestrian access usually remains the same and does not require modification.
- Diagonal diverters require all motor vehicle traffic to turn.
- Median diverters restrict through motor vehicle movements while providing a refuge for bicyclists and pedestrians to cross, in two stages, if necessary.
- Street closures create a "T" that encourages motor vehicles to divert onto another and restricts them from continuing on a bicycle boulevard, while bicycle travel can continue unimpeded. Full closures can accommodate emergency vehicles with the use of mountable curbs (maximum of six inches high).

Partial Closure

Diagonal Diverter


Median Diverter


Full Closure

Discussion

Bicycle boulevards on streets with volumes higher than 3,000 vehicles per day are not recommended, although a segment of a bicycle boulevard may accommodate more traffic for a short distance if necessary to complete the corridor. Providing additional separation with a bike lane, separated bike lane, or other treatment is recommended where traffic calming or diversion cannot reduce volumes below this threshold.

Additional References and Guidelines

AASHTO. *Guide for the Development of Bicycle Facilities.* 2012.
Alta Planning + Design and IBPI. *Bicycle Boulevard Planning and Design Handbook.* 2009.
BikeSafe. *Bicycle countermeasure selection system.*
Ewing, Reid. *Traffic Calming: State of the Practice.* 1999.
Ewing, Reid and Brown, Steven. *U.S. Traffic Calming Manual.* 2009.
NACTO. *Urban Street Design Guide*. 2013.

Materials and Maintenance

Depending on the diverter type, these treatments can be challenging to keep clear of snow and debris. Vegetation should be regularly trimmed to maintain visibility and attractiveness.

Appendix E:

Cost-Benefit Analysis (2017-2058)

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MEMORANDUM

To: Bronson Bundy and Mike Shaw, Washington City Public Works

From: Tom Millar and Kyle James, Senior Planners, Alta Planning + Design

Date: July 1, 2017

Re: Washington City Cost-Benefit Analysis

Summary

This cost-benefit analysis weighs the costs (capital and maintenance) and benefits (environmental sustainability, quality of life, economic competitiveness, safety, and state of good repair) that would accrue during construction (2017-20138) and over a 20-year evaluation period *after completion* of the recommended projects in the *Washington City Active Transportation Plan*. Below is a summary of the undiscounted findings of the cost-benefit analysis (all values presented in 2017 constant dollars):

- The recommended projects will **cost an estimated $73,769,000** to construct and, on average, an estimated $122,670 per year to maintain.
- After construction, the recommended projects could encourage between **36.4 million and 58.1 million more bicycle and pedestrian trips** in the project study area between 2017 (start of construction) and 2058 (20 years post-construction), resulting in between 22.1 million and 43.7 million fewer vehicle-miles traveled (VMT).
- This range in estimated VMT reductions could help prevent between 11,000 and 21,700 fewer metric tons of greenhouse gases and criteria pollutants from entering the atmosphere between 2017 and 2058, the equivalent of **$2.2 million to $4.4 million in avoided environmental damage or mitigation costs**.
- The recommended projects could also encourage, on average, 40 to 110 more people to meet the Centers for Disease Control's recommended number of physical activity, helping residents save **$2.4 million to $6.8 million in healthcare expenses** between 2017 and 2058.
- By encouraging more people to bicycle and walk instead of drive in single-occupant automobiles, residents could also save residents, visitors, and local agencies **$13.9 million to $27.4 million in household transportation expenses**, **$1.2 million to $2.4 million in costs related to traffic congestion**, **$87.9 million in costs related to collisions**, and **$3.2 million to $6.3 million in roadway maintenance expenditures** between 2017 and 2058.

At a 3 percent real discount rate, the net present value of the recommended projects ranged between $7,590,000 and $18,530,000, and the benefit-cost ratio ranged between 1.12 and 1.30 percent (beyond the cost of the recommended projects and their continual maintenance). At a 7 percent real discount rate, the net present value of the recommended projects ranged between -$9,630,000 and -$4,970,000, and the benefit-cost ratio ranged between 0.80 and 0.90.

Background

The approach used in this cost-benefit analysis expands on the methods suggested by the National Cooperative Highway Research Program (NCHRP) Report 552: *Guidelines for Analysis of Investments in Bicycle Facilities* by incorporating detailed local demographic information and using new data and research that has become available since *Guidelines for Analysis* was published in 2006. One notable alternation is the consideration of benefits from both bicycling and walking activity using different impact areas for each mode. By comparison, *Guidelines for Analysis* only provides guidance for measuring bicycling benefits and does not quantify pedestrian benefits for multi-use paths. Another alteration is the estimate of utilitarian (non-commute) and school trips in addition to work commute trips. This addition helps capture the full range of bicycling and walking trips in the project area. The cost-benefit analysis also considers local travel patterns, trip distances, and public health to create a complete, detailed picture of benefits generated by the proposed facilities. A major advantage of this expanded approach is the ability to quantify benefits at a line-item level for each distinct type of benefit associated with the recommended projects.

Study Area

The study area for this cost-benefit analysis was limited to the city boundaries of Washington, Utah.

Demand

In order to forecast the change in demand for bicycle and pedestrian trips following construction of the recommended projects, the commute mode share of people traveling to work from within Washington City limits was compared with the commute mode share of nine aspirational cities that have existing facilities similar to those proposed in the *Washington City Active Transportation Plan*. The aspirational cities shown in **Table 1** were Hudson (OH), Piqua (OH), Shaker Heights (OH), Troy (OH), Ogden (UT), Riverdale (UT), St. George (UT), and Onalaska (WI).

Table 1: Aspirational Cities

Cities	Region	Climate[i]	Elevation[ii]	Population[iii]	Population Density[iv]	Percent Minority Population[v]	Bicycle Friendly Community Award[vi]
Washington (UT)	Southwest	*Bwks*	2,851 ft	22,080	571/sq. mile	9.3%	None
Hudson (OH)	Midwest	*Dfa*	1,066 ft	22,389	870/sq. mile	7.3%	Bronze
Piqua (OH)	Midwest	*Cfa*	876 ft	20,681	1,766/sq. mile	7.6%	Bronze
Shaker Heights (OH)	Midwest	*Dfa*	1,050 ft	27,934	4,529/sq. mile	45.0%	Bronze
Troy (OH)	Midwest	*Cfa*	853 ft	25,411	2,138/sq. mile	9.9%	Bronze
Ogden (UT)	Southwest	*Dfa*	4,334 ft	84,273	3,057/sq. mile	24.8%	Bronze

Riverdale (UT)	Southwest	*Dfa*	4,373 ft	8,610	1,843/sq. mile	12.3%	Bronze
St. George (UT)	Southwest	*Bwks*	2,533 ft	76,915	1,036/sq. mile	12.8%	Bronze
Onalaska (WI)	Midwest	*Dfa*	725 ft	18,255	1,752/sq. mile	9.3%	Bronze

After the identification of aspirational cities based on general characteristics, the bicycle and pedestrian commute data for each city was analyzed. Compared to the selected aspirational cities, Washington has the lowest bicycle commute mode share (0.0 percent), according to 2011-2015 American Community Survey data. Compared to the selected aspirational cities, Washington is tied for the lowest pedestrian commute mode share (0.8%).

Table 2 shows the existing bicycle and pedestrian commute mode shares for Washington City and its nine aspirational cities, as well as the range of forecasted bicycle and pedestrian commute mode shares for Washington City.

Table 2: Existing and Forecasted Bicycle and Pedestrian Commute Mode Share (American Community Survey, 2011-2015)

Counties	Employed Population	Existing Daily Bicycle Commute Trips	Existing Daily Pedestrian Commute Trips	Forecasted Future Bicycle/ Pedestrian Mode Split		
				Low[vii]	Mid[viii]	High[ix]
Washington (UT)	9,643	0 (0.0%)	80 (0.8%)	0.2%/ 1.5%	0.3%/ 1.6%	0.7%/ 1.7%
Hudson (OH)	10,381	15 (0.1%)	164 (1.6%)			
Piqua (OH)	8,555	19 (0.2%)	138 (1.6%)			
Shaker Heights (OH)	13,193	89 (0.7%)	219 (1.7%)			
Troy (OH)	12,531	31 (0.36%)	211 (1.7%)			
Hurricane (UT)	5,388	23 (0.4%)	45 (0.8%)			
Ogden (UT)	37,464	360 (1.0%)	871 (2.3%)			
Riverdale (UT)	4,136	9 (0.2%)	62 (1.5%)			
St. George (UT)	29,140	277 (1.0%)	902 (3.1%)			
Onalaska (UT)	9,060	25 (0.3%)	83 (0.9%)			

If Washington City increased its bicycle mode share to the 25th percentile of its nine aspirational cities, its bicycle mode share would increase from 0.0 percent to 0.2 percent. At the 50th percentile, it would increase from 0.0 percent to 0.3 percent. And at the 75th percentile, it would increase from 0.0 percent to 0.7 percent.

If Washington City increased its pedestrian mode share to the 25th percentile of its nine aspirational cities, its pedestrian mode share would increase from 0.8 percent to 1.5 percent. At the 50th percentile, it would increase from 0.8 percent to 1.6 percent. And at the 75th percentile, it would increase from 0.8 percent to 1.7 percent.

Limitations

The primary purpose of the analysis is to enable a more informed policy discussion on whether and how best to invest in an active transportation network in Washington City, Utah. Even with extensive primary and secondary research incorporated into the cost-benefit analysis, it is impossible to accurately predict the *exact* impacts of various factors. Accordingly, all estimated benefit values are rounded and should be considered order of magnitude estimates, rather than exact amounts. In addition, the residual benefit of the fully-maintained facilities recommended to be built in the *Washington City Active Transportation Plan* was not claimed as a lump sum at end of the analysis period.

It should also be noted that because Washington City's existing *commute* bicycle mode share is at 0.0%, the derived benefits based on the mode share are likely lower than actual future benefits. Therefore, **the cost-benefit analysis should be performed again in about 5-10 years once infrastructure is progressing toward buildout and/or Census and American Community Survey data indicates more than 0 people are using bicycling to get to work.**

Inputs

This cost-benefit analysis uses a series of factors and multipliers to quantify the costs and benefits of the recommended projects. First, the analysis looks at the percent of bicycle and pedestrian trips by trip purpose that will take place within the project study area (see **Table 3**) and how many of those trips would otherwise replace motor vehicle (see **Table 10** for estimated annual bicycle and pedestrian trips). Second, the average trip length by trip purpose is estimated for the replaced trips (see **Table 4**). Third, the number of utilitarian and social/recreational trips within the project study area (see **Table 5**) are estimated to provide a more balanced view of trip purpose within the project study area (see **Table 11**). Finally, an estimate of the reduction in vehicle-miles traveled (VMT) is multiplied by a series of benefit multipliers: environmental sustainability (see **Table 6**), quality of life (see **Table 7**), economic competitiveness (see **Table 8**), and safety (see **Table 9**). In addition, the impact on travel time, delays from construction, noise, and property value were analyzed but found to have a negligible impact compared to a no build alternative.

*Table 3: Motor Vehicle Trip Replacement Factors**

	Bike	Walk
Commute Trips	0.70	0.70
College Trips	0.56	0.58
K-12 School Trips	0.46	0.48
Utilitarian Trips	0.87	0.88
Social/Recreational Trips	0.16	0.16

*Estimated by comparing local commute mode share data from the American Community Survey (2011-2015) to statewide mode share data for all trip purposes (Utah Household Travel Survey, 2012).

Table 4: Trip Distance (miles)

	Bike	Walk
Commute Trips[x]	3.54	0.67
College Trips[xi]	2.09	0.48
K-12 School Trips[xii]	0.77	0.36
Utilitarian Trips[xiii]	1.89	0.67
Social/Recreational Trips[xiv]	2.41	0.86

Table 5: Trip Purpose Multipliers[xv]

	Bike	Walk
Utilitarian Trip Multiplier	1.61	4.32
Social/Recreational Multiplier	4.77	3.91

Table 6: Environmental Sustainability Multipliers

	Value (metric tons/VMT)	Value ($USD/VMT)
Particulate Matter (PM) [xvi]	0.0000001	$0.0193
Nitrous Oxides (NOx) [xvii]	0.0000009	$0.0073
Sulfur Oxides (SOx) [xviii]	0.0000000	$0.0004
Volatile Organic Compounds (VOC) [xix]	0.0000012	$0.0024
Carbon Dioxide[xx]	0.0004940	$0.0212

Table 7: Quality of Life Multipliers

	Value
Physical Inactive Adults in Utah	19%[xxi]
Physically Inactive Youth in Utah	10%[xxii]
Healthcare Cost Savings	$1,444 USD per newly active person[xxiii]

Table 8: Economic Competitiveness Multipliers

	Value ($USD)
Household Transportation Cost Savings	$0.63 per VMT[xxiv]
Congestion Cost Savings	$0.06 per VMT[xxv]
Travel Times Savings – All Trip Purposes*	$13.46 per hour[xxvi]

*The Victoria Transport Policy Institute found in their 2013 study "Transportation Cost and Benefit Analysis II – Travel Time Costs" that the user of an average car and a bicycle had the same "effective speed" after taking into account annual hours worked, average travel speed, travel time, and support time (maintenance, etc.). This CBA, therefore, excludes travel time as a cost or benefit.

Table 9: Safety Multiplier

Type of Collision (est. collisions)	Value ($USD)
Property Damage Only Prevented (0.7 per year)	$4,198 per collision
Minor Injuries Prevented (1.7 per year)	$28,800 per minor injury
Moderate Injuries Prevented (1.3 per year)	$451,200 per moderate injury
Severe Injuries Prevented (0.6 per year)	$2,553,600 per severe injury
Fatal Injuries Prevented (0.0 per year)	$9,600,000 per fatality

Table 10: Estimated Mode Shift

Project Year	Year	Annual Bike/Ped Trips (Baseline)	Annual Bike/Ped Trips (Low)	Annual Bike/Ped Trips (Mid)	Annual Bike/Ped Trips (High)
Year -21	2017	498,000	489,000	493,000	502,000
Year -20	2018	527,000	544,000	553,000	573,000
Year -19	2019	557,000	602,000	616,000	647,000
Year -18	2020	587,000	663,000	683,000	727,000
Year -17	2021	616,000	727,000	753,000	811,000
Year -16	2022	646,000	794,000	826,000	899,000
Year -15	2023	676,000	863,000	903,000	992,000
Year -14	2024	705,000	936,000	984,000	1,089,000
Year -13	2025	735,000	1,012,000	1,068,000	1,191,000
Year -12	2026	765,000	1,090,000	1,155,000	1,298,000
Year -11	2027	794,000	1,172,000	1,246,000	1,409,000
Year -10	2028	824,000	1,256,000	1,340,000	1,524,000
Year -9	2029	854,000	1,344,000	1,437,000	1,645,000
Year -8	2030	883,000	1,434,000	1,538,000	1,769,000
Year -7	2031	913,000	1,527,000	1,643,000	1,898,000
Year -6	2032	942,000	1,623,000	1,750,000	2,032,000
Year -5	2033	972,000	1,722,000	1,862,000	2,170,000
Year -4	2034	1,002,000	1,824,000	1,976,000	2,313,000
Year -3	2035	1,031,000	1,929,000	2,094,000	2,460,000
Year -2	2036	1,061,000	2,037,000	2,216,000	2,612,000
Year -1	2037	1,091,000	2,094,000	2,278,000	2,685,000
Year 0	2038	1,120,000	2,151,000	2,340,000	2,758,000
Year 1	2039	1,150,000	2,207,000	2,402,000	2,831,000
Year 2	2040	1,180,000	2,264,000	2,464,000	2,904,000
Year 3	2041	1,209,000	2,321,000	2,526,000	2,977,000
Year 4	2042	1,239,000	2,378,000	2,588,000	3,050,000
Year 5	2043	1,269,000	2,435,000	2,649,000	3,123,000
Year 6	2044	1,298,000	2,492,000	2,711,000	3,196,000
Year 7	2045	1,328,000	2,549,000	2,773,000	3,269,000
Year 8	2046	1,358,000	2,606,000	2,835,000	3,342,000
Year 9	2047	1,387,000	2,663,000	2,897,000	3,415,000
Year 10	2048	1,417,000	2,720,000	2,959,000	3,489,000

Project Year	Year	Annual Bike/Ped Trips (Baseline)	Annual Bike/Ped Trips (Low)	Annual Bike/Ped Trips (Mid)	Annual Bike/Ped Trips (High)
Year 11	2049	1,447,000	2,777,000	3,021,000	3,562,000
Year 12	2050	1,476,000	2,834,000	3,083,000	3,635,000
Year 13	2051	1,506,000	2,891,000	3,145,000	3,708,000
Year 14	2052	1,536,000	2,947,000	3,207,000	3,781,000
Year 15	2053	1,565,000	3,004,000	3,269,000	3,854,000
Year 16	2054	1,595,000	3,061,000	3,331,000	3,927,000
Year 17	2055	1,625,000	3,118,000	3,393,000	4,000,000
Year 18	2056	1,654,000	3,175,000	3,455,000	4,073,000
Year 19	2057	1,684,000	3,232,000	3,517,000	4,146,000
Year 20	2058	1,714,000	3,289,000	3,578,000	4,219,000
AVERAGE		1,106,000	1,971,000	2,132,000	2,488,000
TOTAL		46,436,000	82,796,000	89,557,000	104,505,000

Table 11: Estimated VMT Reduction from Walking/Bicycling

Project Year	Year	Annual VMT Reduction (Baseline)	Annual VMT Reduction (Low)	Annual VMT Reduction (Mid)	Annual VMT Reduction (High)
Year -21	2017	216,000	222,000	225,000	236,000
Year -20	2018	229,000	251,000	257,000	279,000
Year -19	2019	242,000	281,000	290,000	326,000
Year -18	2020	255,000	312,000	326,000	376,000
Year -17	2021	268,000	346,000	364,000	429,000
Year -16	2022	280,000	381,000	403,000	485,000
Year -15	2023	293,000	418,000	445,000	545,000
Year -14	2024	306,000	456,000	489,000	608,000
Year -13	2025	319,000	497,000	535,000	675,000
Year -12	2026	332,000	539,000	583,000	744,000
Year -11	2027	345,000	582,000	632,000	817,000
Year -10	2028	358,000	627,000	684,000	894,000
Year -9	2029	371,000	675,000	738,000	973,000
Year -8	2030	383,000	723,000	794,000	1,056,000
Year -7	2031	396,000	774,000	852,000	1,142,000
Year -6	2032	409,000	826,000	913,000	1,232,000
Year -5	2033	422,000	880,000	975,000	1,324,000
Year -4	2034	435,000	935,000	1,039,000	1,420,000
Year -3	2035	448,000	992,000	1,105,000	1,520,000
Year -2	2036	461,000	1,051,000	1,173,000	1,622,000
Year -1	2037	474,000	1,081,000	1,206,000	1,668,000
Year 0	2038	487,000	1,110,000	1,239,000	1,713,000
Year 1	2039	499,000	1,139,000	1,272,000	1,758,000
Year 2	2040	512,000	1,169,000	1,304,000	1,804,000
Year 3	2041	525,000	1,198,000	1,337,000	1,849,000
Year 4	2042	538,000	1,227,000	1,370,000	1,894,000
Year 5	2043	551,000	1,257,000	1,403,000	1,940,000
Year 6	2044	564,000	1,286,000	1,436,000	1,985,000
Year 7	2045	577,000	1,316,000	1,468,000	2,030,000
Year 8	2046	590,000	1,345,000	1,501,000	2,076,000
Year 9	2047	602,000	1,374,000	1,534,000	2,121,000
Year 10	2048	615,000	1,404,000	1,567,000	2,166,000

Project Year	Year	Annual VMT Reduction (Baseline)	Annual VMT Reduction (Low)	Annual VMT Reduction (Mid)	Annual VMT Reduction (High)
Year 11	2049	628,000	1,433,000	1,600,000	2,212,000
Year 12	2050	641,000	1,463,000	1,632,000	2,257,000
Year 13	2051	654,000	1,492,000	1,665,000	2,302,000
Year 14	2052	667,000	1,521,000	1,698,000	2,348,000
Year 15	2053	680,000	1,551,000	1,731,000	2,393,000
Year 16	2054	693,000	1,580,000	1,764,000	2,438,000
Year 17	2055	705,000	1,609,000	1,796,000	2,484,000
Year 18	2056	718,000	1,639,000	1,829,000	2,529,000
Year 19	2057	731,000	1,668,000	1,862,000	2,574,000
Year 20	2058	744,000	1,698,000	1,895,000	2,620,000
AVERAGE		480,000	1,008,000	1,117,000	1,521,000
TOTAL		20,163,000	42,328,000	46,931,000	63,864,000

Outputs

The following tables documented the estimated costs and benefits of the recommended projects for the low, mid, and high scenarios compared to the no build/baseline scenario.

Table 12: Costs (Undiscounted)

Project Year	Year	Capital Costs	Maintenance Costs	Travel Time/Delays	Annual Costs (Build)	Annual Costs (No Build)
Year -21	2017	$0	$43,479	$0	$43,479	$43,479
Year -20	2018	$6,576,600	$43,479	$0	$6,620,079	$43,479
Year -19	2019	$6,576,600	$64,863	$0	$6,641,463	$43,479
Year -18	2020	$6,576,600	$64,863	$0	$6,641,463	$43,479
Year -17	2021	$6,576,600	$64,863	$0	$6,641,463	$43,479
Year -16	2022	$6,576,600	$64,863	$0	$6,641,463	$43,479
Year -15	2023	$4,913,800	$109,719	$0	$5,023,519	$43,479
Year -14	2024	$4,913,800	$109,719	$0	$5,023,519	$43,479
Year -13	2025	$4,913,800	$109,719	$0	$5,023,519	$43,479
Year -12	2026	$4,913,800	$109,719	$0	$5,023,519	$43,479
Year -11	2027	$4,913,800	$109,719	$0	$5,023,519	$43,479
Year -10	2028	$1,631,700	$109,719	$0	$1,741,419	$43,479
Year -9	2029	$1,631,700	$138,247	$0	$1,769,947	$43,479
Year -8	2030	$1,631,700	$138,247	$0	$1,769,947	$43,479
Year -7	2031	$1,631,700	$138,247	$0	$1,769,947	$43,479
Year -6	2032	$1,631,700	$138,247	$0	$1,769,947	$43,479
Year -5	2033	$1,631,700	$138,247	$0	$1,769,947	$43,479
Year -4	2034	$1,631,700	$138,247	$0	$1,769,947	$43,479
Year -3	2035	$1,631,700	$138,247	$0	$1,769,947	$43,479
Year -2	2036	$1,631,700	$138,247	$0	$1,769,947	$43,479
Year -1	2037	$1,631,700	$138,247	$0	$1,769,947	$43,479
Year 0	2038	$0	$138,247	$0	$138,247	$43,479
Year 1	2039	$0	$138,247	$0	$138,247	$43,479
Year 2	2040	$0	$138,247	$0	$138,247	$43,479
Year 3	2041	$0	$138,247	$0	$138,247	$43,479
Year 4	2042	$0	$138,247	$0	$138,247	$43,479
Year 5	2043	$0	$138,247	$0	$138,247	$43,479
Year 6	2044	$0	$138,247	$0	$138,247	$43,479

Project Year	Year	Capital Costs	Maintenance Costs	Travel Time/Delays	Annual Costs (Build)	Annual Costs (No Build)
Year 7	2045	$0	$138,247	$0	$138,247	$43,479
Year 8	2046	$0	$138,247	$0	$138,247	$43,479
Year 9	2047	$0	$138,247	$0	$138,247	$43,479
Year 10	2048	$0	$138,247	$0	$138,247	$43,479
Year 11	2049	$0	$138,247	$0	$138,247	$43,479
Year 12	2050	$0	$138,247	$0	$138,247	$43,479
Year 13	2051	$0	$138,247	$0	$138,247	$43,479
Year 14	2052	$0	$138,247	$0	$138,247	$43,479
Year 15	2053	$0	$138,247	$0	$138,247	$43,479
Year 16	2054	$0	$138,247	$0	$138,247	$43,479
Year 17	2055	$0	$138,247	$0	$138,247	$43,479
Year 18	2056	$0	$138,247	$0	$138,247	$43,479
Year 19	2057	$0	$138,247	$0	$138,247	$43,479
Year 20	2058	$0	$138,247	$0	$138,247	$43,479
AVERAGE		$1,756,000	$123,000	$0	$1,879,000	$43,000
TOTAL		$73,769,000	$5,152,131	$0	$78,921,131	$1,826,132

Table 13: Estimated Annual Benefits (Low)

Project Year	Year	Annual Environmental Sustainability Benefits (Build)	Annual Quality of Life Benefits (Build)	Annual Economic Competitiveness Benefits (Build)	Annual Safety Benefits (Build)	Total Annual Benefits (Build)	Total Annual Benefits (No Build)
Year -21	2017	$11,000	$5,000	$152,000	$2,093,000	$2,261,000	$190,000
Year -20	2018	$13,000	$3,000	$171,000	$2,093,000	$2,280,000	$201,000
Year -19	2019	$14,000	$5,000	$191,000	$2,093,000	$2,303,000	$212,000
Year -18	2020	$16,000	$7,000	$213,000	$2,093,000	$2,329,000	$223,000
Year -17	2021	$18,000	$9,000	$236,000	$2,093,000	$2,356,000	$235,000
Year -16	2022	$19,000	$11,000	$260,000	$2,093,000	$2,383,000	$246,000
Year -15	2023	$21,000	$13,000	$285,000	$2,093,000	$2,412,000	$257,000
Year -14	2024	$23,000	$16,000	$311,000	$2,093,000	$2,443,000	$269,000
Year -13	2025	$25,000	$18,000	$339,000	$2,093,000	$2,475,000	$280,000
Year -12	2026	$27,000	$21,000	$367,000	$2,093,000	$2,508,000	$291,000
Year -11	2027	$30,000	$24,000	$397,000	$2,093,000	$2,544,000	$303,000
Year -10	2028	$32,000	$28,000	$428,000	$2,093,000	$2,581,000	$314,000
Year -9	2029	$34,000	$31,000	$460,000	$2,093,000	$2,618,000	$325,000
Year -8	2030	$37,000	$34,000	$493,000	$2,093,000	$2,657,000	$336,000
Year -7	2031	$39,000	$38,000	$528,000	$2,093,000	$2,698,000	$348,000
Year -6	2032	$42,000	$42,000	$563,000	$2,093,000	$2,740,000	$359,000
Year -5	2033	$45,000	$46,000	$600,000	$2,093,000	$2,784,000	$370,000
Year -4	2034	$47,000	$50,000	$638,000	$2,093,000	$2,828,000	$382,000
Year -3	2035	$50,000	$55,000	$677,000	$2,093,000	$2,875,000	$393,000
Year -2	2036	$53,000	$59,000	$717,000	$2,093,000	$2,922,000	$404,000
Year -1	2037	$55,000	$61,000	$737,000	$2,093,000	$2,946,000	$416,000
Year 0	2038	$56,000	$62,000	$757,000	$2,093,000	$2,968,000	$427,000
Year 1	2039	$58,000	$64,000	$780,000	$2,093,000	$2,995,000	$438,000
Year 2	2040	$59,000	$66,000	$797,000	$2,093,000	$3,015,000	$449,000
Year 3	2041	$61,000	$67,000	$817,000	$2,093,000	$3,038,000	$461,000
Year 4	2042	$62,000	$69,000	$837,000	$2,093,000	$3,061,000	$472,000
Year 5	2043	$64,000	$71,000	$857,000	$2,093,000	$3,085,000	$483,000
Year 6	2044	$65,000	$72,000	$877,000	$2,093,000	$3,107,000	$495,000
Year 7	2045	$67,000	$74,000	$897,000	$2,093,000	$3,131,000	$506,000
Year 8	2046	$68,000	$76,000	$917,000	$2,093,000	$3,154,000	$517,000
Year 9	2047	$70,000	$77,000	$937,000	$2,093,000	$3,177,000	$529,000

Project Year	Year	Annual Environmental Sustainability Benefits (Build)	Annual Quality of Life Benefits (Build)	Annual Economic Competitiveness Benefits (Build)	Annual Safety Benefits (Build)	Total Annual Benefits (Build)	Total Annual Benefits (No Build)
Year 10	2048	$71,000	$79,000	$957,000	$2,093,000	$3,200,000	$540,000
Year 11	2049	$73,000	$81,000	$977,000	$2,093,000	$3,224,000	$551,000
Year 12	2050	$74,000	$82,000	$998,000	$2,093,000	$3,247,000	$562,000
Year 13	2051	$76,000	$84,000	$1,018,000	$2,093,000	$3,271,000	$574,000
Year 14	2052	$77,000	$86,000	$1,038,000	$2,093,000	$3,294,000	$585,000
Year 15	2053	$79,000	$87,000	$1,058,000	$2,093,000	$3,317,000	$596,000
Year 16	2054	$80,000	$89,000	$1,078,000	$2,093,000	$3,340,000	$608,000
Year 17	2055	$82,000	$91,000	$1,098,000	$2,093,000	$3,364,000	$619,000
Year 18	2056	$83,000	$92,000	$1,118,000	$2,093,000	$3,386,000	$630,000
Year 19	2057	$85,000	$94,000	$1,138,000	$2,093,000	$3,410,000	$642,000
Year 20	2058	$86,000	$96,000	$1,158,000	$2,093,000	$3,433,000	$653,000
AVERAGE		$51,000	$53,000	$687,000	$2,093,000	$2,884,000	$421,000
TOTAL		$2,147,000	$2,235,000	$28,872,000	$87,906,000	$121,160,000	$17,691,000

Table 14: Estimated Annual Benefits (Mid)

Project Year	Year	Annual Environmental Sustainability Benefits (Build)	Annual Quality of Life Benefits (Build)	Annual Economic Competitiveness Benefits (Build)	Annual Safety Benefits (Build)	Total Annual Benefits (Build)	Total Annual Benefits (No Build)
Year -21	2017	$11,000	$6,000	$175,000	$2,093,000	$2,285,000	$190,000
Year -20	2018	$13,000	$4,000	$175,000	$2,093,000	$2,285,000	$201,000
Year -19	2019	$15,000	$6,000	$198,000	$2,093,000	$2,312,000	$212,000
Year -18	2020	$17,000	$8,000	$222,000	$2,093,000	$2,340,000	$223,000
Year -17	2021	$18,000	$11,000	$248,000	$2,093,000	$2,370,000	$235,000
Year -16	2022	$20,000	$14,000	$275,000	$2,093,000	$2,402,000	$246,000
Year -15	2023	$23,000	$17,000	$304,000	$2,093,000	$2,437,000	$257,000
Year -14	2024	$25,000	$20,000	$333,000	$2,093,000	$2,471,000	$269,000
Year -13	2025	$27,000	$23,000	$365,000	$2,093,000	$2,508,000	$280,000
Year -12	2026	$30,000	$27,000	$397,000	$2,093,000	$2,547,000	$291,000
Year -11	2027	$32,000	$31,000	$431,000	$2,093,000	$2,587,000	$303,000
Year -10	2028	$35,000	$35,000	$467,000	$2,093,000	$2,630,000	$314,000
Year -9	2029	$37,000	$39,000	$504,000	$2,093,000	$2,673,000	$325,000
Year -8	2030	$40,000	$44,000	$542,000	$2,093,000	$2,719,000	$336,000
Year -7	2031	$43,000	$49,000	$581,000	$2,093,000	$2,766,000	$348,000
Year -6	2032	$46,000	$54,000	$622,000	$2,093,000	$2,815,000	$359,000
Year -5	2033	$49,000	$59,000	$665,000	$2,093,000	$2,866,000	$370,000
Year -4	2034	$53,000	$64,000	$709,000	$2,093,000	$2,919,000	$382,000
Year -3	2035	$56,000	$70,000	$754,000	$2,093,000	$2,973,000	$393,000
Year -2	2036	$60,000	$75,000	$800,000	$2,093,000	$3,028,000	$404,000
Year -1	2037	$61,000	$77,000	$823,000	$2,093,000	$3,054,000	$416,000
Year 0	2038	$63,000	$80,000	$845,000	$2,093,000	$3,081,000	$427,000
Year 1	2039	$65,000	$82,000	$870,000	$2,093,000	$3,110,000	$438,000
Year 2	2040	$66,000	$84,000	$890,000	$2,093,000	$3,133,000	$449,000
Year 3	2041	$68,000	$86,000	$912,000	$2,093,000	$3,159,000	$461,000
Year 4	2042	$70,000	$88,000	$934,000	$2,093,000	$3,185,000	$472,000
Year 5	2043	$71,000	$90,000	$957,000	$2,093,000	$3,211,000	$483,000
Year 6	2044	$73,000	$92,000	$979,000	$2,093,000	$3,237,000	$495,000
Year 7	2045	$74,000	$94,000	$1,002,000	$2,093,000	$3,263,000	$506,000
Year 8	2046	$76,000	$96,000	$1,024,000	$2,093,000	$3,289,000	$517,000
Year 9	2047	$78,000	$98,000	$1,046,000	$2,093,000	$3,315,000	$529,000

Project Year	Year	Annual Environmental Sustainability Benefits (Build)	Annual Quality of Life Benefits (Build)	Annual Economic Competitiveness Benefits (Build)	Annual Safety Benefits (Build)	Total Annual Benefits (Build)	Total Annual Benefits (No Build)
Year 10	2048	$79,000	$101,000	$1,069,000	$2,093,000	$3,342,000	$540,000
Year 11	2049	$81,000	$103,000	$1,091,000	$2,093,000	$3,368,000	$551,000
Year 12	2050	$83,000	$105,000	$1,113,000	$2,093,000	$3,394,000	$562,000
Year 13	2051	$84,000	$107,000	$1,136,000	$2,093,000	$3,420,000	$574,000
Year 14	2052	$86,000	$109,000	$1,158,000	$2,093,000	$3,446,000	$585,000
Year 15	2053	$88,000	$111,000	$1,180,000	$2,093,000	$3,472,000	$596,000
Year 16	2054	$89,000	$113,000	$1,203,000	$2,093,000	$3,498,000	$608,000
Year 17	2055	$91,000	$115,000	$1,225,000	$2,093,000	$3,524,000	$619,000
Year 18	2056	$93,000	$117,000	$1,248,000	$2,093,000	$3,551,000	$630,000
Year 19	2057	$94,000	$120,000	$1,270,000	$2,093,000	$3,577,000	$642,000
Year 20	2058	$96,000	$122,000	$1,292,000	$2,093,000	$3,603,000	$653,000
AVERAGE		$57,000	$68,000	$763,000	$2,093,000	$2,981,000	$421,000
TOTAL		$2,379,000	$2,846,000	$32,034,000	$87,906,000	$125,165,000	$17,691,000

Table 15: Estimated Annual Benefits (High)

Project Year	Year	Annual Environmental Sustainability Benefits (Build)	Annual Quality of Life Benefits (Build)	Annual Economic Competitiveness Benefits (Build)	Annual Safety Benefits (Build)	Total Annual Benefits (Build)	Total Annual Benefits (No Build)
Year -21	2017	$12,000	$14,000	$161,000	$2,093,000	$2,280,000	$190,000
Year -20	2018	$14,000	$9,000	$190,000	$2,093,000	$2,306,000	$201,000
Year -19	2019	$17,000	$14,000	$222,000	$2,093,000	$2,346,000	$212,000
Year -18	2020	$19,000	$20,000	$256,000	$2,093,000	$2,388,000	$223,000
Year -17	2021	$22,000	$26,000	$292,000	$2,093,000	$2,433,000	$235,000
Year -16	2022	$25,000	$33,000	$331,000	$2,093,000	$2,482,000	$246,000
Year -15	2023	$28,000	$40,000	$372,000	$2,093,000	$2,533,000	$257,000
Year -14	2024	$31,000	$48,000	$415,000	$2,093,000	$2,587,000	$269,000
Year -13	2025	$34,000	$56,000	$460,000	$2,093,000	$2,643,000	$280,000
Year -12	2026	$38,000	$65,000	$508,000	$2,093,000	$2,704,000	$291,000
Year -11	2027	$41,000	$74,000	$557,000	$2,093,000	$2,765,000	$303,000
Year -10	2028	$45,000	$84,000	$609,000	$2,093,000	$2,831,000	$314,000
Year -9	2029	$49,000	$94,000	$664,000	$2,093,000	$2,900,000	$325,000
Year -8	2030	$54,000	$105,000	$720,000	$2,093,000	$2,972,000	$336,000
Year -7	2031	$58,000	$116,000	$779,000	$2,093,000	$3,046,000	$348,000
Year -6	2032	$62,000	$128,000	$840,000	$2,093,000	$3,123,000	$359,000
Year -5	2033	$67,000	$140,000	$903,000	$2,093,000	$3,203,000	$370,000
Year -4	2034	$72,000	$153,000	$969,000	$2,093,000	$3,287,000	$382,000
Year -3	2035	$77,000	$166,000	$1,036,000	$2,093,000	$3,372,000	$393,000
Year -2	2036	$82,000	$180,000	$1,106,000	$2,093,000	$3,461,000	$404,000
Year -1	2037	$85,000	$185,000	$1,137,000	$2,093,000	$3,500,000	$416,000
Year 0	2038	$87,000	$190,000	$1,168,000	$2,093,000	$3,538,000	$427,000
Year 1	2039	$89,000	$195,000	$1,200,000	$2,093,000	$3,577,000	$438,000
Year 2	2040	$92,000	$200,000	$1,230,000	$2,093,000	$3,615,000	$449,000
Year 3	2041	$94,000	$205,000	$1,261,000	$2,093,000	$3,653,000	$461,000
Year 4	2042	$96,000	$210,000	$1,292,000	$2,093,000	$3,691,000	$472,000
Year 5	2043	$98,000	$215,000	$1,323,000	$2,093,000	$3,729,000	$483,000
Year 6	2044	$101,000	$221,000	$1,354,000	$2,093,000	$3,769,000	$495,000
Year 7	2045	$103,000	$226,000	$1,385,000	$2,093,000	$3,807,000	$506,000
Year 8	2046	$105,000	$231,000	$1,416,000	$2,093,000	$3,845,000	$517,000
Year 9	2047	$108,000	$236,000	$1,447,000	$2,093,000	$3,884,000	$529,000

Project Year	Year	Annual Environmental Sustainability Benefits (Build)	Annual Quality of Life Benefits (Build)	Annual Economic Competitiveness Benefits (Build)	Annual Safety Benefits (Build)	Total Annual Benefits (Build)	Total Annual Benefits (No Build)
Year 10	2048	$110,000	$241,000	$1,478,000	$2,093,000	$3,922,000	$540,000
Year 11	2049	$112,000	$246,000	$1,508,000	$2,093,000	$3,959,000	$551,000
Year 12	2050	$115,000	$251,000	$1,539,000	$2,093,000	$3,998,000	$562,000
Year 13	2051	$117,000	$256,000	$1,570,000	$2,093,000	$4,036,000	$574,000
Year 14	2052	$119,000	$261,000	$1,601,000	$2,093,000	$4,074,000	$585,000
Year 15	2053	$121,000	$266,000	$1,632,000	$2,093,000	$4,112,000	$596,000
Year 16	2054	$124,000	$271,000	$1,663,000	$2,093,000	$4,151,000	$608,000
Year 17	2055	$126,000	$276,000	$1,694,000	$2,093,000	$4,189,000	$619,000
Year 18	2056	$128,000	$281,000	$1,725,000	$2,093,000	$4,227,000	$630,000
Year 19	2057	$131,000	$286,000	$1,756,000	$2,093,000	$4,266,000	$642,000
Year 20	2058	$133,000	$291,000	$1,787,000	$2,093,000	$4,304,000	$653,000
AVERAGE		$77,000	$162,000	$1,037,000	$2,093,000	$3,369,000	$421,000
TOTAL		$3,241,000	$6,805,000	$43,556,000	$87,906,000	$141,508,000	$17,691,000

Table 16: Costs and Benefits (Discounted, 3%)

Project Year	Year	Net Cumulative Costs and Benefits (Discounted 3%, Baseline)	Net Cumulative Costs and Benefits (Discounted 3%, Low)	Net Cumulative Costs and Benefits (Discounted 3%, Mid)	Net Cumulative Costs and Benefits (Discounted 3%, High)
Year -21	2017	$115,000	$2,216,000	$2,220,000	$2,236,000
Year -20	2018	$236,000	-$1,998,000	-$1,990,000	-$1,953,000
Year -19	2019	$362,000	-$6,088,000	-$6,071,000	-$6,002,000
Year -18	2020	$493,000	-$10,035,000	-$10,008,000	-$9,895,000
Year -17	2021	$628,000	-$13,844,000	-$13,803,000	-$13,635,000
Year -16	2022	$768,000	-$17,518,000	-$17,460,000	-$17,223,000
Year -15	2023	$912,000	-$19,705,000	-$19,628,000	-$19,310,000
Year -14	2024	$1,059,000	-$21,803,000	-$21,704,000	-$21,292,000
Year -13	2025	$1,209,000	-$23,815,000	-$23,689,000	-$23,171,000
Year -12	2026	$1,362,000	-$25,743,000	-$25,588,000	-$24,949,000
Year -11	2027	$1,518,000	-$27,588,000	-$27,401,000	-$26,630,000
Year -10	2028	$1,676,000	-$26,983,000	-$26,760,000	-$25,842,000
Year -9	2029	$1,836,000	-$26,388,000	-$26,126,000	-$25,050,000
Year -8	2030	$1,997,000	-$25,784,000	-$25,480,000	-$24,232,000
Year -7	2031	$2,161,000	-$25,171,000	-$24,822,000	-$23,388,000
Year -6	2032	$2,325,000	-$24,548,000	-$24,151,000	-$22,520,000
Year -5	2033	$2,491,000	-$23,917,000	-$23,469,000	-$21,627,000
Year -4	2034	$2,657,000	-$23,277,000	-$22,774,000	-$20,709,000
Year -3	2035	$2,825,000	-$22,628,000	-$22,068,000	-$19,768,000
Year -2	2036	$2,992,000	-$21,971,000	-$21,351,000	-$18,803,000
Year -1	2037	$3,161,000	-$21,320,000	-$20,640,000	-$17,845,000
Year 0	2038	$3,329,000	-$19,799,000	-$19,059,000	-$16,018,000
Year 1	2039	$3,497,000	-$18,310,000	-$17,510,000	-$14,223,000
Year 2	2040	$3,665,000	-$16,852,000	-$15,993,000	-$12,462,000
Year 3	2041	$3,833,000	-$15,426,000	-$14,508,000	-$10,733,000
Year 4	2042	$4,001,000	-$14,030,000	-$13,053,000	-$9,036,000
Year 5	2043	$4,168,000	-$12,664,000	-$11,628,000	-$7,371,000
Year 6	2044	$4,334,000	-$11,327,000	-$10,233,000	-$5,737,000
Year 7	2045	$4,500,000	-$10,019,000	-$8,867,000	-$4,134,000
Year 8	2046	$4,665,000	-$8,740,000	-$7,530,000	-$2,561,000
Year 9	2047	$4,829,000	-$7,488,000	-$6,222,000	-$1,019,000

Project Year	Year	Net Cumulative Costs and Benefits (Discounted 3%, Baseline)	Net Cumulative Costs and Benefits (Discounted 3%, Low)	Net Cumulative Costs and Benefits (Discounted 3%, Mid)	Net Cumulative Costs and Benefits (Discounted 3%, High)
Year 10	2048	$4,992,000	-$6,263,000	-$4,940,000	$494,000
Year 11	2049	$5,153,000	-$5,065,000	-$3,686,000	$1,978,000
Year 12	2050	$5,314,000	-$3,893,000	-$2,459,000	$3,433,000
Year 13	2051	$5,474,000	-$2,747,000	-$1,258,000	$4,859,000
Year 14	2052	$5,632,000	-$1,625,000	-$83,000	$6,258,000
Year 15	2053	$5,789,000	-$529,000	$1,068,000	$7,629,000
Year 16	2054	$5,944,000	$543,000	$2,193,000	$8,973,000
Year 17	2055	$6,098,000	$1,592,000	$3,294,000	$10,290,000
Year 18	2056	$6,251,000	$2,617,000	$4,372,000	$11,581,000
Year 19	2057	$6,401,000	$3,620,000	$5,426,000	$12,846,000
Year 20	2058	$6,551,000	$4,600,000	$6,457,000	$14,086,000
NET PRESENT VALUE (3% DISCOUNT RATE)		$6,550,000	$4,600,000	$6,460,000	$10,230,000
BENEFIT - COST RATIO		N/A	1.07	1.10	1.22

Table 17: Costs and Benefits (Discounted, 7%)

Project Year	Year	Net Cumulative Costs and Benefits (Discounted 7%, Baseline)	Net Cumulative Costs and Benefits (Discounted 7%, Low)	Net Cumulative Costs and Benefits (Discounted 7%, Mid)	Net Cumulative Costs and Benefits (Discounted 7%, High)
Year -21	2017	$115,000	$2,216,000	$2,220,000	$2,236,000
Year -20	2018	$231,000	-$1,840,000	-$1,832,000	-$1,796,000
Year -19	2019	$348,000	-$5,630,000	-$5,614,000	-$5,549,000
Year -18	2020	$465,000	-$9,151,000	-$9,126,000	-$9,021,000
Year -17	2021	$581,000	-$12,422,000	-$12,385,000	-$12,232,000
Year -16	2022	$697,000	-$15,458,000	-$15,408,000	-$15,198,000
Year -15	2023	$811,000	-$17,198,000	-$17,132,000	-$16,858,000
Year -14	2024	$924,000	-$18,806,000	-$18,722,000	-$18,376,000
Year -13	2025	$1,034,000	-$20,289,000	-$20,186,000	-$19,762,000
Year -12	2026	$1,143,000	-$21,657,000	-$21,533,000	-$21,024,000
Year -11	2027	$1,249,000	-$22,918,000	-$22,772,000	-$22,172,000
Year -10	2028	$1,353,000	-$22,519,000	-$22,350,000	-$21,654,000
Year -9	2029	$1,455,000	-$22,143,000	-$21,949,000	-$21,152,000
Year -8	2030	$1,553,000	-$21,775,000	-$21,556,000	-$20,654,000
Year -7	2031	$1,649,000	-$21,415,000	-$21,170,000	-$20,159,000
Year -6	2032	$1,742,000	-$21,064,000	-$20,791,000	-$19,669,000
Year -5	2033	$1,832,000	-$20,720,000	-$20,420,000	-$19,183,000
Year -4	2034	$1,919,000	-$20,385,000	-$20,056,000	-$18,703,000
Year -3	2035	$2,003,000	-$20,059,000	-$19,701,000	-$18,229,000
Year -2	2036	$2,085,000	-$19,740,000	-$19,353,000	-$17,761,000
Year -1	2037	$2,163,000	-$19,436,000	-$19,021,000	-$17,314,000
Year 0	2038	$2,239,000	-$18,753,000	-$18,311,000	-$16,493,000
Year 1	2039	$2,311,000	-$18,109,000	-$17,641,000	-$15,717,000
Year 2	2040	$2,381,000	-$17,502,000	-$17,009,000	-$14,984,000
Year 3	2041	$2,449,000	-$16,930,000	-$16,414,000	-$14,291,000
Year 4	2042	$2,513,000	-$16,392,000	-$15,853,000	-$13,636,000
Year 5	2043	$2,575,000	-$15,885,000	-$15,324,000	-$13,018,000
Year 6	2044	$2,635,000	-$15,407,000	-$14,825,000	-$12,434,000
Year 7	2045	$2,692,000	-$14,957,000	-$14,355,000	-$11,882,000
Year 8	2046	$2,746,000	-$14,533,000	-$13,912,000	-$11,361,000
Year 9	2047	$2,799,000	-$14,134,000	-$13,495,000	-$10,869,000

Project Year	Year	Net Cumulative Costs and Benefits (Discounted 7%, Baseline)	Net Cumulative Costs and Benefits (Discounted 7%, Low)	Net Cumulative Costs and Benefits (Discounted 7%, Mid)	Net Cumulative Costs and Benefits (Discounted 7%, High)
Year 10	2048	$2,849,000	-$13,758,000	-$13,102,000	-$10,405,000
Year 11	2049	$2,897,000	-$13,404,000	-$12,731,000	-$9,966,000
Year 12	2050	$2,942,000	-$13,070,000	-$12,382,000	-$9,553,000
Year 13	2051	$2,986,000	-$12,757,000	-$12,053,000	-$9,162,000
Year 14	2052	$3,028,000	-$12,461,000	-$11,743,000	-$8,793,000
Year 15	2053	$3,067,000	-$12,183,000	-$11,452,000	-$8,446,000
Year 16	2054	$3,105,000	-$11,921,000	-$11,177,000	-$8,117,000
Year 17	2055	$3,142,000	-$11,674,000	-$10,918,000	-$7,808,000
Year 18	2056	$3,176,000	-$11,442,000	-$10,674,000	-$7,516,000
Year 19	2057	$3,209,000	-$11,224,000	-$10,444,000	-$7,240,000
Year 20	2058	$3,240,000	-$11,018,000	-$10,228,000	-$6,980,000
NET PRESENT VALUE (7% DISCOUNT RATE)		$3,240,000	-$11,020,000	-$10,230,000	-6,980,000
BENEFIT - COST RATIO		N/A	0.77	0.79	0.86

Notes

[i] Köppen Climate Classification System:

Cfa	*Humid subtropical climate*
Bwks	*Desert southwest*
Dfa	*Humid continental climate*

[ii] USGS, Geographic Names Information System (GNIS), <http://geonames.usgs.gov/>
[iii] US Census, American Community Survey, five-year estimates (2011-2015)
[iv] US Census, Quick Facts, Population Density (2010), <http://www.census.gov/quickfacts/table>
[v] US Census, Quick Facts, Population (2011-2015), <http://www.census.gov/quickfacts/table>
[vi] The League of American Bicyclists (2017), <http://www.bikeleague.org/sites/default/files/BFC_Master_Spring%202017.pdf>
[vii] The low estimate for future bike and pedestrian commute mode share is the difference between the study area's existing bike and pedestrian commute mode share and the 25th percentile bicycle and pedestrian mode share of the selected aspirational cities
[viii] The low estimate for future bike and pedestrian commute mode share is the difference between the study area's existing bike and pedestrian commute mode share and the 50th percentile bicycle and pedestrian mode share of the selected aspirational cities
[ix] The low estimate for future bike and pedestrian commute mode share is the difference between the study area's existing bike and pedestrian commute mode share and the 75th percentile bicycle and pedestrian mode share of the selected aspirational cities
[x] NHTS (2009). <http://nhts.ornl.gov/tables09/fatcat/2009/aptl_TRPTRANS_WHYTRP1S.html>
[xi] Ibid.
[xii] Safe Routes National Center for Safe Routes to School, Trends in Walking and Bicycling to School from 2007 to 2013 (2015). <http://www.saferoutesinfo.org/sites/default/files/SurveyTrends_2007-13_final1.pdf>
[xiii] NHTS (2009). <http://nhts.ornl.gov/tables09/fatcat/2009/aptl_TRPTRANS_WHYTRP1S.html>
[xiv] Ibid.
[xv] Ibid.
[xvi] Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks, EPA (2008). <https://www3.epa.gov/otaq/consumer/420f08024.pdf>
[xvii] Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks, EPA (2008). <https://www3.epa.gov/otaq/consumer/420f08024.pdf>
[xviii] Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks, EPA (2008). <https://www3.epa.gov/otaq/consumer/420f08024.pdf>
[xix] Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks, EPA (2008). <https://www3.epa.gov/otaq/consumer/420f08024.pdf>
[xx] Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866. <https://www.whitehouse.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf>
[xxi] State Indicators Report on Physical Activity, CDC. (2014) <http://www.cdc.gov/physicalactivity/downloads/pa_state_indicator_report_2014.pdf>
[xxii] Ibid.
[xxiii] Inadequate Physical Activity and Health Care Expenditures in the United States. <http://www.cdc.gov/nccdphp/dnpao/docs/carlson-physical-activity-and-healthcare-expenditures-final-508tagged.pdf>
[xxiv] "Our Driving Costs, AAA (2016). <http://exchange.aaa.com/automobiles-travel/automobiles/driving-costs/#.Vw_xCPkrKUk>
[xxv] Crashes vs. Congestion: What's the Cost to Society? AAA (2011). <http://www.camsys.com/pubs/2011_AAA_CrashvCongUpd.pdf>
[xxv] Kitamura, R., Zhao, H., and Gubby, A. R. Development of a Pavement Maintenance Cost Allocation Model. Institute of Transportation Studies, University of California, Davis. <https://trid.trb.org/view.aspx?id=261768>
[xxvi] Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis (Revision 2 - corrected). <http://www.dot.gov/office-policy/transportation-policy/guidance-value-time>

Appendix F:

Recommended Project Information

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Table F.1. *Linear Recommended Project Information*

Proj #	Name	Facility Type	North or West Limit	South or East Limit	Jurisdiction	Agency Partners	Plan Origin	Feasibility Study	Action	Long Term	Miles	Per Mile Cost	Total Cost	Prioritization Score	Phase	TMP Build	Parks Build	Notes
L1		Shared Use Path	Bramble Way	Lost Ridge Drive	Washington City		WATP		Build trail		0.17	$700,000	$116,000	5	2		Yes	Connecting south and north, especially as connection to school to the north.
L2		Shared Use Path	300 East	Desert Ridge Drive	Washington City		WATP		Coordinate with property owners to build trail		0.95	$700,000	$664,000	7	2		Yes	Coordinate with gated community to facilitate this path. Will require hybrid beacon crossing of 300 East.
L3		Shared Use Path	Existing Western Terminus of Desert Ridge Drive	Existing Eastern Terminus Desert Ridge Drive	Washington City		WATP				0.26	$700,000	$182,000	7	1		Yes	Connection between paths.
L4		Shared Use Path	Desert Ridge Drive	Hell Hole Trail (New Route)	Washington City		WATP		Build trail		0.20	$700,000	$138,000	7	1		Yes	Connects the future Hell Hole Trail and neighborhoods as part of alternative route to Telegraph.
L5		Shared Use Path	Bulloch Street	Washington Parkway Trail	Washington City		WATP		Build trail		0.26	$700,000	$181,000	5	2		Yes	Connects existing path to future roadway through existing drainage.
L6		Shared Use Path	Bulloch Street	Telegraph Street	Washington City		WATP		Coordinate with property owners to build trail		0.45	$700,000	$314,000	5	3		Yes	Viability depends on where a facility is implemented on Telegraph.
L7		Shared Use Path	Millcreek Trail	300 North	Washington City		WATP		Coordinate with property owners to build trail		0.35	$700,000	$248,000	7	1		Yes	Provides off-street connection between Millcreek Trail and north part of downtown.
L8	1100 East	Separated Bike Lane	Washington Parkway	Telegraph Street	Washington City		WATP		TMP buildout		1.11	$500,000	$558,000	7	2	Yes		When improved per TMP.
L10	20 East	Buffered Bike Lane	2000 South	City Limit	Washington City		WATP		TMP buildout		2.40	$16,000	$39,000	12	2	Yes		When improved per TMP.
L11	200 East	Bicycle Boulevard	Existing Northern Terminus	Dogtown Park Path Connector	Washington City		WATP		Implement traffic calming, signalization		1.05	$15,000	$16,000	16	1			Will provide a low-stress alternative to 300 East, connects to parks, downtown, and near schools. Enhanced crossing beacons likely required at Telegraph.
L12	200 South	Buffered Bike Lane	Star Nursery Entrance	300 East	Washington City		WATP		Widen asphalt or improve entire roadway X-section		0.63	$16,000	$11,000	6	2			Part of alternative route to Telegraph. Requires roadway improvement/widening. Will require hybrid beacon crossing of 300 East.
L13	200 West Path	Shared Use Path	300 South	Millcreek Trail	Washington City		WATP		Coordinate with property owners to build trail		0.14	$700,000	$101,000	6	2		Yes	Connects downtown streets to future Millcreek Trail.
L14	200 West/300 North	Bicycle Boulevard	Main Street	300 South	Washington City		WATP		Implement traffic calming, signalization		0.82	$15,000	$13,000	14	1			Will provide a low-stress alternative on west side of Downtown, connects to parks, downtown, and near schools. Enhanced crossing beacons or signals likely required at Main and Telegraph intersections.
L15	240 West	Bike Lane	2000 South	Merrill Rd	Washington City		WATP		Stripe bike lanes		0.50	$12,000	$7,000	9	1			Can implement now.
L16	240 West	Bike Lane	Merrill Road	City Limit	Washington City	St. George/Washington County	WATP		TMP buildout		1.27	$12,000	$16,000	5	2	Yes		When improved per TMP.
L17	300 East	Bike Lane	Park View Dr	Telegraph Street	Washington City		MPOReg		Stripe		0.18	$12,000	$3,000	15	1			Can implement now.
L18	300 East	Bike Lane	South Nichols Peaks Rd	3650 South	Washington City		WATP		TMP buildout		1.00	$12,000	$13,000	2	3	Yes		When improved per TMP.
L19	300 East	Buffered Bike Lane	Existing Northern Terminus	Park View Dr	Washington City		WATP		Stripe		0.52	$16,000	$9,000	16	1			Can implement now.
L20	300 East Trail	Shared Use Path	Telegraph Street	Virgin River Trail North	Washington City		MPOReg		Widen sidewalks to sidepath		1.01	$700,000	$707,000	14	1		Yes	If bike lanes or insufficient or not possible, upgrade existing sidewalks to sidepaths along 300 E/Washington Fields Rd.
L21	300 North	Bike Lane	Main Street	300 East	Washington City		MPOReg		Stripe		0.27	$12,000	$4,000	6	1			Stripe 5' bike lanes. May require 11' travel lanes. Enhanced crossing beacons or signals likely required at Main and Telegraph intersections.

Proj #	Name	Facility Type	North or West Limit	South or East Limit	Jurisdiction	Agency Partners	Plan Origin	Feasibility Study	Action	Long Term	Miles	Per Mile Cost	Total Cost	Prioritization Score	Phase	TMP Build	Parks Build	Notes
L22	3050 East/Millcreek Trail Connector	Shared Use Path	3050 East	Millcreek Trail	Washington City		WATP				0.46	$700,000	$325,000	9	1		Yes	May conflict if a road is constructed here in the future. Otherwise, provides connection between shopping and trail.
L23	3090 South	Buffered Bike Lane	City Limit	Camino Real	Washington City	St. George	WATP		TMP buildout		1.25	$16,000	$20,000	5	2	Yes		When improved per TMP. Signal may be needed at intersection with Washington Fields Road.
L24	3210 East	Bike Lane	Merrill Road	City Limit	Washington City	St. George	WATP		TMP buildout		0.37	$12,000	$5,000	6	2	Yes		When improved per TMP.
L26	3650 South	Separated Bike Lane	3000 East	City Limit	Washington City	St. George	WATP		TMP buildout		2.36	$500,000	$1,179,000	11	1	Yes		When improved per TMP. Modified from MPO Plan.
L28	3650 South	Bike Lane	515 West	City Limit	Washington City	St. George	WATP		TMP buildout		0.14	$12,000	$2,000	3	1	Yes		When improved per TMP.
L30	3650 South Trail	Shared Use Path	City Limit	City Limit	Washington City	Washington County	ParksRec				2.27	$700,000	$1,589,000	13	1	Yes		Recommended in Parks and Rec Plan, and plans for this path should coincide with or be replaced by possible on-street SBL recomendations.
L31	4200 South	Buffered Bike Lane	City Limit	Future Trail 82	Washington City	St. George	WATP		TMP buildout		0.94	$16,000	$16,000	6	2	Yes		When improved per TMP. May need to be upgraded to match minor arterial classification on east end.
L32	500 South	Bicycle Boulevard	Main Street	100 East	Washington City		WATP		TMP buildout		0.10	$15,000	$2,000	5	2	Yes		When roadway is improved per TMP.
L33	500 West/200 South	Bike Lane	Telegraph Street	Star Nursery Entrance	Washington City		WATP		Remove one side of parking		0.19	$12,000	$3,000	6	2			Part of alternative route to Telegraph.
L34	515 West	Bike Lane	3650 South	City Limit	Washington City	St. George	WATP		TMP buildout		0.26	$12,000	$4,000	0	3	Yes		When improved per TMP.
L35	840 South	Buffered Bike Lane	City Limit	300 East	Washington City	St. George	WATP		TMP buildout		0.55	$16,000	$9,000	4	2	Yes		When improved per TMP.
L37	Arabian Way	Bike Lane	Washington Dam Road	Bramble Way	Washington City		WATP		Remove one side of parking		0.86	$12,000	$11,000	4	2			Would require removing one side of parking. Otherwise, can implement now. Great connection to school.
L38	Bella Vista Drive	Shared Use Path	Telegraph Street	Florence Drive	Washington City		WATP		Coordinate with property owners to build trail		0.46	$700,000	$326,000	5	3		Yes	Coordinate with gated community to facilitate this path. Signal may be needed at intersection with Telegraph Street.
L39	Buena Vista Boulevard	Separated Bike Lane	Main Street	Washington Parkway	Washington City		WATP		TMP buildout		1.29	$500,000	$646,000	7	2	Yes		When improved per TMP.
L40	Buena Vista Trail	Shared Use Path	Main Street	Washington Parkway	Washington City		ParksRec				1.25	$700,000	$875,000	7	2	Yes		
L41	Bulloch Street	Bike Lane	300 East	Washington Parkway	Washington City		WATP		TMP buildout		1.08	$12,000	$13,000	4	3	Yes		When improved per TMP.
L42	Camino Real	Bike Lane	Chinook Drive	Wild Horse Ridge Road	Washington City		WATP		Stripe		1.46	$12,000	$18,000	6	1			Can implement now. Signal may be needed at intersection with Washington Dam Road.
L43	Canal Trail	Shared Use Path	Virgin River Trail	Medallion Drive	Washington City		ParksRec	Floodplain	Coordinate with properties, canal to build trail		7.01	$700,000	$4,906,000	12	1		Yes	Construct a shared use path along the historic canal alignment. Highly supported by community. Signal may be needed at intersection with Washington Dam Road.
L44	Canal Trail	Shared Use Path	4200 South	City Limit	Washington City	Washington County	ParksRec				0.32	$700,000	$226,000	8	2		Yes	Construct a shared use path along the historic canal alignment.
L45	Canal Trail Connector	Shared Use Path	Canal Trail	Camino Real	Washington City		WATP				0.04	$700,000	$27,000	3	1		Yes	In conjunction with Canal Trail implementation, providing neighborhood to trail connectivity.
L46	Canyon Greens Drive	Shared Use Path	Little Francisco Trail	Coral Canyon Boulevard	Washington City		WATP		Build trail		0.12	$700,000	$85,000	7	2		Yes	Connects Coral Canyon Blvd to existing trail on the north, via a sidepath
L47	Concord Parkway	Bike Lane	Existing Northern Terminus	Green Spring Drive	Washington City		WATP		Stripe		0.61	$12,000	$8,000	2	1			Can implement now. Enhanced crossing beacons likely required at Green Spring.
L48	Coral Canyon Alternative Trail	Shared Use Path	Coral Canyon Boulevard	Telegraph Street	Washington City		WATP		Coordinate with property owners to build trail		0.86	$700,000	$601,000	7	2		Yes	Provide alternative to sidepath and possible bike lanes on Coral Canyon Blvd.
L49	Coral Canyon Boulevard	Shared Use Path	Canyon Greens Drive	City Limit	Washington City		WATP		Build trail		0.21	$700,000	$151,000	8	2		Yes	Extends Coral Canyon Blvd sidepath to the east to connect with future Hurricane facilities.

Proj #	Name	Facility Type	North or West Limit	South or East Limit	Jurisdiction	Agency Partners	Plan Origin	Feasibility Study	Action	Long Term	Miles	Per Mile Cost	Total Cost	Prioritization Score	Phase	TMP Build	Parks Build	Notes
L50	Coral Canyon Boulevard	Bike Lane	City Limit	Telegraph Street	Washington City		WATP		Restripe roadway, possible widening intersections		2.19	$12,000	$27,000	5	3			Can be implemented by removing center turn lane. If left turn lanes are needed, may need 4-5' of extra width (road widening) at intersection.
L51	Coral Canyon Trail Connector	Shared Use Path	Coral Canyon Trail	Coral Canyon Blvd	Washington City		WATP				0.42	$700,000	$292,000	7	2		Yes	Implement above the slope and behind houses.
L52	Cottonwood Trail/Coral Canyon Lake Connector	Shared Use Path	Telegraph Street	Existing Cottonwood Trail	Washington City		MPOReg		Build trail		0.81	$700,000	$570,000	9	1		Yes	Extend the Cottonwood Wash Trail to Telegraph St. Either this or the Parks and Rec Plan alignment should be implemented, but likely not both.
L53	Cottonwood Wash Trail	Shared Use Path	Telegraph Street	Existing Cottonwood Trail	Washington City		ParksRec		Build trail		0.87	$700,000	$611,000	12	1		Yes	10yr from original source. Either this or the MPO Regional ATP alignment should be implemented, but likely not both.
L54	Country Way	Shared Use Path	500' South of Bridge	Washington Dam Road	Washington City		WATP		Widen sidewalk, use SUP joints and ramps		0.17	$700,000	$121,000	5	2		Yes	Short section of sidepath to connect to bridge and future Virgin River Trail on north and south. Existing wide sidewalk should be widened further and designed for bike and peds.
L55	Creek Ridge/Omni Connector	Shared Use Path	Creek Ridge Cir	Omni Ln	Washington City		WATP		Property easement		0.05	$700,000	$33,000	5	2		Yes	May require easement or agreement with homeowners or develop if space is not left over when development is completed.
L56	Dogtown Park Path	Shared Use Path	100 East	300 East	Washington City		WATP		Build trail		0.17	$700,000	$119,000	5	2		Yes	North of residential fence line.
L57	Dogtown Park Path Connector	Shared Use Path	Southern Terminus of 200 East	Dogtown Park Path	Washington City		WATP		Build trail		0.05	$700,000	$39,000	5	2		Yes	Connects street network to east-west trail in park.
L58	Fairway Drive	Bike Lane	1860 North	Green Spring Drive	Washington City		WATP		Stripe		1.46	$12,000	$18,000	6	1			Can implement now if 18' center travel lane is okay.
L59	Fairway Drive (Future)	Bike Lane	Future Northern Terminus	1860 North	Washington City		WATP		TMP buildout		0.19	$12,000	$3,000	0	3	Yes		When improved per TMP.
L60	Foothill Drive	Bike Lane	100 East	300 East	Washington City		WATP		Stripe		0.19	$12,000	$3,000	4	1			Can implement now if 18' center travel lane is okay.
L61	Future Road	Separated Bike Lane	City Limit	Washington Fields Road (Future)	Washington City	St. George	WATP		TMP buildout		0.89	$500,000	$444,000	4	3	Yes		When improved per TMP.
L62	Future Road	Separated Bike Lane	Future Road	City Limit	Washington City	St. George	WATP		TMP buildout		0.76	$500,000	$382,000	4	3	Yes		When improved per TMP.
L63	Future Trail 19	Shared Use Path	City Limit	City Limit	Washington City	Washington County/St. George	STGATP				2.50	$700,000	$1,750,000	4	3		Yes	Develop shared use path in conjunction with future development.
L65	Future Trail 82	Shared Use Path	City Limit	Washington Fields Road	Washington City	St. George	MPOReg				0.94	$700,000	$660,000	6	2		Yes	Develop shared use path in conjunction with future development.
L66	Future Trail 83	Shared Use Path	City Limit	City Limit	Washington City	Washington County/St. George	MPOReg				0.55	$700,000	$387,000	4	3		Yes	Develop shared use path in conjunction with future development.
L67	Grapevine Trail	Shared Use Path	Washington Parkway	Telegraph Substation	Washington City		ParksRec				0.19	$700,000	$130,000	7	2		Yes	Signal may be needed at intersection of Telegraph and Washington Parkway.
L68	Grapevine Trail	Shared Use Path	Washington Parkway Trail	Highland Park Loop Trail West	Washington City	UDOT	ParksRec				1.17	$700,000	$821,000	9	2		Yes	Connects trails in Coral Canyon to main part of town on and west of Washington Parkway.
L69	Grapevine Trail (N-S)	Shared Use Path	Church Rocks Trail (North of I-15)	Grapevine Trail	Washington City	UDOT	ParksRec	I-15 Undercrossing	Build trail; improve I-15 undercrossing		0.12	$700,000	$83,000	7	3		Yes	
L70	Green Spring Drive	Shared Use Path	Buena Vista Boulevard	Telegraph Street	Washington City	UDOT	WATP		Build trail		0.22	$700,000	$155,000	12	1		Yes	Only on east side (northwestbound). Replaces sidewalk, improves crossings with better visibility and slower speeds. Reduce turn radii as much as possible on the east side of the road in order to accommodate safe shared use path crossings (4).
L71	Green Spring Drive	Shared Use Path	Telegraph Street	City Limit	Washington City	St. George/UDOT	WATP		Coordinate with property owners to build trail		0.17	$700,000	$120,000	12	1		Yes	Only on east side (northwestbound). Replaces sidewalk, improves driveways with better visibility and slower speeds. May impact parking.

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L72	Green Spring Drive	Shared Use Path	Existing Northern Terminus	Buena Vista Boulevard	Washington City		WATP		Build trail	Separated Bike Lane	2.20	$700,000	$1,542,000	14	1		Yes	Widen sidewalks to paths on both sides. In future, if widened to new Minor Arterial cross section, include SBLs.
L73	Green Spring Park Trail	Shared Use Path	West Side of Park	Green Spring Drive	Washington City		WATP		Build trail		0.18	$700,000	$125,000	5	2		Yes	Widen sidewalk to path.
L74	Harvest Lane Bike Lanes	Bike Lane	Merrill Road	240 West	Washington City		WATP		Stripe bike lanes		0.43	$12,000	$6,000	13	1			Can implement now. Possible east of 240 West, as well, but requires removing parking on one side.
L75	Hell Hole Trail	Shared Use Path	Telegraph Street	Existing Hell Hole Trail	Washington City		ParksRec		Build trail		0.12	$700,000	$83,000	12	1		Yes	10yr from original source.
L76	Hell Hole Trail (New Route)	Shared Use Path	Telegraph Street	Existing Hell Hole Trail	Washington City		WATP				0.12	$700,000	$84,000	12	1		Yes	Signal may be needed at intersection of Telegraph and Washington Parkway.
L77	Henry Walker Homes Trail	Shared Use Path	Main Street/100 East	Buena Vista Boulevard	Washington City		ParksRec				0.71	$700,000	$499,000	5	2		Yes	10yr from original source.
L78	Henry Walker Homes Trail (N-S)	Shared Use Path	Washington Parkway (Future)	Henry Walker Homes Trail	Washington City		ParksRec				0.39	$700,000	$276,000	3	2		Yes	10yr from original source.
L79	Highland Park Loop Trail	Shared Use Path	Coral Canyon Trail	Highland Park Loop Trail West	Washington City		ParksRec				0.06	$700,000	$41,000	7	2		Yes	10yr from original source.
L80	Highland Park Loop Trail East	Shared Use Path	I-15 Water Tank	Existing Highland Park Loop Trail	Washington City		ParksRec				0.88	$700,000	$615,000	9	1		Yes	10yr from original source.
L81	Highland Park Loop Trail West	Shared Use Path	I-15 Water Tank	Highland Parkway	Washington City		ParksRec				0.84	$700,000	$589,000	9	1		Yes	10yr from original source.
L82	Highland Park South Loop Trail	Shared Use Path	Highland Parkway	Black Canyon Avenue	Washington City		ParksRec				1.29	$700,000	$907,000	8	2		Yes	10yr from original source.
L83	Highland Park South Loop Trail (E-W)	Shared Use Path	Highland Park South Loop Trail	Highland Park South Loop Trail	Washington City		ParksRec				0.25	$700,000	$174,000	8	2		Yes	10yr from original source.
L84	Highland Parkway	Bike Lane	Horizon Parkway	Telegraph Street	Washington City		WATP		Restripe roadway		0.93	$12,000	$12,000	6	1			Restripe to provide bike lanes. Can be implemented now.
L85	Indian Springs Drive	Buffered Bike Lane	Washington Fields Road	Seminole Way	Washington City		WATP		TMP buildout		0.33	$16,000	$6,000	2	3	Yes		When roadway is improved per TMP.
L86	Industrial Drive	Buffered Bike Lane	City Limit	Washington Fields Road	Washington City	St. George	WATP		Stripe		0.73	$16,000	$12,000	9	1			Can implement now within wide shoulders. St. George recommendation to the west should be updated, too.
L88	Liberty Greens Drive	Bike Lane	Coral Canyon Boulevard	Coral Canyon Boulevard	Washington City		WATP		TMP buildout		0.35	$12,000	$5,000	4	2	Yes		When improved or upgraded per TMP.
L89	Lost Ridge Drive	Bike Lane	Washington Field Road	Camino Real	Washington City		WATP		Stripe		0.30	$12,000	$4,000	4	1			Can implement now.
L90	Main Street	Separated Bike Lane	Washington Parkway	South Frontage Road	Washington City		WATP		TMP buildout		2.33	$500,000	$1,164,000	17	3	Yes		Design proposed interchange to accomodate bike lanes. Implement when road is upgraded per TMP. In short terms, buffered bike lanes. Design and build new interchange in accordance with best bicycle and pedestrian practice.
L91	Main Street Trail	Shared Use Path	Washington Parkway (Future)	Buena Vista Boulevard	Washington City		ParksRec				0.62	$700,000	$432,000	10	1	Yes		
L92	Main Street Trail	Shared Use Path	Future Northern Terminus	Washington Parkway (Future)	Washington City		ParksRec				0.81	$700,000	$565,000	3	3		Yes	
L93	Main Street/100 East	Separated Bike Lane	South Frontage Road	Industrial Drive	Washington City		WATP		TMP buildout		2.33	$500,000	$1,164,000	17	1	Yes		Design proposed interchange to accomodate bike lanes. Implement when road is upgraded per TMP. In short terms, buffered bike lanes. Design and build new interchange in accordance with best bicycle and pedestrian practice.
L94	Majestic Drive	Bike Lane	Camino Real	Antingua Lane	Washington City		WATP		Stripe		0.67	$12,000	$9,000	6	1			Can implement now.
L95	Majestic Drive	Bike Lane	Antingua Lane	Future Eastern Terminus	Washington City		WATP		TMP buildout		0.20	$12,000	$3,000	0	3	Yes		When improved per TMP.
L97	Merrill Road	Separated Bike Lane	3000 East	Washington Fields Road	Washington City	Washington County/St. George	WATP		TMP buildout		1.29	$500,000	$643,000	13	1	Yes		To be improved per TMP and upcoming capital project.
L98	Merrill Road	Bike Lane	20 East	Washington Fields Road	Washington City	Washington County/St. George	MPOReg		Narrow lanes/widen shoulders		0.55	$12,000	$7,000	4	1			Narrow lanes/widen shoulders as needed to accomodate bike lanes. Implement bike lanes on unimproved or unbuilt segments as development/roadway construction occurs.

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L99	Millcreek Trail	Shared Use Path	Millcreek Trail	Washington Parkway (Future)	Washington City		ParksRec				0.02	$700,000	$14,000	3	3		Yes	
L100	Millcreek Trail	Shared Use Path	1660 North	Telegraph Street	Washington City		ParksRec				2.01	$700,000	$1,410,000	13	1		Yes	
L101	Millcreek Trail	Shared Use Path	200 South	Virgin River Trail	Washington City	St. George	ParksRec		Build trail		1.12	$700,000	$781,000	12	1		Yes	Southern extension of Millcreek Trail between Nisson Park and Sullivan Park.
L102	Millcreek Trail Connector	Shared Use Path	Millcreek Trail	Creek Ridge/Omni Connector	Washington City		WATP	Grade	Study grade		0.06	$700,000	$42,000	5	3		Yes	Grade may cause issue connected neighborhoods to Millcreek Trail.
L103	Millcreek Trail Connector	Shared Use Path	Millcreek Trail	Cottontown Village Parking Lot	Washington City		WATP		Coordinate with property owners to build trail		0.05	$700,000	$33,000	13	1		Yes	Will connect Millcreek Trail to downtown north of Telegraph, thereby forgoing possible signalization for crossing.
L104	Noble Drive	Bike Lane	Majestic Drive	Current Southern Terminus	Washington City		WATP		Stripe		0.24	$12,000	$3,000	2	1			Can implement now if 18' center travel lane is okay.
L105	Noble Drive	Bike Lane	Current Southern Terminus	3650 South	Washington City		WATP		TMP buildout		0.20	$12,000	$3,000	0	3	Yes		When improved per TMP.
L106	North Green Springs Trail	Shared Use Path	Various	Various	Washington City		ParksRec				1.10	$700,000	$771,000	6	2		Yes	
L107	North SITLA Block Trail	Shared Use Path	Washington Parkway (Future)	Washington Parkway Trail	Washington City		ParksRec				2.32	$700,000	$1,626,000	7	2		Yes	
L108	North SITLA Block Trail	Shared Use Path	Future Northern Terminus	Main Street Trail	Washington City		ParksRec				0.73	$700,000	$512,000	5	3		Yes	
L109	Northern Parkway Trail	Shared Use Path	City Limit	Grapevine Trail	Washington City		ParksRec				2.99	$700,000	$2,097,000	6	2	Yes		
L110	Pine View Park Trail	Shared Use Path	City Limit	East End of Pine View Park	Washington City	St. George	ParksRec				0.48	$700,000	$334,000	8	2		Yes	10yr from original source.
L111	Purgatory Road	Bike Lane	City Limit	Washington Dam Rd	Washington City	Washington County/Hurricane					2.64	$12,000	$32,000	1	3	Yes		Rough alignment of preferred alternative of new Purgatory Road, as of April 2017
L114	Red Hills Parkway/Buena Vista Boulevard	Bike Lane	Red Hills Parkway/Buena Vista Boulevard Bike Lane	Main Street	Washington City		MPOReg		Restripe roadway	Separated Bike Lane	0.97	$12,000	$12,000	11	1			Narrow lanes and reconfigure striping to accommodate bike lanes; when built out per TMP, include SBLs
L115	Red Hills Parkway/Buena Vista Boulevard	Bike Lane	City Limit	Red Hills Parkway/Buena Vista Boulevard BBL	Washington City	St. George	MPOReg		Narrow lanes	Separated Bike Lane	0.34	$12,000	$5,000	10	1			Narrow lanes to accommodate bike lanes; when built out per TMP, include SBLs
L116	Riveredge Road/Apache Drive	Shared Use Path	Three Rivers Trail System	Seminole Way	Washington City		WATP		Coordinate with property owners to build trail		0.33	$700,000	$234,000	5	2		Yes	Sidepath on north side to connect bike lane and other proposed path on Riveredge Rd.
L117	Riverside School Trail Extension	Shared Use Path	325 West	240 West	Washington City		WATP		Property easement		0.07	$700,000	$52,000	12	1		Yes	Would require coordination for easement from several property owners, but provides neighborhood connectivity to school.
L118	Riverside School Trail Extension	Shared Use Path	Sandia Rd	Riverside School Trail	Washington City	WCSD	WATP		Extend current path west		0.22	$700,000	$152,000	14	1		Yes	Extends existing path, allowing better access to school.
L119	Riverside School Trail Extension Connector	Shared Use Path	Riverside School Trail Extension	Riverside School North Entrance	Washington City	WCSD	WATP		Build path through grass		0.04	$700,000	$27,000	14	1		Yes	Connects new extension of path to the north into the school.
L120	Rock Creek Drive	Shared Use Path	Highland Parkway	Black Canyon Ave	Washington City		WATP		Wait for development on south side		0.06	$700,000	$43,000	5	3		Yes	Place on south side when development goes in.
L121	Sandia Road/2000 South	Buffered Bike Lane	Merrill Road	Washington Fields Road	Washington City	St. George	WATP		Stripe		1.57	$16,000	$26,000	11	1			Stripe buffered bike lanes in wide shoulders.
L123	Seminole Way	Bike Lane	Apache Drive	Chinook Drive	Washington City		WATP		Complete/improve roadway on the south		0.48	$12,000	$6,000	2	3	Yes		When improved per TMP.
L124	Sienna Hills Park Trail	Shared Use Path	Sienna Hills Park	Telegraph Street	Washington City		ParksRec				0.48	$700,000	$336,000	7	2		Yes	Along wash through future neighborhood.
L125	Silver Falls Drive	Shared Use Path	Washington Fields Road	Camino Real	Washington City		WATP		Build trail		0.03	$700,000	$23,000	3	3		Yes	Shared use paths on both sides of road to link Washington Fields Rd and Canal Trail for bikes and peds.
L126	SITLA North Block Trail (E-W)	Shared Use Path	SITLA North Block Trail (N-S)	Buena Vista Boulevard	Washington City		ParksRec				0.27	$700,000	$191,000	3	3		Yes	

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L127	SITLA North Block Trail (N-S)	Shared Use Path	Northern Parkway Trail	Buena Vista Boulevard	Washington City		ParksRec				0.31	$700,000	$221,000	3	3		Yes	
L128	Solway Drive/Blue Mountain Road	Bicycle Boulevard	Green Spring Drive	Fairway Drive	Washington City		WATP		Implement traffic calming, signage		0.54	$15,000	$9,000	7	1			Provides a calm connection on residential street between two major north-south streets in neighborhood. Enhanced crossing beacons likely required at Green Spring.
L129	South Frontage Road	Buffered Bike Lane	Main Street	1100 East	Washington City		WATP		TMP buildout		1.12	$16,000	$18,000	4	3	Yes		When improved per TMP.
L130	South Nichols Peak/Merrill Road Trail	Shared Use Path	Sandia Road	Washington Fields Road	Washington City	Washington County	ParksRec				1.32	$700,000	$924,000	15	1	Yes		
L131	Southern Parkway Connector Trail	Shared Use Path	Washington Dam Road	SR-7 EB On-Ramp	Washington City	Washington County/UDOT	ParksRec				0.23	$700,000	$159,000	7	1		Yes	
L132	Southern Parkway Trail	Shared Use Path	City Limit	City Limit	Washington City	Washington City/UDOT	ParksRec				3.65	$700,000	$2,558,000	7	1		Yes	
L133	Southern Parkway Trail	Shared Use Path	City Limit	City Limit	Washington City	Washington County/UDOT	ParksRec				2.81	$700,000	$1,969,000	7	1		Yes	
L139	St. George City Connector	Shared Use Path	City Limit	Future Trail 19	Washington City		ParksRec				0.32	$700,000	$222,000	4	3		Yes	
L141	St. George City Connector	Shared Use Path	Future Western Terminus	Northern Parkway Trail	Washington City	Washington County	ParksRec				0.28	$700,000	$193,000	6	2		Yes	
L142	Staheli Farms Trail	Shared Use Path	Canal Trail	Camino Real	Washington City		ParksRec		Coordinate with property owners to build trail		0.14	$700,000	$102,000	7	2		Yes	Provides connection between and access to Canal Trail and neighborhood streets.
L143	Stucki Farms Trail	Shared Use Path	3650 South	4485 South	Washington City		ParksRec				0.92	$700,000	$643,000	8	2	Yes		
L144	Stucki Farms Trail	Shared Use Path	Warner Valley Rd	City Limit	Washington City	St. George	ParksRec				1.87	$700,000	$1,312,000	9	3	Yes		
L145	Stucki Farms Trail	Shared Use Path	City Limit	Washington Fields Road (Future)	Washington City	St. George	ParksRec				2.23	$700,000	$1,560,000	4	3		Yes	
L146	Stucki Farms Trail	Shared Use Path	Stucki Farms Trail	Future Eastern Terminus	Washington City		ParksRec				0.07	$700,000	$48,000	4	3		Yes	
L147	Stucki Farms Trail	Shared Use Path	Future Western Terminus	Stucki Farms Trail	Washington City		ParksRec				0.03	$700,000	$19,000	3	3		Yes	
L148	Stucki Farms Trail	Shared Use Path	Future Western Terminus	Southern Parkway Trail	Washington City	UDOT	ParksRec	Undercrossing			0.38	$700,000	$267,000	3	3		Yes	
L149	Stucki Farms Trail	Shared Use Path	Future Western Terminus	Stucki Farms Trail	Washington City		ParksRec				0.37	$700,000	$261,000	3	3		Yes	
L150	Stucki Farms Trail	Shared Use Path	Stucki Farms Trail	Warner Valley Rd	Washington City	St. George	ParksRec				1.87	$700,000	$1,312,000	9	2	Yes		
L151	Telegraph Street	Buffered Bike Lane	Green Spring Drive	500 West	Washington City		WATP		Restripe roadway	Separated Bike Lane	0.34	$16,000	$6,000	15	1			Can be implemented now (5' bike lane 2' buffer). Upgrade to SBL when roadway is improved and some accesses consolidated.
L152	Telegraph Street	Shared Use Path	Highland Parkway	Coral Canyon Boulevard	Washington City		WATP		Build trail		0.57	$700,000	$401,000	5	3	Yes		Will connect two neighborhoods and form part of Telegraph east-west route.
L153	Telegraph Street	Shared Use Path	300 East	Sienna Hills Park Trail	Washington City		WATP		Coordinate with property owners to build trail		1.26	$700,000	$886,000	14	1		Yes	North side, replacing sidewalk in some locations. Signal may be needed at intersection of Telegraph and Washington Parkway.
L154	Telegraph Street	Separated Bike Lane	Washington Parkway	SR-9	Washington City	UDOT	WATP		TMP buildout		3.58	$500,000	$1,789,000	8	2	Yes		When improved per TMP. Signal may be needed at intersection of Telegraph and Washington Parkway.
L155	Telegraph Street	Shared Use Path	City Limit	Green Spring Drive	Washington City	St. George/UDOT	WATP		Coordinate with property owners to build trail	Separated Bike Lane	0.20	$700,000	$141,000	13	1		Yes	Connects to proposed north side path in St. George ATP. Second, south side path in Washington is optional. Intersection should be designed in order to connect bi-directional bike lanes to path on one side.
L156	Telegraph Street	Bike Lane	300 East	Washington Parkway	Washington City		WATP		Narrow lanes and stripe bike lanes	Separated Bike Lane	1.08	$12,000	$14,000	11	1			Narrow lanes to add bike lanes to shoulders. Signal may be needed at intersection of Telegraph and Washington Parkway.
L157	Telegraph Trail	Shared Use Path	East of Fourteen Fairward Drive	West of Razor Ridge Drive	Washington City		MPOReg		Build trail		0.90	$700,000	$632,000	7	2	Yes		Construct shared use path as part of longer trail along Telegraph St. to SR 9.

Proj #	Name	Facility Type	North or West Limit	South or East Limit	Jurisdiction	Agency Partners	Plan Origin	Feasibility Study	Action	Long Term	Miles	Per Mile Cost	Total Cost	Prioritization Score	Phase	TMP Build	Parks Build	Notes
L158	Telegraph Trail	Shared Use Path	Telegraph Substation	Highland Park Loop Trail	Washington City		ParksRec				0.82	$700,000	$578,000	7	2		Yes	Part of larger Telegraph Street Trail running east-west.
L159	Telegraph Trail	Shared Use Path	Razor Edge Park Trail	SR-9	Washington City	Hurricane/UDOT	MPOReg				0.30	$700,000	$207,000	8	2	Yes		Construct shared use path along Telegraph St. to SR 9.
L160	Three Rivers Trail System East	Shared Use Path	Canal Trail	City Limit	Washington City	Washington County/Hurricane	MPOReg	Floodplain			0.48	$700,000	$338,000	4	3		Yes	Construct a shared use path along portions of Hwy 9 and the Virgin River.
L161	Three Rivers Trail System West	Shared Use Path	Virgin River Trail	Canal Trail	Washington City		ParksRec	Floodplain			0.36	$700,000	$251,000	9	1		Yes	Build possibly once Canal Trail is being built.
L162	Treasure Valley Road	Bike Lane	20 East	Wild Horse Ridge Road	Washington City		WATP		TMP buildout		1.77	$12,000	$22,000	6	2	Yes		When improved per TMP.
L164	Virgin Ridge South	Unpaved Trail	City Limit	Virgin River	Washington City	Washington County/Hurricane	MPOReg				1.83	$15,000	$28,000	1	3		Yes	
L165	Virgin River South Trail	Shared Use Path	Pine View Park Trail	Washington Fields Rd	Washington City	St. George	ParksRec	Floodplain	Study floodplain		1.75	$700,000	$1,222,000	10	2		Yes	
L167	Virgin River Trail	Shared Use Path	Virgin River Trail (Existing)	Canal Trail	Washington City		ParksRec	Floodplain			1.90	$700,000	$1,328,000	10	1		Yes	10yr from original source. Likely to be constructed as part of development and/or as far east as the fairgrounds.
L169	Virgin River Trail	Shared Use Path	Waterfront Drive	Industrial Park	Washington City	St. George	MPOReg				0.32	$700,000	$227,000	10	2		Yes	Construct a shared use path along the Virgin River.
L170	Virgin River Trail River Connector	Shared Use Path	Virgin River North Trail	Virgin River South Trail	Washington City		WATP	Overcrossing	Study possibility of overcrossing		0.07	$700,000	$52,000	3	3		Yes	Bridge the river in order to connect two sides of trail. North of Mariposa Dr.
L171	Virgin River Trail River Connector	Shared Use Path	Virgin River North Trail	Virgin River South Trail	Washington City		WATP	Overcrossing	Study possibility of overcrossing		0.07	$700,000	$51,000	5	3		Yes	Bridge the river in order to connect two sides of trail. North of 1775 East.
L172	Virgin River Trail River Connector	Shared Use Path	Industrial Drive	Virgin River Trail South Proposed	Washington City		WATP	Overcrossing	Study possibility of overcrossing		0.30	$700,000	$210,000	7	3		Yes	Bridge the river in order to connect two sides of trail. South of 100 East.
L173	Virgin River Trail/Country Way	Shared Use Path	North of Bridge	500' South of Bridge	Washington City		ParksRec		Widen sidewalk, use SUP joints and ramps		0.15	$700,000	$109,000	7	1		Yes	Existing wide sidewalk should be widened further and designed for bike and peds.
L174	Warm Springs Park Trail	Shared Use Path	Buena Vista Boulevard	Warm Springs Trail	Washington City		ParksRec				0.14	$700,000	$96,000	5	2		Yes	10yr from original source. Hybrid beacon crossing should be implemented to connect path to the south and neighborhood to the north of Buena Vista Blvd.
L175	Warm Springs Trail	Shared Use Path	Millcreek Trail	Main Street	Washington City		MPOReg		Build trail		0.52	$700,000	$366,000	12	1		Yes	Construct a shared use path from Washington's Main Street to the proposed Mill Creek Trail adjacent to I-15. 10yr from original source.
L176	Warner Valley Road	Separated Bike Lane	Washington Fields Road	City Limit	Washington City	Washington County	WATP		TMP buildout		0.77	$500,000	$387,000	4	3	Yes		When improved per TMP.
L177	Washington Dam Road	Bike Lane	Washington Fields Road	1900 East	Washington City		WATP		Stripe bike lanes when 5 lane is implemented	Separated Bike Lane	1.44	$12,000	$18,000	7	1			Can be restriped with 11' lanes and 5-6' bike lanes when 5-lane cross section is implemented or right now with slight lane narrowing. Upgrade to SBL when roadway is built out. Signal may be needed at intersection with Camino Real.
L178	Washington Dam Road	Separated Bike Lane	1900 East	City Limit	Washington City		WATP		TMP buildout		2.08	$500,000	$1,040,000	7	1	Yes		When roadway is improved per TMP.
L179	Washington Fields Road	Buffered Bike Lane	3650 South	Warner Valley Rd	Washington City		WATP		TMP buildout	Separated Bike Lane	3.63	$16,000	$59,000	5	2	Yes		When improved per TMP. SBL if possible when built out. Signal may be needed at intersection with 3090 South.
L180	Washington Fields Road	Bike Lane	2000 South	Merrill Road	Washington City		WATP		Stripe bike lanes	Separated Bike Lane	0.80	$12,000	$10,000	11	1			Stripe bike lanes now, SBL in future TMP build out/widening.
L181	Washington Fields Road	Buffered Bike Lane	Merrill Road	3650 South	Washington City		WATP		TMP buildout	Separated Bike Lane	3.63	$16,000	$59,000	8	1	Yes		When improved per TMP. SBL if possible when built out. Signal may be needed at intersection with 3090 South.
L182	Washington Fields Road	Buffered Bike Lane	Warner Valley Rd	City Limit	Washington City		WATP		TMP buildout	Separated Bike Lane	3.63	$16,000	$59,000	5	3	Yes		When improved per TMP. SBL if possible when built out. Signal may be needed at intersection with 3090 South.

Proj #	Name	Facility Type	North or West Limit	South or East Limit	Jurisdiction	Agency Partners	Plan Origin	Feasibility Study	Action	Long Term	Miles	Per Mile Cost	Total Cost	Prioritization Score	Phase	TMP Build	Parks Build	Notes
L183	Washington Fields Road/300 East	Bike Lane	Telegraph Street	2000 South	Washington City		MPOReg		Restripe roadway	Separated Bike Lane	1.94	$12,000	$24,000	11	1			Requires 10' travel lanes to accommodate bike lanes on existing sections. Upgrade to SBL when roadway is built out.
L184	Washington Parkway	Bike Lane	I-15 Off-Ramp	Telegraph Street	Washington City	UDOT	WATP		Stripe	Separated Bike Lane	1.20	$12,000	$15,000	7	1			Stripe bike lanes in wide shoulders. May require some focused widening near roundabout, ditches constraining ROW. Signal may be needed at intersection of Telegraph and Washington Parkway. Create bike-ped focused on- and off-ramps on all sides.
L185	Washington Parkway (Future)	Separated Bike Lane	City Limit	I-15 Off-Ramp	Washington City		WATP		TMP buildout		2.97	$500,000	$1,486,000	9	1	Yes		When improved per TMP.
L186	Washington Parkway Trail	Shared Use Path	North of North SITLA Block Trail	City Park	Washington City	UDOT	ParksRec	I-15 Undercrossings	Build trail; improve I-15 undercrossings		0.59	$700,000	$412,000	12	2		Yes	Replaces existing natural surface trail. Provides connection to recreation north of I-15.
L187	Washington Parkway Trail	Shared Use Path	Sandy Talus Drive	Telegraph Street	Washington City		WATP		Build trail		0.25	$700,000	$176,000	10	1		Yes	Links existing trail on the north to Telegraph on the south. Signal may be needed at intersection of Telegraph and Washington Parkway.
L188	Washington Parkway Trail/Sandy Talus Drive	Shared Use Path	Washington Parkway	Sienna Hills Park Trail	Washington City		ParksRec		Build trail		0.21	$700,000	$149,000	7	2		Yes	Connection between two trails, to be installed when they are implemented or when development occurs.
L189	Washington Sports Complex Trail	Shared Use Path	Stucki Farms Trail	Southern Parkway Trail	Washington City	UDOT	ParksRec				0.42	$700,000	$295,000	3	3		Yes	
L190	Washington Sports Complex Trail	Shared Use Path	Stucki Farms Trail	Washington Fields Road (East of SR-7)	Washington City	St. George	ParksRec	Undercrossing			0.56	$700,000	$394,000	4	3		Yes	
L192	West Virgin River Link South	Unpaved Trail	City Limit	Virgin River	Washington City	Washington County/Hurricane	MPOReg				1.57	$15,000	$24,000	1	3		Yes	
L193	Willow Springs Drive	Bicycle Boulevard	Prospector Lane	Canyon Crest Avenue	Washington City		WATP		Implement traffic calming, signalization		0.16	$15,000	$3,000	9	1			May just include shared lane markings and some traffic calming, especially at intersections.

Relevant St. George Projects

L9	1140 South	Buffered Bike Lane	Existing Western Terminus	City Limit	St. George	Washington City	WATP				0.37	$16,000	$6,000	3	3			
L25	3210 East	Bike Lane	City Limit	City Limit	St. George	Washington City	WATP		TMP buildout		0.63	$12,000	$8,000	1	3	Link		When improved per TMP.
L27	3650 South	Bike Lane	3000 East	City Limit	St. George	Washington City	MPOReg				0.23	$12,000	$3,000	4	1			
L29	3650 South	Separated Bike Lane	3000 East	City Limit	St. George	Washington City	WATP		TMP buildout		0.25	$500,000	$126,000	7	1	Link		When improved per TMP. Modified from MPO Plan.
L36	850 North	Bike Lane	2450 East	City Limit	St. George	Washington City	MPOReg				0.84	$12,000	$11,000	8	1			11' Travel lanes | 5' bike lanes | 8' parking
L64	Future Trail 82	Shared Use Path	City Limit	Banded Hill Drive	St. George	Washington City	MPOReg				1.89	$700,000	$1,325,000	4	3		Link	Develop shared use path in conjunction with future development.
L87	Industrial Drive	Bike Lane	Deseret Drive	City Limit	St. George	Washington City	MPOReg				0.07	$12,000	$1,000	3	2			Narrow center turn lane, restrict parking both sides. St. George recommendation to the west should be updated to match buffered bike lanes in Washington, too.
L96	Mall Drive/2500 South	Bike Lane	Riverside Drive	City Limit	St. George	Washington City	MPOReg		Narrow lanes, widen road		0.92	$12,000	$11,000	8	1			Narrow lanes/widen shoulders as needed to accomodate bike lanes. Implement bike lanes on unimproved or unbuilt segments as development/roadway construction occurs.
L113	Red Hills Parkway	Bike Lane	1000 East	City Limit	St. George	Washington City	MPOReg				2.26	$12,000	$28,000	14	1			Narrow lanes as needed to accommodate bike lanes
L122	Sandia Road/2000 South	Bike Lane	Merrill Road	1450 South	St. George	Washington City	MPOReg				0.82	$12,000	$10,000	3	2			Stripe bike lanes in wide shoulders. Implement bike lanes on unimproved roadway segments as development/roadway widening occurs.
L134	St. George City Connector	Shared Use Path	St. George City Connector	City Limit	St. George	Washington City	ParksRec				0.40	$700,000	$278,000	8	2		Link	

Proj #	Name	Facility Type	North or West Limit	South or East Limit	Jurisdiction	Agency Partners	Plan Origin	Feasibility Study	Action	Long Term	Miles	Per Mile Cost	Total Cost	Prioritization Score	Phase	TMP Build	Parks Build	Notes
L135	St. George City Connector	Shared Use Path	Mall Drive	City Limit	St. George	Washington City	ParksRec				0.14	$700,000	$96,000	4	3		Link	
L136	St. George City Connector	Shared Use Path	Future Trail 101 (St. George)	City Limit	St. George	Washington City	ParksRec				0.68	$700,000	$473,000	6	2		Link	
L137	St. George City Connector	Shared Use Path	Future Trail 82 (St. George)	City Limit	St. George	Washington City	ParksRec				0.60	$700,000	$421,000	4	3		Link	
L138	St. George City Connector	Shared Use Path	City Limit	Future Trail 101 (St. George)	St. George	Washington City	ParksRec				0.43	$700,000	$300,000	4	3		Link	
L140	St. George City Connector	Shared Use Path	3000 East	City Limit	St. George	Washington City	ParksRec				0.22	$700,000	$157,000	4	3		Link	
L166	Virgin River Trail	Shared Use Path	Waterfront Drive	Industrial Park	St. George	Washington City	MPOReg				0.41	$700,000	$284,000	10	2		Link	Construct a shared use path along the Virgin River.
L168	Virgin River Trail	Shared Use Path	Waterfront Drive	Industrial Park	St. George	Washington City	MPOReg				0.09	$700,000	$65,000	10	2		Link	Construct a shared use path along the Virgin River.

Relevant Washington County Projects

L112	Purgatory Road	Bike Lane	City Limit	Continues NE-ward	Washington County	Washington City/Hurricane					0.22	$12,000	$3,000	1	3	Link		Rough alignment of preferred alternative of new Purgatory Road, as of April 2017
L163	Virgin Ridge North	Unpaved Trail	SR-9	City Limit	Washington County	Washington City/Hurricane	MPOReg				2.29	$15,000	$35,000	1	3		Link	
L191	West Virgin River Link North	Unpaved Trail	SR-9	City Limit	Washington County	Washington City/Hurricane	MPOReg				2.52	$15,000	$38,000	1	3		Link	

Table F.2. Spot Recommended Project Information

Proj #	Name	Facility Type	Address	Jurisdiction	Agency Partners	Plan Origin	Feasibility Study	Action	Unit Cost	Total Cost	Prioritization Score	Phase	TMP Build	Parks Build	Notes
S1	300 East RRFB	RRFB	300 East & 300 North	Washington City	WCSD	WATP		Can implement now	$22,000	$22,000	16	1	0	0	Improves visibility of school crossing. Implement continental crosswalks along with this project.
S2	Arabian Way Curb Extensions	Curb Extensions & School Crosswalks	Arabian Way & Stable Way	Washington City	WCSD	WATP		Can implement now	$7,500	$60,000	7	1	0	0	Will improve this intersection so near to Horizon Elementary School.
S3	Coral Canyon Elementary RRFB	RRFB	Canyon Crest Avenue & Willow Springs Drive	Washington City	WCSD	WATP		Can implement now or with bike boulevard	$22,000	$22,000	11	1	0	0	Provides a safer, marked, and beaconed crossing from the homes west of the school directly to the main pedestrian entrance. May be implemented as part of traffic calming and bicycle boulevard.
S4	Curb Extensions for Riverside School Crossing	Curb Extensions & School Crosswalks	Harvest Lane & 2500 South	Washington City	WCSD	WATP		Implement and replace parking with curb extensions	$7,500	$45,000	11	1	0	0	School (continental) crossings. 6 curb extensions on each possible corner.
S5	Fairway Drive RRFB	RRFB	Fairway Drive & Existing Cart Path	Washington City		WATP		Can implement now	$22,000	$22,000	9	1	0	0	Will improve visibility of crossing carts on a curve with low visibility.
S6	I-15 Grapevine Trail Undercrossing	Grade Separated Crossing	I-15 & Grapevine Trail	Washington City	UDOT	WATP	Undercrossing	Construct undercrossing	$2,000,000	$2,000,000	9	3	0	1	Construct a trail undercrossing below I-15 for the proposed improvement of Grapevine Trail.
S7	I-15 Millcreek Trail Undercrossing	Grade Separated Crossing	I-15 & Millcreek Trail	Washington City		MPOReg	Undercrossing	Construct undercrossing	$2,000,000	$2,000,000	9	1	0	1	Construct a trail undercrossing below I-15 for the proposed Millcreek Trail.
S8	Siena Hills Park Trail Undercrossing	Grade Separated Crossing	Siena Hills Park Trail & Telegraph St	Washington City		MPOReg	Undercrossing	Construct undercrossing	$850,000	$850,000	5	2	0	1	Connects two proposed trails and one existing under Telegraph.
S9	Virgin River Trail Overcrossing	Grade Separated Crossing	Virgin River & ~East of Alveo Drive	Washington City		WATP	Floodplain	Construct overcrossing	$600,000	$600,000	7	3	0	1	Will connect both sides of Virgin River Trail and improve north-south connectivity, especially for neighborhoods to the south of river.
S10	Virgin River Trail Overcrossing	Grade Separated Crossing	Virgin River & ~Cottonwood Wash	Washington City		WATP	Floodplain	Construct overcrossing	$600,000	$600,000	5	3	0	1	Will connect both sides of Virgin River Trail and improve north-south connectivity, especially as this connects into the to-be-completed Hell Hole and Cottonwood Wash Trail up to Telegraph Street.
S11	Virgin River Trail Overcrossing	Grade Separated Crossing	Virgin River & Canal Trail	Washington City		WATP	Floodplain	Construct overcrossing	$600,000	$600,000	5	1	0	1	Will connect both sides of Virgin River Trail and connect future Canal Trail into wider system.
S12	Virgin River Trail Overcrossing	Grade Separated Crossing	Virgin River & 300 East	Washington City		WATP	Floodplain	Construct overcrossing	$600,000	$600,000	11	2	0	1	Bridges both sides of Virgin River Trail at river level without requiring users to go to up roadway level.
S13	Virgin River Trail Overcrossing	Grade Separated Crossing	Virgin River & ~100 East	Washington City		WATP	Floodplain	Construct overcrossing	$600,000	$600,000	5	3	0	1	Connects both sides of Virgin River Trail and neighborhoods to north and south. Alternative to Washington Fields.
S14	Washington Parkway Trail I-15 Undercrossing	Grade Separated Crossing	Washington Parkway Trail & I-15	Washington City	UDOT	WATP	Undercrossing	Improve existing undercrossing	$1,500,000	$1,500,000	7	2	0	1	Undercrossing exists, but should be improved (widened and heightened, if necessary) when trail is built.