CITY OF APPLETON

Appendices

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PUBLIC INVOLVEMENT SUPPLEMENTAL COMMENTS

March 2016: City of Appleton Comprehensive Plan Issues and Opportunities Workshops

ACTIVITY 1: A FULL LIST OF COMMENTS RELATING TO TRAILS

- Lighted safe trails
- Complete connectivity of trails and bike lanes
- Downtown bridges to the river with lovely views and trails
- More creative use of large Riverview Gardens land, designated trails...
- Need to plow our paved trails all year
- Trails that are connected using roads with high traffic
- Promote riverfront...as a neat nature area for trails (comment shortened)
- River trails
- Trails, stairs, docks, access to river at key waterfront locations
- Parks and trails with public access along the river, connecting to downtown and the neighborhoods
- More connecting trails to parks
- Pedestrian bridge over the Fox River to connect trails
- More walking/biking trails that are family friendly
- Singletrack, ski, bike, hiking trails

ACTIVITY 2: A FULL LIST OF COMMENTS RELATING TO TRAILS

- Trails, stairs, docks; river view gardens; great property with water front location; feels under utilized
- Parks and trails with public access along river (which connects to downtown and neighborhoods)
- Trail connection from old formost property along river past Peabody, Riverside Cemetery to Wisconsin Ave.
- Mountain biking trail Pierce Park
- More walking/biking trails that are family friendly where (kids) can bike safely on (not on roads) and bathrooms
- Single track, ski, bike, hike trails
- Creative mountain biking trail
- Connect Wisconsin Ave. and College Ave. with quiet, walkable and bikable trail/path

May 2016 City of Appleton Comprehensive Plan Downtown and Trails Design Workshop

ACCESS AND CONNECTIVITY TO THE RIVER

- Connect riverfront trails, better signage and connections (3)
- Love idea for boardwalks (3)
- Love the concept for Jones Park, additional ramp access and bikes (2)
- Like the concepts and ability to link Oneida Street to the river (2)
- Walking bridge connecting East John St to other side of river.
- There is no bike access to river between State and Drew.

WALKABILITY

- Lots of good ideas (3)
- Keep in mind most people will only walk ½ the time in this climate.
- Slow traffic and/or provide barrier to walkers and bicyclists on Oneida Street bridge.
- Love walkability ideas and bike lanes.
- Need to emphasize trails for both pedestrians and bikers.
- Is essential to future growth and accessibility.

STREETSCAPE

- Build bike infrastructure and bikes will come. Seeing big increases in biking every year as trail network expands.
- More plants, sidewalk cafes, bicycle parking.

City of Appleton Comprehensive Plan Survey

As part of the City's Comprehensive Plan Update, an on-line survey was launched over the period May 4th to June 6th. A total of 1,098 participants responded to the survey, including 940 completed surveys and 158 partially completed surveys. Trails related comments from the survey are summarized below:

NEIGHBORHOOD PERCEPTION

- 87.8% of respondents agreed or strongly agreed with the statement "My neighborhood is walkable"
- 69.9% of respondents agreed or strongly agreed with the statement "My neighborhood is bike friendly"

NEIGHBORHOOD – OPEN ENDED COMMENTS

The survey included several open-ended comments including "In your own words please share any additional comments related to your neighborhood." Of the 179 responses the second most frequent response had to do with bike and pedestrian improvements (44 comments). Key themes and specific comments included:

- 2 bike lanes on East Fremont deny on street parking on this street, served by city buses, as a major ambulance route to St. E's ,as a major fire truck, as a fast track east from Lawe st. Many still use sidewalks to bike..much safer.
- A stop sign on Alton Street that slowed traffic going up or down that road would make the street safer for bikes and for the growing (once again) number of young children who live there. There is a stop sign on Rankin but as there is virtually no traffic on Rankin that sign is meaningless.
- Area parks are nice. It would be nice to see less traffic. W Glendale Ave is a fairly busy street the closer you get to Mason St. I think this prevents a close knit community.
- Broadway Drive is not safe. Vehicles travel too fast and most don't slow down for pedestrians. People use this road asa short cut and drive wayyyy too fast.
- Busy street but quite neighborhood
- Drivers on the busy road don't seem to understand rules for bike riding and how the bike lanes operate. Sometimes it can be scary taking small kids biking in a trailer for this reason.
- Even with bike lanes would not feel safe riding in my neighborhood because of the high traffic volume.
- Motorcycle traffic and loud motorcycles that the police do not enforce. Pit bulls , people walking in the middle of the street cursing. Drug deals on the corners.
- My neighborhood is on a busy four lane highway. The other side of our block is a quiet residential area. We have a lot of walker's, runners, bicycles and vehicle traffic on a well maintained boulevard. Nice area.
- Road is very busy. Cars go too fast down the street.
- The city services like trash and leaf collection have always been timely and good. Midway Road traffic is increasing and may need addressing as far as safety and lighting.
- There are busy streets and no suitable places to walk to even reach a "walkable" trail. I was spoiled after living in Minneapolis for a decade where bike lanes and beautiful trails are everywhere. It would be wonderful to have a similar environment here in Appleton.
- Vehicles drive by too fast. Heavy foot traffic and bike traffic by Erb park
- We need physical barriers between motorized traffic and bicyclists and pedestrians. Texting and hurried, intolerant drivers make cycling seem so much more risky than it once did. The Dutch offer a safer approach to cycling friendly infrastructure. I live near the CE trail, but getting there feels risky.
- Bike paths for busy streets would make getting to the park easier. Prospect Ave is too busy to ride bikes with my kids, but the park is over 1 mile away.
- I have easy walkable access to the west side of downtown; however, I would love to have bike access to the

shops and establishments on the east part of College Ave

- I live in the McCarthy Creek apartment complex. It is as if we are on an island because there are no sidewalks, bike lanes, or pedestrian friendly roadways which allow for safe and easy access out of the triangle formed by Wisconsin Ave, Greenville Drive, and Mayflower Drive. I would love to be able to walk/bike to work (on Communication Dr < 1.5mi away), to the mall (also < 1.5mi away), and to the inside of the 41/441 circle.
- I walk/bike frequently, although I do not feel particularly safe doing these activities on South Oneida (the bridge updates have helped, however).
- I wish there were more sidewalks on Oneida, I live by 441, and anytime I want to walk anywhere on Oneida, I have to go on the grass, and the drivers don't pay attention to people crossing the street.
- I would like to have sidewalks in the Seminole Drive neighborhood.
- I would like to see the river public access point be more user friendly. Just a simple stepped or switchback path would make a world of difference
- I would like the city to have a campaign to educate citizens about riding bikes like vehicles rather than pedestrians and educate people about walking safely by facing traffic where there are not sidewalks.
- I would love to see a walking/biking path/trail and a playground close to my house. It would be nice to have somewhere safe to let my kids play and ride bikes. Our closest playground is Lions Park, and I'd love to have one closer!
- would really like there to be more safe biking options available.
- I wouldn't say it's bike unfriendly, but there are no designated biking lanes. There are no signs to yield for bikers, and in general biking is not well tolerated.
- I'd love a better bike/walking lane on North Ballard (north of JJ). It could bring more people to Plamann Park. I also hope that as the area around JJ and North High is developed, leaders consider beauty and walking and don't just create another Darboy/east Calumet.
- I've lived in many other states and Wisconsin has been the first one where we don't have a sidewalk for my kids to bike on or walk on
- Impossible to walk to run basic errands. There is no grocery store, pharmacy, etc. within walking distance from my house. Problem is, if I were to move closer to any of these services I wouldn't be able to walk downtown, which is 90% of the reason I choose to live where I do. Walkability is the future, and Appleton needs to provide those essential daily services.
- It would be great to have more ways to bike and/or walk safely within and between communities.
- Keep making the city more bike friendly green bay is a great example
- Lack of sidewalks, would like to have a more dog-friendly community (ex. dogs in parks, off-leash dog parks)
- Live close to downtown and Lawrence. Walkable to the post office and library and the farmers market. Wish there was a grocery store close.
- Need a sidewalk on French Road and intersection lights or another round about.

- Need more bikes intersecting the ones that currently exist!
- Neighborhood sidewalks not so great. Bus lines need to operate more frequently for people that need it (1 trip per hour is way too long)
- No sidewalks in our neighboorhood by Janet Berry Elementary.
- No sidewalks, so not very walkable.
- Our neighborhood is easily accessible for bikes, however there is not any street parking because both sides are bike lanes without parking space. Having elderly grandparents and family over means they have to walk a block or two because of restricted driveway space.
- Our neighborhood would be much safer for walking, biking, and children if we had sidewalks.
- Our street is very narrow, especially in winter with plowing, which also makes it unsafe for biking.
- Sidewalks would make our neighborhood so much safer for our kids. Especially to give them a safe route to our neighborhood park. Also it would be great to see a roundabout go in at Kennsington and Newberry.
- The Fox Valley is still very non-bike friendly outside of the CE trail.
- There are no sidewalks in our neighborhood so when walking with young children it is very hard. This is the same for bikes.
- There are no sidewalks on many of our neighborhood streets. Shoulders are gravel and traffic is too fast to feel real safe while walking and biking.
- Too many bike riders on the sidewalks in the Downtown....an accident if waiting to happen! Please at least consider signage on the pavement corners saying it is illegal and what the fine is!
- Very accessible to school, playgrounds, AMC hospital, Fire Dept. Overall good service - garbage pick-up , mail etc.
- We have always loved the easy access to the elementary school, the Y, the library, small businesses, the parks, entertainment. As someone about to retire, and thinking about aging, the walkability is critical.
- We have no sidewalks, you have to walk on the street when you do walk somewhere. I don't think my neighbors are very welcoming to anyone that looks different from the majority in this area. I don't really care about this b/c my purpose to live there is for my kids to have access to better schools.
- We live in a neighborhood without sidewalks. I think sidewalks would add to walkability and to an increased friendliness among neighbors.
- We live on N. Gillett Street and there are no sidewalks and the road is not big enough to walk or bike safely on the side of the road as people rarely move over if they are able and do not go 25 mph.
- We need more bike lanes please! A lot of us commute to work using bicycles.
- We're very near walking /biking trail, but because we have no date way to walk to it, we have to drive 1/2 mile to get to it too walk. It would be nice to connect or neighborhood to the others nearby
- While my neighborhood is safe and bike friendly, I don't consider it walkable because there are no

destinations in walking distance. It may be fine to take a stroll in the neighborhood for exercise, but I'd rather live in a neighborhood where I can walk to stores, shops, etc.

- Would like bike paths especially around popular destinations on college avenue
- Would like biking paths around the south side. I feel riding my bike on the street isn't safe.
- You can walk around in my neighborhood, but there isn't really anywhere to go. Would be nice if there were local spots to walk to where people hang out.
- West college ave. is completely unwalkable/bikeable. I would like to see bike lane/path that links from the CB trail by the airport, all the way down college to the CE trail.

TRANSPORTATION PERCEPTIONS

- 51% of respondents agreed or strongly agreed with the statement "More on-street bicycling lanes are needed"
- 76% of respondents agreed or strongly agreed with the statement "More off-street bicycling and pedestrian trails are needed"

TRANSPORTATION – OPEN ENDED COMMENTS

The survey included several open-ended comments to the statement "In your own words please share any additional comments related to your transportation needs." 338 comments were received including 30 trail specific related comments. The key themes included:

- Appleton has a nice selection of bicycle lanes and bike/pedestrian trails, and I would love to see this continue to grow.
- Appleton needs more biking lanes and scenic trails walking trails that are well marked and known.
- Better ways to get around via bike and/or walking trails would be amazing!
- Bike trails are decent but the major downfall is they are not connected
- Bike trails! We moved here from Eau Claire, WI and definitely miss the bike trails the most. We could get anywhere in EC on trails. It was very convenient and safer!
- I feel that public transportation is much easier to use with a bicycle but we lack secure bike storage near the bus station, and we have a long way to go to complete trail systems integrated with public transportation that would allow people to use them in combination safely.
- I like the concept of "complete streets" where all modes of transportation can safely transit. I love to walk on the trails along the river and wish there were more connections to get there.
- I wish that the recreational trails near my home (off French Road) were accessible by sidewalk on BOTH sides of the street.
- I would LOVE to see more dedicated bike paths and trails in Appleton. My family would definitely make frequent use of them.
- I would like to see the city continue to expand bicycle and pedestrian related or focused lanes, trails and paths

that everyone can enjoy. As a bike commuter, I very much appreciate having a “dedicated” space for riding to work or to shop. As a parent of an elementary aged child however, I wish we would be far more aggressive in installing pedestrian friendly crossings like we see on College Ave on the Lawrence campus. If grown adults can enjoy the luxury of bright flashing lights warning drivers that they are crossing the street, why are school zones only equipped with one small light to alert drivers to the presence of elementary aged children? Our son has to navigate Freemont and S. Oneida street to get to and from school and both streets are increasingly difficult to cross and dangerous. Rather than making the Freemont/Oneida intersection safer

- •I would love to see trails going around the whole fox city area I love walking and biking for fun and transportation what an awesome why to bring people together while they are out moving around town on bikes or foot
- It would be nice to get more biking and walking trails put in throughout the city.
- Keep expanding the off street bike trails! Please
- More bike trails!!

HOPES FOR THE FUTURE OF APPLETON

Respondents were asked to list their top 3 hopes for the future of Appleton. 69 trail related comments were made. Key themes included:

- More biking/walking trails
- Bike trails along the fox
- COMPLETE TRESTLE BRIDGE TRAILS
- Connect trail systems in North Appleton to rest of Fox Cities
- Connecting all sides of the city with trails
- Exercise trails throughout downtown area
- Improved Bike Trails
- More bike lanes
- More recreational trails
- More trails throughout city
- Mountain bike trails and jumps.
- Bike trail from north Appleton to downtown
- Create a riverwalk and bike trail system integrated throught the valley
- Feeling safe on trails
- Connected and expanding hiking/biking trails to neighboring citys
- Connecting parks along the river with trails.

- Continued trail connections and more access to them
- Emphasis walking trails along the river
- Maintaining parks and trails
- More fitness trails for walking, jogging, or biking.
- Trails/paths along the river (significant expansion of existing)
- Additional off street trails
- Clean up the walking trails on the Oneida St Trails-too much overgrowth prevents nice river ews. More walkable retail shops down by the river.
- I hope to see more trails integrated throughout the greenspaces.
- Improve quality of trails.
- Increase/coordination of recreation trails
- More connected trails along river
- More green space trails.
- More parks and trails on river
- Mountain bike trails
- Walking trail similar to high line in New York City make a fun trail thru flats in Appleton

NON-TAXABLE DEVELOPMENT

The survey asked respondents to list what types of non-taxable development they would like to see in Appleton. Over 400 responses referenced trails. Key themes included:

- More biking and walking trails
- Better trail connectivity
- More trails along the river
- Mountain biking trails needed

NEW ACTIVITIES, ATTRACTIONS, OR EVENTS

Participants were asked “what new activities, attractions, or events would you like to see downtown or along the river. 65 trails related comments were made. Key themes included:

- Trails along the river
- Better riverfront access including trails
- Dog friendly trails

PARK AMENITIES AND TRAILS

Participants were asked “what specific park amenities or trails do you feel are needed (and where) within the City. 215 trails related comments were made. Key themes included:

» More trails

» Better connected trails, both within the City and with surrounding communities

» Better accessibility

» Well marked trails

» Dog friendly trails

» Trails along the river

UPGRADE PROJECT TABLES

Upgrade Projects: Drainage*

Location	Cross Street 1	Cross Street 2	Length (Feet)	# of Issues	Cost per Unit	Sub-total Drainage
Newberry Trail	S Lawe Street	S Olde Oneida Street	1928	0	$8,500.00	$0.00
Newberry Trail	East of S Lawe Street	S Lawe Street	1083	0	$8,500.00	$0.00
Newberry Trail	West of E College Ave	East of S Lawe Street	1276	1	$8,500.00	$8,500.00
North Island Trail	S Lawe St	S Olde Oneida St	2005	4	$8,500.00	$34,000.00
Newberry Trail	E College Ave	West of E College Ave	890	0	$8,500.00	$0.00
Newberry Trail	West of E Newberry St	West of E Newberry St	949	0	$8,500.00	$0.00
Newberry Trail	E Newberry St	West of E Newberry St	1949	0	$8,500.00	$0.00
Newberry Trail	E Newberry St	South of E Newberry St	929	0	$8,500.00	$0.00
Newberry Trail	W of S Kensington Dr	N of E College Ave	2473	2	$8,500.00	$17,000.00
Newberry Trail	S Kensington Dr	W of S Kensington Dr	955	0	$8,500.00	$0.00
Newberry Trail	Highway 441	S Kensington Dr	1136	0	$8,500.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	268	0	$8,500.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	85	0	$8,500.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	245	0	$8,500.00	$0.00
Newberry Trail	West of S Railroad St	Highway 441	2043	0	$8,500.00	$0.00
Newberry Trail	S Railroad St	West of S Railroad St	2078	0	$8,500.00	$0.00
Newberry Trail	East of S Railroad St	S Railroad St	652	0	$8,500.00	$0.00
Apple Creek Trail	N Ballard Rd	N Meade St	6515	2	$8,500.00	$17,000.00
Apple Creek Trail	N Lightning Rd	N Ballard Rd	2412	2	$8,500.00	$17,000.00
Applecreek Trail	N French Rd	N Lightning Rd	4961	2	$8,500.00	$17,000.00
Highview Trail	N Meade St	West of N Meade St	2104	0	$8,500.00	$0.00
Highview Trail	N Meade St	West of N Meade St	1402	0	$8,500.00	$0.00
Applecreek Trail	Cherryvale Ave	N French Rd	3147	7	$8,500.00	$59,500.00
Apple Creek Trail	E Edgewood Dr	Cherryvale Ave	3698	3	$8,500.00	$25,500.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	907	0	$8,500.00	$0.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	463	0	$8,500.00	$0.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	471	0	$8,500.00	$0.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	743	1	$8,500.00	$8,500.00
				Drainage Subtotal		**$204,000.00**

** Drainage fixes assume installation of 16 LF of 12" culvert pipe with apron endwalls, 90 foot of trail removal and replacement. Cost estimated from project 4992-00-46 Contract Mod 4 for similar work.*

Upgrade Projects: Crackfill

Location	Cross Street 1	Cross Street 2	Length (Feet)	Number of Issues	Feet/ Issue	**Crackfill	Cost Per Unit	Sub-total Crackfill
Newberry Trail	S Lawe Street	S Olde Oneida Street	1928	1	1928	Yes	$50.00	$50.00
Newberry Trail	East of S Lawe Street	S Lawe Street	1083	7	155	Yes	$50.00	$350.00
Newberry Trail	West of E College Ave	East of S Lawe Street	1276	45	28	No	$50.00	$0.00
North Island Trail	S Lawe St	S Olde Oneida St	2005	79	25	No	$50.00	$0.00
Newberry Trail	E College Ave	West of E College Ave	890	19	47	No	$50.00	$0.00
Newberry Trail	West of E Newberry St	West of E Newberry St	949	25	38	No	$50.00	$0.00
Newberry Trail	E Newberry St	West of E Newberry St	1949	134	15	No	$50.00	$0.00
Newberry Trail	E Newberry St	South of E Newberry St	929	48	19	No	$50.00	$0.00
Newberry Trail	West of S Kensington Dr	N of E College Ave	2473	113	22	No	$50.00	$0.00
Newberry Trail	S Kensington Dr	West of S Kensington Dr	955	58	16	No	$50.00	$0.00
Newberry Trail	Highway 441	S Kensington Dr	1136	43	26	No	$50.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	268	0	NA	NA	$50.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	85	0	NA	NA	$50.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	245	0	NA	NA	$50.00	$0.00
Newberry Trail	West of S Railroad St	Highway 441	2043	0	NA	NA	$50.00	$0.00
Newberry Trail	S Railroad St	West of S Railroad St	2078	0	NA	NA	$50.00	$0.00
Newberry Trail	East of S Railroad St	S Railroad St	652	0	NA	NA	$50.00	$0.00
Apple Creek Trail	N Ballard Rd	N Meade St	6515	46	142	Yes	$50.00	$2,300.00
Apple Creek Trail	N Lightning Rd	N Ballard Rd	2412	39	62	No	$50.00	$0.00
Applecreek Trail	N French Rd	N Lightning Rd	4961	62	80	Yes	$50.00	$3,100.00
Highview Trail	N Meade St	West of N Meade St	2104	70	30	No	$50.00	$0.00
Highview Trail	N Meade St	West of N Meade St	1402	47	30	No	$50.00	$0.00
Applecreek Trail	Cherryvale Ave	N French Rd	3147	39	81	Yes	$50.00	$1,950.00
Apple Creek Trail	E Edgewood Dr	Cherryvale Ave	3698	29	128	Yes	$50.00	$1,450.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	907	16	57	No	$50.00	$0.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	463	0	NA	No	$50.00	$0.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	471	5	94	Yes	$50.00	$250.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	743	15	50	No	$50.00	$0.00
						Crackfil Subtotal		**$9,450.00**

*** Price estimate based upon web averages including labor https://howmuch.net/costs/sealing-asphalt-crack-repair. Assumes Crack is full trail width. Assumes Let as part of a larger project.*

Upgrade Projects: Pavement Replacement

Location	Cross Street 1	Cross Street 2	Length (Feet)	Pavement Replacement ***	Cost per Foot	Subtotal Pavement Replacement	Sub-Total Pavement Surface Repair Project
Newberry Trail	S Lawe Street	S Olde Oneida Street	1928	No	$25.00	$0.00	$50.00
Newberry Trail	East of S Lawe Street	S Lawe Street	1083	No	$25.00	$0.00	$350.00
Newberry Trail	West of E College Ave	East of S Lawe Street	1276	Yes	$25.00	$31,900.70	$31,900.70
North Island Trail	S Lawe St	S Olde Oneida St	2005	Yes	$25.00	$50,114.99	$50,114.99
Newberry Trail	E College Ave	West of E College Ave	890	Yes	$25.00	$22,241.34	$22,241.34
Newberry Trail	West of E Newberry St	West of E Newberry St	949	Yes	$25.00	$23,720.80	$23,720.80
Newberry Trail	E Newberry St	West of E Newberry St	1949	Yes	$25.00	$48,722.39	$48,722.39
Newberry Trail	E Newberry St	South of E Newberry St	929	Yes	$25.00	$23,221.57	$23,221.57
Newberry Trail	West of S Kensington Dr	N of E College Ave	2473	Yes	$25.00	$61,824.71	$61,824.71
Newberry Trail	S Kensington Dr	West of S Kensington Dr	955	Yes	$25.00	$23,876.16	$23,876.16
Newberry Trail	Highway 441	S Kensington Dr	1136	Yes	$25.00	$28,402.84	$28,402.84
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	268	NA	$25.00	$0.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	85	NA	$25.00	$0.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	245	NA	$25.00	$0.00	$0.00
Newberry Trail	West of S Railroad St	Highway 441	2043	NA	$25.00	$0.00	$0.00
Newberry Trail	S Railroad St	West of S Railroad St	2078	NA	$25.00	$0.00	$0.00
Newberry Trail	East of S Railroad St	S Railroad St	652	NA	$25.00	$0.00	$0.00
Apple Creek Trail	N Ballard Rd	N Meade St	6515	No	$25.00	$0.00	$2,300.00
Apple Creek Trail	N Lightning Rd	N Ballard Rd	2412	Yes	$25.00	$60,298.79	$60,298.79
Applecreek Trail	N French Rd	N Lightning Rd	4961	No	$25.00	$0.00	$3,100.00
Highview Trail	N Meade St	West of N Meade St	2104	Yes	$25.00	$52,607.81	$52,607.81
Highview Trail	N Meade St	West of N Meade St	1402	Yes	$25.00	$35,041.78	$35,041.78
Applecreek Trail	Cherryvale Ave	N French Rd	3147	No	$25.00	$0.00	$1,950.00
Apple Creek Trail	E Edgewood Dr	Cherryvale Ave	3698	No	$25.00	$0.00	$1,450.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	907	Yes	$25.00	$22,672.72	$22,672.72
Providence Trail	E Ashbury Dr	E of N Providence Ave	463	Yes	$25.00	$11,566.63	$11,566.63
Providence Trail	E Ashbury Dr	E of N Providence Ave	471	No	$25.00	$0.00	$250.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	743	Yes	$25.00	$18,572.66	$18,572.66
				Pavement Rep. Subtotal		**$514,785.88**	**$524,235.88**

******Assumes pavement removal, and replacement as part of a larger project, and 25% of the repair length requiring base replacement to typical section.***

Upgrade Projects: Crossings

Location	Cross Street 1	Cross Street 2	Length (Feet)	****Crossings	Cost per Unit4	Sub-total Crosswalks
Newberry Trail	S Lawe Street	S Olde Oneida Street	1928	0	$1,520.00	$0.00
Newberry Trail	East of S Lawe Street	S Lawe Street	1083	0	$1,520.00	$0.00
Newberry Trail	West of E College Ave	East of S Lawe Street	1276	2	$1,520.00	$3,040.00
North Island Trail	S Lawe St	S Olde Oneida St	2005	0	$1,520.00	$0.00
Newberry Trail	E College Ave	West of E College Ave	890	1	$1,520.00	$1,520.00
Newberry Trail	West of E Newberry St	West of E Newberry St	949	1	$1,520.00	$1,520.00
Newberry Trail	E Newberry St	West of E Newberry St	1949	4	$1,520.00	$6,080.00
Newberry Trail	E Newberry St	South of E Newberry St	929	0	$1,520.00	$0.00
Newberry Trail	West of S Kensington Dr	N of E College Ave	2473	0	$1,520.00	$0.00
Newberry Trail	S Kensington Dr	W of S Kensington Dr	955	0	$1,520.00	$0.00
Newberry Trail	Highway 441	S Kensington Dr	1136	0	$1,520.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	268	0	$1,520.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	85	0	$1,520.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	245	0	$1,520.00	$0.00
Newberry Trail	West of S Railroad St	Highway 441	2043	0	$1,520.00	$0.00
Newberry Trail	S Railroad St	W of S Railroad St	2078	0	$1,520.00	$0.00
Newberry Trail	East of S Railroad St	S Railroad St	652	0	$1,520.00	$0.00
Apple Creek Trail	N Ballard Rd	N Meade St	6515	1	$1,520.00	$1,520.00
Apple Creek Trail	N Lightning Rd	N Ballard Rd	2412	1	$1,520.00	$1,520.00
Applecreek Trail	N French Rd	N Lightning Rd	4961	5	$1,520.00	$7,600.00
Highview Trail	N Meade St	West of N Meade St	2104	3	$1,520.00	$4,560.00
Highview Trail	N Meade St	West of N Meade St	1402	1	$1,520.00	$1,520.00
Applecreek Trail	Cherryvale Ave	N French Rd	3147	0	$1,520.00	$0.00
Apple Creek Trail	E Edgewood Dr	Cherryvale Ave	3698	1	$1,520.00	$1,520.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	907	3	$1,520.00	$4,560.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	463	0	$1,520.00	$0.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	471	0	$1,520.00	$0.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	743	5	$1,520.00	$7,600.00
				Crosswalks Subtotal		**$42,560.00**

*****Assumes a crossing width of 40 feet and ladder style walk epoxy with 2 foot cross bars and 1.5' longitudinal bars.*

Upgrade Projects: Gate and Bollard Removal

Location	Cross Street 1	Cross Street 2	Length (Feet)	Bollards	*****Cost per Unit	Gates	*****Cost per Unit	Sub-total Gate and Bollard Removal
Newberry Trail	S Lawe Street	S Olde Oneida Street	1928	0	$375.00	1	$750.00	$750.00
Newberry Trail	East of S Lawe Street	S Lawe Street	1083	0	$375.00	1	$750.00	$750.00
Newberry Trail	West of E College Ave	East of S Lawe Street	1276	0	$375.00	0	$750.00	$0.00
North Island Trail	S Lawe St	S Olde Oneida St	2005	1	$375.00	0	$750.00	$375.00
Newberry Trail	E College Ave	West of E College Ave	890	0	$375.00	0	$750.00	$0.00
Newberry Trail	West of E Newberry St	West of E Newberry St	949	0	$375.00	0	$750.00	$0.00
Newberry Trail	E Newberry St	West of E Newberry St	1949	0	$375.00	0	$750.00	$0.00
Newberry Trail	E Newberry St	South of E Newberry St	929	0	$375.00	0	$750.00	$0.00
Newberry Trail	West of S Kensington Dr	N of E College Ave	2473	0	$375.00	0	$750.00	$0.00
Newberry Trail	S Kensington Dr	West of S Kensington Dr	955	0	$375.00	0	$750.00	$0.00
Newberry Trail	Highway 441	S Kensington Dr	1136	0	$375.00	0	$750.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	268	0	$375.00	0	$750.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	85	0	$375.00	0	$750.00	$0.00
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	245	0	$375.00	0	$750.00	$0.00
Newberry Trail	West of S Railroad St	Highway 441	2043	0	$375.00	0	$750.00	$0.00
Newberry Trail	S Railroad St	West of S Railroad St	2078	0	$375.00	0	$750.00	$0.00
Newberry Trail	East of S Railroad St	S Railroad St	652	0	$375.00	0	$750.00	$0.00
Apple Creek Trail	N Ballard Rd	N Meade St	6515	0	$375.00	1	$750.00	$750.00
Apple Creek Trail	N Lightning Rd	N Ballard Rd	2412	0	$375.00	0	$750.00	$0.00
Applecreek Trail	N French Rd	N Lightning Rd	4961	0	$375.00	1	$750.00	$750.00
Highview Trail	N Meade St	West of N Meade St	2104	0	$375.00	0	$750.00	$0.00
Highview Trail	N Meade St	West of N Meade St	1402	0	$375.00	0	$750.00	$0.00
Applecreek Trail	Cherryvale Ave	N French Rd	3147	0	$375.00	1	$750.00	$750.00
Apple Creek Trail	E Edgewood Dr	Cherryvale Ave	3698	0	$375.00	1	$750.00	$750.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	907	0	$375.00	0	$750.00	$0.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	463	0	$375.00	0	$750.00	$0.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	471	0	$375.00	0	$750.00	$0.00
Providence Trail	E Ashbury Dr	E of N Providence Ave	743	0	$375.00	0	$750.00	$0.00
					Gates and Bollard Subtotal			$4,875.00

*****Assumes gates are not significantly larger than bollards and both are in concrete bases. Two posts per gate.*

Upgrade Projects: Total Cost

Location	Cross Street 1	Cross Street 2	Length (Feet)	Total Project Cost	Total Project Cost (w Contingency)
Newberry Trail	S Lawe Street	S Olde Oneida Street	1928	$1,000	$1,200
Newberry Trail	East of S Lawe Street	S Lawe Street	1083	$1,000	$1,200
Newberry Trail	West of E College Ave	East of S Lawe Street	1276	$43,000	$51,600
North Island Trail	S Lawe St	S Olde Oneida St	2005	$84,000	$100,800
Newberry Trail	E College Ave	West of E College Ave	890	$24,000	$28,800
Newberry Trail	West of E Newberry St	West of E Newberry St	949	$25,000	$30,000
Newberry Trail	E Newberry St	West of E Newberry St	1949	$55,000	$66,000
Newberry Trail	E Newberry St	South of E Newberry St	929	$23,000	$27,600
Newberry Trail	West of S Kensington Dr	N of E College Ave	2473	$79,000	$94,800
Newberry Trail	S Kensington Dr	West of S Kensington Dr	955	$24,000	$28,800
Newberry Trail	Highway 441	S Kensington Dr	1136	$28,000	$33,600
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	268	$0	$0
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	85	$0	$0
Newberry Trail	Highway 441 Ramp	Highway 441 Ramp	245	$0	$0
Newberry Trail	West of S Railroad St	Highway 441	2043	$0	$0
Newberry Trail	S Railroad St	West of S Railroad St	2078	$0	$0
Newberry Trail	East of S Railroad St	S Railroad St	652	$0	$0
Apple Creek Trail	N Ballard Rd	N Meade St	6515	$22,000	$26,400
Apple Creek Trail	N Lightning Rd	N Ballard Rd	2412	$79,000	$94,800
Applecreek Trail	N French Rd	N Lightning Rd	4961	$28,000	$33,600
Highview Trail	N Meade St	West of N Meade St	2104	$57,000	$68,400
Highview Trail	N Meade St	West of N Meade St	1402	$37,000	$44,400
Applecreek Trail	Cherryvale Ave	N French Rd	3147	$62,000	$74,400
Apple Creek Trail	E Edgewood Dr	Cherryvale Ave	3698	$29,000	$34,800
Providence Trail	E Ashbury Dr	E of N Providence Ave	907	$27,000	$32,400
Providence Trail	E Ashbury Dr	E of N Providence Ave	463	$12,000	$14,400
Providence Trail	E Ashbury Dr	E of N Providence Ave	471	$0	$0
Providence Trail	E Ashbury Dr	E of N Providence Ave	743	$35,000	$42,000
			Total of all Projects	**$775,000**	**$930,000**

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FUNDING OPPORTUNITIES

FEDERAL				
INCENTIVE	**PROGRAM DESCRIPTION**	**AVAILABILITY**	**EFFECTIVENESS**	**RELEVANCE**
TIGER Discretionary Grants	$500 million to road, rail, transit, and port projects. Applicants must detail the benefits their project would deliver for five long-term outcomes: safety, economic competitiveness, state of good repair, quality of life, and environmental sustainability. USDOT also evaluates projects on innovation, partnerships, project readiness, benefit cost analysis, and cost share. TIGER can provide capital funding directly to any public entity. TIGER can fund projects that have a local match as low as 20 percent of the total project costs.	Highly competitive. Must demonstrate significant impact on the nation, a metropolitan area, or a region. Recognizes projects nationwide that will advance key transportation goals such as safety, innovation, and opportunity.	Since 2009, more than $210 million have gone to bicycle and pedestrian projects.	Pedestrian Projects
Transportation Alternatives Program (TAP) Funding	Combination of Safe Routes to School, Bicycle and Pedestrian, and Transportation Enhancement programs	Applications are accepted every other year, with the next round of applications being available in 2017 (likely late in year) for construction to begin in 2018/2019	Applications go through the Appleton MPO. Grants are 80% of project cost.	Trail development
Community Development Block Grant (CDBG)	Federal program which provides funds for the benefit of Low and Moderate Income Persons (LMI) and for blight elimination. Range of eligible activities include acquisition, demolition, public improvements, relocation, property rehab, housing, planning, microenterprise assistance and public service.	Appleton is a designated entitlement community. Application cycle is annual, with next deadline May 27, 2016.	Slightly more administratively burdensome but serves a different purpose and complements well with other incentives.	Infrastructure improvements, which could include trails
Surface Transportation Program (STP)	Funding to States and localities to preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel project on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals. 10% set aside can be used to build bicycle and pedestrian facilities. Applications go through the Appleton MPO.	Bi-annual, spring 2016 for 2018-2020 funding. Amount varies; 2016 has a $50 million fund. Bicycle, pedestrian, and trails		

FEDERAL				
INCENTIVE	**PROGRAM DESCRIPTION**	**AVAILABILITY**	**EFFECTIVENESS**	**RELEVANCE**
Congestion Mitigation and Air Quality Improvement Program (CMAQ)	Funding source to state and local governments for transportation projects and programs to help meet the requirements of the Clean Air Act. Funding is available to reduce congestion and improve air quality. 10% set aside can be used to build bicycle and pedestrian projects that emphasize air quality improvements. Applications go through the Appleton MPO.	Bi-annual, spring 2016 for 2018-2020 funding. Amount varies; 2016 has a $27 million fund. Bicycle and pedestrian facilities, trail bridges, and roadway intersections with trails		
Land & Water Conservation Fund (LWCF) from National Park Service	The LWCF program can be divided into the "State Side" which provides grants to State and local governments, and the "Federal Side" which is used to acquire lands, waters, and interests necessary to achieve the natural, cultural, wildlife, and recreation management objectives of federal land management agencies.	Annually, spring application for funding in following spring. $3 million biennially; $500,000 project cap.		ROW acquisition and construction
Land and Water Conservation Fund (LWCF) Outdoor Recreation Legacy Partnership Program from National Park Service	Identifies and highlights new ways of promoting opportunities for expanding outdoor play in areas with great need, as well as promoting the development of new or enhanced partnerships for outdoor recreation in urban communities across the nation. Targets projects that serve economically and/or recreationally-disadvantaged communities in areas with over 50,000 people.	Annually, spring application for funding in following spring. Up to $15 million biennially; $750,000 project cap		Acquisition and development of public outdoor recreation areas and facilities.
Federal Highway Safety Improvement Program (HSIP)	Program aims to achieve significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal lands. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance.	WiDOT is currently accepting completed HSIP applications. The application review process will begin after the February 15, 2017 deadline.		Engineering strategies to reduce fatal and serious injury crashes including wayfinding, pedestrian and bicycle safety infrastructure and improvements.

FEDERAL				
INCENTIVE	**PROGRAM DESCRIPTION**	**AVAILABILITY**	**EFFECTIVENESS**	**RELEVANCE**
Enhanced Mobility of Seniors and Individuals with Disabilities Program	Funds for capital and operating projects that improve the mobility of seniors and individuals with disabilities. Eligible applicants include private non-profits and local public bodies. Eligible projects include the purchase of Human Service Vehicles (see the procurement webpage for details), operating budgets, Mobility Managers, coordination and non-vehicle capital.	Funding determined by a formula based on the number of seniors and people with disabilities in each state		
Federal Lands Access Program	Funds to improve transportation facitilies that provide access to or within Federal lands, specifically high-use recreation sites and economic generators. Funding can apply to public roads, transit systems, and other facilities as a supplement to State and local resources.	Future funding dependent on Federal Transportation Funding authorization; anticipated in 2021.		
Recreational Trails Aids (RTA) Program	This is a federal program administered in all states. Municipal governments and incorporated organizations are eligible to receive reimbursement for development and maintenance of recreational trails and trail-related facilities for both motorized and non-motorized recreational trail uses. Eligible sponsors may be reimbursed for up to 50 percent of eligible project costs. Funds from this program may be used in conjunction with funds from Knowles-Nelson Stewardship development projects.	May 1st annually	Municipal governments and incorporated organizations whose primary purpose is trails or trail usage can apply for this funding.	Maintenance or restoration of existing trails; Development or rehabilitation of trailside/ trailhead facilities and trail linkages; Construction of new trails; Property acquisition for trails.

STATE				
INCENTIVE	**PROGRAM DESCRIPTION**	**AVAILABILITY**	**EFFECTIVENESS**	**RELEVANCE**
Community Development Investment Grant (CDIG)	State of WI program offered by WEDC for re/development providing financial incentives for shovel-ready projects for downtown community-driven efforts. Funds go to City.	Grants up to $250,000 are available and applications are accepted throughout the fiscal year, however WEDC staff estimates all funding for this fiscal year will be committed by December of 2016, making an early application mandatory should the City desire to access this funding source. Having a Development Agreement in place is needed for a competitive application.	Very effective depending on the project. Requires a community match so should be structured with project benefitting residents and employees downtown. Possibility for redevelopment of Soldiers Square or other public project.	Downtown redevelopment projects; including parks, trails as well as tax producing projects
Natural Resource Damage Assessment (NRDA) Program	Settlement funding from Fox River contamination lawsuits. Money can be used for environmental, recreation, and access activities in Lower Fox River	On-going grant cycle; currently approx. $42 million available. Current 5-yr plan to expend $3M/ year including up to $400K on “public use.” On-going application process.	Numerous communities along Lower Fox River have used the funding on a variety of projects	Trail development, pier. However, need to frame project as providing “fisheries access” vs. active transportation
Transportation Facilities Economic Assistance and Development Program (TEA)	WDOT funding for transportation related projects which support economic development	Year Round. Generally up to $5,000 per job created or retained for streets and stormwater improvements.	Funding is generally limited to projects supporting development of manufacturing and or distribution, however the Department has funded projects involving large scale medical center development. Should transportation improvements be needed, this program should be evaluated for use	Trail development if tied to positive economic development outcome

STATE				
INCENTIVE	**PROGRAM DESCRIPTION**	**AVAILABILITY**	**EFFECTIVENESS**	**RELEVANCE**
WDNR Recreational Boating Facilities Grant	These grants may be used by counties, towns, cities, villages, tribes, sanitary districts, public inland lake protection and rehabilitation districts and qualified lake associations for recreational boating facility project. Past projects have included ramps and service docks to gain access to the water, feasibility studies, purchase of aquatic weed harvesting equipment, navigation aids and dredging waterway channels.	A five-member Waterways Commission, appointed by the governor, reviews and recommends projects for funding. Deadlines are established quarterly.	Focus on boating facilities	Riverfront development; could fund portion of trail if used to provide access to water resource
WDNR Sports Fishing Restoration (SFR)	These grants may be used to construct fishing piers and motorboat access projects. Eligible components include boat ramp construction and renovation, along with related amenities such as parking lots, accessible paths, lighting and restroom facilities. Funding for this program comes from federal excise taxes on fishing equipment and a portion of the federal gas tax.	Grant application materials may be submitted at any time. For consideration in the federal fiscal year that begins each October, applications must be received by the regional Grants specialist no later than December 1 of the previous year.	Focus on fishing access	Riverfront development, accessible trails
WDNR Knowles-Nelson Stewardship Program	Aids for the Acquisition and Development of Local Parks (ADLP) is a regional allocation program which provides up to 50 percent matching grants to local and county units of government and nonprofit conservation organizations (NCOs) to provide assistance for the acquisition and development of local and county parks. NCOs can use these funds for the acquisition of land or easements only. County and local governments may use ADLP funds for the purchase of land and easements and the development of outdoor recreation areas for nature-based outdoor recreation purposes.	Application deadline - May 1 of each year; $4.0 million distributed annually statewide	Projects submitted for grants under the Stewardship Program must be included in a locally-adopted park plan.	Jones/Ellen Kort/YMCA Ramp Site; Trail development

STATE				
INCENTIVE	**PROGRAM DESCRIPTION**	**AVAILABILITY**	**EFFECTIVENESS**	**RELEVANCE**
WDNR Knowles-Nelson Stewardship Program	Urban Green Space (UGS) is a Statewide program which provides up to 50 percent matching grants to local and county units of government and NCOs to acquire or protect scenic, ecological, or other natural features within or near urban areas and provide land for nature-based outdoor recreation, including noncommercial gardening. These funds can be used for the acquisition of land only.	[Application deadline - May 1 of each year; $4.0 million distributed annually statewide]	Projects submitted for grants under the Stewardship Program must be included in a locally-adopted park plan.	Jones/Ellen Kort/YMCA Ramp Site
WDNR Knowles-Nelson Stewardship Program	Urban Rivers (URGP) is a Statewide program which provides up to 50 percent matching grants to local and county units of government and NCOs to purchase land or easements, or to develop shoreline enhancements on or adjacent to rivers that flow through urban or urbanizing areas. This program is intended to preserve or restore urban rivers or riverfronts for the purpose of revitalization and nature- based outdoor recreation activities. NCOs can use these funds for the acquisition of land or easements only.	[Application deadline - May 1 of each year; $1.6 million distributed annually statewide]	Projects submitted for grants under the Stewardship Program must be included in a locally-adopted park plan.	Jones/Ellen Kort Peace Park
WDNR Knowles-Nelson Stewardship Program	The Land and Water Conservation Fund (LAWCON) program was established by the U.S. Congress in 1964 to provide funding for the acquisition of land for park or open space preservation purposes and the development of outdoor recreation facilities. In Wisconsin, LAWCON funds are administered by the DNR. Up to 50 percent of project costs are eligible for funding under this program. A portion of this amount is available to local and county units of government for the acquisition of land and the development of parks and trails. The “nature-based” restriction in the Stewardship Program does not apply to LAWCON funds.	[Application deadline - May 1 of each year; $1.6 million to the State of Wisconsin allocated by Congress, 2005]	Projects submitted for grants under the Stewardship Program must be included in a locally-adopted park plan.	Jones/Ellen Kort Peace Park

CITY				
INCENTIVE	**PROGRAM DESCRIPTION**	**AVAILABILITY**	**EFFECTIVENESS**	**RELEVANCE**
Tax Increment Financing (TIF)	Property taxes generated in a defined area on new development is used by City to pay for investments in improvements or entice new improvements, and therefore increase tax base. Incentive goes to private sector project expected to generated incremental property tax revenue.	TIF should be used wherever possible, particularly if building on an underutilized site with low value. Where a district does not exist now, a new TIF district should be explored as an option. The possibility of transferring funds from a district with positive increment to a downtown TIF should be explored.	Extremely effective when development occurs and generates positive increment.	Downtown redevelopment projects

OTHER				
INCENTIVE	**PROGRAM DESCRIPTION**	**AVAILABILITY**	**EFFECTIVENESS**	**RELEVANCE**
American Greenways Kodak Awards Program	Provides small grants ($500-$2,500) to local greenways projects.	National competition – single digit number of awards annually. Applications due between March 1 and June 1 yearly.	Highly competitive and relatively low dollar awards.	
American Hiking Society – National Trails Fund	Privately supported, national grants program dedicated to building and protecting hiking trails.	Only open to American Hiking Society members (must be a 501(c)(3) or have a fiscal agent. Grants available up to $5,000. Deadline is typically February annually.	Relatively low dollar amount. Projects must be completed in one year – multi-year projects only considered in exceptional circumstances.	
People for Bikes Community Grant Program	Funding for projects that leverage federal funding, including bike paths and rail trails, mountain bike trails, bike parks, BMX facilities, and large-scale bicycle advocacy initiatives.	Local governments and non-profits may apply with requests of up to $10,000. 2017 grant cycle will be posted and available in November of 2016.	National competition – relatively low dollar grants. Does not fund planning activities.	
International Mountain Biking Association (IMBA)	Funding for maintaining and improving the sustainability of local trails, preserve the environment and enhance conservation in the mountain biking community.	Deadline is typically late summer or fall annually. Open to 501(c)(3) organizations and chapter or supporting organization status with IMBA.		

OTHER				
INCENTIVE	**PROGRAM DESCRIPTION**	**AVAILABILITY**	**EFFECTIVENESS**	**RELEVANCE**
Fox Cities Greenways	Non-Profit dedicated to fostering preservation and development of greenways and trails in the Fox Cities.	Smaller grant amounts, no deadlines. Inquire with administrative assistant with specific request. annette4greenways@gmail.com	Matching funds	Trail development; corridor preservation
Fox Cities Convention and Visitors Bureau	Funding for projects which attract visitors to greater Fox Valley.	Inquire with Director for specific request. pseidl@foxcities.org	Matching funds	Trail development
Community Foundation of the Greater Fox Cities	Partnership grant up to $25K. The partners work together for shared outcomes. Traditionally one organization is the lead and takes responsibilities for the financial liabilities for the joint effort.	Call to discuss idea. Program in the process of being combined with other grant pools, may provide opportunity for larger funding amount. https://www.cffoxvalley.org/grants/environmental-sustainability-partnership-grants/	Matching funds, likely require non-profit partnership.	Trail development
WE Energies Foundation	Relevant focus areas include economic health and environment. Grantee must be a qualified charitable, not-for-profit 501(c)(3) tax exempt organization, per Internal Revenue Service Code guidelines	Applications are reviewed on a quarterly basis. Applications for the first quarter must be received by Jan. 31, second quarter by April 30, third quarter by July 31 and fourth quarter by Oct. 31. https://www.we-energies.com/foundation/faq.htm	Requires partnering with a non-profit. WE Energies trail	WE Energies trail
Outagamie County Greenways	Designed as a partnership grant opportunity for local units of government to further develop Outagamie County's greenway system, up to 25% of a greenway project's costs can be reimbursed as part of this program. For 2016, $25,000 in funding has been allocated for greenway projects.	Spring grant deadline (2016). Check website for next year's cycle. http://www.outagamie.org/index.aspx?page=1400	Matching funds.	Bike, pedestrian, and other networks (e.g. trails, paths, and lanes), and environmental corridors (e.g. wildlife, waterways or other natural corridors).

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TRAIL DESIGN BEST PRACTICES

CITY OF APPLETON, WISCONSIN

Trail Design Best Practices

Introduction

Trails are an important part of the non-motorized transportation network in Appleton. Trails provide both recreational opportunities, and low-stress off-street connections to local destinations. Trails appeal to a variety of users with a variety of skill levels and abilities, and residents are expressing a growing interest in trail expansion. To accommodate growing user demand and ensure that future trails are appropriately designed for all types of users, this document presents trail design best practices to be used as guidelines in conjunction with existing city design guidelines. This document is part of the Trails Master Plan for Appleton which provides a framework for future investments in multi-modal facilities, improved network connectivity, improved safety and accessibility for all trail users, and improved quality of non-motorized facilities to the benefit of Appleton visitors and residents.

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TRAIL USER NEEDS

Trails attract a variety of users with different needs and expectations. Important design characteristics for different users are width, surface material, sight distances, clearances, and trail amenities. The following section provides the framework for incorporating standards and guidelines for trail design and planning. Trail users include:

- **Pedestrians**—joggers, walkers, baby strollers, pet walkers, nature watchers
- **Bicyclists**—commuters, recreational riders, touring riders
- In-line **skaters** and skateboarders
- **Wheelchair users** and users of other mobility devices, such as Electronic Personal Mobility Devices (EPMD)

User Behavior

The flexibility of trails draws many different users, and accommodating a safe and predictable environment for all is an important issue in trail planning, design, and development. Within a given trail width, there will be different user types traveling at different speeds, potentially large groups traveling together, and/or high volumes of people. Trail users should recognize and anticipate other user behaviors unique to user type to avoid potential conflicts. The potential user-type behavior conflicts are indicated in the table below.

***Table 1** - User Type Potential Conflicts With Other Users*

PEDESTRIANS (includes any users on foot)
Multiple pedestrians may walk more than two abreast, making it difficult for other users to pass
Children may wander unpredictably on the trail
Pet owners may not exercise on-leash etiquette, and pets may wander unpredictably on the trail
May stop or turn suddenly, before other users can react
May not keep to the right, making it difficult for other users to pass
BICYCLISTS
Have tendency to startle other users if not using voice or bell when passing
May ride more than two abreast, making it difficult for other users to pass
May not obey posted speed limits
May frighten wildlife
SKATERS
Have tendency to startle other users if not using voice or bell when passing
May use a wider portion of the trail for sweep width, making it difficult for other users to pass
May frighten wildlife
WHEELCHAIR USERS
May not keep to the right, making it difficult for other users to pass

Trail user behavior can be managed through safety programs that provide the individual user with a **Code of Conduct** for the trail, sometimes called a **Trail Ordinance**. Several communities across the U.S. have adopted progressive trail ordinances for public use. Other factors which lead to user conflicts, including the design and engineering of a trail, are discussed further in following sections of this document.

Design Needs of Pedestrians

Aside from space requirements related to pedestrian-specific activities such as pet walking or running, pedestrians have a wide variety of physical characteristics determining user needs and abilities. Age is one major factor that affects pedestrians' 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 cognitive development. Older adults walk more slowly and may require assisting devices for walking stability, sight, and hearing. The table below summarizes common pedestrian characteristics for various age groups. As a rule of thumb, the MUTCD recommends a normal walking speed of three and a half feet per second for calculating the time needed for pedestrian crossings at traffic signals. Average walking speed is lowered to three feet per second in areas with older populations and persons with mobility impairments. While the type and degree of mobility impairment varies greatly across the population, the trail system should accommodate these users to the greatest reasonable extent at trail intersections, sharp turns, overpasses, and underpasses.

***Table 2** - Pedestrian Characteristics by Age*

AGE	CHARACTERISTICS
0-4	Learning to walk Require constant adult supervision Developing peripheral vision and depth perception
5-8	Increasing independence, but still require supervision Poor depth perception
9-13	Susceptible to "dart out" or intersection dash Poor judgment Sense of invulnerability
14-18	Improved awareness of traffic environment Poor judgment
19-40	Active, fully aware of traffic environment
41-65	Slowing of reflexes
65+	Difficulty crossing street in time Vision loss Difficulty hearing vehicles approach from behind

Design Needs of Dog Walkers

Dog walking is a common, anticipated use on trails. Dog sizes vary largely, as does leash length and walking style, leading to wide variation in possible design dimensions. Trails designed to accommodate wheelchair users are likely to provide the necessary dimensions for the average dog walker. Amenities such as dog waste stations at trailheads enhance conditions for dog walkers.

Design Needs of Joggers and Runners

Running is an important recreation and fitness activity commonly performed on trails. Many runners prefer softer surfaces (such as rubber, bare earth, or crushed rock) to reduce impact. Among hardened surfaces, asphalt is preferred over concrete because it is more forgiving on joints. Runners can change their speed and direction frequently. Typical running speed is 6.2 miles per hour (mph).

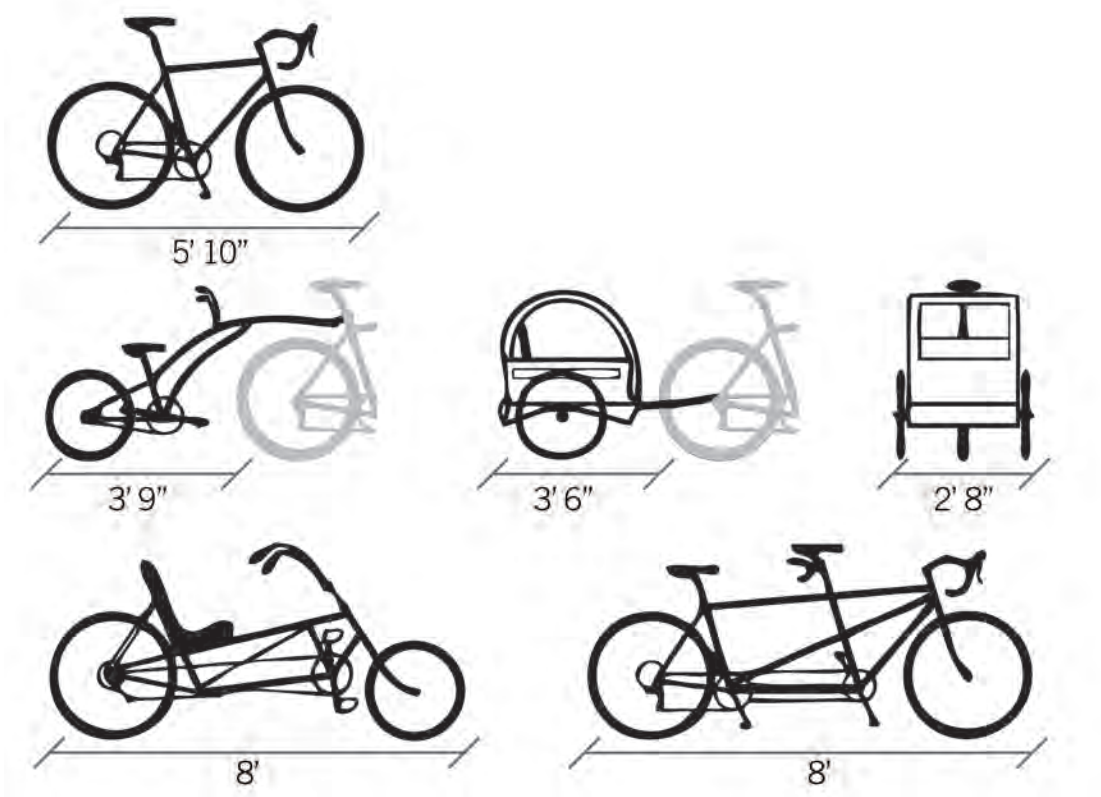
Design Needs of Strollers

Strollers are wheeled devices pushed by pedestrians to transport babies or small children. Stroller models vary greatly in their design and capacity. Some strollers are designed to accommodate a single child; others can carry three or more. Design needs of strollers depend on the wheel size, geometry, and ability of the adult who is pushing the stroller. Strollers commonly have small pivoting front wheels for easy maneuverability, but these wheels may limit their use on unpaved surfaces or rough pavement. Curb ramps are valuable to these users. Lateral overturning is one main safety concern for stroller users.

Design Needs of Bicyclists

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 trail should consider expected bicycle types on the facility and utilize the appropriate dimensions.
The figure below illustrates the varying dimensions of bicycles. Bicyclists require clear, open space with no visual obstructions to operate within a facility. The minimum operating width is greater than the physical dimensions of the bicyclist to allow the bicyclists shy distance from vertical obstacles and to allow maneuvering space around uneven pavement or other obstructions. Bicyclists prefer five feet or more operating width, although four feet may be minimally acceptable. Bicyclist speeds range from 8-15 mph on a paved level surface. Uphill speeds range from 5-12 mph, and downhill bicyclist speeds can reach 20-30 mph. A design speed of 10 mph is used for bicycle signage and crossings.

Figure 1 *- Typical Bicycle Dimensions Source: AASHTO 3.2*



Design Needs of Skaters

In-line skates are commonly used for recreational and transportation purposes. They typically have three to five wheels of three to four inches diameter, aligned in a straight line. Operational characteristics vary by skill level. Novice skaters travel more slowly and have a narrower sweep width from advanced skaters. Novice users may also have trouble making sharp turns and stopping quickly, particularly on steep grades. In-line skates are nearly impossible to use on unpaved surfaces and can be uncomfortable and difficult to operate on rough pavements, such as asphalt with large aggregate. In-line skaters have a typical speed of 10 mph.

Design Needs of Wheelchair Users

As the population ages, the number of people using mobility assistance devices increases. Manual wheelchairs are self-propelled by the user's hands and arms by pushing rims attached to the 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. Typical speed for manual wheelchair users is 3.6 mph. Power wheelchairs use a battery powered motor to move. 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 user ability (e.g., joystick control, breath controlled). Typical speed for power wheelchair users is 6.8 mph. Maneuvering around turns requires additional space for both types of wheelchair devices. Providing adequate space for 180° turns at appropriate locations is an important element for accessible design.

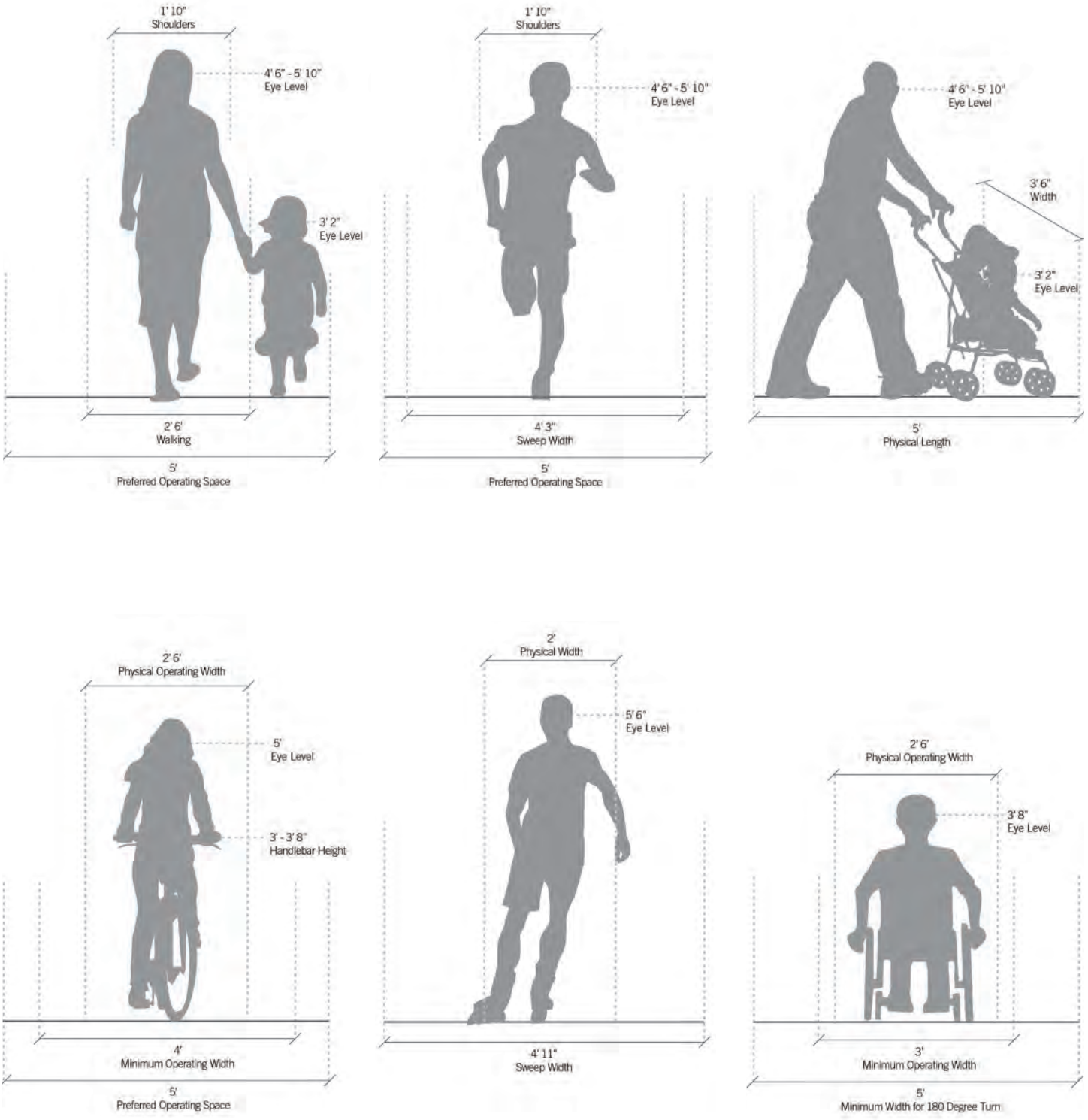
Winter Design Needs

Trails can also be used for winter recreational activities such as snowshoeing, nordic skiing, or riding fat bikes. Trails used for these activities should only be on trails or segments of trails that do not serve as key bicycle and pedestrian connections that would require snow removal. For more information, see Winter Maintenance pg 60.

Trail User Dimensions

The figure to the right illustrates the spatial needs of the trail user groups discussed. Note that the preferred operating width for all user types is approximately five feet.

Figure 2 *- Trail User Dimensions*



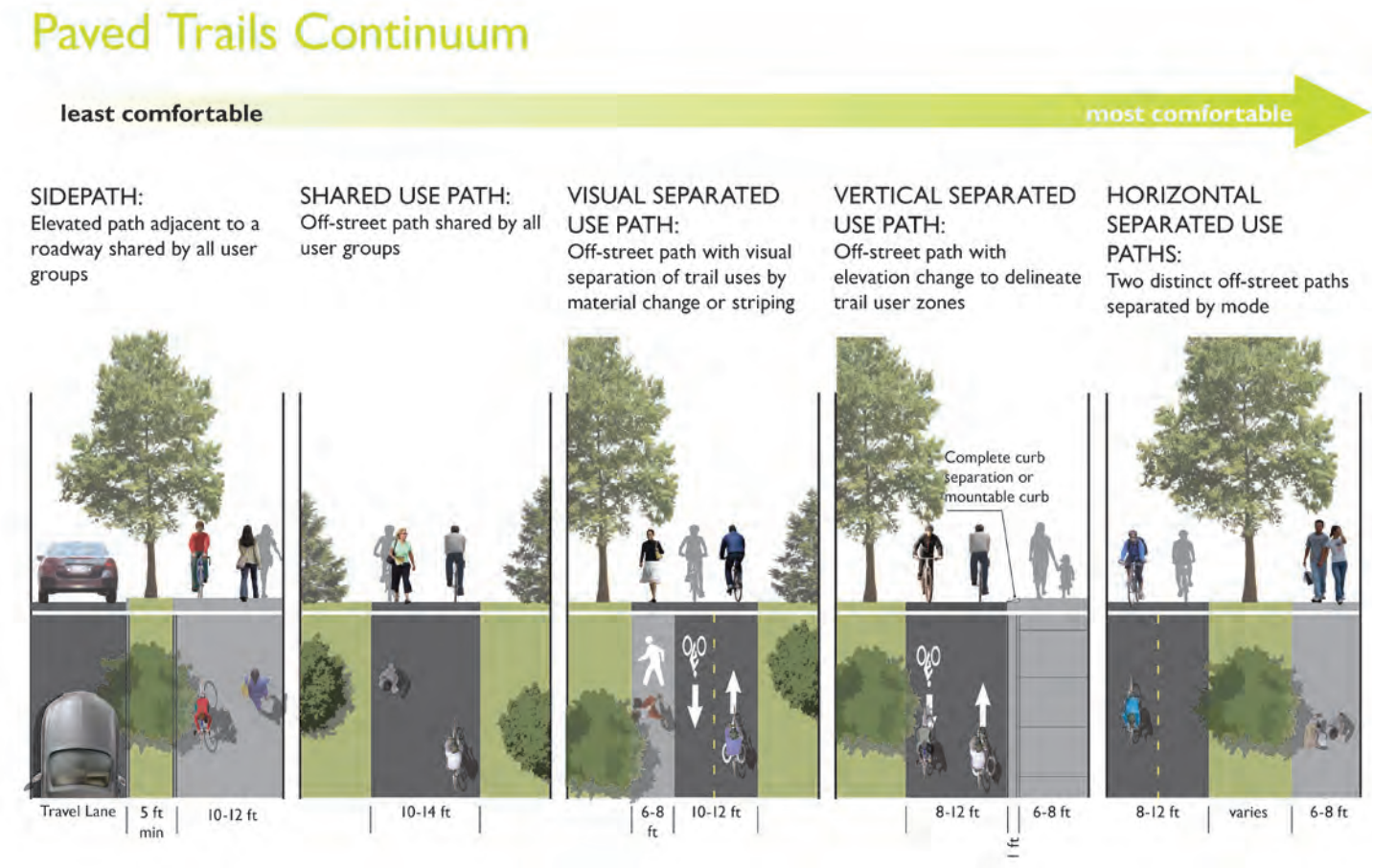
FACILITY SELECTION

Trails can vary in width, material, and degrees of user separation. Trail types are selected based on available width, anticipated user types, and user volumes. This section outlines the following trail typologies:

- **Sidepaths**—designated non-motorized facility adjacent to a roadway
- **Shared Use Paths**—off-street facility for use of all non-motorized user groups
- **Separated Use Paths**—parallel off-street facilities separated by mode, typically pedestrians and slower moving users on one path and faster moving users such as bicycles and skaters on an adjacent path
- **Soft-Surface Trails**—narrow dirt or compact gravel paths for use by runners, equestrians, or mountain bikes either adjacent to a paved trail or in parks or other natural areas

Paved Trails Continuum

For trails with anticipated use from multiple user groups, including bicyclists or other wheeled users that prefer a paved surface, there is a spectrum of trail widths from minimal comfort to complete mode separation. Moreover, there are different means of separating user groups. Figure below illustrates the spectrum of trail facilities.



Sidepath

As defined by AASHTO, a sidepath is a shared use path located immediately adjacent and parallel to a roadway. Sidepaths are for two-way movement by bicycles, pedestrians and other non-motorized users. Sidewalks are not considered sidepaths as they are not conducive to riding a bicycle and can lead to user conflicts (AASHTO, Section 3.4.2). Sidepaths are appropriate adjacent to roadways with high speed or high volumes of motor vehicles that would discourage bicyclists from using the roadway, and there are no practical alternatives to improving the roadway or redirecting cyclists to alternate routes. Sidepaths may also be used to supplement on-street bikeways. However where sidepaths are placed adjacent to roadways without on-street bike facilities, some cyclists may still opt for the roadway as a more direct route, and may suffer driver harassment. Moreover, drivers may not anticipate bicycles on the sidepath and there are potential conflict points at driveways and intersections (AASHTO, Section 5.2.2). Thus, if possible, shared use paths should be designed on a corridor distinct from the roadway, as described in the shared use path section below.

Sidepaths must have a minimum of five feet of distance between the path and the roadway. If this setback distance is not available, there must be a barrier or railing to protect the path from vehicles and to discourage path users from crossing the roadway other than designated locations (AASHTO, Section 5.2.2). Sidepaths are eight to fourteen feet wide, and accommodate low volumes of users as described in the shared use path section below.

Shared Use Path

A shared use path is an off-street dedicated facility for two-way bicycle traffic and other non-motorized users such as pedestrians, skaters, wheelchair users, and joggers. Shared use paths are a 10 to 12 feet wide single surface capable of accommodating low to moderate volumes of users. 12 feet is preferred to enable a cyclist to pass another path user going the same direction, while another path user is approaching from the opposite direction. AASHTO defines 10 feet as the minimum paved dimension for two way travel. An absolute minimum width of eight feet which should only be considered in constrained conditions for short distances (Section 5.2.1). At low volumes shared use paths are functional, pleasant, and adequate for use by users of all ages and abilities. Preferred volumes for shared use paths:

» Volumes less than 30 pphpf* (CROW, p.136)

pedestrians per hour per foot of path width

Visual Separated Use Path

Separated use paths are multi-use paths with delineated space to separate travel modes and sometimes directions. Separation generally separates fast user types (bicyclists, roller-bladers, skate boarders) from slow user types (pedestrians, or small children on bicycles). Separation may be visual, such as a four inch painted line and pavement markings, or a material change. Commonly, concrete is used for pedestrian tread area, and dark asphalt is used for bicycle tread area. Signs can also supplement pedestrian and bicycle zones. Visual separation of paths is appropriate for paths with limited widths and lower volumes. Preferred minimum width for separated use is 15 feet: a 10 foot bicycle path and five foot pedestrian path (AASHTO, Section 5.2.1).

» Volumes of 30 - 48 pphpf (CROW, p.136)

Vertical Separated Use Path

Another type of trail user separation is an elevation change, where pedestrians are at a higher elevation than cyclists. The elevation is generally achieved by a mountable or rolled curb so that users can briefly move onto the adjacent path for a passing or evasive maneuver if necessary. A minor grade separation of a three inch curb offers positive guidance for user positioning without interfering with pedals (NACTO, 2012). This type of separation is appropriate for slightly higher user volumes.

» Volumes of 48-60 pphpf (CROW, p.136)

Horizontal Separated Use Path

Finally, trail user groups can be on completely distinct paths so there is no point of conflict. This is necessary for trails of very high user volumes. However, these trails will often need to converge to one trail at intersections and driveway crossings for limited conflict points with motor vehicles. Paths can be divided by a narrow dividing strip of gravel, cobblestones, grass, or pavers. With four feet or greater space for user separation, this area may be used for path furnishings such as lighting, shrubs, or small trees. These vertical elements further enforce user separation. Trail direction can also be separated into separate paths. If bicycle treads are physically separated by direction, each path should be five feet minimum width with a preferred minimum is seven feet to allow for passing (NACTO, 2012).

» Volumes greater than 60 pphpf (CROW, p.136)

Soft Surface Trails

Soft surface trails are usually adjacent to paved trails, or travel through parks or other natural areas. Trail width will vary depending on the existing topographic and environmental conditions, but are typically three to eight feet wide with no required shoulder. Trail surface can be made of dirt, rock, soil, forest litter, or other native materials. Some trails use crushed stone (aka “crush and run”) that contains about 4% fines by weight, and compacts with use. Soft surface trails may be preferred by runners and mountain bikers, but are not preferred by road bikers or in-line skaters. There are also slope and surface material considerations for ADA accessible trails. See Accessible Trail Design on page 22 for further discussion.

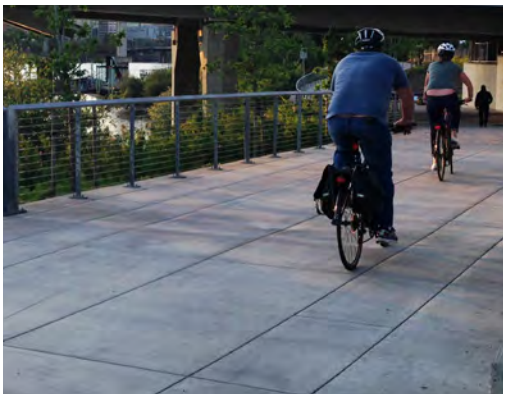
FACILITY DESIGN

Paved trails have basic parameters of best practice design discussed the following sections:

- **Materials**—paving types
- **Standards**—slopes, clearances, ADA and CPTED
- **Pavement Markings**—centerlines and edge lines
- **Edge Conditions**—defining the trail edge
- **Drainage**-ensuring proper water flow and erosion control

Trail Surface

When determining surface type for paved trails, consider topography, surrounding landscape, underlying soils, and user needs. All surfaces have advantages and disadvantages, and each must be analyzed to determine which surface is appropriate in any given location. American Disabilities Act Accessibility Guidelines (ADAAG) compliant trails require firm, stable, slip resistant surfaces, which in most instances is a paved surface for access and ease of use. In some cases, packed gravel fines can be used, where there is little to no topography. However, packed surfaces require much more maintenance effort and cost over time, and may not be desirable in the long term.



Paved Surface Materials

For paved trails, a proper foundation will increase the longevity of the trail surface. Two inches of surfacing material over six inches of base course gravel over geotextile fabric is recommended for construction.

Asphalt is a common surface for trails, offering substantial durability for the cost of installation and maintenance. Asphalt is popular with users for its smooth, continuous surface and has the benefit of lower cost, but requires more upkeep than concrete. As a flexible pavement, asphalt can also be considered for installing a paved trail on grades steeper than 3%. If constructed properly on suitable sub-grade, asphalt has a life span of about half that of concrete, or 10 to 15 years.

Concrete can last twenty five years or more when properly constructed and maintained on a regular basis,. The high cost of concrete is often the most limiting factor since it is one of the most expensive surfaces to install. It is recommended that concrete be used for its superior durability and lower maintenance requirements in areas prone to frequent flooding, and for intensive urban applications. To prevent expansion joints from jarring cyclists or in line skaters, saw cut concrete joints rather than troweled improve user experience.

Permeable paving is twice the cost of asphalt to install and is only recommended in very special trail applications. Permeable paving should only be used areas with proper drainage, and is not suitable in floodplain or areas with ponding or sedimentation. Permeable paving also requires a maintenance schedule for vacuuming debris after storm events to retain permeability.

Width

Eight feet is the absolute minimum width allowed for a shared use trail and is only recommended in constrained conditions for short distances. The AASHTO defined minimum width for a two-way trail is 10 feet. However, 12 feet (and in very heavy trail use, fourteen feet or more) is recommended for trails with moderate to high concentrations of users and/or variety of users. A separate soft surface track (five feet minimum) can be provided adjacent to a paved shared use path for pedestrian use where right-of-way permits.

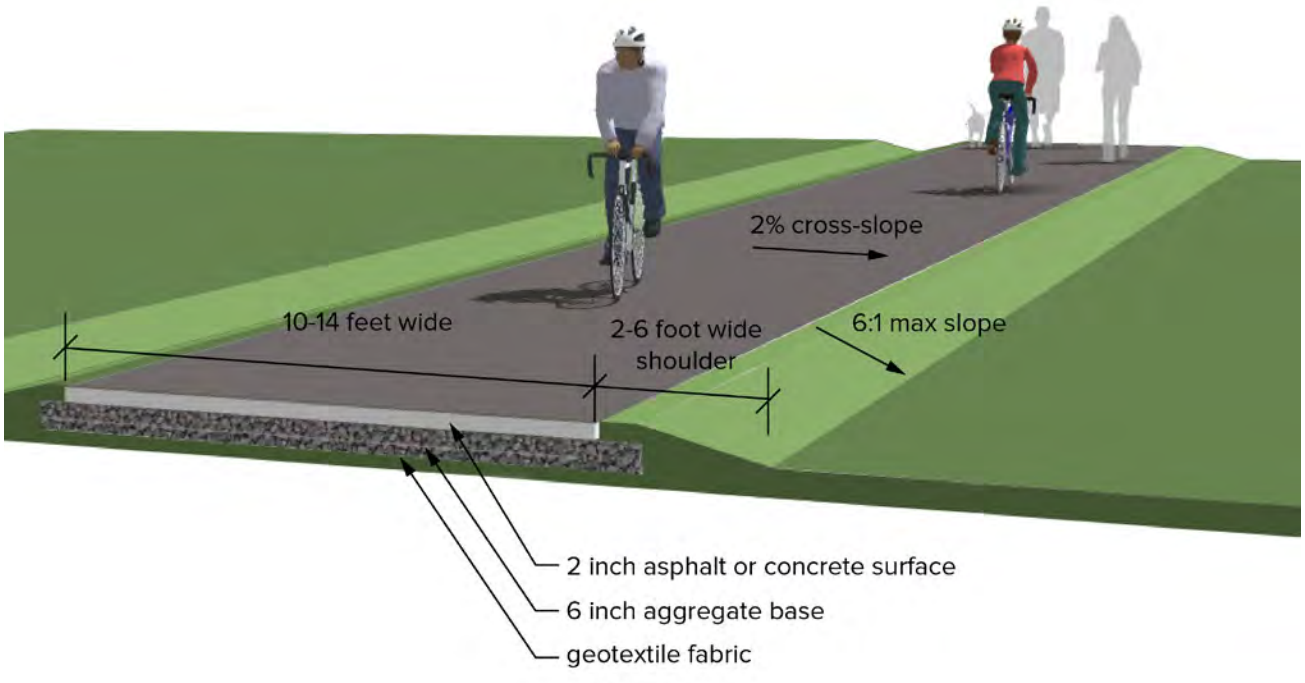
Clearances

A two foot minimum graded shoulder should be provided on both sides of the trail for clearance from lateral obstacles such as signs, vegetation, or bridge abutments. Ideally, shoulders are three to five feet wide with a maximum cross slope of 1V:6H (AASHTO, Section 5.2.1).

Clearance to overhead obstructions should be 10 feet, and an absolute minimum of eight feet only in constrained conditions. Note that higher clearances may be necessary for maintenance or emergency vehicle access.

Cross-Slope

Trails should provide a 2% cross slope from crown of trail in both directions to provide positive drainage off the trail as conditions allow. The cross slope should be no greater than 5% for accessibility requirements.



Accessible Trail Design

The United States Access Board ADA accessibility guidelines apply to trails and outdoor recreational access routes. In addition to the surface and cross-slope requirements described prior, accessible trails require the following:

Clear tread width: three feet minimum for low-volume, pedestrian-only facilities; 10 feet minimum for multi-use facilities. Where trail width is less than 60 inches, passing space must provided at least every 1,000 feet.

Low longitudinal slope: 5% or less. Steeper slopes may be used if resting intervals of no less than five feet long and equal to the width of the trail are provided at the bottom and the top of the slope in the intervals listed below. No more than a third of the total trail length may exceed a running slope of 8.33%.

» Up to 8.33% for a maximum of 200 longitudinal feet

» Up to 10% for a maximum of 30 longitudinal feet

» Up to 12.5% for a maximum of 10 longitudinal feet

Consistent smooth surface: 0.5 inches is the maximum vertical discontinuity, and any disruption greater than 0.25 inches high shall be beveled to avoid trip hazards

Detectable pavement changes: provided at curb ramps, before entering roadways, and at rail crossings

Crime Prevention Through Environmental Design (CPTED) Principles for Trails

Personal safety, both real and perceived, heavily influences a trail user's decision to use a facility and a community's decision to embrace the trail system. CPTED is a proactive approach of using design principles to deter undesired behavior.

» Principle #1: Natural Surveillance

» Principle #2: Natural Access Control

» Principle #3: Territorial Reinforcement

» Principle #4: Maintenance

These principles can be applied to trail facility design, management features, and trail amenities:

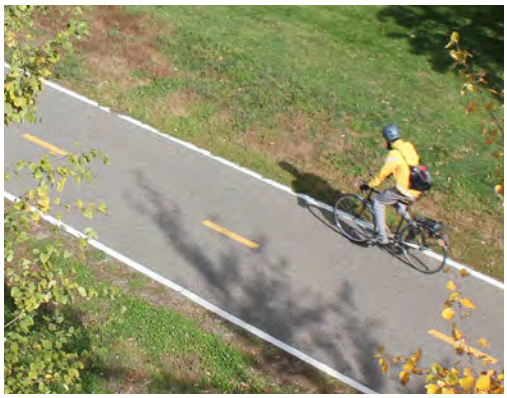
Sight lines: Where possible, trails should be located near buildings with windows facing the trail, or adjoining properties with open views to the trail. Convex mirrors should be provided at blind corners and at the approaches to underpasses with poor sight lines.

Fencing: Where feasible, fencing installed along trails should not obstruct the view of trail users. Permeable fencing of four feet tall or less can provide a barrier sufficient to denote property boundaries or deter access. Opaque fencing or walls can degrade the experience of trail users, obscure views, and create a "tunnel" effect that can cause users to feel "trapped." Where the trail is fenced for long stretches, intermittent openings should be located to allow users to enter and exit the trail. Access points to the trail should be at locations with good visibility from the surrounding neighbors.

Vegetation: All ground cover and shrubs along trails should be trimmed to a maximum height of three feet above ground level. Trees should be limbed-up to provide 10 feet of vertical clearance over the trail within the trail corridor. Tree canopies should not obstruct pathway illumination. Hostile native landscaping material (e.g. vegetation with thorns) can be used in strategic areas to discourage unauthorized use and eliminate entrapment areas.

Lighting: Light quality is as important as the quantity. Poor lighting, whether too bright or not bright enough, can diminish safety. Where lighting is installed on trails, the illumination should be adequate to identify a face up to 20 yards away. The lighting should provide uniform coverage and good color rendition. The use of metal halide or light emitting diode (LED) lamps are recommended, as they provide excellent color rendition. Color rendition is especially important when describing identifying features such as hair, clothing, and vehicle color.

Maintenance: Signage should be placed at trailheads indicating a contact number to report graffiti, suspicious behavior, and maintenance issues. Add anti-graffiti application to retaining walls or other blank surfaces where appropriate. A maintenance schedule should be established to regularly monitor trail conditions.



Striping and Pavement Markings

Striping and pavement markings are particularly beneficial in areas of limited sight distance, high traffic areas, intersection approaches, and in areas where night time use is anticipated. All markings should be non-slip or non skid material, and shall be retroreflective per the MUTCD. High visibility thermoplastic is the most durable and visible material for trail applications.

Under most conditions, trail centerline markings are not necessary. However, per AASHTO guidelines, "on pathways with heavy peak hour and/or seasonal volumes, or other operational challenges such as sight distance constraints, the use of a centerline stripe on the path can help clarify the direction of travel and organize pathway traffic." (5.2.1) Centerlines can also reinforce trail user etiquette to travel on the right and pass on the left. A four to six inch dashed yellow centerline stripe should be used where passing is allowed, and a solid stripe should be used where passing is discouraged. Solid centerlines should be provided on tight or blind corners and on the approaches to roadway crossings.

Four inch solid white edgeline striping should be provided on trails with anticipated nighttime use. White edge lines can also be used on intersection approaches to highlight changing trail conditions, or to delineate a separation of path users (AASHTO, 5.4.1).

Pavement markings are commonly used to reinforce signs along a trail, such as separation of bicycles and pedestrians. However, pavement markings should not be used to replace signs altogether. Instead, pavement markings should be used to call additional attention to a possible problem area, such as trail access points, roadway intersections or bridges, or converging trails. Possible pavement markings for trails include the pedestrian and bicycle symbols, yield lines, stop bars, and the word markings “Stop,” “Yield,” and “Slow.” Due to slower travel speeds, word pavement markings should not be elongated, should read in conventional order, and should be scaled minimally as to not overwhelm the pathway.

Trail Edge Definition

Vegetation, topography, ditches, fencing, railings, or walls may be used to clearly mark trail edges beyond the shoulder. These features can serve multiple purposes, including:

- Providing visual separation/privacy screens
- Delineating public space from private property
- Discouraging the development of unauthorized foot trails
- Separating users from hazardous drop-offs or adjacent non-compatible land use

Wildlife passage and safety for trail users are important factors in determining appropriate trail edge treatments. If separation is desired purely for privacy reasons, native vegetation buffers or the use of topography are recommended where possible. For separation to preventing trespassing or guard against hazardous slopes, consider the use of topography, ditches, semi-transparent fencing or railings, and hostile vegetation.

Drainage and Erosion Control

Drainage and erosion control are necessary to ensure a stable and low maintenance facility. Excessive soil erosion near a trail is usually the result of water collecting and flowing along the trail edge or onto the surface with enough volume and velocity to carry away soil. This impacts trail width, trail surface quality, and degrades adjacent habitat or downstream water resources. Designing the trail to follow natural land contours and planting low ground cover vegetation up to the edge of the trail help prevent and reduce erosion problems. Proper drainage for a trail can be ensured with a 2% cross slope for both the paved tread and trail shoulders. A maximum 1:6 slope is allowable for shoulders, but 2% is preferred. When managing storm water along all trails, use dispersed infiltration systems such as vegetated swales or over engineered storm water control structures such as storm drains and catch basins for reduced maintenance and improved aesthetic. For sections of trail where uphill water is collected in a ditch and directed to a catch basin, water should be directed under the trail in a drainage pipe of suitable dimensions.

Vegetative Screening

The presence or absence of vegetation and the type of vegetation present in a trail corridor impacts habitat quality, ecological sustainability, and the aesthetic experience for the trail user. Trees and shrubs on trails can serve as habitat for wildlife, stabilize erodible soils, and shelter trail users shade from the sun and rain. Vegetation is also an effective means of establishing trail boundaries while maintaining visual permeability. Strategic placement of bushes and plantings can deter users from using unauthorized foot trails, access points, or exits. When using vegetative screening, ground cover and shrub height should be a maximum of two feet above ground level to maintain an open line of sight on the trail. Similarly, trees should be trimmed to provide a minimum of eight feet of vertical clearance for trail circulation and to avoid obstructing trail lighting.

In locations where trees and shrubs are lacking and can be planted, native species are the most ecologically sustainable choice. As a group, native species require less maintenance than horticultural plantings and often provide wildlife with a food source. Topography and soil moisture regime largely determine where different plant species occur. Competing invasive vegetation should be removed regularly and replaced with mulch to conserve water. Trail vegetation should be selected and placed to provide seasonal comfort: shade in the warmer months and sunlight in colder months. Seeds and plants should be placed either right before or during the rainy season to take advantage of seasonal rainfall (spring and fall). Note that larger plants require more water to survive than seeds and smaller plants. Fertilizing native plants is only necessary in extreme cases when the condition of the soil is in need of repair.

Railings and Fences

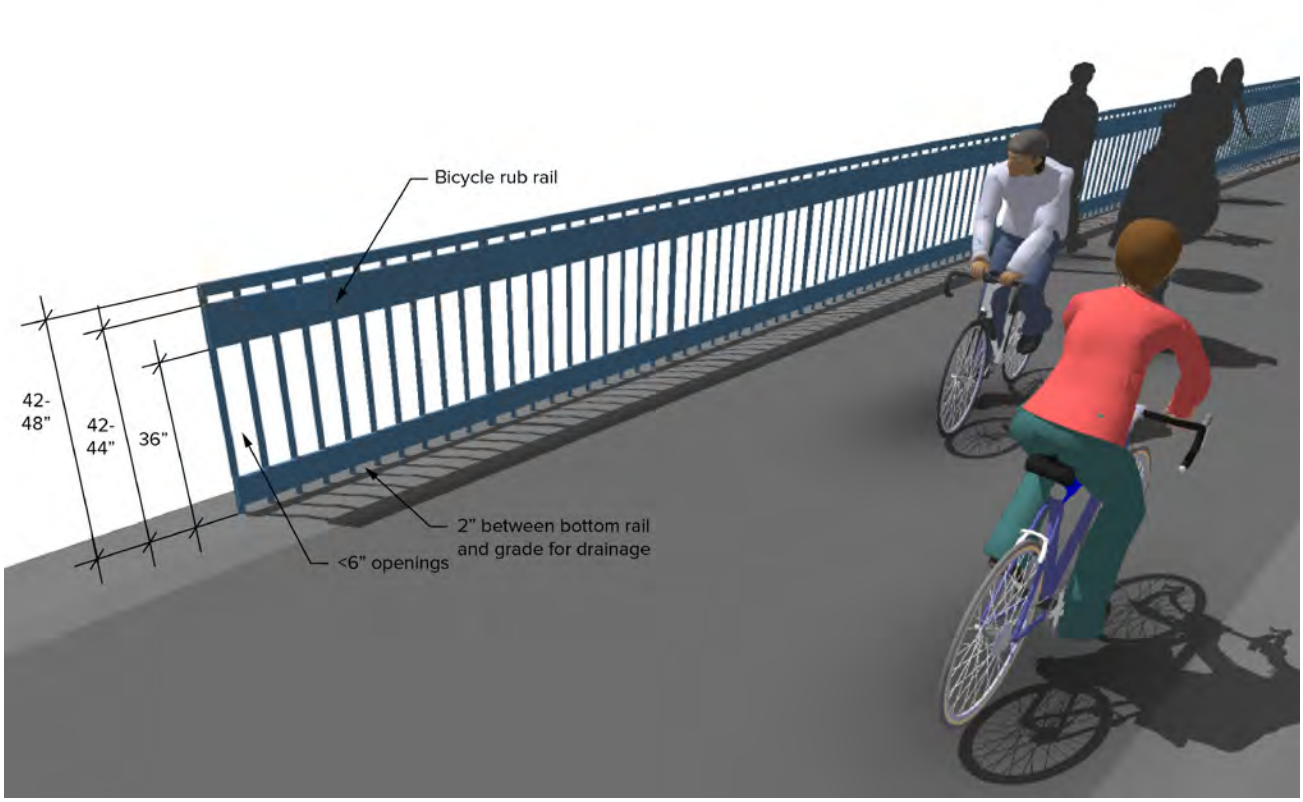
Railing and fences are important features on bridges, some boardwalks, or in areas where there may be a hazardous drop-off or incompatible adjacent land uses. By AASHTO standards, where there is a side slope or considerable vertical drop within six feet of the edge of the trail, a 42 inch safety rail is required:

» Slope is greater than or equal to 3:1 and drop of six feet

» Slope is greater than or equal to 2:1 and drop of four feet

» Slope is greater than or equal to 1:1 and drop of one foot

Railings may need to be as tall as 48 inches where more hazardous conditions exist, such as a bridge over a highway. At a minimum, railings and fences should consist of a horizontal top, bottom, and middle rail. The middle railing functions as a 'rub rail' to reduce the risk of bicycle handlebars getting caught by a railing. Middle rails should be located 36 inches to 44 inches above the finished grade. The bottom rail should be two inches above finished grade to allow for drainage. Openings between horizontal or vertical members on railings should be small enough that a six inch sphere cannot pass through in the lower 27 inches. This is to prevent children from falling through the railing openings. For the portion of railing higher than 27 inches, openings may be spaced such that an eight inch sphere cannot pass through. Local, state, and/or federal regulations and building codes should be consulted to determine when it is appropriate to install a railing and comply with current standards.



CORRIDORS

Ideal locations for trails are often found along existing corridors used for natural areas, utilities, or railroads. Each of these corridors presents additional design considerations for trails:

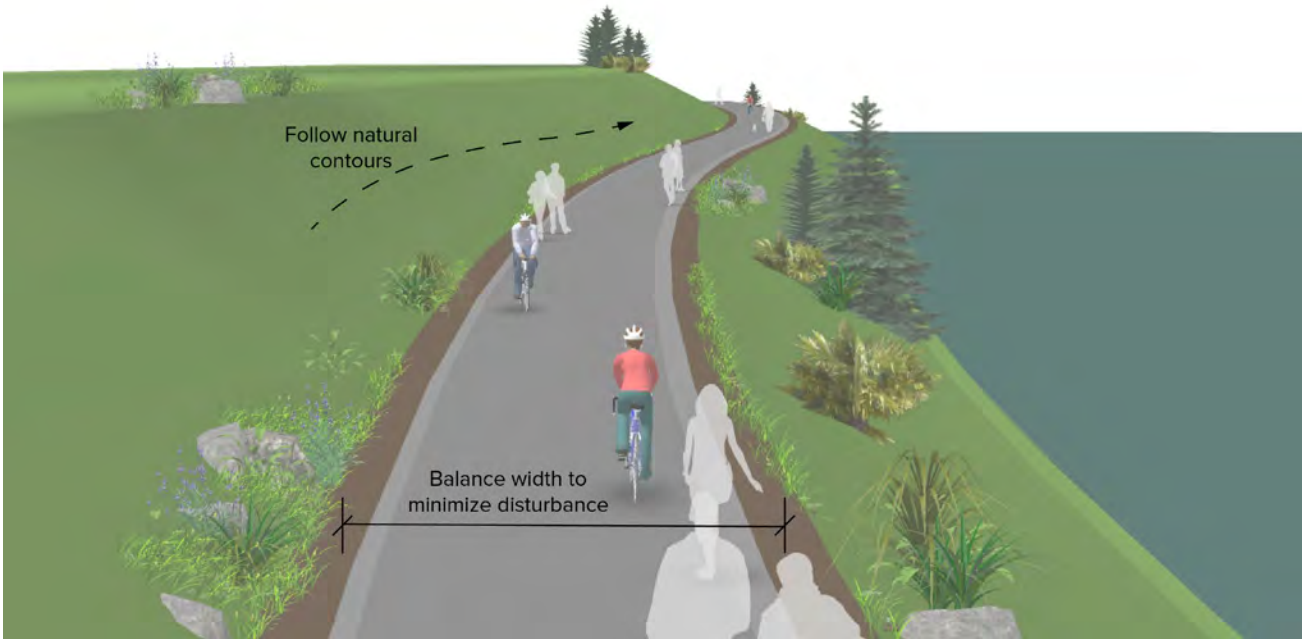
- **Riparian**—preservation of wildlife and natural habitat
- **Utility**—adequate clearances to equipment
- **Rail**—safety considerations adjacent to active rail lines

Riparian Corridors

Riparian corridors often offer substantial recreational and open space preservation opportunities. These corridors include rivers and streams, drainage facilities, and wetlands (where environmentally feasible). All trails constructed within riparian corridors should be studied for storm water impacts, wildlife habitat impacts, and floodplain development impacts. All trails within floodplain areas will require adequate environmental permits from local floodplain administrators. Local requirements for storm water and watershed buffers should be consulted to determine acceptable uses and buffer widths.

Trail Location: Trails in riparian corridors should follow the contours and avoid fall lines, which are prone to erosion and generally cannot be maintained over time. Existing native vegetation should be preserved to the extent possible to limit soil erosion and ecological impacts. Trails should be constructed at the maximum practical distance from streams, and locations immediately adjacent to or abutting stream banks should be avoided. Trails constructed near streams should include restoration projects where feasible. Restoration projects commonly involve reshaping of the floodplain to reduce bank angles and heights to allow the stream to access its floodplain. Trail locations in wetlands should be avoided. If wetlands must be crossed, choose the narrowest crossing point and use low impact elevated tread structures for trail construction, such as boardwalks and bridges to preserve these fragile ecosystems.

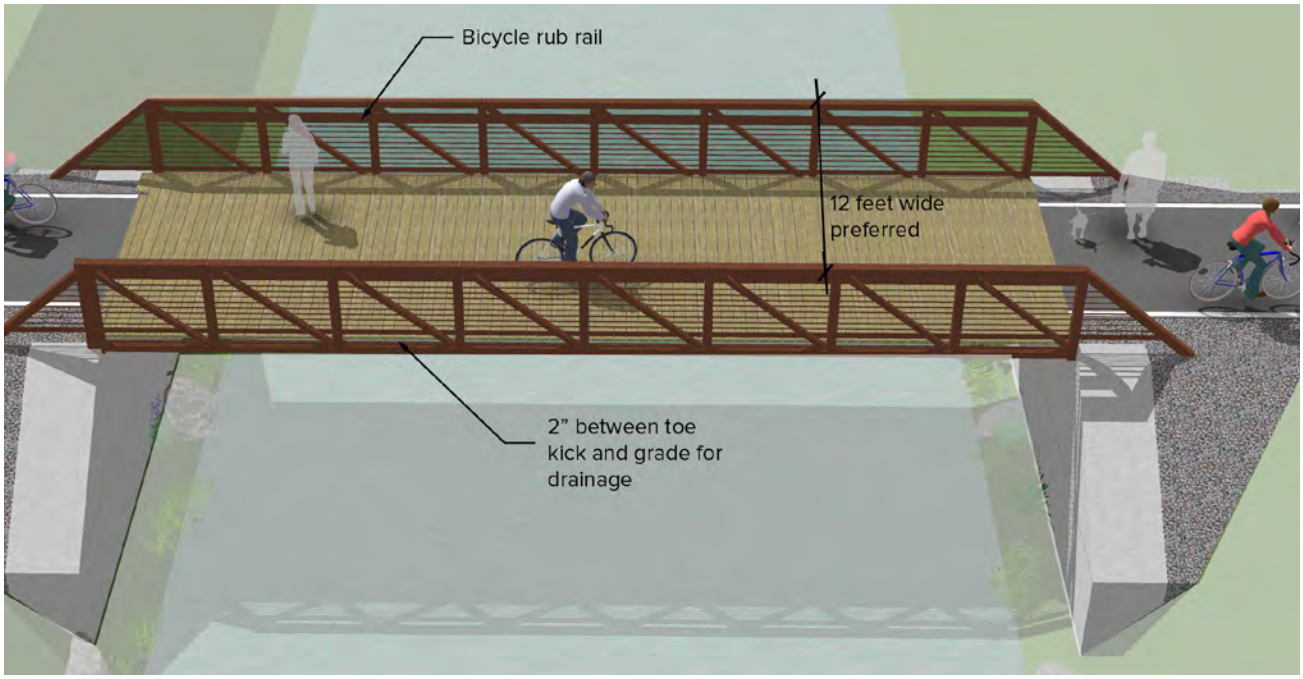
Surface Materials: Other than wetland areas, concrete is the recommended surface treatment for trails prone to flooding due to its superior durability and lower maintenance requirements. Permeable paving is not recommended in floodplain areas or areas without proper drainage. Sheet flow and sediment transport clog permeable pavement pores and will require vacuuming after all storm events. Gravel or crushed stone fines should not be used in riparian areas prone to flooding as these materials have very low cohesiveness and erode easily, contributing to increased sediment in streams.



Boardwalks and Bridges: Where trails cross over sensitive natural or inundated areas such as small creeks and wetlands, boardwalks and bridges should be used to limit the potential for environmental impact. Note that local, state, and federal permits will be likely be required for any construction in wetlands. Consult a structural engineer for member sizing and post footing design of these structures. Common boardwalk foundations consists of marine-grade timber posts or auger piers (screw anchors) which provide greater support and durability. The evaluation of boardwalk footings should include uplift as well as loading consideration for flood events.

Boardwalks range in length and can span as little as 10 feet or stretch for longer distances depending on site conditions. Boardwalk clear span width should be a minimum of 10 feet when no rail is used. 12 feet is preferred in areas with higher anticipated use and whenever railings are used. Bridges are used where greater span lengths are required and when the objective is to reduce base flood elevations. Boardwalks are usually constructed of timber, concrete, or recycled plastic decking. Recycled systems such as Trex® are popular for their material durability, however they have structural limitations. Modular concrete boardwalk systems are gaining popularity due to their low-impact installation methods and durability within wet areas. Permatrak™ is a system being used in some communities in the state and by the National Park Service. In choosing boardwalk material, careful consideration should be given to minimize slippery decking surfaces following storm events. A topcoat of non-skid paint, sandy compounds, or a light asphalt overlay can be effective on timber decking. Concrete is the most reliable non-skid surface.

On boardwalks, typically a six inch curb rail is recommended. However, a 42 inch guardrail is required at locations where there is a 30 inch or greater difference in the low water bridge elevation and the ground elevation below. Railings will also be required for bridges. Refer to the previous section for best practice design for fences and railings.

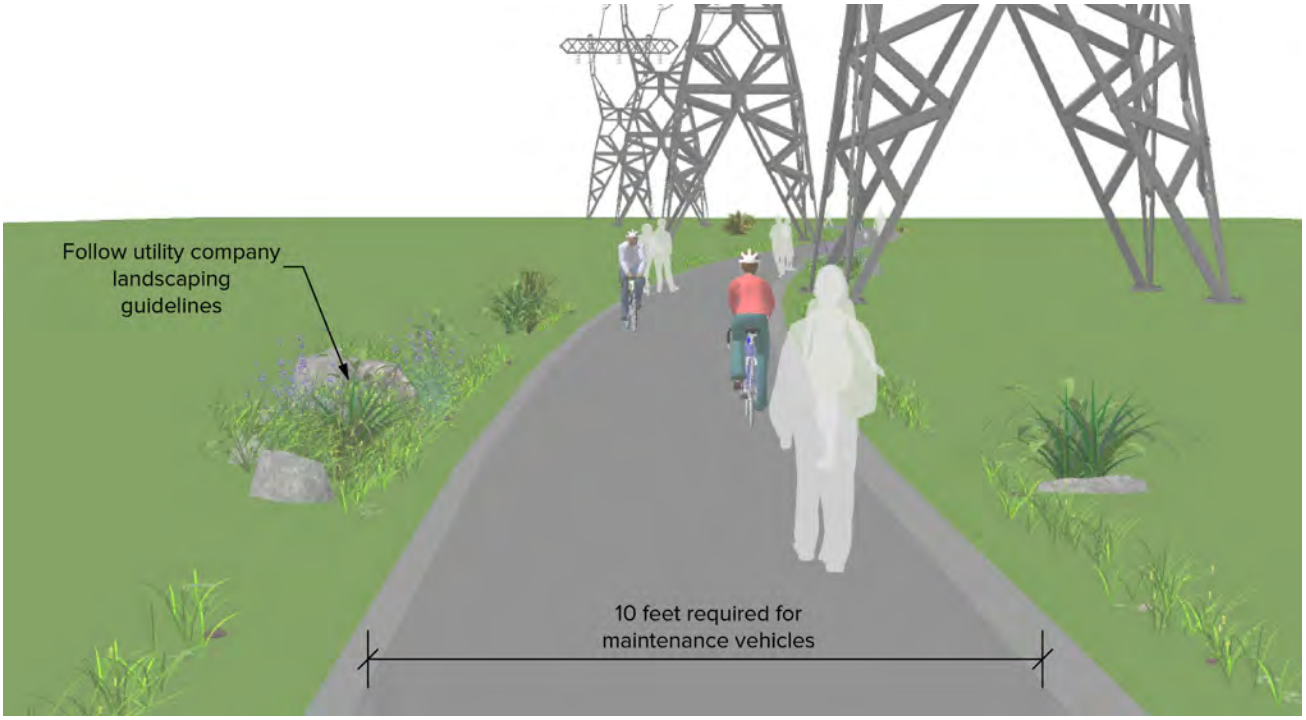


Utility Corridors

Underground and above-ground utility corridors can potentially accommodate trails. Utility companies benefit from this arrangement by having an easily accessible route to their utility service. Review each utility's policy and construction specifications for repair, access, and corridor maintenance requirements. The trail may need to be closed at certain times when utility repairs are necessary. Note that utility companies will likely require specific design guidelines, may determine trail routing and alignment, and may impose landscaping limitations. All trails in utility corridors require acquisition of an easement from the current title owner of the land.

Trail width: 10 feet of width is required for maintenance vehicle access. In sewer easements, the edge of trail should be at least 10 feet from manhole rims. For electrical utility corridors, a minimum separation of 25 feet is required between the trail and any associated electrical equipment (such as guy wires, power poles, and towers).

Trail amenities: Structures, which include signage, lighting, and benches, are typically restricted within utility easements. Review each utility's policy.

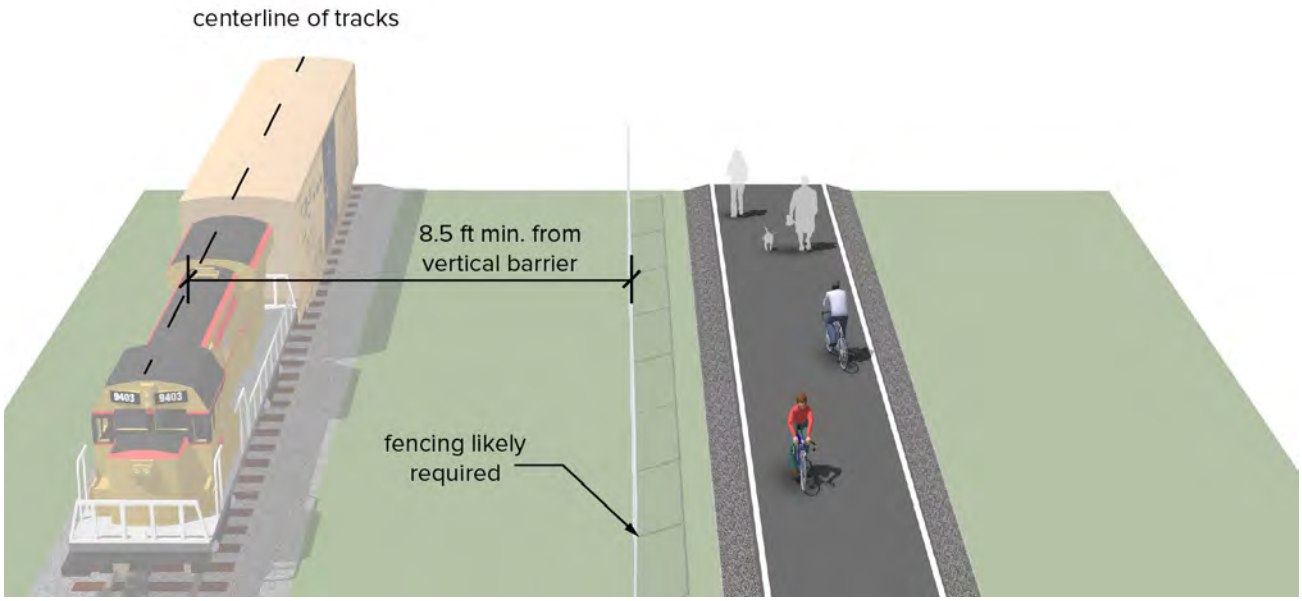


Active Rail Corridors

Rails-with-trails are multi-use paths adjacent to active railroads. It should be noted that several constraints can impact the feasibility of rail-with-trail projects. In some cases, corridor space needs to be preserved for future planned freight, transit or commuter rail service. In other cases, limited right-of-way width, inadequate setbacks, concerns about safety/trespassing, and numerous crossings may affect a project's feasibility.

Fencing: Railroads may require fencing with rail-with-trail projects due to concerns with trespassing and security. Requirements can vary based on the volume and speed of train traffic on the adjacent rail line and the setting of the shared use path, i.e. whether the section of track is in an urban or rural setting. If required, fencing should be a minimum of five feet in height with higher fencing than usual next to sensitive areas such as switching yards.

Setback: Trail setbacks from the active rail line will vary depending on the speed and frequency of trains, and available right-of-way. Separation greater than 20 feet will result in a more pleasant trail user experience and should be pursued where possible.



ACCESS + INTERSECTIONS

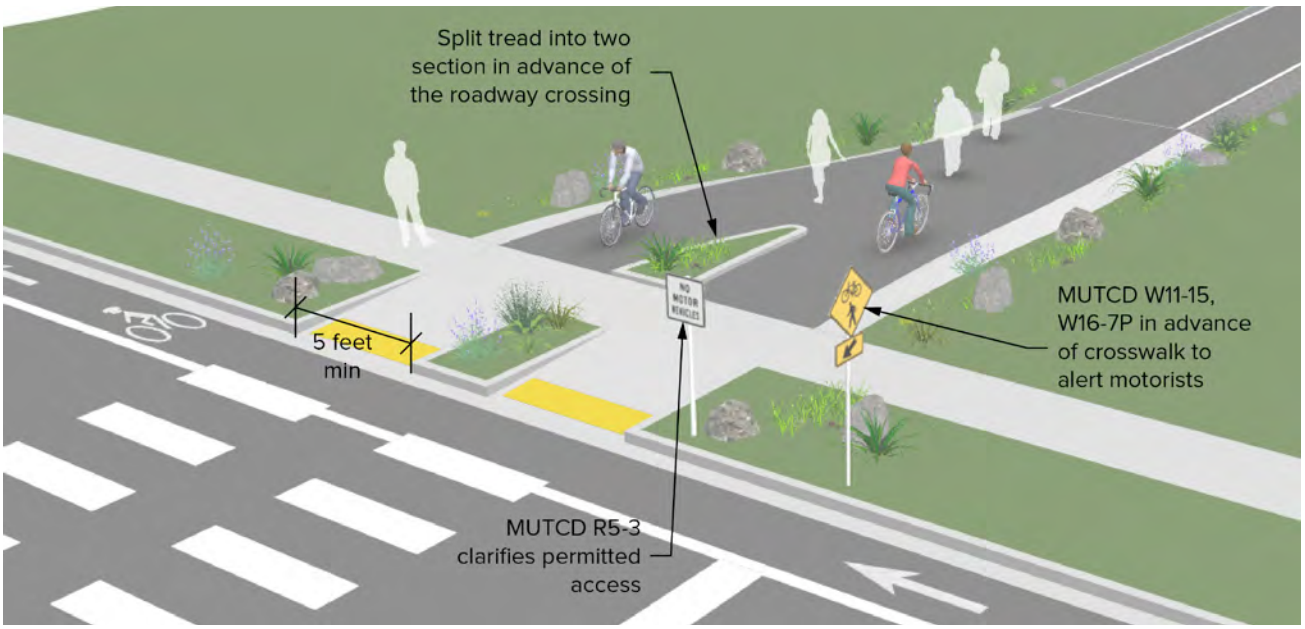
Roadway and trail crossings can create potential conflict points; however, well-designed crossings can mitigate many operational issues and provide a higher degree of safety and comfort for all users. Generally speaking, trail facilities require additional considerations due to the higher travel speed of bicyclists versus other trail users. The sign types, pavement markings, and treatments will vary based on the roadway type the trail crosses. Proper signage and pavement markings alerting trail users of at-grade crossings must also be utilized. This section details crossing treatments for the following contexts:

- Trail Entry Control
- Local or Collector Street Crossings
- Arterial Crossings
- Intersections with other Trails
- Railroad Crossings
- Underpasses and Overpasses

Trail Entry Control

A variety of physical barriers and design strategies are employed to restrict motor vehicle access to trails. A common treatment is the bollard post; however the bollard presents numerous safety hazards to trail users, and their use should be discouraged. Potential hazards include inconsistent and unpredictable placement, broken fold-down posts that often do not fold back up, removable posts lacking flush sleeves, or removable posts with theft preventing chains that dangle onto the trail surface. If bollards are used at intersections and access points, they should be adequately spaced and brightly colored and/or supplemented with permanent reflective materials to be visible at night. Removable barriers should leave a flush surface to prevent tripping hazards.

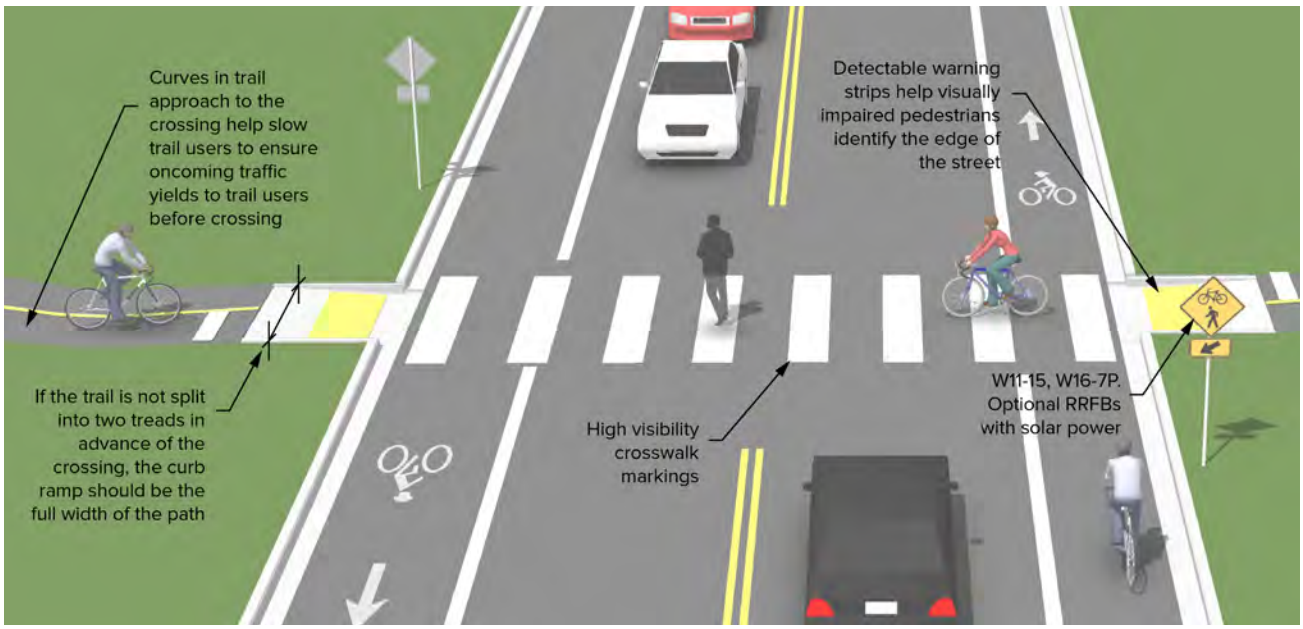
Physical barriers should only be considered when other measures do not adequately control unauthorized vehicles, or where the danger posed by unauthorized vehicles exceeds the safety risks to trail users by the barriers themselves. Alternative design strategies to control shared-use path entry include signage indicating “No Motor Vehicles” (MUTCD R5-3) placed at the trail access point, separating the trail into two treads in advance of the crossing so that the curb cuts are not conducive to motor vehicle access, and including a landscaped median to act as an access barrier. Note that there should be a minimum of five feet clearance for each tread for trail user access.



Local and Collector Street Crossings

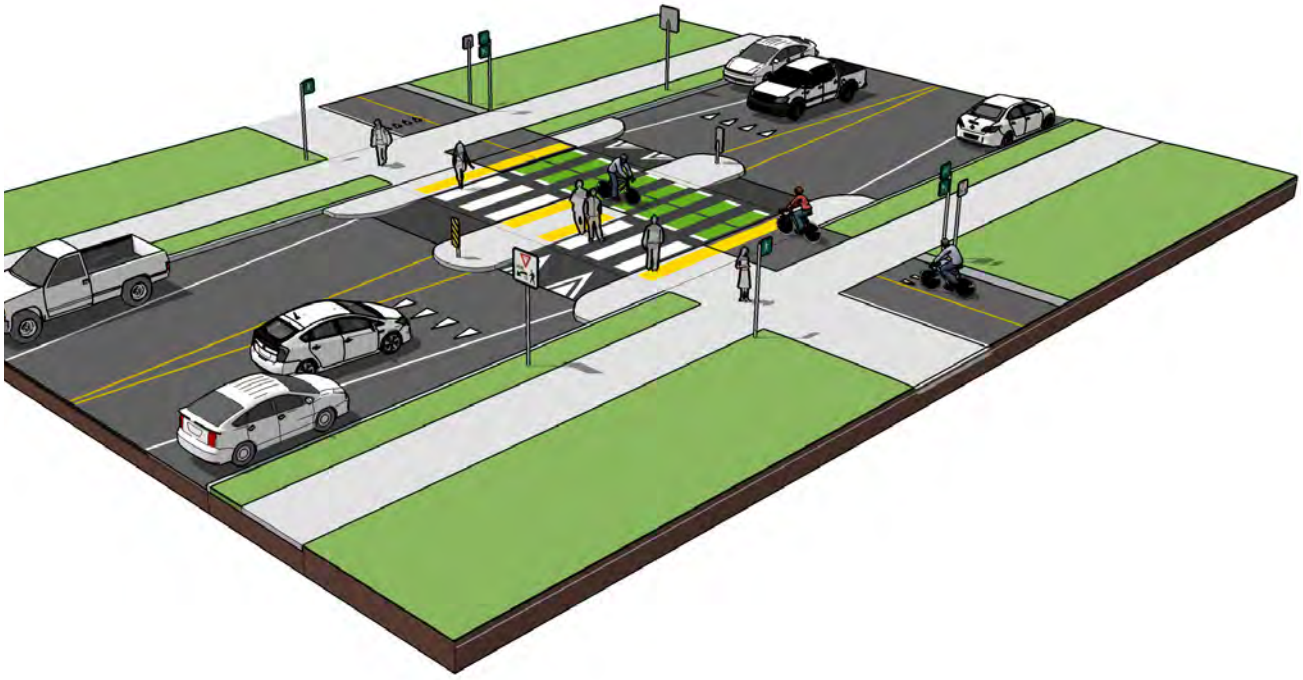
Marked Unsignalized Crossings

The design of trail crossings of local and collector streets depends on an evaluation of vehicular traffic, sight lines, trail volumes, use patterns, vehicle speed, road type, road width, and other safety issues such as proximity to major attractions. An unsignalized crossing typically consists of a marked crossing area, with signage and other markings to slow or stop traffic. Marked crosswalks statistically increase motorists yielding the right-of-way to pedestrians (Mitman). High-visibility crosswalk markings are the preferred marking type (FHWA) as transverse lines are essentially not visible when viewed from a standard approaching vehicle (McGrane). Locate crosswalk markings out of wheel tread when possible to minimize wear and maintenance costs. Stop or Yield lines may be used on the roadway 25 feet in advance of crosswalks where right-of-way priority is given to path users. A yield line must be paired with a Yield (R1-2) or Yield Here To Pedestrians (R1-5) sign. In roadway Yield to Pedestrians (R1-6) signs may be used along the centerline point of a crosswalk. On the trail, add detectable warning strips at the roadway crossing to help visually impaired pedestrians identify the edge of the roadway.



Median Refuge Islands

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. Refuge islands minimize user exposure by shortening crossing distance and increasing the number of available gaps for crossing. The waiting area should eight feet wide or wider to allow for a variety of bicycle types and multiple trail users. The refuge island must be accessible, preferably with an at-grade passage through the island rather than ramps and landings. To promote yielding to trail users, the median safety island should be designed to require horizontal deflection of the motor vehicle travel lanes. If a refuge island is landscaped, the landscaping should not compromise the visibility of trail users crossing in the crosswalk. Consider the use of landscaping with low-growing, minimally-spreading native shrubs and ground cover that require little maintenance and are no higher than 18 inches. Note that refuge islands may collect road debris and may require somewhat frequent maintenance. For separated use trail crossings, the crossing should maintain user separation. The pedestrian path should use crosswalk markings and the bicycle path should use green colored pavement.



Rectangular Rapid Flashing Beacons (RRFBs)

RRFBs alert drivers that path users wish to cross and promote yielding. This treatment provides similar yielding rates to that of a conventional traffic signals. Passive (loop) detection technology or active push buttons can activate warning beacons for oncoming path users. Push buttons should be no higher than four feet above the ground for ADA accessibility.

Bulb-outs

Curb extensions, or bulb-outs, shorten crossing distance and position users in a visible location. They also visually narrow the roadway to slow motor vehicles approaching the crossing.

Raised Crosswalks

Vertical deflection can slow drivers to prepare them to yield to trail users. Raised crossings should raise six inches above the roadway with a steep 1:6 (16%) ramp. Advisory speed signs may be used to indicate the required slow crossing speed.

Rectangular rapid-flashing beacon (RRFB)

Arterial Crossings

Signalized crossings provide the most protection for users through the use of a red-signal indication to stop conflicting motor vehicle traffic. Trail crossings within approximately four hundred feet of an existing signalized intersection with crosswalks are typically diverted to the signalized intersection to avoid traffic operation problems when located so close to an existing signal. If possible, route users directly to a signalized crossing. If the diversion to a signalized intersection is perceived out of the direct line of travel, trail users can be expected to cross at unmarked locations, which is hazardous for all users. If no signalized crossings are within the vicinity of the trail, use an appropriate crossing treatment as described in the previous section.

Signalized crossings are normally activated by push buttons or detection loops. The maximum delay for activation of the signal should be two minutes, with minimum crossing times determined by the width of the street.

Intersections with Other Trails

At the intersection of two trails, users should be aware that they are approaching an intersection and of the potential for encountering different user types from a variety of directions. This can be achieved through a combination of regulatory and wayfinding signage and unobstructed sight lines.

Trails should be aligned to intersect at 90° angles when possible, or consider off-setting the trail intersection and creating two three-way intersections rather than one four-way intersection. Merging paths should be avoided, and the connection should be configured as a T-intersection. Where merges are unavoidable or necessary for other reasons, an open sightline of 75 feet from the merge point should be provided between paths.

A roundabout may be a viable design option to slow speeds and clarify expected operation. If a roundabout design is used, consider the use of landscaping with low growing (no more than 24 inches high) and minimally spreading native shrubs and ground cover that require little maintenance and provide clear sight lines. Other material can be used within roundabouts such as boulders and public art to discourage shortcut paths through the central island as long as clear sight lines under three feet are maintained.

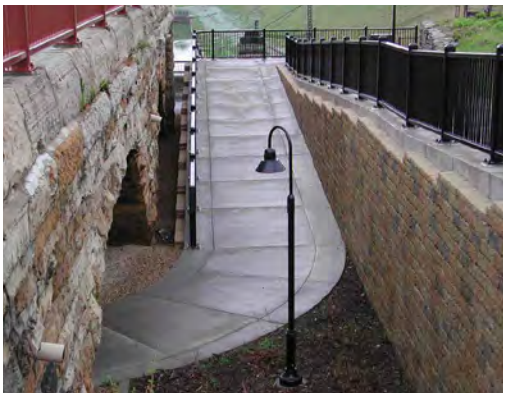
Railroad Crossings

Locations where trails must cross railroad tracks are problematic for pedestrians, particularly for those with mobility or vision impairments. Wheelchair casters and bicycle wheels can easily get caught in the flange-way gap, and slippery surfaces, degraded rough materials, or elevated track height can cause tripping hazards for all users. Angled track crossings also limit sight triangles, impacting the ability to see oncoming trains.

The crossing should be as close as practical to perpendicular with tracks. Ensure clear lines of sight and good visibility so that trail users can see approaching trains. The crossing must be level and flush with the top of the rail at the outer edge and between the rails. Flange-way gaps should not exceed two and a half inches (three inches for tracks that carry freight.) Concrete or rubber is the best material for pedestrian railroad crossings.

Bells or other audible warning devices may be included in the flashing-light signal assembly to provide additional warning for pedestrians and bicyclists. In areas with frequent train movements, pedestrian automatic gate arms or manually operated swing gates may help control trail user movements when a train is approaching.

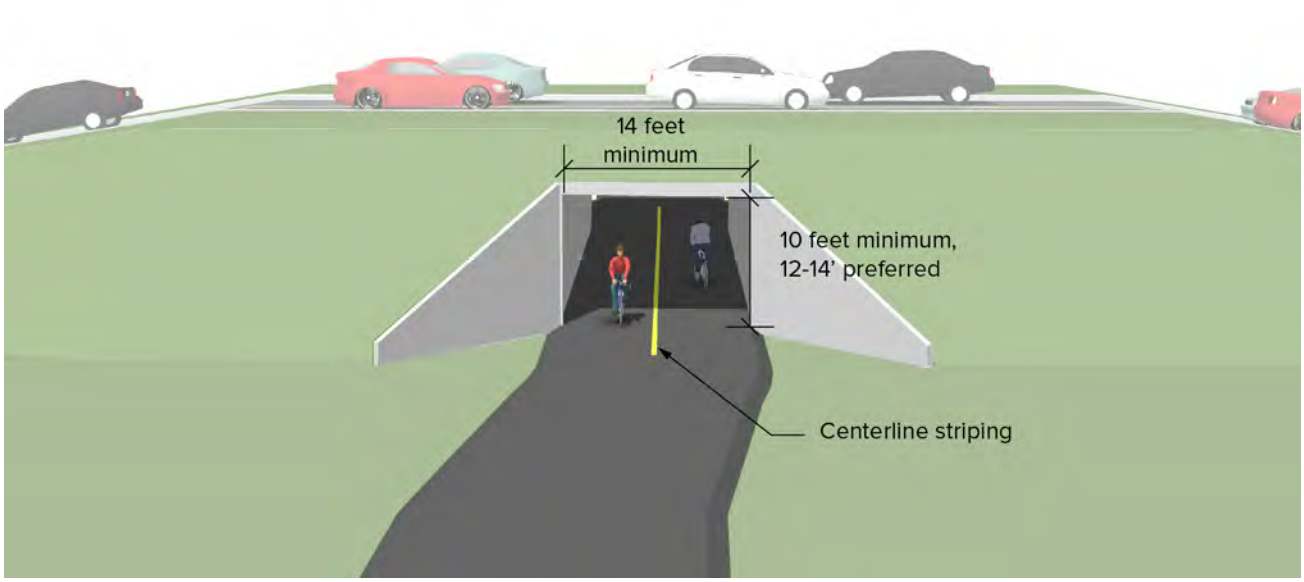
Crossing design and implementation is a collaboration between the railroad company and the highway agency. The railroad company is responsible for the cross-bucks, flashing lights and gate mechanisms, and the highway agency is responsible for advance warning markings and signs. Warning devices should be recommended for each specific situation by a qualified engineer based on various factors including train frequency and speed, path and trail usage, and sight distances.



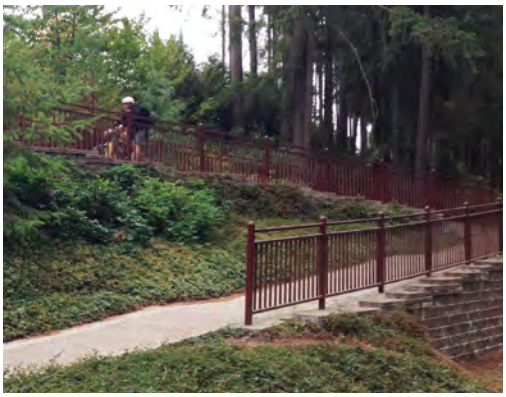
Undercrossings

Undercrossings can provide critical trail system links in areas separated by barriers such as railroads 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. Undercrossings must be a minimum of 14 feet wide, and greater widths are preferred for undercrossing lengths of over 60 feet. For maintenance vehicles, there must be a 10 foot minimum vertical clearance.

The undercrossing should have a centerline stripe, even if the rest of the path does not have one, to discourage passing movements. Safety is a major concern with undercrossings as path users may be temporarily out of sight from public view and may experience poor visibility. To mitigate safety concerns, an undercrossing should be designed to be spacious, well-lit, equipped with emergency phones at each end and completely visible for its entire length from end to end. Potential problems of undercrossings include conflicts with utilities, drainage, flood control, and vandalism.



Overcrossings



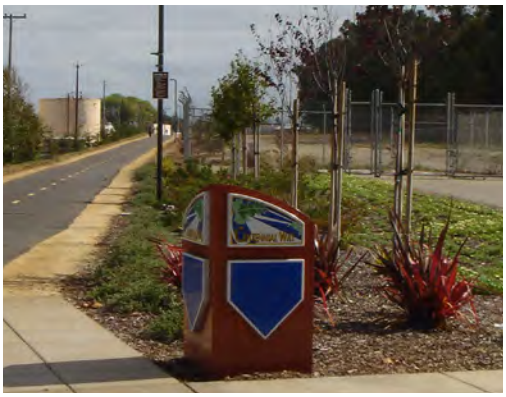
Bicycle and pedestrian overcrossings can be used to continue trails over large barriers such as deep canyons, waterways, or major roadways or rail yards. Overcrossings require a minimum of 17 feet of vertical clearance to the roadway below versus and elevation difference of 12 feet for an undercrossing. This results in greater elevation differences and much longer access ramps for bicycles and pedestrians to negotiate. Access ramps to overcrossings are limited to 5% slopes per the ADA. Level resting landings much be provided at four hundred foot intervals. Steeper grades will require more frequent landings.

Overcrossings pose potential concerns regarding visual impact and functional appeal, as well as space requirements for approach ramps. Overcrossings can be more difficult to clear of snow than undercrossings.

AMENITIES

When designing functional, attractive, and inviting trails, the small details matter. Elements such as a lighting fixtures, public art, benches, and other amenities help create a unique identity for a trail. It is important that these details work together to create a complete experience for all users. This section discusses the following amenities:

- Minor Access Points
- Major Trailheads
- Art
- Lighting
- Signage and Wayfinding



Minor Access Points

Trail access points can occur at parks, residential developments, or other logical points of interest. Any access point to the trail should be well-defined with appropriate signage designating the corridor as a shared-use trail and prohibiting motor vehicles. Well defined trail access points can prevent the development of informal "social" trails which can follow poorly executed routes and trample floodplain vegetation or sensitive areas. Typically, trail access points have very minimal infrastructure, possibly including a small parking lot, drinking fountains, benches, trash and recycling receptacles, an information kiosk, or wayfinding signage about the trail network.

Trailheads

Trailheads should be established near large residential developments, commercial areas, and transportation nodes to be highly accessible to the surrounding community and to the trail system. There is no prescription for the frequency of trailheads. Conduct user counts, vehicle counts, and surveys across the trail network at peak hours of use to determine parking and access demand. There may be opportunities to locate trailheads at existing public facilities or created through partnerships with owners of existing parking areas. Trailheads can include many amenities such as: automobile parking, bicycle parking, comfort stations, drinking fountains, trash and recycle receptacles, dog waste stations, bicycle repair stations, wayfinding and informational signage shelters, and picnic areas. Trail amenities should be placed no higher than four feet off the ground for accessibility. Trailhead signage should provide accessibility information, such as trail gradient/profile, distances, tread conditions, location of drinking fountains, and rest stops.

Parking

Major trailheads can provide parking for 10 to 40 vehicles, depending on availability of land and anticipated level of use of the trail. Minor access points can have small lots accommodating up to 10 vehicles. Typically trailhead parking lots are paved to accommodate vehicles year round. Parking lots should be located in existing disturbed areas to minimize environmental impacts, and vegetative screening can be used to reduce the visual impact of parking areas. Consider one-way vehicle circulation to reduce parking area size. Where major trailheads are located in or near neighborhoods, provide user access from local streets crossing the trail, and possibly install "No Parking" signs to minimize parking impacts on local streets.

Trailheads should provide emergency and maintenance vehicle access and turnaround. Place ADA accessible parking spaces near the site's accessible route, at a rate of one accessible space per 25 standard spaces. ADA parking spaces and access aisles should not exceed 2% slope in any direction, and the remainder of the lot surface should never exceed 5% slope in any direction.

Comfort Stations

There are a number of factors to consider before locating comfort stations, including available land, size of trailhead, existing comfort station facilities, utility availability, maintenance vehicle access, and user need. Prior to undertaking any comfort station building design, consultation with a structural and civil engineer, state building codes, health and safety codes, ADAAG and Public Rights-of-Way Accessibility Guidelines (PROWAG) standards, and local development codes is required.

The space required for each comfort station building depends on the number of toilets to be provided. Prioritize location of comfort stations at trailheads within existing parks and review gaps for placement at other trailheads or locations within the system. If other comfort station facilities are available within the park and trail system, use wayfinding signage along trails to direct users appropriately. Comfort station structures should be located adjacent to vehicular access points for security, maintenance, and access to water and sewer. Composting toilets should be considered in remote areas or where utility connections are unavailable. Always provide comfort station facilities outside of flood-prone areas.

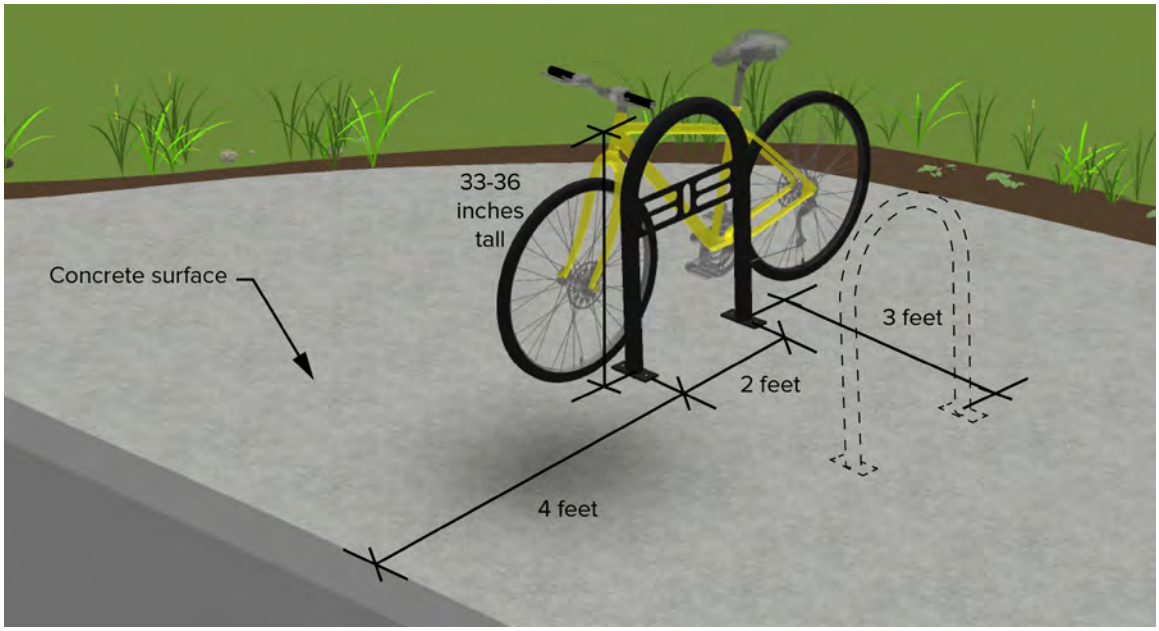
Comfort stations should also make use of natural light and ventilation to the extent possible, and should be constructed of durable materials resistant to vandalism. Bicycle parking should be provided close to comfort station structures so that bicyclists do not have to prop unsecured bicycles against comfort station buildings.

Bicycle Parking

Bicycle parking should be convenient, highly visible, and easily accessible from the trail. Bicycle parking should be located at comfort stations, select trailheads, points of interest, and rest stops. Signage may be desired to direct users to designated bicycle parking areas. Bicycle racks should be located on a hardscape surface and not be located directly in front of other trail amenities. Ideal rack location is parallel along the trail approach, no more than 25 feet from trail ingress/egress points and at least five feet from the edge of trail to avoid trail user conflict. Consideration should be given to avoid emergency ingress/egress, service access, and vehicular conflict areas.

The bicycle rack should support the bicycle in at least two places, preventing it from falling over, and the rack should allow locking of the frame and one or both wheels with a U-lock. Consider bicycle racks that resist cutting, rusting, bending, and deformation. A “staple” rack is an ideal rack type as it is easily recognizable, can accommodate bicycles of all sizes, and allows secure locking techniques.

When installing racks, ensure the rack is securely anchored to ground to prevent bicycle theft. On concrete surfaces, use .375 inch anchors to plate mount and shim as necessary to ensure vertical placement. When installing racks on pavers or other non-stable surfaces, embed the rack into the material base with core holes no less than three inches in diameter and 10 inches deep.



Bicycle Repair Stations

Bicycle repair stations are small kiosks designed to offer a complete set of tools necessary for routine bicycle maintenance and minor repairs. Popular locations for placement include major or minor trailheads and rest stops trails. Bicycle repair station tools are secured by high security cables, but will still be an attractive target for theft. Kiosks should be placed in areas of high activity to reduce potential vandalism. Consider grouping repair stations together with other amenities such as seating, bicycle parking, and drinking fountains at a rest stop.

Drinking Fountains

Drinking fountains provide opportunities for users to replenish fluids and potentially extend their trip. Locate drinking fountains near comfort stations, at trailheads, parks, and other public gathering places along the trail. Drinking fountains should be placed at least five feet from trail edge, and no higher than four feet off the ground to be ADA compliant. Drinking fountains should be placed on a well-drained surface (2% sloped concrete slab). Consider the use of durable and vandalism-resistant materials such as steel or stone.

Seating

Seating along trails provides a place for users to rest, congregate, contemplate, or enjoy art, nature, and interpretive elements throughout a trail. Benches can be designed to create identity along the trail or be strictly utilitarian. Picnic tables provide places for trail users to congregate for meals or to relax. Locate seating along the trail at one mile intervals where appropriate, or where there is a demand by users. Seating within half-mile of trailheads is recommended. Provide benches and picnic tables in areas that provide interesting views, are close to an interpretive element, and offer shade or shelter from wind. Benches and other site furniture should be located a minimum of three feet from the edge of the trail, a minimum of four feet from comfort stations and drinking fountains, or a minimum of two feet from trash and recycling receptacles, lighting poles, and sign posts. Wheelchair access should be ensured by providing compact, level surfaces at picnic tables and alongside benches. To prevent vandalism, seating should be securely anchored to hardened surfaces such as concrete or asphalt. Consider durable or native materials such as boulders that are vandalism-resistant.

Trash Receptacles

Trash and recycle receptacles are necessities for trail maintenance and appearance. Trash and recycling receptacles should be prioritized along more heavily used trail sections, at each trailhead, and each seating area (one per every one picnic table, one per every two benches). Placement of other receptacles will depend upon the location of concessions, facilities and areas of group activities. Receptacles need to be accessible to maintenance personnel and should be set back a minimum of three feet from the edge of the trail. For recycling receptacles, signage should be provided indicating which recyclables are accepted. Consider including educational signage about the importance of recycling and the environmental benefits.

Receptacles should be selected for the expected trash/recycling amount, maintenance and collection program requirements, durability, and animal-resistance. In areas with adequate sunlight, consider compacting receptacles for trash and recyclables that use smart technology.

Art

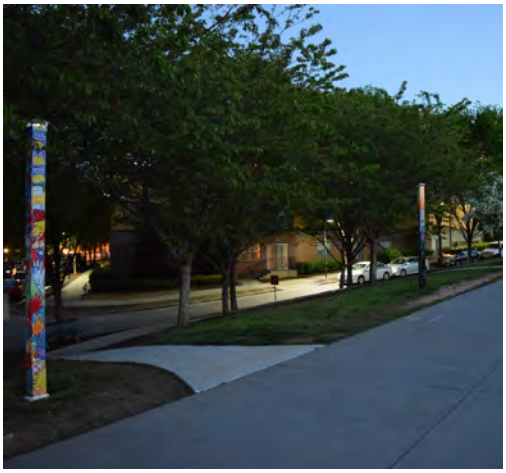
Including public art on trails can engage the local community and create an identity for the trail. Public art can be aesthetic or functional, doubling as seating or shelter, and depending on the scale and form, an activity in itself to serve as a public attraction. Memorable art installations can act as landmarks and serve as valuable wayfinding tools. Public art can also be a used as an interpretive device for telling a compelling story about the trail and area history.

Art can be placed at one or multiple locations along trails. Provide art displays on trails with anticipated high use and user exposure. Key locations such as turns or landscape changes could be areas to highlight through the inclusion of public art. When appropriate, artists can be engaged as part of the corridor planning and development process.

Artists should be encouraged to produce artwork in a variety of materials for sites along the corridor. Consider developing furnishings and amenities with artistic intent and providing continuity between elements while maintaining the unique styles of multiple artists. Community-based art and temporary installations are also effective ways of integrating public art into a trail.

Lighting

Lighting for trails should be analyzed on a case-by-case basis with full consideration of the maintenance commitment lighting requires. Lighting can improve visibility for day time use in tunnels and underpasses, and night-time use along the trail and intersection crossings. Lighting can provide extended operation hours for all trail users, which should be considered particularly during winter months when trips to and from work are often made before sunrise and after sunset. Dependent upon trail hours, consider lighting in urban and/or commercial land use areas. Recommended locations for lighting include trailheads and parking areas, comfort stations, trail intersections, entrances and exits of bridges and underpasses and in tunnels, and street crossings. Lighting spacing along trails depends on the type and intensity of lights, though thirty to fifty feet spacing is common for pedestrian scale lighting. Solar powered lighting is available where utility collection is difficult or when alternative energy sources are desired. Lighting is generally not appropriate for trails in remote areas, trails with low use, or where there is little to no development.



Lighting should respond to the conditions of the site and meet the minimum standards set forth by the Illuminating Engineering Society of North America (IESNA). Full cut-off fixtures, or luminaries with no direct uplight, should be used to reduce light pollution. These fixtures also limit direct glare or excessive illumination on to adjacent properties, streets, or sidewalks.

Trail lighting should be at pedestrian scale, but avoid light fixtures at eye level that could impair visibility. Pedestrian scale lighting is typically about 15 ft tall, has lower levels of illumination, and closer spacing to avoid dark zones between lights. Pedestrian scale light fixtures are typically high pressure sodium vapor or metal halide lamps, which produce better "white light" than sodium vapor lamps. LEDs are the preferred lighting bulb as they offer a wide range of light levels and can reduce long term utility costs. Average horizontal illumination levels are 0.5 to two foot candles or five to 22 lux (AASHTO, Section 5.2.12).

Signage and Wayfinding

A comprehensive system of signage ensures that information regarding the safe and appropriate use of all facilities, both on-road and on shared-use paths. The bicycle and trails networks should be signed seamlessly with other alternative transportation routes, such as bicycle routes from neighboring jurisdictions, trails, and local transit systems. Signage includes post- or pole-mounted signs and pavement markings. Signage is further divided into information signs, wayfinding signs, regulatory signs, and warning signs. All signage should conform to the Manual on Uniform Traffic Control Devices and the American Association of State Highway Transportation Official Guide for the Development of Bicycle Facilities.

Wayfinding Signage

The ability to navigate through a city or across a trail network is informed by landmarks, natural features, and other visual cues. Wayfinding signs indicate:

» Direction of travel

» Location of destinations

» Designated bike routes or trails

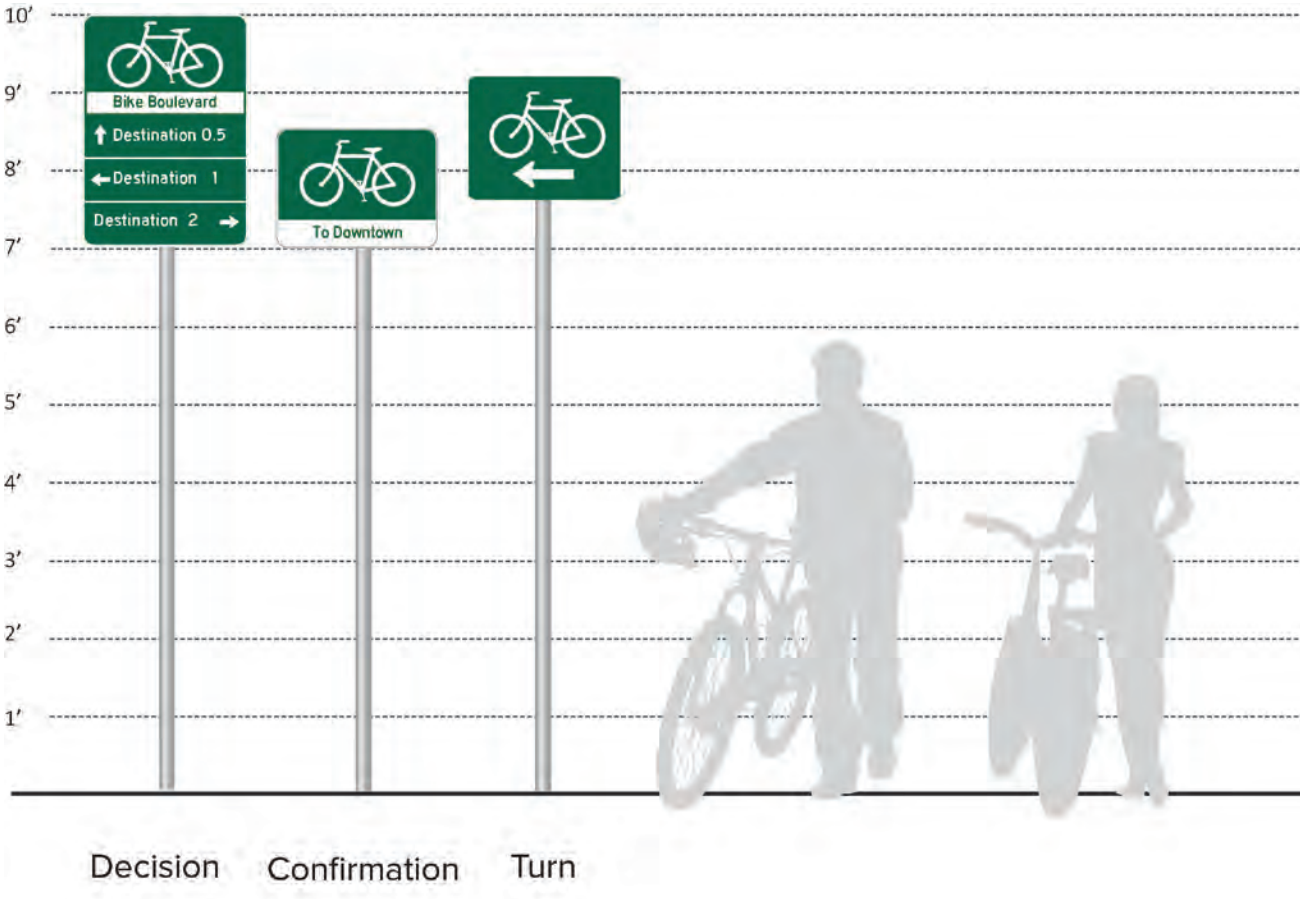
Wayfinding signage serves many purposes, including familiarizing users with a trail system, helping users and emergency responders identify locations, marking designated bike routes, and labeling trail access points. Wayfinding signs also visually cue motorists that they are driving near a trail corridor and should use caution. There are three general types of wayfinding signs:

Decision Signs mark the junction of bikeways and/or trails and inform users of the route options to access key destinations. Destinations, arrows, distances, and travel times are included on decision signs.

Confirmation Signs indicate to bicyclists that they are on a designated bikeway and make motorists aware of the bicycle route. This signage can indicate a single regional destination and distance/time, but does not include arrows or a full list of destinations.

Turn Signs indicate with arrows where a bikeway turns from one street onto another street or trail. This signage can be used in conjunction with pavement markings.

Section 1A.12 of the MUTCD establishes the general meaning for sign colors. Green is the color used for directional guidance and is the most common color of bicycle wayfinding signage in the US. Custom community wayfinding signs may use other MUTCD allowed colors, and include pedestrian-oriented travel times and designs such as local town logos or sponsorship branding.



Sign Placement

Signs are typically placed at decision points such as the intersection of two or more bikeways or trails, and at other key locations leading to and along bicycle and pedestrian routes. 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 five 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.

Decision Signs are placed on the near-side of intersections in advance of a junction with another bicycle route, and along a route to indicate a nearby destination.

Confirmation Signs are placed every quarter to half mile on off-street facilities and every two to three blocks along on-street bicycle facilities, unless another type of sign is used (e.g., within one hundred fifty feet of a turn or decision sign). Confirmation signs 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 are placed on the 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.

Regulatory Signs

Regulatory signs give a direction that must be obeyed, and apply to intersection control, speed, vehicle movement, and parking. The examples below are types of regulatory signs that could be integrated into a signage program. Smaller scale signs or plaques may be used for trail applications. See the MUTCD 9B for a detailed list of regulatory sign application and guidance.

Etiquette Signage

Informing trail users of acceptable etiquette is a common issue when multiple user types are anticipated. Yielding the right-of-way is a courtesy and yet a necessary part of a safe trail experience. The message must be clear and easy to understand. The most common trail etiquette systems involve yielding of bicyclists to pedestrians. Trail etiquette information should be posted at access points and periodically along the trail.

Interpretive Signage

Interpretive displays provide trail users with information about the surrounding environment or site, wildlife, vegetation, history, and the significance of cultural elements. Interpretive displays may also be combined with public art and sculpture opportunities along the trail. Consider the character of the trail and surrounding elements when designing these signs. Work with experts specific to the information you are conveying on the signs such as historians, ecologists, or artists. Separate interpretive signage panels from the main trail circulation so that users can stop and not impede traffic Consider including interpretive signage at rest stops or areas of congregation. Panels must be ADA accessible. Consider use of technology for interpretation.

Informational Kiosks and Message Centers

Kiosks and message centers provide trails users with information to orient themselves, learn of areas of interest, read the rules and regulations of the trail system, and find the hours of operation. Kiosks should be installed at each major and minor trailhead. When locating kiosks next to parking facilities, set the units back far enough from traffic and protect the support posts or structure with appropriately sized barriers. Evaluate the use of emerging technology options for implementation of information and messages as part of the signage program.

MAINTENANCE

Regular, routine maintenance on a year-round basis will not only improve trail safety, but will also prolong the life of the trails. Maintenance activities required for continuous, safe trail operations should always receive top priority. This section discusses:

- General Trail Maintenance
- Winter Trail Maintenance
- Temporary Trail Closures

General Trail Maintenance

A high level of trail maintenance is critical to the overall success and safety of the trail system. Maintenance includes such activities as pavement stabilization, landscape maintenance, facility upkeep, sign replacement, fencing, mowing, snow removal, litter removal, painting, and pest control. However, the effects of a good maintenance program are not limited to the physical and biological features of the trails. A high standard of maintenance is an effective way of promoting use of trails, and is necessary to preserve positive public relations with adjacent land owners. Moreover, the psychological effects of good maintenance can be an effective deterrent to vandalism, litter, and encroachments. A successful maintenance program requires continuity and a high level of citizen involvement. Scheduled trail Inspections and volunteer patrols can prevent maintenance issues and ensure rapid identification of problems. In addition to scheduled inspections, the following table is a list of maintenance needs and suggested frequency of completion:

MAINTENANCE TASK	SUGGESTED FREQUENCY
Major damage response (fallen trees, washouts, flooding)	Immediately
Site furnishings; replace damaged components	As needed
Graffiti removal	Weekly; immediately as needed
Shrub/tree irrigation for introduced planting areas	Weekly during summer months until plants are established
Trash disposal	Weekly during high use; twice monthly during low use
Litter pick-up	Weekly during high use; twice monthly during low use
Fencing repair	Inspect monthly for holes and damage, repair immediately
Inspections	Daily routine inspections; seasonal detailed inspections (4 times/year); immediately after wind storms or flood events
Pavement sweeping/blowing	As needed; before high-use season
Culvert inspection	Before rainy season; after major storms
Maintaining culvert inlets	Inspect before onset of wet season
Lighting repair	Monthly; annually
Shoulder plant trimming (weeds, trees, branches)	Bi-annual (Fall or Spring)
Sign repair/replacement	1-3 years
Pavement markings replacement	1-3 years
Introduced tree and shrub plantings, trimming	1-3 years
Pavement sealing; pothole repair	5-15 years
Comfort station maintenance	Daily

Trail Surface

To maintain a smooth trail surface, cracks, ruts, potholes, and water damage will have to be repaired periodically. The trail surface should be swept regularly to keep them free of debris, especially broken glass and other sharp objects, loose gravel, leaves and stray branches. Sweeping should be scheduled based on location, for example, path segments in forested areas will tend to accumulate plant litter such as leaves and pine needles and should be swept more frequently in order to maintain safe surface conditions.

Drainage

Where drainage problems exist along the trails, ditches and drainage structures will need to be kept clear of debris and periodically cleaned or flushed to prevent trail wash outs. Checks for erosion along the trails should be conducted immediately after any storm that brings flooding to the trail area.

Vegetation Management

In general, plantings alongside a trail should allow trail users clear views of their surroundings to avoid creating the feeling of an enclosed space. Understory vegetation along trail corridors should not be allowed to grow higher than three feet, and any overhanging branches over the trail should be pruned to a minimum vertical clearance of 10 feet. Tree canopies may also need to be trimmed for light fixtures or overhead utilities. Thus vegetation management will require a regular schedule of mowing, pruning, trimming, plant replacement, and tree removal as needed. Tree and plant species along a trail should be selected to minimize vegetative litter and prevent root uplifting of the trail pavement. To maintain ideal plant selections, trails also require brush removal during installation to prevent invasion of unwanted plants, and regular weeding.

Facilities and Signs

Trailhead amenities and trail signs will require regular maintenance and visual inspections. Facilities including parking lots, picnic tables, trash receptacles, and comfort stations will need scheduled cleanings. Signs such as informational kiosks, directional signs, or distance markers should be periodically checked for graffiti or damage to the sign face or post.

Graffiti

Graffiti not only affects trail aesthetics; it can also encourage other undesired behaviors, such as littering, crime, and more graffiti. The appearance of graffiti and litter is perceived as an indicator that an area is in decline. Rapid removal of graffiti and illegally dumped materials is critical to maintaining a safe facility and conveying to the community that the trail is cared for and regularly observed. Signage should be posted at trailheads indicating a contact number to report graffiti and illegal dumping.

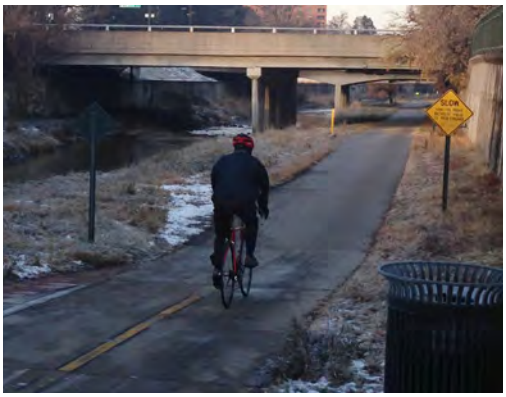
Winter Maintenance

Paved multi-use trails require significant public investment and should be used to their fullest potential year-round. Fortunately, the fleeting nature of snow allows for flexibility and creativity in dealing with it from storm to storm and season to season. The decision to clear or leave a trail unmaintained should be the result of a public decision making process involving officials, residents, and stakeholders. The decision will necessarily be based on the demand for different activities on each trail segment and the physical and budgetary constraints associated with winter pathway maintenance. Any changes to winter maintenance operations along paved paths should be made by early spring so that the appropriate changes can be made to maps and signage in time for the upcoming winter season. Appleton should produce a winter trails maintenance plan with prioritized trails that will require snow removal.

Snow Removal

Snow removal should be considered for trails that provide key connections to bicycle or pedestrian destinations. If clearing a trail or segment of trail will help to improve winter pedestrian or bicycle safety, serious consideration should be given to snow removal, unless it would place undue burden on city resources. If it is decided that a segment of trail is to be cleared in the winter, every effort should be made to ensure that the trail remains free of ice to prevent slipping injuries. This will likely require ongoing inspection between snow events to ensure that ice buildup and drifting snow is removed promptly. Salt, sand, or de-icing solution should only be used if special circumstances warrant; such as severe ice buildup or freeze thaw cycles on the trail surface. Salt or de-icing solutions will create runoff damaging to vegetation, and sand should be used in limited amounts for traction concerns and because sand can become stuck in a bicycle's gears and chain. Gravel application should be avoided as the

smaller tire width of bicycles does not adequately grip to larger aggregate and may cause cyclists to lose control and fall. Snow stakes should be used along all paths intended for clearing in order to ensure that only the paved surface is cleared and the adjacent vegetation is not damaged. Note that snow removal on some trails can also accelerate the need for major trail maintenance or reconstruction during summer months.



No Snow Maintenance

As snow removal is a significant expense, in some cases it may be preferable to not provide snow maintenance. The decision not to maintain a trail during the winter should be made as part of an open public process that clearly presents the mobility, recreational, and budgetary impacts of that decision. Snow can act as an insulating layer and help prevent pavement heaving or other damage. However, as the snow melts in the spring, paved paths can emerge from winter operations covered in dirt and debris. Because residents and visitors will begin using these facilities in the spring, every effort should be made to sweep and clear these facilities as early as practical. Lingering patches of snow should be cleared to provide a safe smooth surface for bicyclists and pedestrians. Signage along paved paths can also sustains significant damage from natural snow movement. Any signage that is missing should be replaced and any striping or stenciling that has become well worn should be repainted. This is also an opportunity to remove any irrelevant or misleading signage and add any additional signage that may be relevant to upcoming summer and winter trail activities.

Temporary Trail Closures

Partial or full sections of the trail may need to be closed for regular or emergency maintenance of the facility. Trail access for users will need to be managed during these closures. Signs should be posted at all trail entrances on the impacted segments to be closed indicating the length and duration of the closure. Notice of closure should be publicly posted forty eight hours in advance, unless in case of emergency. Trail closures should have physical barriers, and detour signs to alternate routes. The trail should not be re-opened until it has been inspected to ensure that the trail is in usable condition. Where obstructions remain, warning signs should be placed for trail users to slow down or dismount, where needed.

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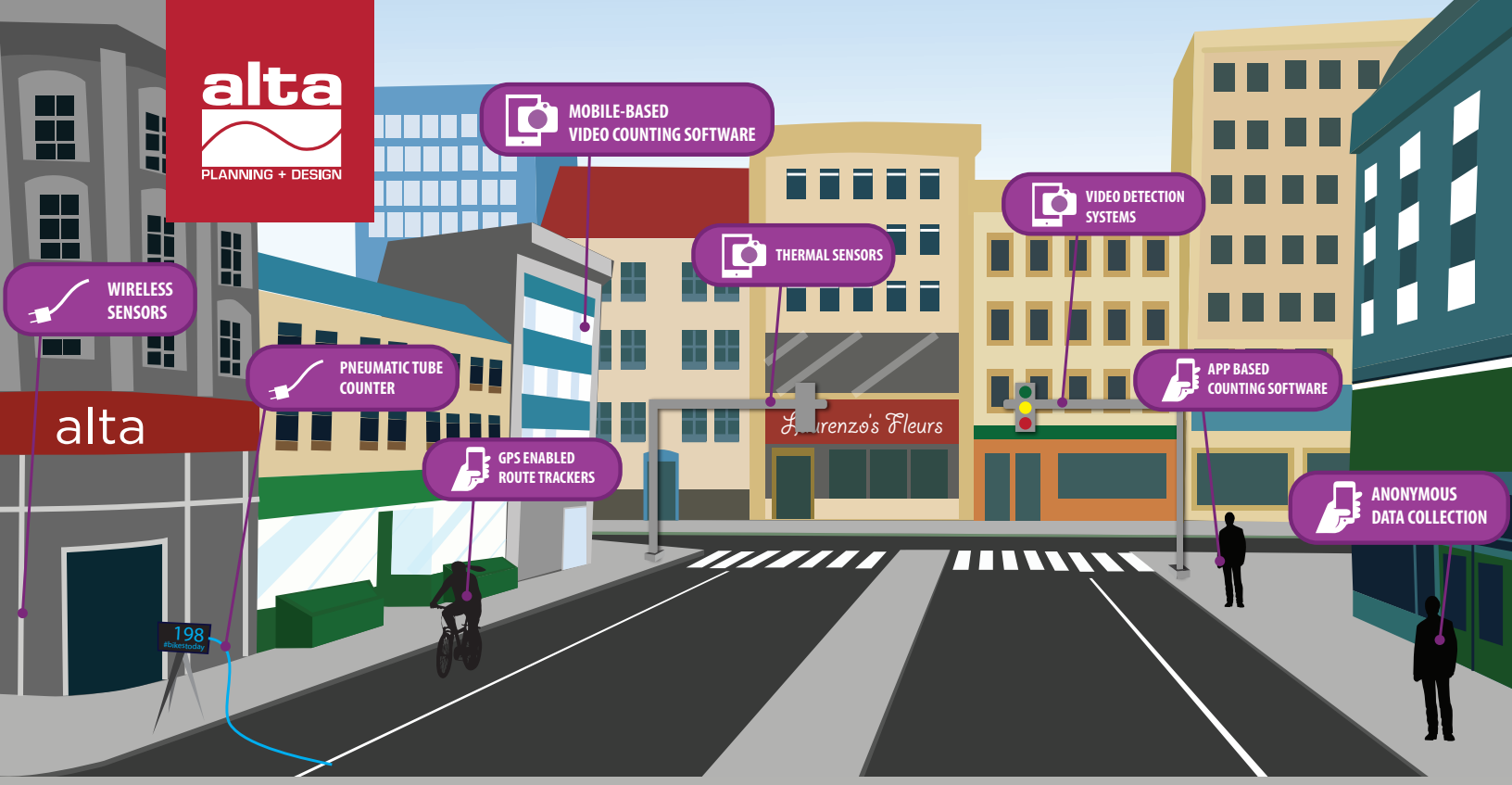
INNOVATION IN BICYCLE AND PEDESTRIAN COUNTS



Innovation in Bicycle and Pedestrian Counts

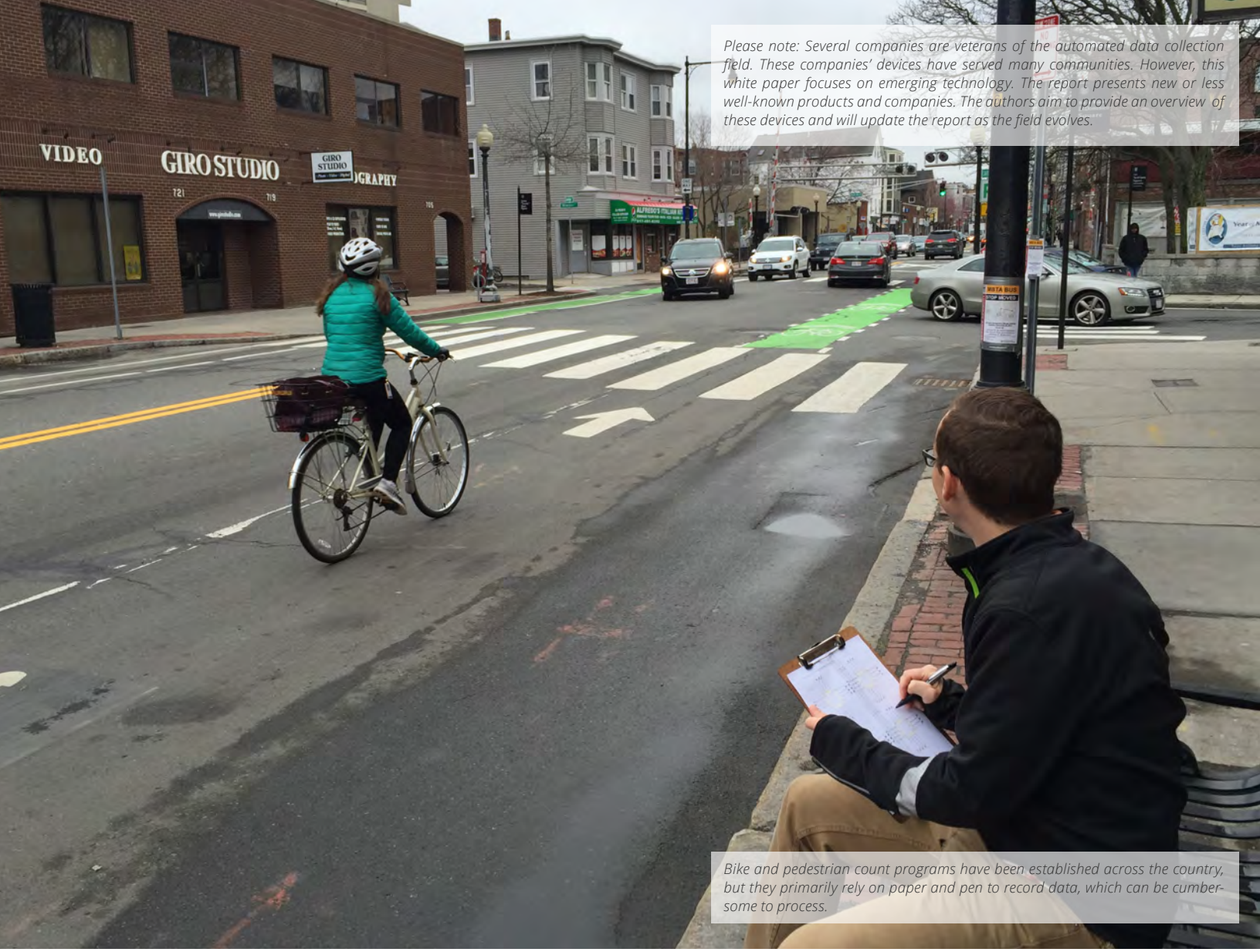
A Review of Emerging Technology

Summary

To create better facilities for people walking and biking, and to locate these facilities where demand and need is the highest, transportation professionals need reliable data to guide decision-making. Historically, collecting active transportation data has been both time and resource intensive. Although many communities have established robust count programs, there are still funding, quality control, and data management limitations. New technologies are emerging that aim to change the way active transportation data is collected, making it less expensive and easier to collect, resulting in more reliable data. This report provides a review of these technologies and their applications.

Contributors: Hugh Louch, Brad Davis, Kim Voros, Kristen O'Toole, and Sam Piper, Alta Planning + Design
This white paper is based on research leading to online publication in Spring 2016. The report is based on findings as of this date.

Please note: Several companies are veterans of the automated data collection field. These companies' devices have served many communities. However, this white paper focuses on emerging technology. The report presents new or less well-known products and companies. The authors aim to provide an overview of these devices and will update the report as the field evolves.



Bike and pedestrian count programs have been established across the country, but they primarily rely on paper and pen to record data, which can be cumbersome to process.

Introduction

Rates of active transportation have increased nationally over the past fifteen years, driven by steady growth in better walking and bicycling infrastructure. As this trend continues, transportation professionals have become frustrated by a general lack of bike and pedestrian count data. Having access to more robust data is important for several reasons:

» Data helps to determine where investments in walking and biking infrastructure are most needed

» Data makes it possible to assess changes over time, draw conclusions about the impact of new facilities, and improve the design of future facilities

» Data helps to quantify the benefits of walking and biking, which ultimately makes active transportation projects more competitive for funding

» A federal-level initiative, the US Department of Transportation's Mayor's Challenge for Safer People, Safer Streets, calls for improved walking and bicycling data collection

One of the most persistent challenges facing the bicycle and pedestrian field is the lack of usage and demand documentation. Without accurate and consistent count data, it is difficult to measure the positive benefits of investments in these forms of transportation, especially when compared to other modes, such as the private automobile. Fortunately, current and emerging technologies can capture and process non-motorized data efficiently and economically. This report provides a review of these technologies and how they can be integrated into bike and pedestrian count programs.

NATIONAL BIKE AND PEDESTRIAN DOCUMENTATION PROJECT

In 2004, Alta Planning + Design and the Institute of Transportation Engineers (ITE) Pedestrian and Bicycle Council established the National Bicycle & Pedestrian Documentation Project (NBPD).* This nationwide effort provided a consistent model of data collection for use by planners, governments, and bicycle and pedestrian professionals. Before the program, there were few systematic and coordinated efforts to include bicycle and pedestrian movements in count data.

The NBPD specifies that standardized counts should occur twice a year, in the spring and the fall. Communities record activity at key locations during two-hour morning and afternoon 'peak-commute' periods on weekdays (Tuesdays, Wednesdays, or Thursdays). A Saturday count precedes or follows the official count dates. Typically, cities and towns enlist volunteers to staff the various locations. Since its inception in 2004, hundreds of cities and towns across the country have used this methodology to count bicycle and pedestrian activity within their communities. The NBPD project has succeeded in changing the way these cities and towns collect active transportation data. However, after nearly a decade of operation, challenges to the program have become apparent:

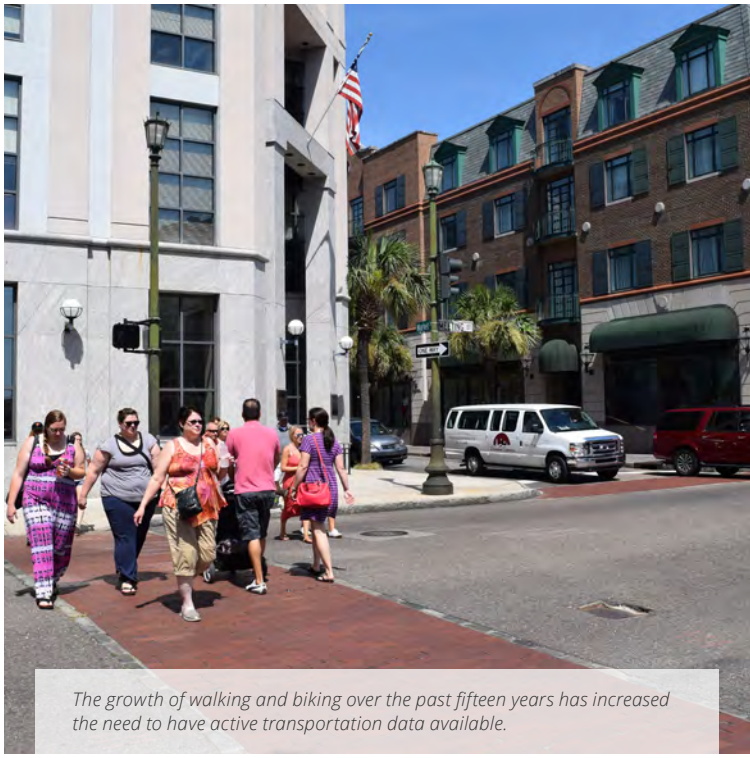
» Two-hour AM and PM count periods provide invaluable data, but planners have difficulty making annualized assumptions from this data. A single day does not represent typical travel patterns. National Cooperative Highway Research Program (NCHRP) Report 797: Guidebook on Pedestrian and Bicycle Volume Data Collection found, "the error in estimating average annual bicycle traffic from two-hour, 12-hour, or even one-week counts can be up to 40%" (TRB, 2015, http://www.trb.org/Main/Blurbs/171973.aspx). Conversely, annualized vehicle count data is readily available. Annualized data is critical because it provides the ability to understand change and forecast trends. Without comparable annualized walk and bike figures, it is more difficult to make a case for investments in these modes.

» Bicyclists and pedestrians have different travel habits than motor vehicles – trips tend to be shorter and distributed throughout the day. These factors make it more difficult to reliably capture their activity with two hour counts.

» Enlisting volunteers to staff counts is time consuming, and organizing volunteers can be a burden for municipal employees who have limited time and budget available to dedicate to this important task.

» Non-motorized counts are still primarily conducted with paper and pen. Staff digitize these records after data collection. This process can be time consuming, making data analysis a tedious task.

**Now called the ITE Pedestrian and Bicycle Standing Committee.*



The growth of walking and biking over the past fifteen years has increased the need to have active transportation data available.

Alta is not advocating for the cessation of manual count programs. Alta recognizes that integrating technology into count programs will be a gradual process that will take time. Manual programs have many benefits, including the following, which are listed in no particular order:

- They are great community building exercises that help to engage advocates and highlight the importance of walking & biking.
- Some communities may not have the resources to purchase and install automated counters, making manual count programs the most economical option. In the event that an automated program cannot be implemented, manual counts should continue to be conducted as usual.
- They can quickly produce data in locations of interest (e.g., high-crash locations, corridors that are under review for design changes).
- They can be combined with automated technology, such as mobile applications that replace clipboards with counting boards or screens.
- They are used before deploying automated devices to study a given location's suitability for automated counters. They are also used after automated devices are installed to calibrate and confirm data collected through automated means.

SHORT- AND LONG-TERM COUNT TECHNOLOGY FROM EXISTING LITERATURE AND PRACTICE

NCHRP Report 797: Guidebook on Pedestrian and Bicycle Volume Data Collection compares several types of automated equipment designed to count people walking and bicycling. The report aims to compare different solutions' accuracy, precision, and suggested uses. Due to federal funding, the NCHRP report cannot specify which brands were tested to create the report. This section discusses selected technology types discussed within the NCHRP report and similar references, such as the FHWA Traffic Monitoring Guide (TMG).

SHORT- AND LONG-TERM PEDESTRIAN COUNTERS

Pedestrian counters often use an infrared beam to count people passing a counting point. Active infrared devices are composed of a transmitter and a receiver. An infrared beam travels through the middle, undetected by the human eye. The device counts a person when they break the beam.

Similarly, passive infrared devices project an infrared beam from a fixed point. Anyone within the beam's cone shape is counted. TrailMaster, TRAFx, and EcoCounter are three commonly-used infrared count device manufacturers.

SHORT- AND LONG-TERM BICYCLE COUNTERS

Bicycle counters come in a number of shapes and sizes. Most cities with count programs use one of a handful of data collection options. Pneumatic tubes are appropriate for short-duration counts. They sit on the surface of a roadway and record bicycle traffic. Specialized filters allow the devices to "ignore" motorized traffic that passes over the tubes. EcoCounter and MetroCount are two companies that create bicycle-specific pneumatic tubes as well as other types of traffic monitoring technology. Longer duration counts are possible by using a number of technology types including inductive loops, magnetometers, piezoelectric strips, radar sensors, and thermal imaging. The NCHRP Report 797, Traffic Monitoring Guide, and NBPD outline these and other types of technology. Inductive loops, magnetometers, piezoelectric strips, and radar sensors are embedded in the pavement and detect bicycles as they pass the respective sensor. Thermal imaging cameras are affixed to existing poles within the right of way and capture bicyclists' heat signature as they ride within a counting zone. Video imaging is suitable for long- or short- duration count periods. Subsequent sections will discuss emerging thermal and video imaging solutions.

Table 1. Counter Types from Existing Literature and Practice

Technology Type	Common Manufacturers	User Type	Duration	Typical Uses
Infrared (Active and Passive)	• TRAFx • EcoCounter • TrailMaster	*Does not automatically distinguish between peds/bikes.*	Short or long	Sidewalk or shared-use path
Pneumatic Tubes	• EcoCounter • MetroCount • TRAFx • Road Sys		Short	On-road
Inductive Loop	• EcoCounter • Road Sys		Long	On-road or paved shared-use path
Magnetometer	• TRAFx		Long	Shared-use path
Piezoelectric	• MetroCount		Long	On-road
Radar Sensors	• Sensys Networks		Long	On-road
Thermal Imaging	• FLIR		Long	On-road
Video Imaging	• Miovision		Short or long	On-road

Again, the NBPD has been an extremely successful program. Countless communities have used the data to build better facilities for walking and biking. Many of the program's issues are due to it being a product of its time; in 2004, when it was launched, paper and pen was the only low-cost option for data collection (Facebook had its first birthday in 2004, the first iPhone was not released until 2007, and the first iPad not until 2010). The wireless tech-revolution that has occurred over the past 10 years has ushered in new tools to facilitate non-motorized data collection. As these products scale up, their prices fall, creating a marketplace that is changing the way we can monitor traffic.

Active Infrared

Passive Infrared
(Source: ecocounter.com)

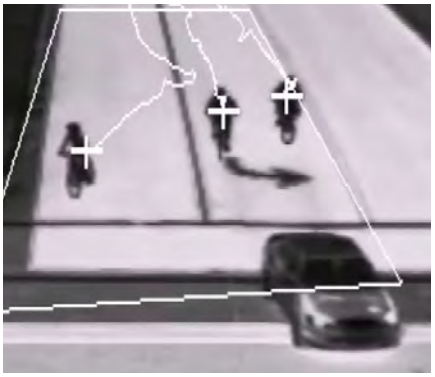
Pneumatic Tubes

Inductive Loops

Magnetometer. (Source: trafx.net)

Piezoelectric Strips/Tubes

Radar Sensors (Source: Twitter user Dongho Chang, Traffic Engineer, Seattle Department of Transportation)

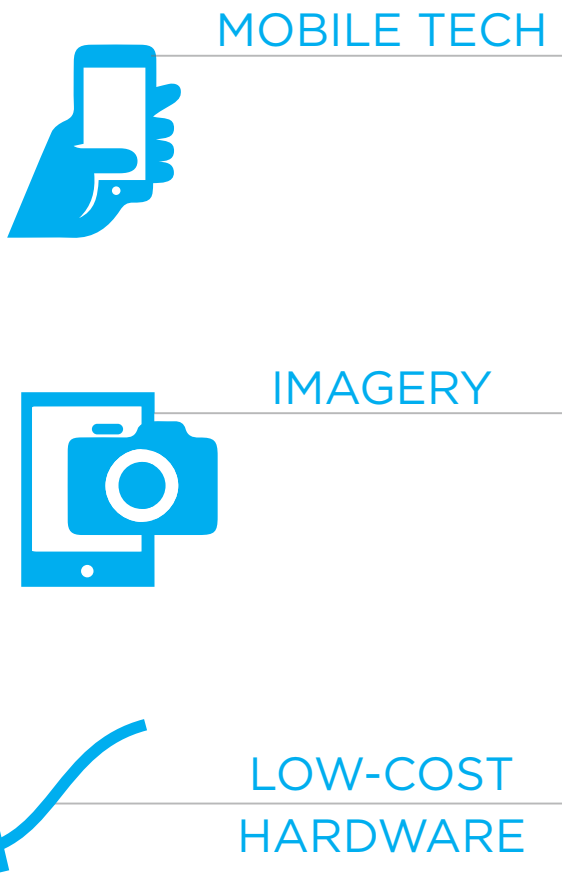


Thermal Imaging (Source: Popular Mechanics)

Video Imaging (Source: Iteris)

Innovative Counting Technologies

Several cities are leading the way in using mobile devices to measure increasing levels of bicycle traffic. Several others would like to retire their clipboards and install higher-tech, automated machines. Until very recently, such programs were cost prohibitive. New technologies can reduce the cost of non-motorized data collection, analysis, and visualization. These market disrupters have the potential to provide a variety of services, while frequently costing a fraction of traditional counting equipment. The following section outlines several services and corresponding technological solutions. The technologies that are emerging can be grouped into the categories listed below, and the graphic on page six summarizes the technologies reviewed.



Device Accuracy:

No independent authority has yet conducted a peer review of these devices' accuracy. At this time, the devices offer varying margins of error. Interested parties should contact the device suppliers to learn more about potential devices and their precision and accuracy.

Device Cost:

Device costs vary based on a number of factors. Costs are based on the price of purchasing counting units, but may also include additional charges for data processing (i.e., an hourly processing rate). Some companies allow users to utilize their own, pre-existing cameras as counting devices. In these cases, prices will differ, since they may not involve data processing but not hardware purchase costs.

INNOVATIVE COUNTING TECHNOLOGIES

Alta Planning + Design has been at the forefront of non-motorized data collection since its co-establishment of the National Bike and Pedestrian Documentation Project in 2004. New technologies are emerging that make it easier and cheaper to collect bike and ped data. Alta is assessing these technologies. The most promising are listed below, grouped by type. The relative cost of each is also identified.

$ Least Expensive $$ Moderately Expensive $$$ Most Expensive ? Prototype Stage

MOBILE TECH

APP BASED COUNTING SOFTWARE

- COUNTERPOINT $

GPS ENABLED ROUTE TRACKERS

- STRAVA METRO $$$
- RIDE REPORT $

ANONYMOUS DATA COLLECTION

- AIR SAGE $$

IMAGERY

VIDEO DETECTION SYSTEMS

- ITERIS $
- MIOVISION SCOUT $$

VIDEO COUNTING SOFTWARE

- PLACEMETER $$

THERMAL SENSORS

- VIP BIKE SENSOR $$ to $$$

LOW-COST HARDWARE

PNEUMATIC TUBE COUNTER

- WAYCOUNT $ to $$$

WIRELESS SENSOR

- NUMINA $$
- ARRAY OF THINGS ?

MOBILE TECHNOLOGY

Mobile applications and devices can harness human action to count a variety of road users, track their travel, and measure the quality of transportation infrastructure.

COUNTERPOINT (APP BASED COUNTING SOFTWARE)

Counterpoint is a mobile app designed to "make it easy to count traffic." It provides the ability to make your own counting site or add to an existing site. Tap specific buttons to record who uses the public realm during your counting session. The app also boasts robust traffic categories that are more nuanced than traditional pen and paper tallies, including user-friendly options such as "baby in stroller", "oversized bike", and "visually impaired pedestrian."

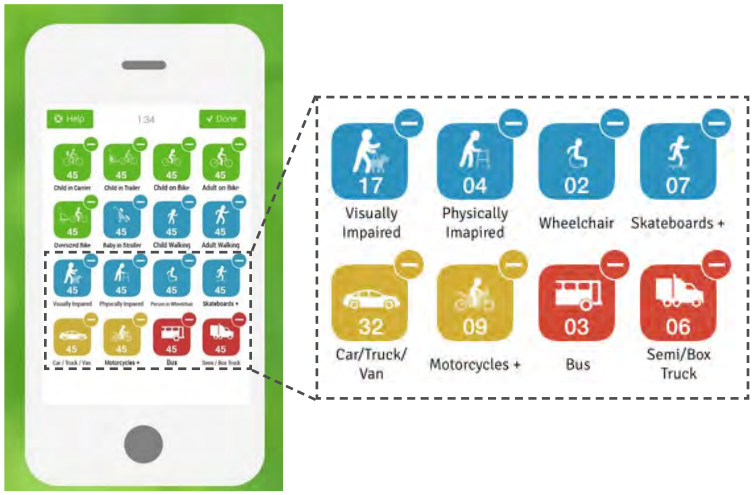
STRAVA METRO, CYCLETRACKS, AND CYCLE ATLANTA (GPS ENABLED ROUTE TRACKERS)

Many people who bike or jog use Strava or related apps to track their distance, speed, and route. Portland Bureau of Transportation (PBOT) made history a few years ago when they decided to purchase a large Strava-collected data set. Cities around the world have since purchased Strava data sets to get a sense of their cities' own trip patterns.

Although the data tends to capture recreational riders, whose gender and ethnicity do not typically represent the overall population, the data is useful to generally determine what routes people are riding. Strava is currently working with municipalities to identify the shortcomings of the data and tailor it better to cities' needs. Eighteen cities have adapted a similar app, CycleTracks, originally created for data collection in San Francisco in 2010. The application's code is open

COUNTERPOINT

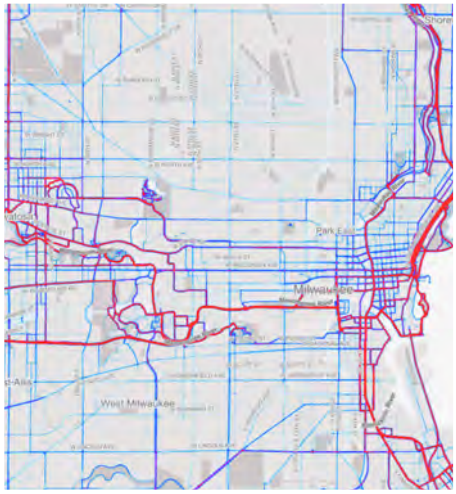
Creator Name:	Green Action Centre
User Type:	
Pros:	• Free • Easy to Use
Cons:	• Does not replace manual counting
Typical Uses:	• Crowdsourced or semi-automated volunteer-collected counts • Short-term research projects
Cost	$
Installation	Easy
Data Extraction	Mobile device



Counterpoint app screenshot (Source: http://counterpointapp.org/)

STRAVA METRO

Creator Name:	Strava, Inc.
User Type:	
Pros:	• Easily readable heat maps • Potentially high number of users per city because of crowd-sourced data
Cons:	• Potential bias towards recreational riders, especially white, older males
Typical Uses:	• Coupled with additional data sources to assist with bicycle infrastructure planning
Cost	$$$
Installation	Easy
Data Extraction	Mobile device



Heatmap of Milwaukee/Wauwatosa, WI. Red shows popular routes (Source: labs.strava.com/heatmap/)

source (http://github.com/sfcta). Cycle Atlanta (cycleatalanta.org) was created to help the City make decisions about locations for new bicycle infrastructure. App users could also submit data about their experience along a given route.

RIDE REPORT (GPS ENABLED ROUTE TRACKER + HARDWARE)

Another app, Ride Report, shares a similar mission to Strava. Once downloaded, the app automatically logs any bicycle trip. Over 20,000 people in Portland have used the app, generating a continuously updating map that displays the ease or stress of bicycling the city's streets. Ride Report's creators are developing bicycle counting hardware to augment their mobile application. The device combines a magnetometer and an infrared camera to count bicyclists. The application automatically logs other app users who pass within 20 to 30 feet of the device. The developing device uses cloud-based data storage instead of expensive physical storage. According to Bike Portland, the Portland Bureau of Transportation (PBOT) purchased 200 of the devices in 2015.

AIRSAGE (ANONYMOUS DATA COLLECTION SOFTWARE)

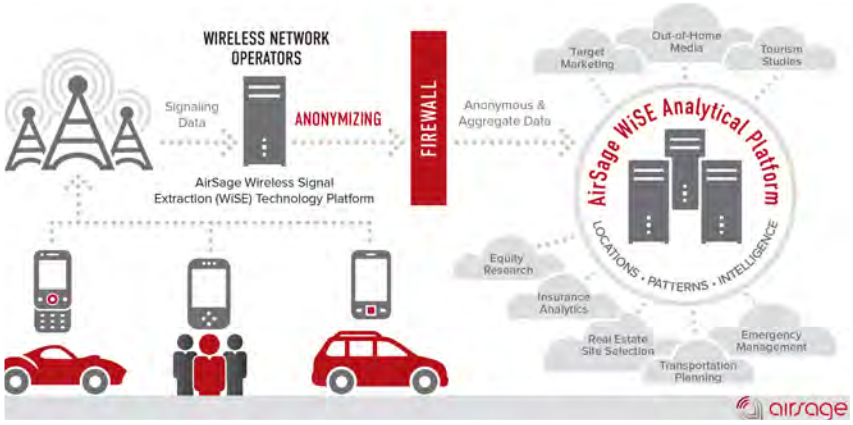
What if the data could originate from common, household devices independent of their owners' guidance? Enter, AirSage, which uses ordinary cellphone signals to generate overall traffic patterns for all roadway users. According to the company website, "AirSage generates billions of anonymous location data points, transforming terabytes of signaling data every day into valuable, relevant and accessible information." However, the current technology makes it difficult to separate the data according to form of transportation.

Ride Report stress map. The least stressful maps are shown in green (Source: ride.report/map)

RIDE REPORT

Creator Name:	Knock Software
User Type:	
Pros:	• Free • Estimates route stress
Cons:	• Only available in Portland, as of this report
Typical Uses:	• Infrastructure planning
Cost	$
Installation	Easy
Data Extraction	Mobile device

Magnetometer/ infrared sensor hardware is under development as of this report.



AirSage's process of collecting and analyzing cell phone data (Source: airsage.com)

AIRSAGE

Creator Name:	Airsage, Inc.
User Type:	
Pros:	• Large data pool • Works well when analyzing data at the macro scale
Cons:	• Difficult to accurately assess geographic travel patterns and mode used at the micro scale
Typical Uses:	• Travel volumes • Site analysis
Cost	$$
Installation	Easy
Data Extraction	Online Dashboard

IMAGERY COUNT TECHNOLOGY

Your city may already have the components necessary for bringing pedestrian and bicycle count volumes to life. Cities already use camera hardware as part of traffic signal operations. Some are beginning to install cameras to detect bicycles at traffic signals. These cameras can help give bicyclists the green light by helping them trigger traffic signals. Modifying other cameras can yield data that analyzes foot traffic, particularly traffic associated with areas of high commercial value.

VANTAGE AND AUTOSCOPE (VIDEO DETECTION HARDWARE)

Vantage video detection systems, produced by Iteris, only require a software update, called SmartCycle, to begin counting people as they bicycle through intersections.

Autoscope video detection, produced by Econolite, also has the ability to detect and count bicyclists. Video technology is useful for long-term count periods. Deploying the equipment for a one year minimum can help the city establish adjustment factors to better estimate annual ridership statistics.

MIOVISION (VIDEO DETECTION HARDWARE)

Miovision's Scout video imaging device uses a telescopic mounting device to obtain unobstructed video imagery. Scout can differentiate between motor vehicles, pedestrians, and bicyclists. The device's screen allows staff to check the unit before it is dismantled in the field. The Miovision Platform helps users understand the captured data. The Platform is also used to transmit data to Miovision staff for processing and quality assurance. Scout imagery is best for capturing data in short durations, such as week-long studies.

VANTAGE AND AUTOSCOPE

Creator Name:	Iteris; Econolite
User Type:	
Pros:	• Cities may already own hardware • Supports other functions, such as bicycle detection at intersections
Cons:	• No pedestrian features
Typical Uses:	• Bicycle traffic volumes; intersection detection; bike minimum green
Cost	$
Installation	Medium
Data Extraction	Depends on model

Iteris SmartCycle bicycle detection and counting (Source: www.iteris.com)

MIOVISION SCOUT VIDEO UNIT

Creator Name:	Miovision
User Type:	
Pros:	• Portable • Online dashboard • Large detection area
Cons:	• Presence or absence of lighting at night can affect accuracy
Typical Uses:	• Short duration studies at one or multiple intersections
Cost	$$
Installation	Medium
Data Extraction	Automatic; field collection

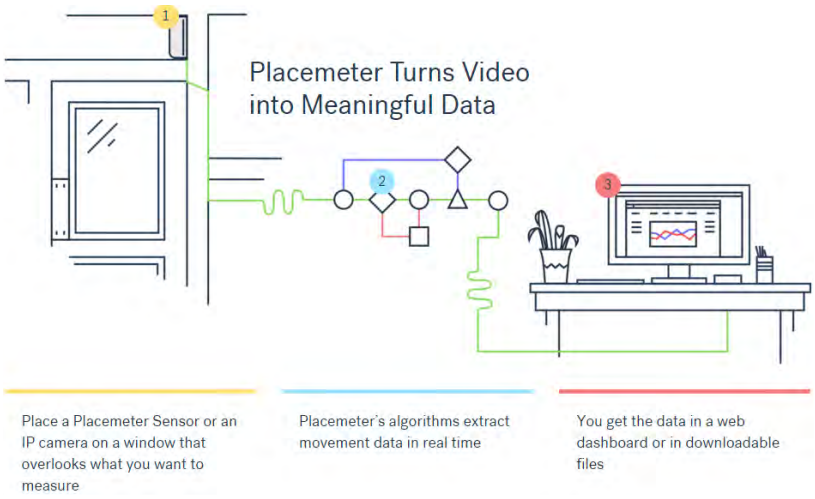
Miovision Scout video camera and LCD screen (Source: www.miovision.com)

PLACEMETER (VIDEO COUNTING SOFTWARE)

Placemeter, a company that emerged in 2012, turns video footage from any camera (including cell phones) into pedestrian, bicycle, and car movement data. First, users attach an existing security camera or a Placemeter Sensor in a window over the preferred measuring point. Placemeter defines a "Measurement Point" as a sidewalk, street, or storefront, where one wishes to measure bicycle, pedestrian, or vehicle activity. Since measurement points cannot currently distinguish between forms of transportation; users must purchase one screenline per mode of transportation. Measuring people walking, bicycling, and driving would therefore require three screenlines. After installation, the company turns measurement point video footage into data displayed on an online dashboard or emailed as a downloadable file. Placemeter can continue ongoing measurement using the Placemeter Sensor or live security cameras. In addition to travel volumes, Placemeter can measure walking direction and store visits, and it is particularly well suited for locations where continuous count data is desired. The second generation Placement Sensor is expected in 2016. One drawback of the technology is that it requires a WiFi connection.

FLIR SYSTEMS (THERMAL SENSORS)

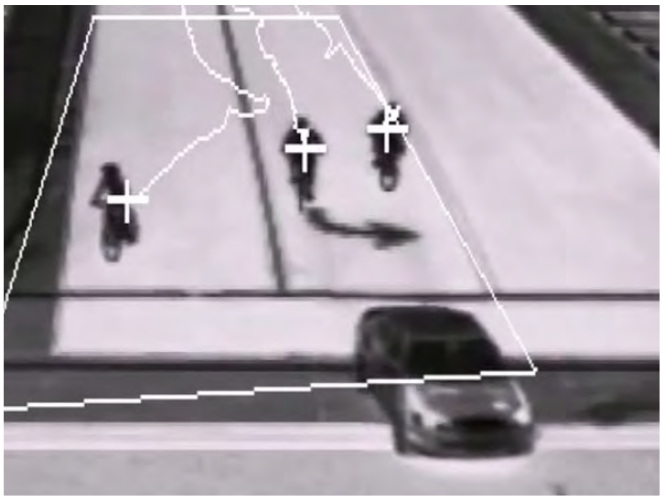
FLIR Systems, Inc. produces thermal imaging devices capable of long-term detection and counting of people walking, biking, and driving. Thermal sensors operate similarly to video sensors. While both types of devices capture imagery, thermal sensors generate images based on objects' and people's naturally-occurring infrared radiation. Thermal cameras do not need natural light to produce imagery. Therefore, they are less vulnerable to occlusion than video.



Process of collecting and analyzing data (Source: placemeter.com)

PLACEMETER

Creator Name:	Placemeter, Inc.
User Type:	
Pros:	• Use existing cameras • Dashboard to view data
Cons:	• Mode differentiation across one screenline is still in development • Need for WiFi may limit suitability in some locations
Typical Uses:	• Place sensor indoors to count in/out shop movements; traffic volumes on a sidewalk/street
Cost	$$
Installation	Easy
Data Extraction	Automatic



Bicycle detection at an intersection (Source: www.popularmechanics.com)

VIP BIKE DETECTION BOARD FOR THERMAL SENSOR

Creator Name:	FLIR Systems, Inc.
User Type:	
Pros:	• Easily installed • Bicycle detection can be used to adapt green time for people bicycling • Large detection area
Cons:	• Poor weather at night can affect accuracy
Typical Uses:	• Long duration counts at one or more intersections
Cost	$$ to $$$
Installation	Medium
Data Extraction	Automatic

INEXPENSIVE HARDWARE

WAYCOUNT (PNEUMATIC TUBE COUNTER)

WayCount, based in New York, offers three DIY-type models. Each device uses pneumatic tubes and inexpensive, easily portable components to count bikes and cars. WayCount produces three devices: Lite, Aluminum, and Hi-Viz. The Lite model is $199. The Aluminum device is $200 plus freight. WayCount Aluminum requires a minimum purchase of 250 units. WayCount Hi-Viz features a screen with 6" tall LED letters, which makers say can be viewed 100' away. The screen lets bicyclists, passersby, and drivers see the number of bicyclists counted in real time since the session began. Each of the WayCount devices can collect continuous data throughout a 24-hour period.

NUMINA (WIRELESS SENSOR)

Numina, an emerging product from CTY, used the Knight Foundation Prototype Fund to develop a device to track people walking, biking, and driving. The start-up aims to produce an inexpensive sensor, easily installed on existing light poles, without the need for special tools or know-how.

The 2015 Association of Pedestrian and Bicycle Professionals (APBP) conference proved the perfect testing ground for the fledgling device. Conference attendees provided feedback to improve the prototype. With time, Numina aims to measure noise pollution, air quality, and green space, in relation to traffic counts.

WAYCOUNT

Creator Name:	Tomorrow Lab
User Type:	
Pros:	• Less expensive than other pneumatic tubes • Real time count display
Cons:	• Minimum unit purchase for Aluminum counter
Typical Uses:	• Short-duration counts as part of a citywide program; one-off data collection efforts along a bike facility
Cost	$ to $$$
Installation	Easy
Data Extraction	Field collection

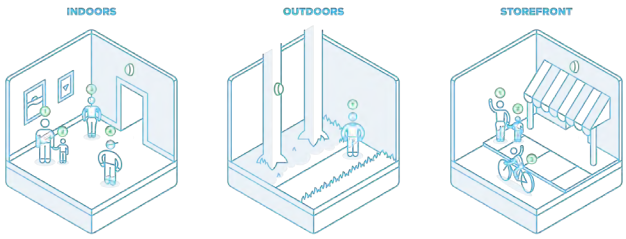
WayCount Hi-Viz in action (Source: http://waycount.com/)

NUMINA

Creator Name:	CTY
User Type:	
Pros:	• Alternative to more expensive equipment • Online dashboard
Cons:	• Not currently available for purchase- in prototyping stage
Typical Uses:	• On-street or off-street volume analysis for short- or long-term counts
Cost	$$
Installation	Easy
Data Extraction	Automatic

Potential applications for Numina sensors (Source: Numina by CTY)

Numina is **analytics for places**.



See **real-time heat maps of activity** for your neighborhood, park, institution, or business. See how *people* move, not just cars.

COUNTING AND MORE

Some devices go beyond counts data collection to investigate other characteristics of an urban space. The Array of Things (AoT) project team is developing sensors to count people in public spaces. They are also working to collect place-related data such as air quality and other indicators.

AoT, led by Argonne National Laboratory and the University of Chicago, is currently working with a $3.1 million grant from the National Science Foundation to develop an "urban-scale 'instrument'" to track a laundry list of freely-available, public data. The project team and the City of Chicago plan to install 50 sensor nodes to streetlights in early 2016. By 2017, the number will grow to 500.

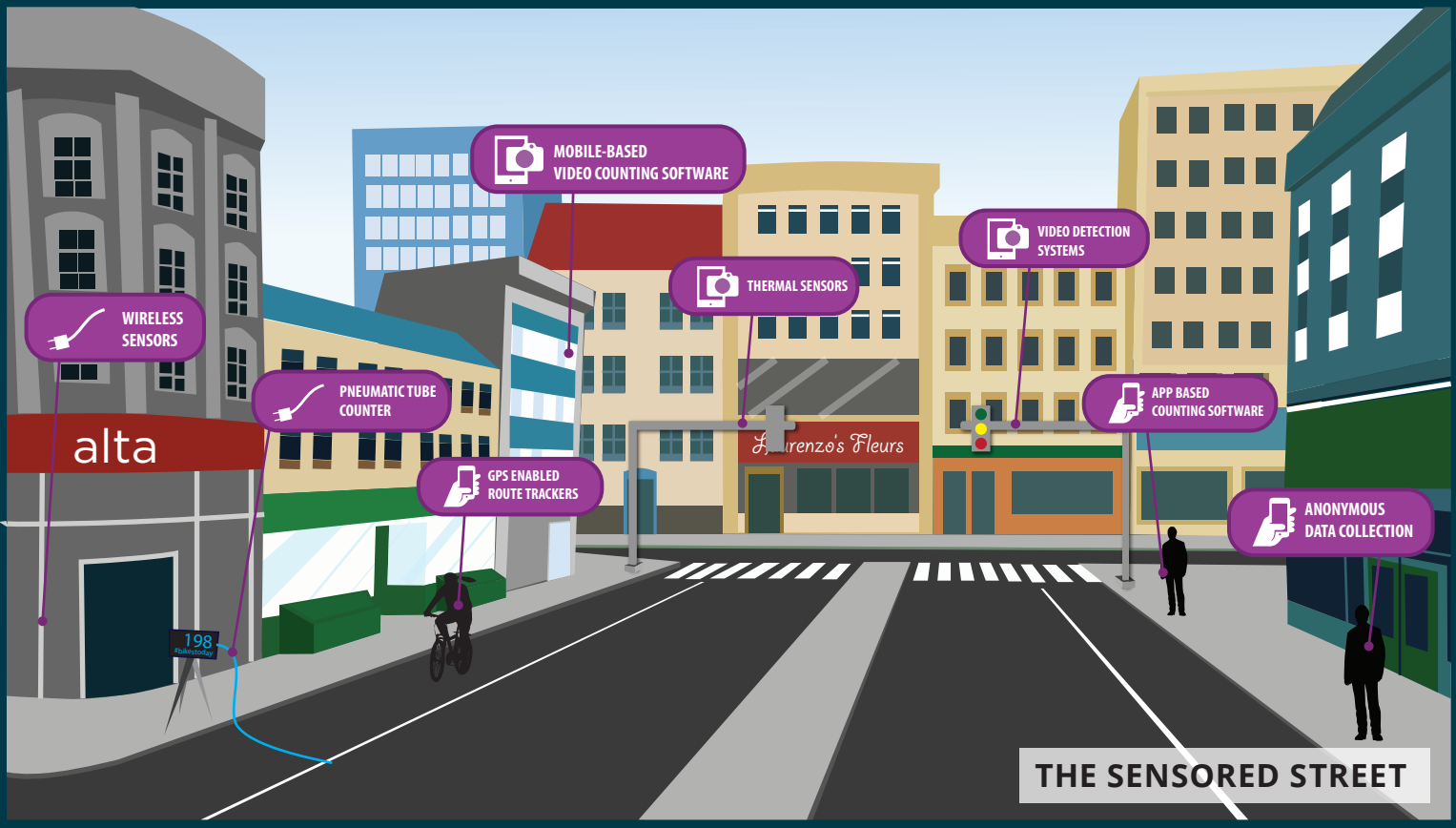
ARRAY OF THINGS PROJECT

Creator Name:	Argonne National Laboratory and the University of Chicago
User Type:	
Pros:	• Will eventually collect data related to air quality and other metrics
Cons:	• Not currently available for purchase- in prototyping stage
Typical Uses:	• Monitor citywide trends related to economic, environmental, and transportation trends
Cost	Unknown

Prototype Photo (Source: Anthony Souffle / Chicago Tribune)

Interested in Learning More?

The range of technologies shown below can help you create powerful datasets to inform transportation planning in your community. Alta Planning + Design offers comprehensive services to develop custom tailored active transportation count programs. We can help you determine which tools are the most appropriate, identify count locations, and coordinate installation. Our analytics team can also collect the data and create compelling visuals to make it useful for decision makers. Please contact us with any questions you have about instituting a tech-driven count program today.



ABOUT THE AUTHORS

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Kristen assists in managing a variety of bicycle and pedestrian projects ranging from data collection and analysis to master planning. She guides cities, regions, and states through the data collection process with the ultimate goal of deciphering data to support their current and future visions.

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Sam has focused his career on developing better infrastructure for active modes of transportation. He has extensive experience leading long-term count programs and visualizing bike and pedestrian data. He enjoys using technology to make sense of our surroundings and to facilitate decision making.