Appendix C: Issue Papers

INTRODUCTION

The Montgomery County Planning Department contracted the Toole Design Group to research best practices in bicycling planning, and apply this research to inform recommendations for the county's Bicycle Master Plan. This section of the appendix is a compendium of the resulting research reports.

1. Elements of a World-Class Bicycle Plan
2. Bikeway Classification
3. Advisory Bike Lanes
4. Are Separated Bike Lanes a Replacement for Dual Bikeways?
5. How Should Montgomery County Use Signed Shared Roadways in Master Plans?
6. Separated Bike Lanes versus Shared Use Paths
7. Two-Way Bikeways on Both Sides of the Street
8. Phasing Separated Bike Lanes
9. Incremental Implementation
10. Economic Benefits of Bicycling Infrastructure for Montgomery County

01 ELEMENTS OF A WORLD-CLASS BICYCLE PLAN

1.1 INTRODUCTION

What Makes a World-Class Place for Bicycling?

A world-class bicycling city typically has a high rate of bicycling, a low rate of serious injuries and fatalities from bike-related crashes, and residents expressing a high level of satisfaction regarding bicycling conditions. In Copenhagen, Denmark, for example, 30 percent of all trips and 45 percent of work and school trips in 2014 were made by bicycle, but there was only one bicycling fatality and 94 percent of bicycling Copenhageners consider the city to be bicycle-friendly.[1]

Creating such an environment where bicycling is an accepted, appealing, safe and convenient choice requires strategically applied infrastructure, policy and programming. The Cycling Embassy of Denmark, a network of cycling professionals from private companies, local authorities and non-governmental organizations in that country, refers to the "carrot, the stick, and the tambourine"[2] as a means of encouraging bicycling, discouraging car use and celebrating bicycling culture.

The carrot generally refers to a comprehensive and connected network of high quality, low-stress bicycling infrastructure. The stick refers to policies such as motor vehicle parking restrictions and fees, limiting cars in urban centers and congestion charges that make driving more costly and less convenient. The tambourine represents promotional campaigns and programs that foster a culture of bicycling in a community.[3] The carrot and tambourine are fairly common tools employed by American cities competing for bicycle-friendly status. But use of the stick is common in only a few major American cities and remains rare across most of the United States.[4]

How Does a Plan Lead to a World-Class Place for Bicycling?

Creating a world-class bicycling environment requires a commitment on many levels of the planning process. Leading European cities have integrated bicycle planning into the fabric of their transportation departments, established innovative bicycle facility design guidelines and made steady investments in bicycling infrastructure, block by block and curb by curb to build their networks. In some ways, many of these communities have integrated bicycling so deeply into their transportation planning processes that a separate bicycle master plan may, at this point, be superfluous.

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Ed. Note: The reluctance to make driving less convenient or more costly is likely one of the factors keeping even the leading American communities from entering the ranks of consensus world-class bicycling cities.

In the American context, a bicycle master plan is essential to creating a bicycle-friendly place because bicycling has yet to reach a level of integration into urban and suburban planning processes. The master plan for a defined area within a city or a county serves as a reference and touchstone for bicycling during any planning process and can help answer the question of whether a specific planning or design decision will help move the community toward the plan's vision.

An ideal plan vision reflects the unique priorities of its community and helps guide development of goals that are served by clear and coherent strategies for improving bicycling conditions. On a functional level, infrastructure projects related to cycling must be identified through a formal planning process to be eligible for federal funds, and many local funding sources also require a project to be in a plan.

The ultimate impact of a well-made plan, however, is dependent on the degree to which it is implemented.[5] Serious exploration of how projects are implemented must be included in a world-class plan, but the plan development process itself should also be viewed as one of its strongest tools for implementation. This process can touch many diverse community members, bringing them together around a shared vision and building the support for change that can be drawn upon as designs, budgeting and other decisions are debated and decided.

World-class plans can float ideas that will transform bicycling in the community, even if they are not likely or palatable at the present time.

Perhaps most importantly, a world-class plan sets the tone for a world-class place. Such a plan is ambitious and forward-looking in envisioning a future where bicycling is inclusive, widespread, easy, comfortable and efficient. While planners must understand the context and boundaries of the plan, they should not limit the vision for what a community's bicycling future can be. Focused, realistic recommendations that are easy to implement in the short term can pave the way for more ambitious ideas. As the recommendations of the plan are implemented to improve the bicycling environment over time and spur increased ridership, more community members will see these visionary ideas as realistic and desirable means of further improving bicycling.

Understanding World-Class Plans

This paper draws on ideas from more than a dozen plans for world-class bicycling communities and local jurisdictions. The plan elements and key topics described in the following section were identified as those fundamental to creating a world-class plan. A brief summary of each plan is provided in an appendix to this report. Reviewed plans include:

- Houten, Netherlands
- Utrecht, Netherlands
- Vauban, Germany
- London, England
- Fort Collins, CO
- Boulder, CO
- Davis, CA
- Portland, OR
- Madison, WI
- Bellingham, WA
- Atlanta, GA region
- Richfield, MN
- Hennepin County, MN
- Santa Clara and San Mateo Counties, CA
- Fairfax County, VA
- Howard County, MD
- Washington, DC

1.2 ELEMENTS OF A WORLD-CLASS PLAN

Three Fundamentals

A world-class bicycle plan should support the specific goals of the community it serves, determined by a thoughtful community input process and careful analysis. Three critical aspects of a bicycle plan are:

1. Developing a high-quality bicycling network.
2. Fostering a robust culture of bicycling.
3. Outlining clear steps to project and program implementation.

DUTCH KEYS TO A WORLD-CLASS NETWORK

Safety
Protection for bicyclists from crashes and lower speeds at conflict points.

Comfort
Separation of modes and provision of high quality riding surfaces and adequate spaces.

Connectivity
Presence of direct and convenient routes that provide high comfort with seamless transitions.

High Quality Bicycle Network

A bicycle network is the most tangible and high-profile product of a bicycle plan. High-quality bicycle networks allow users to comfortably access destinations throughout the geographic boundaries of the plan area. A complete network should accommodate the wide range of bicyclists and potential bicyclists in the community, and is referred to as All Ages and Abilities, 8 to 80, or a low-stress bicycle network.[6]

Without a bicycle network that accommodates the widest range of riders, all other plan elements will fail to increase bicycling. No level of programs and policies related to encouragement, education and enforcement can overcome the barrier presented by a disconnected, high-stress network for many bicyclists.

The ideal network allows for access to destinations by bicycle without advanced planning for a route that avoids major streets or crossings. This network also offers riders multiple choices of routes by which to access destinations. In a complete, connected, low-stress network, people can travel by bicycle from point A to point B as, or nearly as, easily and directly as by automobile. Designing major streets and crossings to accommodate low-stress bicycle travel will enable this ease of travel. Many Dutch and Danish cities have accomplished this goal, and in some locations even have more extensive bicycle networks than automobile networks where pathways and grade-separated crossings make bike travel easier than in an automobile.

Networks suitable for this wide range of users require facilities that separate bicyclists from motor vehicle traffic where automobile speeds and/or volumes are high. To be truly world-class, these facilities must provide not only a high level of comfort, but also a high level of convenience, safety and efficiency. Their higher-quality design often includes more space to accommodate bicyclists traveling at varying speeds. Thus, the facilities are made safer through lessening the chance of conflicts between high- and low-speed users.

A subset of the low-stress network should also provide for higher speed bicycle travel to accommodate and encourage longer bike trips, which people are more likely to take when they become comparable to driving in travel time. These types of facilities are increasingly being referred to as "bicycle superhighways."

Bicycling Culture

Creating a world-class bicycling community requires more than just building a bicycle network. The network needs to be promoted and supported by a vibrant bicycling culture. A world-class bicycle plan reaches beyond infrastructure to address programmatic elements and foster a culture of bicycling.

Indicators of a healthy bicycling culture can include high profile events, popular and festive group rides, places with a reputation as a bicycling destination, or simply a common acceptance among most people that bicycling is a normal, practical and useful mode of transportation. It is not enough to produce support materials for bicycling, such as maps or guides; a world-class plan helps identify ways in which those materials can reach and be relevant to all community members.

Bicycle master plans can support a bicycling culture by recommending programs – often developed in partnership with community groups or public agencies – to engage a wide range of community members in bicycling activities. It is important to engage agencies that may not be considered players in the transportation or recreation arenas, as they can help planning or transportation agencies reach wider audiences. School districts, for example, can champion district-wide bicycle education programs. Bike shops, clubs, advocacy organizations and health-focused organizations and others may play an active role in establishing and advancing local bike culture through hosting events and keeping bicycling in the public eye.

The enhancement of bicycling culture can even start during the planning process by starting a community dialog. In some ways, the plan document may be less important than the discussions, strategizing, collaboration, public engagement and momentum that is built among staff and the community during the plan development. This process brings bicycling to the forefront of public discourse for a time, spurring a mini-surge in the bicycling culture, leading to more public and political support, and making the topic more top-of-mind for staff across agencies.

Bicycle Plan Implementation

A plan must lead directly into implementation. It is sometimes said by planners and engineers that their favorite plan is the one that gets built. This translation from ideas to reality requires that practical considerations be made during the planning process that will impact implementation later. Several questions should be raised to determine the likelihood of success in overcoming common obstacles. For example, is there likely to be a sufficient right-of-way in a transportation corridor to fit the proposed bicycle facility? Are there large numbers of utilities in a roadway that will make implementation challenging, when another alternative corridor is available? Are there project review policies and design standards that must be changed or made more flexible to accommodate bicycle facilities? Are there redevelopment or street reconstructions planned that can create opportunities to implement a high-quality bicycle facility? Are the various public agencies charged with implementing and maintaining facilities working together and in agreement about the bike plan?

Many plans contain detailed information, including project lists, project prioritization criteria, funding sources and cost estimates to facilitate post-plan implementation. Often, the implementation of a plan is conducted by officials other than those of the plan's primary authoring agency. Sufficient internal documentation should be kept by the authoring agency for the implementer to be able to understand how and why decisions were made so that the original goal can be achieved even if some necessary adjustments are made.

It is critical for the bicycle planner to understand how projects get implemented. Which department is responsible for implementation? Who owns the right-of-way? According to what time frame do important actions (e.g. repaving) take place? The more that the bicycle master plan recommendations are aligned with the daily operating procedures of the implementing agencies, the more likely implementation is to occur efficiently.

In addition, funding is a key determinant as to whether a plan will be implemented to its fullest potential. Finding early opportunities to build proposed projects can set a precedent for implementation – rather than a period of inactivity following the release of the plan. The plan itself may also recommend development of new financial structures to ensure consistent and adequate funding sources for the implementation of plan proposals.

1.3 KEYS

Bicycle plans address a number of topics, but the topics are among the most important. They should be the focus of the plan development process and the document itself.

PLAN DEVELOPMENT AND THEMES

Focused and Strategic Plan

The strongest plans tell a coherent story about where communities are going and how they are going to get there. They have a plausible theory of change and set the path for progress with each component and recommendation contributing thoughtfully to the whole. The weakest bicycle master plans amount to lists of tasks, lacking context and the sense that the whole is greater than the sum of its parts. Fort Collins, CO, Portland, OR and the Atlanta, GA region, for example, have developed bicycle master plans that are built on a clear vision and theory of change. These plans reveal a clear approach to the bicycle network, embrace innovative design, call for strategic and supportive policies and programs, and offer specific implementation methods.

Planning Process

While most of the recommendations in this paper inform the content of a world-class bicycle master plan, it is also vital to consider the process by which this plan is developed. A robust, inclusive and thoughtful process can result in a plan that is reflective of community values and goals, and is thus more likely to gain support for implementation.

Public Support

The planning process can be used to build arguments and gain support for bicycling in a community. In advertising and promoting community meetings related to the development of the plan, an agency has the opportunity to make the case for bicycling to the public and within their own agency. Meetings, surveys and other opportunities to influence the plan can build community excitement about bicycling that carries over to implementation. Speaker series and presentations, organized rides and other events can supplement outreach and help build interest. That excitement can boost the momentum of the plan and build public pressure to construct facilities or initiate bicycling programs.

Bicycle plans often make the case for bicycling, however, that information is often more useful to explain to the public, agency staff and elected officials why the process, the plan and the resulting outcomes are important. Making the case for bicycling, such as explaining its benefits to the local economy, is also put to good effect during bicycle facility implementation as well.

Case Study: Richfield, MN – Community Feedback n a Suburban Context

Jack Broz, the traffic engineer for Richfield, MN, described how important it was that the plan reflected the priorities of the community:

"It is all about understanding the community. Richfield is a first ring suburb of Minneapolis – it's not Minneapolis. Many folks have a template [that they think of when they think of planning for bicycling] – a dense urban setting. There's a reason people live here and not in Minneapolis. Planners need to understand what makes a suburb different. Our plan focuses on activities within the community. Access to schools and parks is more important than commuting.

We have a strong reputation and we have to be responsive to the community. We recently had a proposed cycle track on higher volume, county road. But it was not desirable for families. Instead it became more of a trail design because that's what the community was looking for. Community input made a huge difference."

Inclusive Process

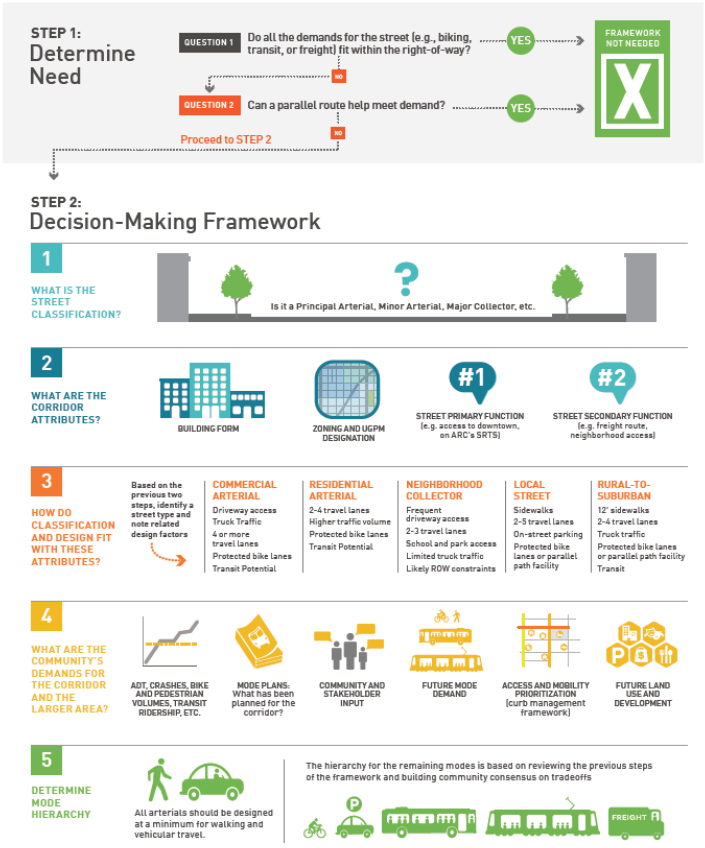
Agencies should design a public process that brings new people to the table and shows participants how their input was incorporated. Many communities have an existing, vocal, small group of residents who will advocate for bicycling. While these people will continue to be important allies, development of the bicycle plan is a chance to bring more people into the tent. A public process that reaches young people, elderly, more women, lower-income people and people of color to the table will result in a plan that is more

reflective of the entire community and more likely to serve this wider audience. Engaging these groups in the process means they will also be exposed to the idea that they, too, can be part of the bicycling community.

In some cases, this broadening of the engagement process may necessitate finding multiple points of entry for the idea of bicycling. For example, some people will be open to the idea of bicycling because their doctor has recommended an increase in physical activity. The process must find these levers that exist across different groups throughout the community and use them to reach a broad audience.

Transparency

Communities should use clear and understandable methods to arrive at the recommendations in their plans. Some of the best recent plans are extremely transparent about their planning and prioritization process. This openness sets community expectations, builds trust and can facilitate implementation. While publishing all supporting data for the public may be impractical, this data should be retained and available to agency staff during the implementation process as routes may need to be adjusted based on real-world constraints.



Key Qualities

Walkways	Bikeways	Trails	Places and Public Spaces	Support Infrastructure
Increases the connectivity of the walkway network	Increases the connectivity of the bikeway network	Increases the connectivity of the local or regional trail system	Sociability	Increases the convenience of walking or biking
Provides a direct route between destinations, including frequent and convenient crossings	Provides convenient access to destinations	Safety, Security, and Universal Access	Designed for the intended user	Increases the attractiveness of walking or biking
Design details promote safety and comfort: adequate width, protection from vehicles, landscaped buffers and shade trees, highly visible crossing treatments	Minimizes potential for bodily harm: smooth and stable surface, adequate operating space, visibility at intersections	Wayfinding and Navigation	Access and Linkages	
Universal Access: smooth, stable, barrier-free surface with ADA-compliant curb ramps	Intuitive, context-appropriate design promotes comfort and predictability for all roadway users	Seamless transition to local networks and regional trails	Comfort and Image	
Includes social spaces for standing, sitting, and visiting	Accommodates expected user type	Adequate width	Sense of place	

Quality visuals can help communicate the decision-making process clearly. This table from the Atlanta regional plan *Walk.Bike.Thrive!* shows the agency's decision-making framework.

Agencies that control funding of bicycle facilities should publish their project selection criteria. This information can help implementers and the public understand why some projects are prioritized for funding over others. Ideally, these priorities are based on the information gained about community values through the planning process. The Atlanta Regional Commission published this table explaining what makes a good bicycle project (left).[7]

Vision, Goals and Objectives

Strong visioning and goal-setting as part of the planning process can build consensus among stakeholders and the public, and establish mutually agreed upon end points to keep conversations on track. The most important outcome of determining a vision, goals and objectives is to provide an overarching framework for the plan. Planners should determine by what means these components will guide the planning process, which will in turn dictate how much effort to put into their development.

A review of vision, goals, and objectives sections from several bike plans showed a wide range in quality of these sections. The best plans include specific measurable outcomes with completion dates, known as performance measures. Performance measures should be considered part of the vision, goals and objectives section that directs the planning process, and they should also be associated with the implementation process and the tracking of progress after the plan is complete. The plan's recommendations should contribute to measurable progress toward the performance measure targets.

Use of Data

Historically, bicycling activity has not been documented with the same level of data that is available for automobile planning and engineering. World-class transportation plans use data for developing recommendations, prioritizing improvements and evaluating outcomes against benchmarks (performance measures). Examples of each of these uses include level of traffic stress analysis, bicycle level of service analysis, crash frequency and rate calculations, and assessments of accessibility via the bicycle network.

Using data throughout the plan development process also leads to defensible recommendations that can be upheld under scrutiny. Supporting data is necessary in the implementation process as competing interests vie for funding, roadway space and scarce resources. A world-class planning process will equip the community with analysis to back up its priorities. Plans should also recommend the implementation of additional routine data collection methods that will provide valuable information to track changes in the bicycle environment, such as bike counts and more detailed crash reporting.

It should be noted that data need not only be tracked in its relation to physical infrastructure and ridership. It is also important to understand the reach of education, encouragement and enforcement efforts. Several communities today include questions about bicycling on their annual or bi-annual citizen surveys to gauge changing attitudes about bicycling. Some communities gather data about resident participation in bicycle classes or rides as well.

Strategies for Evaluating Progress

Evaluation strategies provide a way for both the public and the implementing agency to monitor progress on implementation over time. Performance measurement plans offer a clear, publicly accessible and consistent format to track and report progress. The performance measures should link to the plan's goals and objectives. A tracking matrix typically includes the performance measure, baseline measure, performance target, status and information on the data source. Agencies should consider issuing a public Implementation Report Card based on this information. Several years after Seattle adopted its bicycle master plan, for example, it released its follow-up Implementation Plan 2015-2019, which includes a "goals table" with status updates about specific improvements.

The world-class standard for evaluation is the Bicycle Account from Copenhagen.[8] The Bicycle Account relies on public data and public opinion surveys to evaluate bicycling conditions in the city. It provides a biannual comprehensive review of the city's bike network, including public satisfaction surveys regarding maintenance of the network (surface quality and snow removal), availability of bicycle parking and bikeway facility width. Bicyclists are also questioned about perceived safety, so planners can track the impact of improved infrastructure on residents' sense of safety. The Bicycle Account has been adapted for U.S. communities by the Washington, DC-based League of American Bicyclists.[9]

Incorporating Equity

American communities have become increasingly aware that bicycling infrastructure is often unevenly distributed. To address such inequities, communities are beginning to develop definitions of equity and equity-based goals, performance measures and gap analyses for inclusion in their bicycle master plans. Widespread interest in and acceptance of bicycling is an indication of a world-class bicycling community, and ensuring equitable access to all elements of bicycling will help communities reach that point.

As bicycle and pedestrian master plans address equity, they have developed different definitions of the term. The report Active Transportation Equity: A Scan of Existing Master Plans by the Alliance for Biking and Walking and League of American Bicyclists provides a wide-ranging review of definitions and incorporation of equity into bicycle and pedestrian plans.[10]

Some plans include equity as a specific goal. For example, Madison, WI developed a bicycle master plan to include the following goal: Provide equitable access to the benefits of bicycling. Every individual, regardless of age, gender, income or race, should have access to bicycle facilities that allow for safe and convenient transportation. Low-income neighborhoods that are isolated from high quality transportation facilities like shared-use paths need to be brought into the system.

Communities are also developing equity-based performance measures. For example, Eugene, OR measures density of pedestrian and bicycle facilities in areas withhigher concentrations of racial and ethnic minorities, and low-income households compared to other parts of Eugene.[11] An equity gap analysis evaluates the coverage of an existing or proposed bicycle network based on the ability of different vulnerable populations to access it. Such analyses have been conducted in communities such as Portland, OR and Chicago, IL.[12]

Case Study: Portland State University Equity Analysis of Portland's draft Bicycle Master Plan.[13]

In 2009, the City of Portland hired Portland State University to conduct an equity analysis with the goal of making bicycling more attractive to historically disadvantaged groups. The analysis identified areas where disadvantaged populations live, work, learn, play and shop for groceries. Because the built-out 2030 bicycle network would ultimately cover the entire city, the question of equity in the future was more about project priority and timing of implementation than about network coverage or lack of coverage. The report, therefore, made recommendations about project phasing.

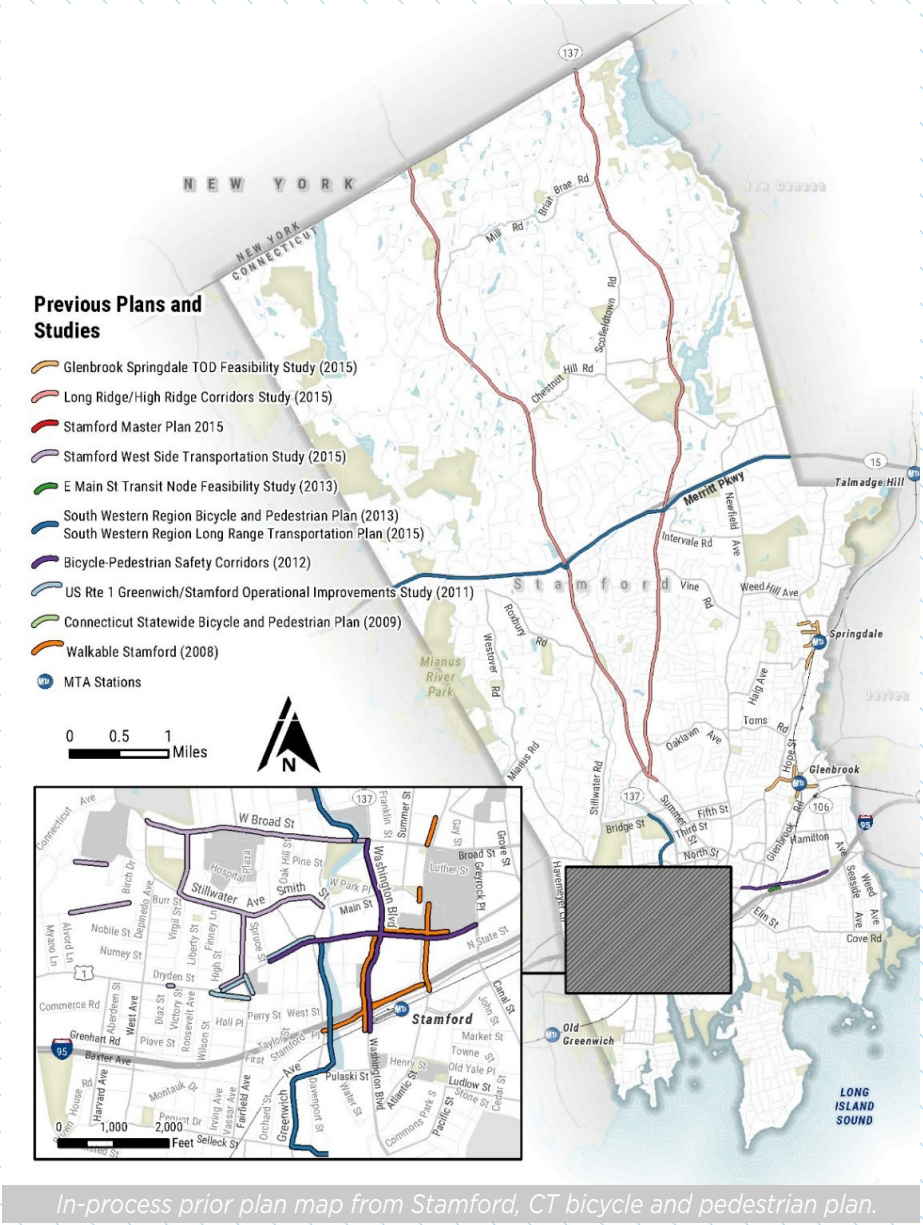
Visual Clarity of Plans

The visual appeal of bicycle plans has improved in recent years. Both the public audience and agency practitioners benefit from clear, informative maps, charts and graphics. An attractive document shows an agency is committed to making its plans accessible to the public and can make it easier for the public to support a plan.

Informational visuals can be almost as impactful on an external audience as the narrative of the plan. The use of visuals in bicycle plans includes:

- Maps
- Tables
- Photos
- Renderings
- Infographics

The upcoming bicycle and pedestrian plan for Stamford, CT uses a map to show the locations of existing plans (e.g. corridor studies, transit studies, bike/ped plans, small area plans, comprehensive plan recommendations/projects). This map provides additional information more clearly than with text alone.

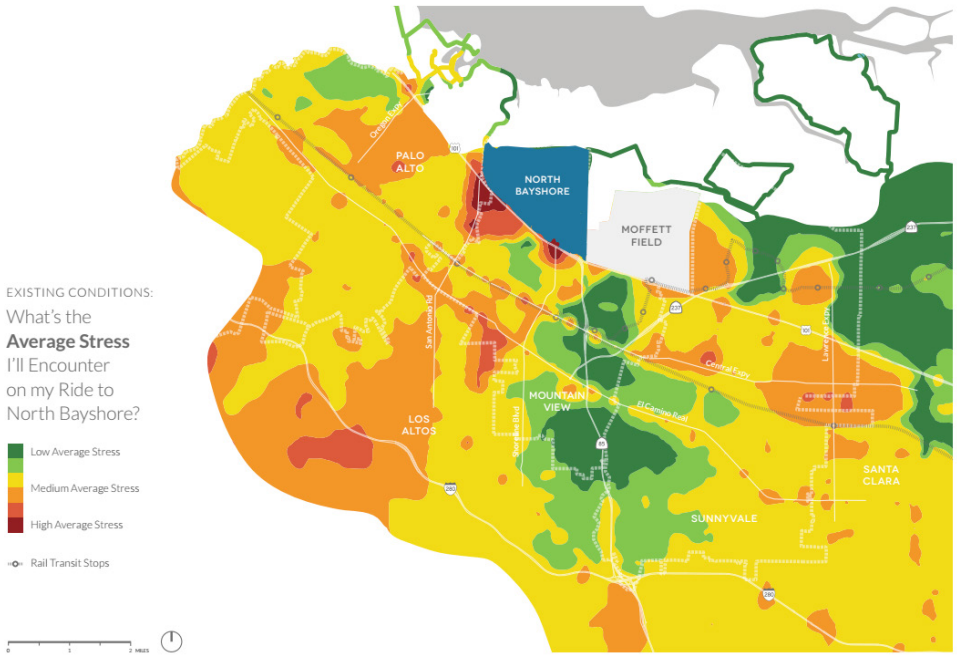


In-process prior plan map from Stamford, CT bicycle and pedestrian plan.

The Google Bike Vision Plan for North Santa Clara County, CA, the Atlanta, GA Regional Commission plan Walk.Bike.Thrive! and the City of Cambridge, MA Bicycle Master Plan are all good examples of plans that are visually attractive and convey information effectively through maps, tables and infographics.

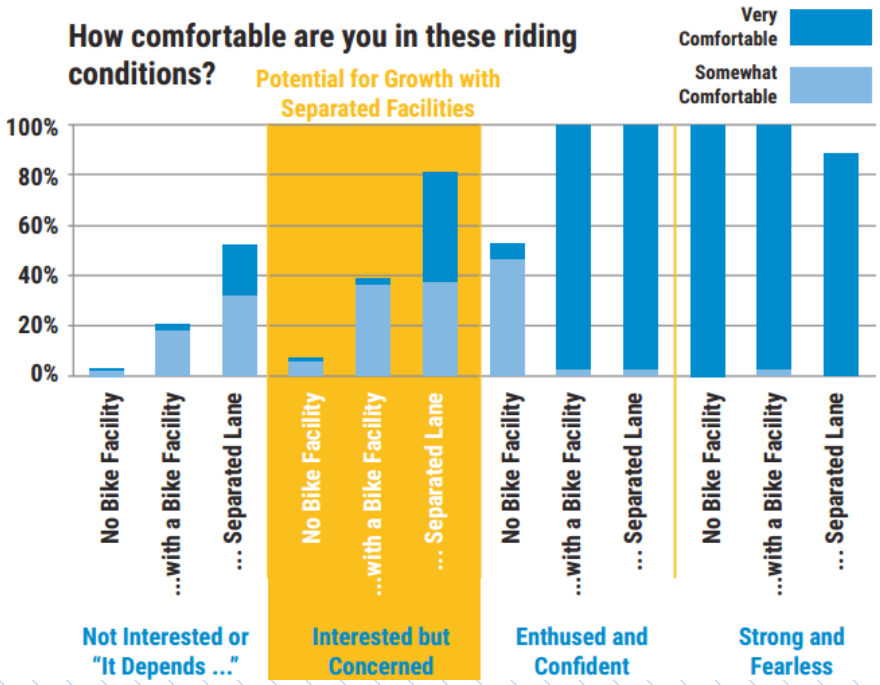
Most master plans are still presented online primarily in static PDF form, but can be displayed on the web in a more exciting way. One step above a static PDF is an interactive PDF, which has been employed to good effect by the Ontario Ministry of Transportation in #CycleOn, a provincial bike plan, that is a much more navigable document than a simple PDF.[14]

Figure 5: What's the Average Stress I'll encounter on my ride to North Bayshore?
This map shows the average stress of any given route to North Bayshore. Areas with bad scores may have short routes, but they also have a high level of stress between the starting point and the North Bayshore.



Clear, appealing maps in the Google Vision Bike Plan tell a story about the amount of stress experienced by bicyclists during their rides to the Google campus.[14]

This chart from the Cambridge Bicycle Plan clearly conveys attitudes of surveyed residents in the city regarding their comfort level with different facility types.[16]



PHYSICAL INFRASTRUCTURE ELEMENTS

Bicycle Facility Standards

Master plans identify projects for the construction or implementation of bicycle facilities, but they also present an opportunity to comment on the current and future state of facilities. Physical bicycle infrastructure must be high-quality to attract and retain riders from all backgrounds and skill levels; for example, bike lanes designed without gutter seams, separated facilities that are wide enough to accommodate expected bicycle volumes and off-street facilities that are constructed with materials that will not degrade quickly as they age. If there are current deficiencies with facility design and implementation, a world-class master plan must provide guidance to ensure high-quality facilities are realized by implementing agencies Design and construction of these facilities indicates a community's level of interest and investment in bicycling, and they must be of high quality to create a world-class experience.

Network Planning Methods

Networks are a central part of bicycle master plans. Therefore, planners have developed several methods of planning and evaluating bicycling networks.

Engineering Standards in the Netherlands

Dutch bicycle networks are widely regarded as world-class in their facilitation of easy bicycle travel. Engineering guidance for these networks is provided through the Dutch CROW Manual, which describes the following qualities:[17]

- Cohesion
  - » The "mesh width" – the distance to the next network segment – is no more than 820 feet.
  - » Centers and important amenities are interconnected.
  - » At least 70 percent of all bicycle journeys are made on the bicycle network.
- Directness
  - » The average detour time is minimized.
  - » The number of intersections where cyclists do not have the right of way is minimized.
  - » Stopping for bicyclists is minimized.
- Safety
  - » Conflicts with crossing traffic are avoided.
  - » Vehicle types are separated.
  - » Speed at conflict points is reduced.
  - » Road classifications are recognizable to the road users.
  - » Bicycling treatments are uniform (solutions that are characteristic of one road type should not be used on another).
- Comfort
  - » Encounters between bicyclists and cars are minimized.
  - » Destinations are easy to find.
  - » The network is comprehensible (bicyclists can easily make a mental map of their routes).
- Attractiveness
  - » Network provides "social safety" (feeling of personal safety).

Analyzing Networks in Denmark

Planners in Denmark ask the following questions to determine the completeness or cohesiveness of a bicycle network:[18]

- Does the cycling infrastructure link residential areas with primary cycling destinations, such as schools, educational institutions and employment centers?
- Are the routes direct?
- Is it easy to get to shops, sports facilities, entertainment venues and traffic terminals?
- Are the residential locations linked, providing cyclists with shortcuts that make it faster to bike than drive on local journeys?
- Has an overall hierarchy been established (formalized or informal) that gives priority to primary routes rather than side streets and local routes, so that most cyclists are attracted to primary routes?
- Is the flow broken by poor lighting, annoying barriers, too many signal intersections or poor maintenance?
- Does the existing cycling infrastructure live up to the newest construction standards?
- Does the plan accommodate experienced as well as vulnerable cyclists?
- Are school route plans coordinated with the cycling infrastructure plan?
- Are there recreational options for "Sunday" cyclists and cycling tourists?
- If the infrastructure is initially established to a relatively low standard, have provisions been made for improvements over time, so that, for example, signed routes can be upgraded to cycle lanes, which in turn can be upgraded to cycle tracks?
- Is the mesh-size of the urban cycling infrastructure appropriate?
- Are enough provisions for supplementary, segregated off-road tracks included in the plan?
- Are cycle tracks planned for roads with fast moving traffic?
- Can the speed limit for vehicles be reduced until cycle path construction is completed?

Case Study: Portland's three-pronged strategy for a complete network.[19]

From a sophisticated analysis of the city's existing and potential network of bikeways, the Portland, OR Bicycle Plan for 2030 was developed according to the following three-pronged strategy:

1. **Form a finer-grained bikeway network.**
   A dense bikeway network has the advantages of limiting out-of-direction travel and providing a variety of route options to each destination. Having more route options allows bicyclists of different skills and comfort levels to identify routes best suited to their transportation needs. Streets optimized for bicycle travel translate to savings in time and energy that help to make bicycling more attractive than driving.[20]

2. **Emphasize low-stress bicycle routes.**
   Many residents who do not bicycle regularly would ride more often if they could minimize their exposure to automobile traffic and lower their stress. Low-stress bicycle facilities, including trails, low-traffic shared roadways (such as bicycle boulevards) and cycle tracks, are bikeways that are separated physically or spatially from higher-volume vehicular roadways. Emphasizing development of a low-stress network of streets and trails provides an effective strategy for advancing the critical principles of cohesion, comfort, directness, safety and attractiveness commonly identified as international best practices for bikeway design.[21]

3. **Ensure access to common destinations.**
   The Portland Bicycle Plan for 2030 promotes bicycle facilities on all main streets and recommends that they be designed to provide as much separation as feasible from high volumes of traffic. The plan identifies facilities such as wide bike lanes, buffered bike lanes and cycle tracks as appropriate to provide separation between bicyclists and motor vehicle traffic.[22]

Multimodal Integration

Bicycle plans in areas with robust transit operations should carefully integrate bicycle and transit planning. Connecting bicycling to transit increases the "catchment area" of transit stations and increases the total possible trip length for bicycle riders. This combination of bicycling and transit replaces longer car trips and can lead to reduced emissions. Some bicycle plans elevate transit integration into a top-level goal and assign a transit integration performance measure to it.

Plans should discuss the importance of bicycle and transit integration to all transit operations (commuter and light rail, Metro, Amtrak, intercity and intracity bus, bike share). Recommendations should include working with transit agencies and identifying the specific partners. The plan should encourage bikes-on-board transit vehicles, secure, covered bike parking at transit stations and bike share stations located near transit stations and in adjacent neighborhoods to allow home-to-transit trips. Full integration of bike share and transit payment systems is the world-class ideal.

Master plans should recommend bike-transit link studies for high-use transit stations to develop specific bike-transit connection strategies and low-stress bicycle routes to these stations. Attention should be paid to facilitate easy transfers across modes, including wayfinding, signs, pavement striping and curb cuts. Plans can also encourage bike racks on taxis and car share vehicles.

End of Trip Facilities

When bicyclists arrive at their destinations, they need to be confident they will have safe and secure places to park their bikes. Planners should work with transit agencies, business districts and private developers to encourage the provision of convenient and secure bicycle parking. Covered or secure long-term parking should be provided at all transit stations. Short-term bike parking should be plentiful in commercial districts. Additionally, end-of-trip facilities like showers, locker rooms and bicycle maintenance stations can promote bike commuting.

World-class bicycling communities help ensure the provision of high-quality parking through the inclusion of bike parking standards in zoning codes. Provision of additional amenities may be incentivized through elements in the development review process. In addition, world-class plans provide policy and implementation guidance to agencies for improving end-of-trip facilities, even in older buildings lacking such amenities.

Case study: Showers and bicycle maintenance stations in Madison, WI

Madison is already a great place for bicycling, but to make bicycling an easy, everyday choice for more riders, the city recognizes a need for more robust end-of-trip facilities. Implementation of these recommendations would create the environment to make bicycling the easy choice.

- Enact policies and laws to ensure appropriate levels of bicycle parking are provided by private property owners.
- Provide ample, secure, well designed, well lit, attractive and conveniently located bicycle parking facilities.
- Work with businesses and campuses to locate on-site bicycle parking.
- Expand and improve bicycle sharing.
- Support the provision of facilities such as showers and bicycle maintenance stations.

    - » Ensure that all appropriate public buildings include showers and locker facilities in new building projects and in buildings being rehabilitated.
    - » Encourage and provide incentives for private developers, building owners and employers to provide showers and locker room facilities for employees.
    - » Work with fitness clubs in or near employment centers to create arrangements whereby, for a small fee, bicyclists could use their shower facilities.
    - » Increase the number of bicycle fix-it stations with tire pumps and basic tools located throughout the urban area. In areas where appropriate, build facilities modeled on the Dawley Bike Hub in Fitchburg, WI with bathrooms, tools, parking, and direct trail access.
    - » Develop a downtown Madison bicycle station.

- Build, enhance and promote multi-modal connections between bicycling and driving.
  - » Locate park–and-pedal lots on shared-use paths that have direct access to employment centers.
- Enhance multi-modal connections between bicycling and transit.
  - » Explore options to increase the bicycle carrying capacity on buses without interfering with transit operations. This support may include front exterior racks that hold three bikes or on-board bicycle space.
  - » Provide adequate short-term bicycle parking and long-term bicycle storage for transportation centers like transit transfer points and park-and-ride lots. The parking may include secure and weather-protected areas.

NON-INFRASTRUCTURE ELEMENTS

One of the most important aspects of cultivating a world-class bicycling environment is to make bicycling an everyday activity that is visible and accepted by all community members. This goal is particularly difficult to achieve in some communities where the perception is that everybody drives and nobody bicycles. Sometimes bicycling is perceived to be too dangerous to replace other transportation modes. High-quality policies and programs can challenge these views by raising the profile of bicycling, bringing more people into the bicycling community and employing education and enforcement strategies to improve safety and perceptions of safety.

The Danish idea of "the carrot, the stick and the tambourine" (see page 3) to encourage cycling speaks to the interconnectivity of infrastructure, policy and programs. The policies and programs from American planning agencies charged with developing bicycle plans are addressed in the following section.

Policy Context

To succeed, bicycle planning must be integrated into the fabric of a transportation agency. This concept, known as "institutionalization," means that bicycling is considered as a matter of course through the regular proceedings of agency operations and not as an add-on or a special case. An effective way of achieving this integration is by ensuring that the jurisdiction's policies support the plan's bicycling objectives. Bicycle plans should recommend that engineering manuals and standards, funding policies and criteria, and zoning policies should be updated to be consistent with the goals and recommendations of the bicycle plan.

A community can institute many policies to support bicycling. These policy types include speed reduction policies to set design speeds and lower and enforce speed limits; policies to accommodate bicycling in construction zones; Vision Zero plans that aim to eliminate traffic fatalities; land use and development codes that allow for short block lengths, mixed-use developments with street-fronting retail and a connected network of streets; complete streets policies, implementation strategies (see Florida) and design guidance (see Boston); requirements to reduce car parking; and maintenance policies that prioritize streets in the bicycle network.

Programs and Bike Culture

Davis, CA, is proudly known as America's Bicycling Capital. Portland, OR, has built a reputation as the best city for bicycling. Other cities around the country are at earlier stages, but are striving to foster a positive bicycling culture to attract residents and employers. The following section focuses on non-infrastructure elements that help build a healthy culture around biking.

Program Leadership

Identifying a single government entity that will take responsibility for bicycle programming is important to the success of any bicycle plan. In Fort Collins, CO, staff in the city's transportation planning department oversee infrastructure implementation and programs, including working with local employers to host bicycling classes, partnering with the school district, directing a bicycle ambassador program, organizing open streets events and other efforts to improve bicycling in the city. These efforts are coordinated through the FC Bikes program within the department.

Bike Arlington in Arlington, VA, is another local example of this type of government effort and is part of

Arlington County Commuter Services. These types of government-led efforts are critical to building bike culture when capacity and leadership are not present from outside groups.

Plans commonly call for partnerships with community groups to deliver targeted programs for specific groups, such as women, new residents, seniors, family biking and people of color, members of the LGBT community, recent immigrants or refugees. The Washington Area Bicyclists Association's (WABA) Women on Bicycles Program is a national model for this type of effort. Partnerships with individual community members can involve residents who volunteer to disseminate bicycle information to neighbors, friends, coworkers and others. A model for such a partnership is Fort Collins' Bicycle Ambassadors program with its wide reach and suite of programming.

Culture and Identity

Hosting bicycling events – both small and large – is great way to build and cultivate a bicycling culture. These programs do not have to be hosted by county government, but the county can provide institutional support and facilitate permitting, as needed. One of the most common types of bicycling events is a Cyclovia (also known as Open Streets or Sunday Parkways), which involves closing streets to automobile traffic to show residents a new way to look at and experience their surroundings.

Community rides are also popular. "Tweed rides" remind people that spandex isn't required for riding a bike. For people who do prefer less leisurely riding, hosting charity rides, competitive rides and even professional races can engage large numbers of people.

World-class communities for bicycling also celebrate bicycling as part of their identity. This status is reflected in marketing for the community, whether to tourists or developers or people relocating to the area, and reflected visually in the public realm. Some of the most bicycle-friendly places in the U.S. and abroad have taken opportunities to create the following highly visible infrastructure for bicycling:

- Collaboration with architects to develop bike-oriented buildings and architecture.[23]
- Visible bike-related sculpture and support facilities,[24] and iconic, architectural non-motorized bridges.[25]
- Artful, whimsical wayfinding that makes it easy and memorable to bike.[26]

Demonstration or pop-up infrastructure projects can build support among the public for bicycling projects and provide a temporary highly visible place for bicycling in the community. Demonstration events can also help convince skeptics, both internal and external to a planning agency, that a given bicycle facility could actually exist in a particular location without negative effects on other transportation modes.

Education and Information

Almost all plans include recommendations related to bicyclist or motorist education. Popular recommendations include good road user behavior programs, bicycle safety awareness campaigns, adult and child bicycle education, bicyclists legal training (classes, guides, handouts), bike and transit education and training, local Safe Routes to School programs and legal quick guides to reporting a crash. Ensuring that all grade school children receive bicycle education is an excellent way to build a safe bicycling culture for years to come. Education can also be critical for agency staff across the board to ensure they understand and are invested in what makes a world-class bicycling environment.

Providing maps and trip planning tools can make bicycling feel more accessible to more people. Mobile technology is pushing the envelope for bicycle route finding. Route mapping is being developed that allows the user to plan a route so that they do not exceed their tolerance for traffic stress. Plans also recommend interactive wayfinding kiosks with real time weather, traffic and routing information for cyclists.

Enforcement

Common enforcement recommendations include partnering with police on three-foot passing and speeding enforcement stings. Positive enforcement programs, such as handing out "tickets" worth a free ice cream to children for good bicycling behavior, can build community support and good will.

Evaluation

Evaluation is the part of bicycle programming most often overseen by local government. World-class evaluation can help push the boundaries of the field of bicycle planning and engineering. Count data collection is an area that is growing in the leading bicycle cities, counties and states. The development of a robust counting program of continuous automated counters provides benchmarks for ridership, helps calculate crash exposure rates and can aid in making the case for bicycle infrastructure improvements.[27]

PLANNING FOR IMPLEMENTATION

The process used during the creation of the plan and the strategy for implementation after the plan is adopted can determine the amount of community and agency buy-in and help or hinder implementation.

Prioritization Process

A large list of projects and programs lacking prioritization is not a useful outcome of a bicycle master plan. By creating a prioritized list, a community can move forward from the plan with concrete steps for implementation. Each community should develop its own prioritization process based on local conditions and plan objectives. For instance, if a plan goal is increased ridership, projects in areas with high opportunity for bicycling should be prioritized, i.e. areas with a higher density of diverse land uses, high percentages of short trips made by other transportation modes and good connectivity to existing bicycle infrastructure. This said, all projects in the network should be considered for implementation when opportunities such as resurfacing or redevelopment occur.

Methodology for Prioritization

Prioritization methodologies vary from plan to plan. Most often, infrastructure recommendations are prioritized into a clear, tiered list, while programmatic and policy recommendations are not. Structuring these recommendations into a hierarchy may necessarily require more qualitative judgments, but an ambitious world-class plan will need to pinpoint those programs and policies warranting investment first. Prioritization of programs and policies should be done through discussion with stakeholders about community priorities and identifiable roadblocks to implementation.

It is important to consider the programs that would change the character of biking in the community, such as district-wide bicycling education, and policy changes that must occur to enable or ease implementation of projects. For instance, some requirements for traffic studies may indirectly make it more difficult to construct bicycle projects. Projects requiring these policy changes may be high priorities and thus spur action to execute changes.

A typical bicycle network prioritization process will flow directly from the plan's performance measures and will consider how well each recommendation addresses the plan's vision as defined by its goals and objectives. While this process varies from community to community, a national resource has been developed through the Transportation Research Board's National Cooperative Highway Research Program (NCHRP) Report 803, Pedestrian and Bicycle Transportation Along Existing Roads, which is adaptable by communities and provides a clear, easily explainable process by which to prioritize infrastructure projects.[28]

Case Studies: Fort Collins, CO – Scoring projects to determine priorities

The City of Fort Collins prioritized infrastructure projects and program recommendations in its bicycle master plan by scoring them according to the "Triple Bottom Line" framework that the city employs for all types of projects. Specific questions in the three areas of economic, environmental and social impacts were developed for infrastructure and program recommendations. For instance, one question in the environmental impacts category asked "Does the project limit the need for additional impervious pavement?" The yes/no answers to questions were summed and these tallies placed projects into high, medium or low priority categories qualitatively.

Additionally, a quantitative score was developed for infrastructure recommendations based on criteria important to stakeholders: demand analysis, crash history, removal of barriers and public input.

Separate methodologies were used to prioritize corridors and intersections since some difficult locations did not lie on identified routes. These locations were often major intersections where experienced riders using bike lanes on major streets still felt uncomfortable or unsafe. The intersections of local streets with arterial roadways were also highly prioritized where the local street was part of a low-stress network. Many of these locations had unsafe crossings which could inhibit the success of the low-stress network if not improved. Corridors were placed into year-long tiers of implementation based on the assumed city budget for project implementation.

Corridors were identified with consideration of providing logical start and end points to improve low-stress network connectivity.

Project Lists and Documentation

Project lists should include planning-level cost estimates. Some communities use cost as a prioritization criterion in developing a cost-benefit analysis for each project. Communities may also choose to prioritize projects exclusive of cost and regardless of their place on in the prioritization list. Low-hanging fruit projects, such as paint-only projects (e.g. lane diet, road diet, shared lane markings) on streets with upcoming resurfacing, should be programmed right away. This immediate action sends a message that the plan is already having an impact on the ground. Initial planning, and sometimes design, can be completed for high-priority projects that can be used to strengthen grant applications later.

Both the publicly available and non-publicly available documentation used to develop the plan should provide enough information for implementers who did not participate in the planning process to understand the rationale behind the recommendations.

Some of the information that should be documented in the plan include:

- Recommendations and actions, each with an assigned priority and responsibility.
- Project list, estimated cost, length.
- Project cost assumptions.
- Existing conditions summary.
- Public outreach process.

Case Study: Portland, Oregon -- Three-part implementation strategy[29]

The Portland Bicycle Plan for 2030 recommends three implementation strategies: the immediate implementation strategy, the 80 percent implementation strategy and the world-class implementation strategy. Each is associated with funding scenarios that provide a starting point for projects that the City of Portland expects to build in the future.

The **immediate** implementation strategy presents a suite of projects to be completed within five years of plan adoption. This suite was selected to meet expected funding levels ($10-14 million) and includes projects that are relatively economical (bike boulevards, striping) that address equity issues, expand access and overcome barriers.

The **80 percent plan** is not tied to a timeline and focuses on spreading funding over a wide geographic area such that 80 percent of Portlanders are within a quarter mile of a low-stress bikeway. This strategy again focuses on bike boulevards but also includes some signature trail projects.

The **world-class plan** is based on implementation of separated and buffered bike lanes on main commercial streets and other high-volume roadways. It is understood that this strategy will be costly and that its implementation depends upon a large shift in funding priorities. The plan makes clear that projects in the 80 percent and world-class lists can be implemented at any time if funds are available and, indeed, the implementation of projects in Portland since the adoption of this plan in 2010 has included some projects from each list and some that were not proposed in the original plan.

Maintenance Strategies

Consistent maintenance of bicycle facilities is critical to keeping them accessible, usable and desirable, and a world-class master plan considers maintenance strategies in its review of the current and future bicycling environment. Maintenance includes pavement marking and signage upkeep, street sweeping, snow removal and surface repairs and assessments from potholes to gutter seams and root heave on trails.

As separated bicycle facilities are becoming more common, transportation agencies are tasked with developing more sophisticated strategies for maintaining bicycle facilities separate from standard roadway maintenance. Some communities empower residents to report bicycle facility maintenance issues. Such citizen participation can lessen a public agency's burden of tracking locations and indicates a concerted interest in ensuring the usability of bike facilities.

Some communities choose to incorporate maintenance costs into project cost estimates. Plan stakeholders should determine whether that strategy or an alternative way of estimating an overall maintenance budget for planned facilities will better serve future funding requests.

CONCLUSION: MONTGOMERY COUNTY, MD – PREPARING FOR THE BICYCLING FUTURE

Montgomery County, MD, is already primed with many of elements to become a world-class place for bicycling through the development of its Bicycle Master Plan. A well-loved trail system already exists. Three separated bike lanes are already on the ground with more coming in 2017. Bike share use is growing. Bike parking is being improved. Wayfinding routes are being added.

More importantly, community members have been engaged in making the County a better place to bicycle for decades. These riders are now united with those who seek low-stress facilities for themselves and their families. Politicians and agency leaders are recognizing and responding to this interest. Businesses and developers are realizing the value of an improved bicycle network. And motivated staff across agencies see the opportunity to move the County forward.

This combination of existing and emerging support can help drive the development of an ambitious world-class bicycle plan that will help residents, leaders, and staff buy into a vision and its implementation. Development of this plan will be another step toward creating the bicycle culture that will help the County become a world-class place for bicycling.

1.4 REVIEW OF INTERNATIONAL BICYCLE MASTER PLANS

This section provides a summary of bicycle master plans from all over the world and the U.S., including communities comparable to Montgomery County, MD, to identify the elements that make up a world-class bicycle plan.

APPROACH

International examples of world-class suburban bicycling communities in Houten, Netherlands, and Freiberg and Vauban, Germany, as well as suburban London, England were reviewed.[30]

To find the best bicycle plans in the U.S., we reviewed the plans of the communities competing to be the most bicycle friendly communities – the five Platinum Bicycle Friendly Communities, according to the League of American Bicyclists: Boulder and Fort Collins, CO; Davis, CA; Portland, OR; and Madison, WI.

In addition, small city, suburban, regional, and County-level bicycle plans were reviewed based on their national reputation for excellence and innovative approaches. These plans were developed for Bellingham, WA, the Atlanta region, Richfield, MN, Hennepin County, MN,[31]and North Santa Clara County, CA.

Finally, the team reviewed bicycle plans for Montgomery County's neighbors: Fairfax County, VA; Howard County, MD; Washington, DC, and Tysons Corner, VA.

Many of the cities whose plans were reviewed for this white paper have developed specific plans for becoming a world-class bicycling community, making them good models for Montgomery County. The cities of Portland, OR; Boulder and Fort Collins, CO; Davis, CA; and Madison, WI are now pursuing the League of American Bicyclists' new Diamond rating, which is modeled on international standards of bicycle friendliness. Google's vision for its campus and surrounding area in North Santa Clara County, CA, is "North County-as-Copenhagen."

The following is a brief summary of the distinctive parts of each plan studied for this report, organized around these questions:

- Why was this plan included in this report?
- What are the notable elements or sections of the plan?
- What are the transferrable ides to borrow for Montgomery County?

INTERNATIONAL PLANS

The following international cities have developed innovative plans for bicycling in suburban contexts.

Houten, Netherlands

Why this location is included:

Houten, a suburb of Utrecht in the Netherlands with a population of 43,900, was designed and built from scratch to prioritize bicycling and walking. It is a real-life example that answers the question: what would happen if we could start over and design our suburbs around transit, walking and bicycling instead of the automobile?

Notable bicycle-friendly elements:

Each of the community's two train stations is surrounded by a two-kilometer wide ring road. The town is connected by a 129-kilometer network of bicycle paths. The 31 residential districts are only accessible to cars by the outer ring roads, while the network of paths for cyclists and pedestrians passes directly through the town center. Most schools and important destinations are located along a primary bicycle/pedestrian thoroughfare. Bicycling is generally the fastest and most direct transportation mode.[32]

Transferrable idea for Montgomery County:

Because it was built on a greenfield from the ground up, Houten is more of a theoretical model than a practical one for Montgomery County, but there are lessons to be learned from the experiment. The concept of "filtered permeability" for cyclists and pedestrians is the planning and design approach that allows bicyclists and pedestrians to travel along more direct routes than the more restricted routes for cars. In Montgomery County, a similar arrangement might mean creating path connections between neighborhoods where there is no road, creating more direct connections for bicyclists.

Vauban, Germany

Why this location is included:

Vauban, outside of Freiburg, Germany, is a model car-light suburb. Located on a former French barracks and redeveloped as a residential enclave, the town prioritized travel by tram, walking and bicycling. Bicycling and walking make up a combined 64 percent of all trips. In a 2002 survey, 81 percent of residents from car-free households said life without owning a car was "easy" or "very easy." [33]

Notable bicycle-friendly elements:

Vauban physically separates car parking from the majority of housing units and has lowered minimum parking requirements. Car access to residential streets is permitted for picking up and dropping off only. Many streets are marked as "play streets" to prioritize children over motor vehicles. Parking is provided in garages located outside the town center.
Transferrable idea for Montgomery County:
Montgomery County could experiment with lower parking requirements in areas with good access to transit and high-quality bicycle facilities.

Outer London. The Mayor's Vision For Cycling

Why this plan is included:

Although London is a large city, it has many suburban areas within its boundaries. The Mayor's Vision for Cycling, unveiled by London Mayor Boris Johnson in 2013, calls for major investments both in the city center, along major corridors and in outer London communities.

Notable bicycle-friendly elements:

The plan calls for "'Mini-Hollands" in the suburbs, bikeways inspired by bicycling-friendly routes in the Netherlands, and would increase cycle spending specifically dedicated to outer London by more than 30 times (roughly equivalent to $150 million). Between one and three volunteering outer London boroughs would be made into Mini-Hollands.

Transferrable idea for Montgomery County:

In addition to the Mini-Hollands in the suburbs idea, the plan includes the corporate-sponsored Better Barclays Cycle Superhighways to provide direct bicycling access into central London on high-quality separated bicycling facilities. Also, the plan includes a "quietway" network on low traffic streets, similar to bicycle boulevards in the U.S., featuring cut-throughs for bicyclists to increase connectivity.[34]

LEADING U.S. CITIES – PLATINUM BICYCLE-FRIENDLY COMMUNITY CITIES

The following U.S. cities have achieved Platinum Bicycle-Friendly Community status, in many cases having developed a "getting to Platinum" plan. They are now racing to be the first American cities to achieve Diamond status, a more bicycle-friendly rating than Platinum.

Fort Collins, Colorado. 2014 Bicycle Master Plan[35]

Why this plan is included:

Fort Collins is rated by the League of American Bicyclists as a Platinum Bicycle Friendly Community and has both urban centers and lower-density residential areas similar to Montgomery County.

Notable bicycle-friendly elements:

The Fort Collins Bicycle Master Plan is known for its level of traffic stress analysis. It includes a clear table describing the existing bicycle facilities and roadway conditions associated with different levels of traffic stress. The plan also contains a clear and informative table of performance measures. The snow removal maintenance map identifies the roadway or trail owner to facilitate the maintenance and implementation process.

Transferrable idea for Montgomery County:

The Fort Collins plan includes several different network analyses that could be relevant to Montgomery County, including a safety analysis, a demand analysis and the low stress network analysis.

Boulder, Colorado, Transportation Master Plan Bicycle Element and Complete Streets Bicycle Action Plan[36]

Why this plan is included:

Boulder is rated by the League of American Bicyclists as a Platinum Bicycle Friendly Community.

Notable bicycle-friendly elements:

The City of Boulder's Living Laboratory, a pilot program to test new street designs for enhancing travel safety, involves pre- and post-evaluation and on-going analysis to improve the city's bicycle network in a continuous fashion. This approach includes demonstration projects, such as an E-bike pilot program on multi-use paths, protected cycle tracks, back-in angle parking and variations of buffered bike lanes.

Transferrable idea for Montgomery County:

Boulder is constantly testing new ideas and learning what works in the community. The Living Laboratory approach does not assume that learning is done once the research for the plan is completed. The City evaluates its projects and new ideas, and tweaks its plans on an on-going basis.

Davis, CA. Bicycle Action Plan: Beyond Platinum[37]

Why this plan is included:

Davis is rated by the League of American Bicyclists as a Platinum Bicycle Friendly Community, with its explicit goal of being a world-class bicycling city.

Notable bicycle-friendly elements:

Many communities adopt the themes of the League's Bicycle Friendly Community Program: engineering, education, enforcement, encouragement and evaluation and planning. The City of Davis embraces these goals and has added equity and enjoyment to the list. Davis is also thinking big in terms of bicycling events in the city and plans to host a Bicycle World's Fair in 2017.

Transferrable idea for Montgomery County:

The Davis bicycle master plan has a notable emphasis on quantitative measurement. The City of Davis is using the League's Diamond status criteria to track its own progress. The city regularly documents its percentage of trips to work and school by bike; fatality and crash rates per 10,000 daily riders; percentage of people who feel safe riding their bikes on city streets; public satisfaction survey results, and network completeness.

Portland, OR, Bicycle Plan for 2030[38]

Why this plan is included:

The League of American Bicyclists rate Portland as a Platinum Bicycle Friendly Community.

Notable bicycle-friendly elements:

Portland's Bicycle Plan for 2030 provides a clear and insightful policy framework for bicycle improvement. The city has embraced the idea of the 20-minute neighborhood where daily needs can be met within an easy walking or bicycling distance. The city's goal is to make bicycling more attractive than driving for trips of three miles or less and create new bike parking policies. The city classifies bicycle street types into major city bikeways, city bikeways, local service bikeways and bicycle districts. Criteria for major city bikeways are continuity, high-level of use, collectors, strategic areas, funneling functionality and equitable spacing.

The plan's network recommendations call for a fine-grained bikeway network that serves key destinations. For example, it recommends the city "prioritize bikeway improvements that serve regional and town centers, main streets, employment centers, commercials districts, transit centers and stations, institutions, schools, parks and recreational destinations."

Transferrable idea for Montgomery County:

The plan profiles individual bicyclists and describes their experience of riding a bike in Portland. For each cyclist, it includes a photograph, a map of a typical route and quotations about the ride.

Madison, WI. "Making Madison the Best Place in the Country to Bicycle" and 2015 Bicycle Transportation Plan for the Madison Metropolitan Area and Dane County[39]

Why this plan is included:

Madison is now a Platinum Bicycle Friendly Community. The name of one of its plans is "Making Madison the Best Place in the Country to Bicycle."

Notable bicycle friendly elements:

Madison's plan includes a healthy emphasis on land use, including these specific recommendations:

- Create a community of compact, walkable, transit and bicycle-oriented, mixed-use neighborhoods, districts and corridors.
- Include specific recommended bicycle connections to major activity centers in neighborhood plans.
- Review and strengthen the local zoning ordinance to ensure adequate on-site pedestrian and bicycle access, parking and circulation.
- Review and strengthen the subdivision ordinance to ensure a connected street network with bicycle facilities.

Transferrable idea for Montgomery County:

The master plan's "Timeline Index" includes a table of recommendations with a calendar (month/year/season) for implementation.

REGIONAL PLAN EXAMPLE

The following section describes a plan prepared by a metropolitan planning organization to show an example of a high quality regional plan.

Walk Bike Thrive!: Atlanta Regional Bicycle & Pedestrian Plan (2016)[40]

Why this plan is included:

Atlanta Regional Council's plan is recent (2016) and highly regarded. The region is characterized by various land uses that are similar to those found in Montgomery County.

Notable bicycle-friendly elements:

The plan is well designed with an attractive layout and informative text and graphics describing the framework of the plan. Its sophisticated theory of change is organized into two parts: the first part describes a regional framework for walking and biking, and the second part describes how local jurisdictions and regional partners can build bicycling and walking networks.

Transferrable idea for Montgomery County:

The plan includes a toolkit for local implementation that might be helpful for the smaller communities inside Montgomery County. The plan is also structured around the idea of 20-minute neighborhoods (those where most daily needs are reachable within a 20-minute walk) that may be applicable to Montgomery County.

SUBURBAN PLANS

Richfield, Minnesota "Sweets Streets" Program[41]

Why this program is included:

The Minneapolis suburb of Richfield is earning praise for having one of the best suburban bicycle plans in the country.[42]

Notable bicycle-friendly elements:

The plan, completed in 2012, aims to "link major destination points within the city, including trails connecting to other communities, to encourage visitors and residents to get out and bike."[43]

Richfield's Sweet Streets program was a marketing campaign that turned into a funding channel after issuing roadway construction bonds. Within next five years, city officials plan to have milled and overlaid all local streets, and reconstructed all their arterials, which will allow them to implement 100 percent of the bicycle master plan.[44]

Transferrable idea for Montgomery County:

This plan has a distinct focus on specific community needs and the places frequented by local residents. "It is about circulation [within the community], bike rides, and friendly trips to ice cream shop," says City of

Richfield Transportation Engineer Jack Broz. "Those priorities drove the routes for the bike plan, so it supports what people want to do. It is not prioritized on commuters; it is prioritized on families." Broz notes that people moved to Richfield and not nearby Minneapolis because they aren't looking for the same things that people in bigger cities want: "What works in Minneapolis might not work in Richfield." [45]

COUNTY PLANS

Hennepin County, MN[46]

Why this plan is included:

Hennepin County, MN, was recently designated a Bicycle Friendly Community by the League of American Bicyclists. The county has a similar range of place types as Montgomery County.

Notable bicycle-friendly elements:

The bicyclists on the cover of the Hennepin County bicycle plan are dressed in everyday clothing (not spandex) and express their joy in bicycling. The goal was to create a plan for everyone in the community and the city worked to humanize plan. The people in the photos were interviewed by planners and their comments about bicycling are included in the document. This public engagement was very intentional. The team went into the community and made a point to reach otherwise under-represented groups of bicyclists.

The plan includes a list of "top 25 gaps," which made building out the system a lot more approachable – the county has released several RFPs for their new "bike gap" program. The plan includes design guidance and specific mode share goals.

Transferrable idea for Montgomery County:

The inclusion of profiles of real bicyclists makes this plan feel approachable by a wider audience. Both written profiles and photos of a wide range of residents (varied ages, genders, races, etc.) should be included in Montgomery County's Bicycle Master Plan.

Google Bike Vision Plan – North Santa Clara County[47]

Why this plan is included:

This is an example of a recent and high quality county bike plan.[48]Santa Clara County is heavily car-oriented, has many large arterial streets that form barriers for bicyclists, and is seeing large amounts of redevelopment. Note that this plan is about access to the Google campus, not bicycle infrastructure improvements on the campus itself.

Notable bicycle-friendly elements:

Google's plan notes that most bicycling maps show the existing bike network, and some even show notable barriers to access. But what they don't show is an actual on-the-street experience for someone trying to ride their bike from one place to another. The Google plan asks these pertinent questions: If you're riding your bike in North County for the first time, will it be a harrowing experience or an easy breeze? Are there any barriers or high-stress locations that are blocking otherwise easy access? What would it take to get more people in North County to feel comfortable getting on a bicycle?"

Transferrable idea for Montgomery County:

To develop the recommended bike network, this plan follows four principles: continuity, connectivity, convenience and completeness. The plan also includes a visualization that compares a bicyclist's actual distance with the distance a trip feels, based on the amount of stress experienced by the rider. Maps include major access barriers for bicyclists, a priority corridor network and existing and proposed low stress routes. These could be good models for the Montgomery County Bicycle Master Plan.

WASHINGTON, DC, REGION PLANS

The following plans are from jurisdictions neighboring Montgomery County.

Fairfax County Bicycle Master Plan, 2014 [49]

Why the plan is included:

The Fairfax County Plan is a countywide plan in the same region as Montgomery County. Similar to Montgomery County, Fairfax has varied land uses and densities (though highly suburban in many areas) and most trips between destinations require travel on a major (often state-maintained) arterial.

Notable bicycle-friendly elements:

The Fairfax County Bicycle Master Plan presents extensive recommendations for the county.

The plan notes that the existing bikeway network is more than 350 miles and proposed bicycling improvements would add more than 1,100 miles. Recommended facilities include bicycle lanes and other on-road bicycle facilities and treatments, shared use paths, cycle tracks, bicycle/pedestrian bridges and underpasses, intersection improvements, trail access improvements and other accommodations.

Transferrable idea for Montgomery County:

As part of its performance measures, the Fairfax County plan uses Arlington and Montgomery Counties and the District of Columbia as comparisons for bicycling levels. Montgomery County could produce a similar benchmarking report to compare progress with its neighbors.

See also the Tysons Corner Bicycle Master Plan, 2010.[50]

Howard County Bicycle Master Plan, 2015 [51]

Why this plan is included:

Howard County is in the same region and state as Montgomery County, and recently completed a Bicycle Master Plan that aims to encourage a wide range of people to ride bikes.

Notable bicycle-friendly elements:

The theme of the Howard County Bicycle Master Plan is comfort for all, using a low stress framework. The plan focuses on connecting people and places, and Howard County to surrounding jurisdictions, removing barriers to these connections extending the existing pathway networks and closing gaps within these networks.

Transferrable idea for Montgomery County:

The Bike Howard plan prioritizes projects according to three tiers: a short-term network, a mid-term network and a long-term network using a specific set of criteria.

Move DC Bicycle Element [52]

Why this plan element is included:

Washington, DC, borders Montgomery County and has seen a major increase in bicycle ridership over the past decade, providing a strong local example of executing one of Montgomery County's plan goals.

Notable bicycle-friendly elements:

The Bicycle Element is one part of the DC's multimodal long-range transportation plan called MoveDC. The element includes recommendations to provide more and better bicycle facilities, enact more bicycle friendly policies and provide more bicycle-related education, promotion and enforcement.

The "Vision to Reality" section is a good example of an implementation strategy. The plan identifies $293 million in infrastructure recommendations (using planning-level estimates). Projects areprioritized and organized into four tiers of bicycle and trail capital investments.

Transferrable idea for Montgomery County:

Many of the recommendations in the Bicycle Element may be applicable to Montgomery County.

END NOTES

1. Copenhagen City of Cyclists: The Bicycle Account 2014. http://www.cycling-embassy.dk/wp-content/uploads/2015/05/Copenhagens-Biycle-Account-2014.pdf
2. The report, Collection of Cycle Concepts 2012, uses the word "whip" instead of "stick," but stick is used here because of its more common usage in the U.S.
3. Collection of Cycle Concepts 2012, Cycling Embassy of Denmark. http://www.cycling-embassy.dk/wp-content/uploads/2013/12/Collection-of-Cycle-Concepts-2012.pdf
4. Pucher and Buehler "Making Cycling Irresistible" Transport Reviews, Vol. 28, 2008. http://bikeportland.org/wp-content/uploads/2007/11/pucherbuehlermakingcyclingirresistible.pdf
5. In the 1990s, then-Seattle Bike/Ped Coordinator Pete Lagerwey entered the office of a long-time trail planner who had half a dozen bike plans from the past 20 years mounted in his office. Lagerwey was impressed and complimented the planner. "This?," the planner said, "No, this is my wall of shame. None of these great plans ever got implemented."
6. 8 to 80 networks are appropriate for a wide range of bicyclists, from children (age 8) to elderly adults (age 80). These bicyclists have an increased need for separation from traffic.
7. Walk.Bike.Thrive! Atlanta Regional Commission, 2016. http://www.atlantaregional.com/transportation/bicycle--pedestrian
8. Bicycle Account from Copenhagen. http://www.cycling-embassy.dk/2015/05/06/new-bicycle-account-from-copenhagen/
9. Bicycle Account Guidelines: Measuring, Tracking and Reporting Progress to Inspire Better Biking in Your Community. http://bikeleague.org/sites/default/files/Bicycle_Account_Guidelines.pdf
10. Active Transportation Equity: A Scan of Existing Master Plans, Advocacy Advance, May 2015 http://www.advocacyadvance.org/docs/ActiveTransportationEquityScan.pdf
11. Eugene Pedestrian and Bicycle Master Plan, 2012. http://www.pedbikeinfo.org/pdf/PlanDesign_SamplePlans_Local_Eugene2012.pdf
12. Equity of Access to Bicycle Infrastructure: GIS Methods for Investigating the Equity of Access to Bike Infrastructure, Rachel Prelog, Texas A&M University, September 2015. http://www.bikeleague.org/sites/default/files/bike_equity_index_final_2.pdf
13. Equity Analysis of Portland's Draft Bicycle Master Plan – Findings, Jennifer Dill, Ph.D. and Brendon Haggerty, Portland State University Center for Transportation Studies, September 24, 2009. http://www.bikeleague.org/sites/default/files/bikeleague/bikeleague.org/programs/bicyclefriendlyamerica/communities/pdfs/portland_bicycle_master_plan_equity_report_final.pdf
14. http://www.mto.gov.on.ca/english/publications/pdfs/ontario-cycle-strategy.pdf
15. http://altaplanning.com/wp-content/uploads/Google-Bike-Vision-Plan_high_res.pdf
16. http://www.cambridgema.gov/CDD/Transportation/bikesincambridge/bicyclenetworkplan
17. The Dutch Design Manual for Bicycle Traffic, known as the CROW Manual, page 65
18. Collection of Cycle Concepts 2012, Cycling Embassy of Denmark, "Is the Plan Cohesive?," p. 61. http://www.cycling-embassy.dk/wp-content/uploads/2013/12/Collection-of-Cycle-Concepts-2012.pdf
19. Portland Bicycle Plan for 2030, part 3: the Bicycle Transportation System, page 41. https://www.portlandoregon.gov/transportation/44597?a=379134
20. Portland Bicycle Plan for 2030, p41.
21. Portland Bicycle Plan for 2030, p42.
22. Portland Bicycle Plan for 2030, p43.
23. https://veloapartments.prospectportal.com/; http://www.archdaily.com/83307/8-house-big; http://www.wsj.com/articles/developers-build-luxury-bike-friendly-buildings-1411660659
    http://www.fastcodesign.com/1663586/a-bike-rack-that-rises-in-the-sky-like-a-ferris-wheel
24. http://www.gizmodo.com.au/2013/06/5-robotic-bike-parking-systems-that-solve-an-urban-dilemma/
25. https://en.wikipedia.org/wiki/Tilikum_Crossing; https://goo.gl/fYq2O2
26. https://www.google.com/search?q=lisbon+portugal+bikeway+belem&tbm=isch&tbo=u&source=univ&sa=X&ved=0ahUKEwiNk5KbqpTNAhUYK1IKHewjBVMQsAQINw&biw=1745&bih=886
27. Programs in Boulder, CO, and Minneapolis, MN, are of note on the city scale. The Delaware Valley Regional Planning Commission has an exemplary regional program.
28. Pedestrian and Bicycle Transportation Along Existing Roads—ActiveTrans Priority Tool Guidebook, NCHRP Report 803, 2015 http://www.pedbikeinfo.org/pdf/PlanDesign_Tools_APT_Guidebook.pdf
29. Strategic implementation plan, Portland Bicycle Plan 2030 https://www.portlandoregon.gov/transportation/44597?a=379136
30. Plans for Western Australia (Perth region) and Melbourne were also reviewed, but were excluded here for space and applicability.
    Western Australian Bicycle Network Plan 2014-2031. http://www.transport.wa.gov.au/mediaFiles/active-transport/AT_CYC_P_WABN_Plan.pdf; BICYCLE PLAN 2016–2020 http://www.melbourne.vic.gov.au/SiteCollectionDocuments/city-of-melbourne-bicycle-plan-2016-2020.pdf
31. The Portage County Countywide Bicycle & Pedestrian Plan, 2014, was also review, but excluded here for space.
    https://stevenspoint.com/DocumentCenter/View/871
32. Case Study: Houten, Utrecht, the Netherlands, Nicole Foletta, ITDP Europe http://www.itdp.org/wp-content/uploads/2014/07/22.-092211_ITDP_NED_Desktop_Houten.pdf
33. Case Study: Vauban, Freiburg, Germany https://www.itdp.org/wp-content/uploads/2014/07/26.-092211_ITDP_NED_Vauban.pdf
34. The Mayor's Vision for Cycling in London: An Olympic Legacy for all Londoners, Mayor of London, Transport for London, Greater London Authority, March 2013 http://content.tfl.gov.uk/gla-mayors-cycle-vision-2013.pdf
35. Fort Collins, Colorado. 2014 Bicycle Master Plan http://www.fcgov.com/bicycling/pdf/2014BicycleMasterPlan_adopted_final.pdf
36. City of Boulder Bicycle System Plan, https://www-static.bouldercolorado.gov/docs/transportation-master-plan-tmp-2014-1-201408271459.pdf
    Complete Streets Bicycle Action Plan https://www-static.bouldercolorado.gov/docs/complete-streets-bicycle-action-plan-1-201406181359.pdf
37. City of Davis, Bicycle Action Plan: Beyond Platinum http://cityofdavis.org/home/showdocument?id=979
38. Portland, OR, Bicycle Plan for 2030. http://www.portlandoregon.gov/transportation/44597?a=379130
39. City of Madison, Mayor's Platinum Bicycling Committee Report, "Making Madison the Best Place in the Country to Bicycle," April 2, 2008 https://www.cityofmadison.com/trafficEngineering/documents/PlatinumAdopted040808sm.pdf
    Bicycle Transportation Plan for the Madison Metropolitan Area and Dane County, 2015 http://www.madisonareampo.org/planning/documents/Final_BTP_2015_web.pdf
40. Walk Bike Thrive!: Atlanta Regional Bicycle & Pedestrian Plan (2016) http://www.atlantaregional.com/transportation/bicycle--pedestrian
41. http://richfieldsweetstreets.org/bigpicture; http://www.cityofrichfield.org/home/showdocument?id=778
42. Richfield is Hailed for Bullish Bike Plans, John Reinan, Star Tribune, February 25, 2016. http://www.startribune.com/richfield-is-hailed-for-bullish-bike-plans/370205551/
    3 Steps to Bicycle friendly Suburbs, Jeff Pearson, American Bicyclist Magazine, Bikeleague.org, June 4, 2015. http://bikeleague.org/content/3-steps-bicycle friendly-suburbs
43. City of Richfield Bicycle Master Plan, Final Version 6-1-12. http://www.cityofrichfield.org/home/showdocument?id=778
44. http://richfieldsweetstreets.org/bigpicture
45. Phone interview, Jack Broz, Transportation Engineer, Public Works, City of Richfield, June 29, 2016.
46. Hennepin County. http://www.hennepin.us/residents/transportation/biking
    http://www.hennepin.us/-/media/hennepinus/residents/transportation/documents/bicycle-transportation-plan.pdf?la=en
47. Google Bike Vision Plan – North Santa Clara County
    https://16294-presscdn-0-20-pagely.netdna-ssl.com/wp-content/uploads/Google-Bike-Vision-Plan_high_res.pdf
48. See also Santa Clara Valley Transportation Authority: http://www.vta.org/projects-and-programs/planning/bike-plan
49. http://www.fairfaxcounty.gov/fcdot/pdf/bike/bicycle_master_plan_draft-final.pdf
50. http://www.fairfaxfederation.org/pdf/TysonsCornerBicycleMasterPlan111118.pdf
51. https://bikehoward.com/
52. http://www.wemovedc.org/resources/Final/Part%202_Plan_Elements/Bicycle.pdf

02

BIKEWAY CLASSIFICATION

Classification of bikeway types is an important step to help planners comprehend how parts of the bike network function and work together. The need for a new bikeway classification system in Montgomery County springs from the introduction of new facility types in the Bicycle Master Plan update, as well as a need to better link policy objectives to the network classification system. Creation of a network classification system that has real policy impacts in the decision-making process can help move the bike plan from lines on a map to a truly useful tool.

Classification also provides planners and the public with an understanding of the level of bicycle accommodation on streets in the network and guidance about prioritization and implementation. This paper refers to two types of bikeway classification:

- Facility classification: groups bikeways by the type of facility; for example, separated bike lanes, bike lanes, shared roadways and trails.
- Network classification: provides a framework for understanding a given bikeway's function or importance in the network, typically by designating primary and secondary networks.

The approach taken by Montgomery County to each of these types of bikeway classification can play an important role in the county's efforts to create a world-class bicycle plan and to be an exemplar of suburban bicycling in the U.S. Using network classification as a means of indicating critical routes will facilitate the creation of a connected low-stress network. This is not to say that every primary bikeway would be separated bike lanes on a major street, but every primary bikeway would play a key role in providing a low-stress connection.[53] A higher network classification would indicate a route's fundamental importance to the bike network and guide county staff in making facility design decisions.

This paper provides an overview of Montgomery County's current classification schemes for bikeways. This overview is followed by a summary of classification practices from a number of local and national cities. Finally, recommendations are presented for how Montgomery County should move forward with classification in its Bicycle Master Plan update. It should be noted that this paper focuses on bikeway classification for the purposes of master-planning and implementation, not for creating bicycling maps or wayfinding.

2.1 CURRENT MONTGOMERY COUNTY BIKEWAY CLASSIFICATIONS

Montgomery County's existing classification scheme was developed for the 2005 Countywide Functional Bikeways Master Plan and includes both facility classification and network classification. Facilities are categorized by type and include:

- Shared use path
- Bike lane
- Signed shared roadway
- Dual bikeway[54]
- Cycle tracks

Facility types were not grouped by bicyclist level of comfort or degree of separation provided from automobile traffic.

The county uses countywide and local routes for network classification. Countywide routes comprise about two-thirds of the network and were the focus of the 2005 Plan. These routes generally are located on arterial streets and provide longer distance connections, linking major destinations throughout the county. Local routes are those that feed into the county route system, typically from smaller neighborhood origins and destinations. The countywide/local designation has no inherent relationship to the prioritization or implementation of facilities.

The Bicycle Master Plan update could include as many as 12 facility classifications. Thus, grouping facility types may benefit the county so as not to create a greater level of complexity than necessary.

The current network classifications of countywide and local route types appear to serve little or no function and likely add unnecessary complexity to the network definition. Since countywide bikeways comprise about two-thirds of all master-planned bikeways, this designation does not indicate those bikeways that are the most important and, which therefore, should be prioritized in discussions related to limited space and trade-offs between various travel modes or designed to a higher standard (e.g., separated bike lanes that are wider than typical conditions) in anticipation of large numbers of bicyclists. Designations have not been related to prioritization of implementation. Creation of a network classification system that has real policy impacts in the decision-making process can help move the bike plan from lines on a map to a truly useful tool.

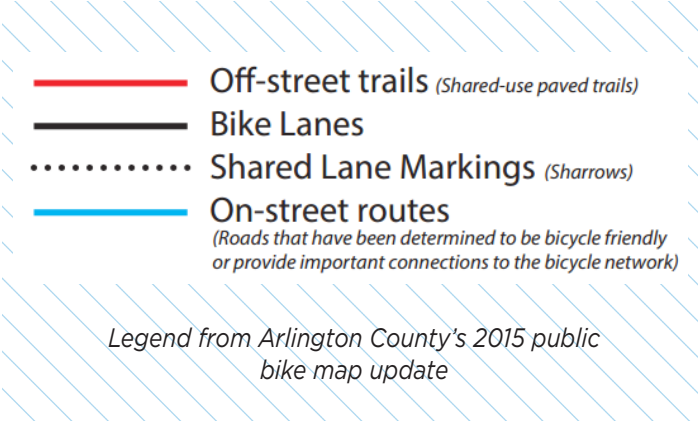
2.2 EXAMPLE CLASSIFICATION SCHEMES

This section reviews bikeway classification schemes in a number of local jurisdictions and exemplary bicycle communities in other parts of the country. Few counties around the country create bike plans with the level of detail and implementation-ready recommendations as supplied by Montgomery County. For this reason, Arlington County, VA, and Hennepin County, MN, are the only two examples of county-wide plans included here. While the rest of the plans are from cities, they are worth reviewing as exemplar bicycling communities, some of which have suburban-type roadways, such as Portland, Minneapolis and Seattle.

ARLINGTON, VIRGINIA

Arlington County uses a facility classification system but does not have a network classification for its bikeways. Arlington's bikeway classification was last updated in the 2008 Master Transportation Plan,[55] though the county is considering updates in its countywide Level of Traffic Stress analysis that will lead to identification of new network recommendations. Currently, Arlington classifies its facilities according to four categories:

- Off-street trails
- Bike lanes
- Sharrows
- Bike routes



Legend from Arlington County's 2015 public bike map update

To date, the buffered bike lane and separated bike lane facilities in Arlington have not been differentiated from standard bike lanes and these two facilities remain in the "bike lane" category. The county may update this classification as more buffered and separated facilities are implemented. Two facility types that Montgomery County will use in the plan update are not included in Arlington's scheme: advisory bike lanes and bike boulevards. Arlington is considering implementation of these facility types as well but has not yet decided how to classify them.

Additionally, Arlington defines "bike routes" as "roads that have been determined to be bicycle-friendly or [emphasis added] provide important connections to the bicycle network." These streets have not been improved with signage or markings, and they have not necessarily been vetted for comfort and suitability of crossings for bicyclists. Some streets may not be very bicycle-friendly, but they are included in the route network because they provide an important or direct connection. This route network will also be revisited as the level of stress analysis is completed to better identify bicycle-friendly streets and focus on intersection improvements.

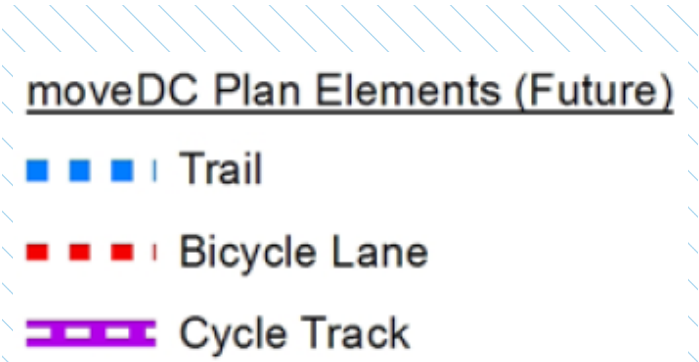
WASHINGTON, DC

DC's bikeway classification was last updated as part of the MoveDC[56] plan completed in 2014. The plan is not explicit in its classification of facility types, as it refers to one set of facility types on maps and another when describing the facility types available to planners. Maps include the following:

- Trail
- Cycle track
- Bike lane, including contraflow and climbing lanes

The plan mentions the following commonly used facility types:

- Shared-use paths
- Cycle track
- Bike lane, including climbing and contraflow lanes
- Sharrows
- Signed shared routes and neighborhood bikeways
- Shared roadway (all other roads minus freeways)



Legend from MoveDC Bicycle Element map

However, the planned network does not include any facility types other than the three included on the map. The District has undertaken a separate wayfinding effort to identify signed routes that consist of streets with bike facilities and those local streets that are bicycle-friendly. The neighborhood bikeway identification and signage program is also separate from the master planning effort and the wayfinding program.

DC does not have network classification for its bikeways. MoveDC does articulate modal priorities for all DC streets, including the identification of some "bicycle priority" streets. However, these priorities have not yet had any bearing on trade-offs made during the design process for a multimodal street.

MINNEAPOLIS, MINNESOTA

The City of Minneapolis updated its facility classification in 2015 as part of a bike plan update[57] aimed at incorporating protected facilities into their toolbox. This update did not define a new bike network for the city, rather focused only on short-term recommendations for the locations of new protected bike lanes. The update includes the following facility classes:

- Protected bikeways
  - » Off-street trail
  - » Pedestrian/bicycle bridge
  - » Sidepath
  - » Protected bike lane
- Bike lanes
  - » Buffered bike lane
  - » Bike lane
  - » Contraflow bike lane
  - » Advisory bike lane
  - » Shoulder accommodation
- Bike boulevards
- Shared lanes
  - » Sharrows
  - » Signed bike route
  - » Shared bus/bike lane

These classes are generally based on the bicyclist's experience on the street and the level of interaction between the cyclist and automobile. Bike boulevards are classed separately from other types of shared lanes because of their lower volumes and speeds. Signed routes are assumed to be comfortable enough for bicyclists without additional pavement markings.

Minneapolis' 2011 bike network plan[58] is modeled after roadway classification and states that the classification

purpose is to help prioritize projects and make better use of limited funds. The classification is as follows:

- Arterial Bikeway: Routes of regional significance that attract the highest number of bicyclists and are intended to form a "spider web" pattern centered on downtown Minneapolis.
    - » Principal arterials spaced at two-mile intervals designed for grade separation and faster speed.
    - » Minor arterials spaced at one-mile intervals.
    - » May be situations where two arterial bikeways are located parallel to one another in close proximity because their differing facility types serve different user groups.
- Collector Bikeway: Feeds into arterial bikeways; spaced at half-mile intervals to capture bicyclists from every part of the city.
- Neighborhood Bikeway: Feeds into collector bikeways; found in every neighborhood and ineligible for regional funding.

While the intent of this scheme is to prioritize bikeways, it has not been used this way in practice. Minneapolis maintains a robust bicycle counting program that city staff found to be a better indication of the importance of any given bikeway project than network classification. Connections to locations with higher existing counts or locations with high counts and deficient facilities have been prioritized.

HENNEPIN COUNTY, MINNESOTA

Hennepin County completed a bike plan[59] in 2015 that is separate from the Minneapolis plan detailed above. The Hennepin plan classes bicycle facilities according to the following groups:

- Off-street
    - » Multi-use trail
    - » Cycle track
    - » Protected bike lane
- On-street
    - » Cycle track
    - » Protected bike lane
    - » Buffered bike lane
    - » Bike lane
    - » Shoulder
    - » Bicycle boulevard

These broad classes were chosen to avoid being overly prescriptive on facility type throughout the county. Hennepin County recognized that it would not be the implementing agency for many of the recommended facilities and wanted to leave flexibility for other jurisdictions. Additionally, the level of effort needed for further facility specificity throughout the network was not possible in the scope of this planning effort.

Network classification consists of a plan recommendation to designate an "enhanced bicycle network." This recommendation emerged from the public engagement process where it was clear that bicyclists and potential bicyclists sought a greater amount of separation from automobile traffic. This classification touched on both facility type and network function with the recommended characteristics:

- Facility type is off-street trail, cycle track or protected bike lane.
- Part of Minneapolis' protected bike lane network.
- Within a priority regional bikeway corridor as identified in Metropolitan Council Regional Bicycle System Study.
- Part of a route that spans major barriers (e.g., river, railroad, highway).
- Connects major activity centers.

This framework has not yet been used for implementation in Hennepin County, nor has the county used these criteria to identify its enhanced bicycle network.

BOSTON, MASSACHUSETTS

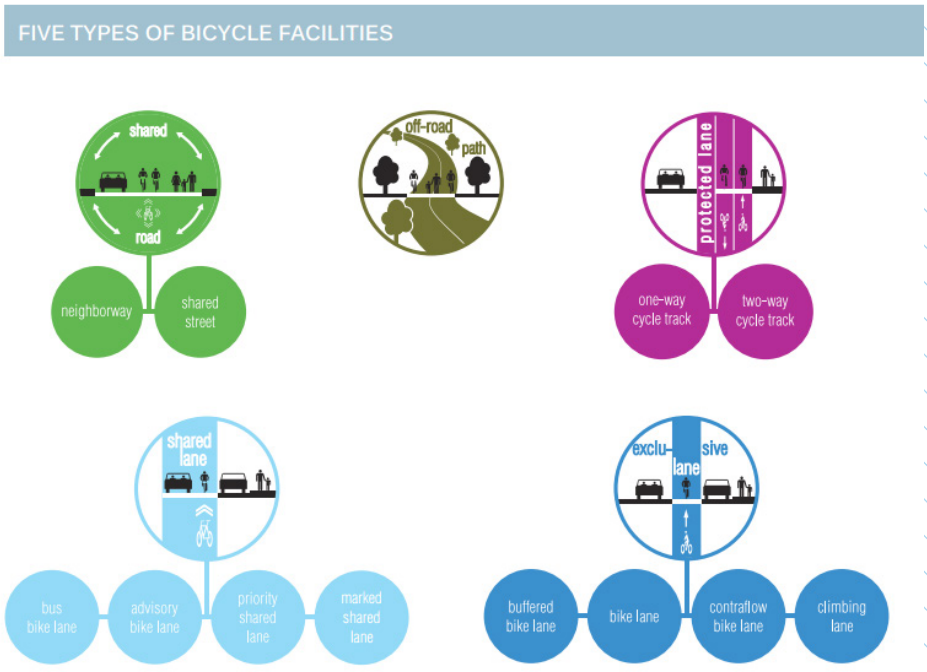
The Boston Bike Network Plan[60], updated in 2013, identifies five classes of bikeway facilities:

- Off-road path
  - » Shared use path
- Protected Bike Lane
  - » Cycle track
- Exclusive Lanes
  - » Buffered bike lane
  - » Bike lane
  - » Contraflow bike lane
  - » Climbing lane
- Shared lanes
  - » Advisory bike lanes
  - » Priority shared lane
  - » Shared lane: denoted with sharrows and signage; constrained corridors with speed limit 35 mph or less
  - » Bus-bike lane
- Shared roads
  - » Shared street (flush)
  - » Neighborway: added traffic calming, prioritizes bicyclists and pedestrians, equivalent to a bicycle boulevard
  - » Recommended local route: unimproved route that provides connectivity, generally lower volume and/or speed than a sharrow street

These classes have enabled Boston to work with a wide variety of facility types that suit the wide range of street types but also retain a manageable vocabulary of bikeways. Facilities are classed, generally, according to the bicyclist's experience on the street. For instance, an exclusive lane is roadway space specifically dedicated for bicyclists but not immune from periodic obstructions, such as double-parked cars. By classifying buffered bike lanes this way, the city may miss some of the advantage that a wider facility provides, but it also recognizes the reality of cyclists' daily experiences.

Boston's plan further classifies the network into primary and secondary routes with the following definitions:

- "Primary routes connect neighborhood centers, regional multi-use paths, transit hubs, major employment centers and institutional destinations."



Bicycle Facility classification graphic from Boston Bike Network Plan

    - Provide long distance routes
    - Carry the highest volumes
    - Have as much separation from traffic as possible
    - Include all major bridges

- "Secondary routes stretch into neighborhoods and provide access to local businesses and neighborhood destinations."

    - Connect schools, neighborhood stores, parks, transit hubs and the primary network routes
    - Have varying levels of bicyclist volumes and separation from traffic

These definitions are helpful in conceptualizing the network and prioritizing facilities at a high level, but in practice, the designations have not had a clear effect on implementation. Closing gaps in the existing facilities along primary routes was prioritized, but the five-year action plan consists of streets and trails that are both primary and secondary routes. Implementation has been based more on opportunities and in response to problems rather than guided by a goal of improving the primary routes first.

SEATTLE, WASHINGTON

The 2014 Seattle Bike Plan[61] identified five facility types for its network, which only group bike lane types together:

- Off-street
- Cycle track
- Neighborhood greenway
- In-street, minor separation (buffered bike lane, bike lane, climbing lane)
- Shared street (sharrow)

Each facility type is designated for use on streets with certain speed, traffic and functional classification criteria. Though not every recommendation conforms to these usage standards, they provide a framework for network development that leads to a system with greater separation between bicyclists and automobiles on higher-speed, higher-volume streets.

Seattle's network classification is the only one examined for this study that links network classification to available facility types by calling for exclusively low-stress facilities to be used in the Citywide Network so that citywide routes are accessible to "all ages and abilities." In practice, this connection means that some facility types, such as bike lanes that may result in a low-stress riding environment on low-volume, low-speed roads, are not included in the citywide network. The classifications are defined as below:

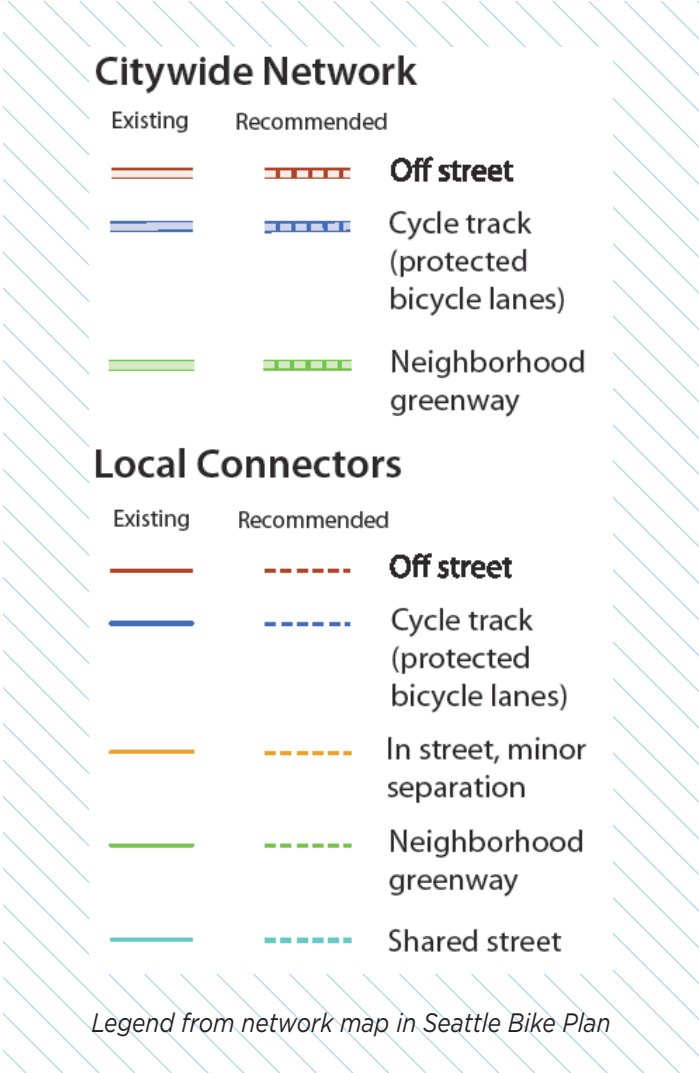
- Citywide Network:

    - » Provide short distance connections to neighborhood destinations, as well as connections to destination clusters across neighborhoods and throughout the city.
    - » Allow people of all ages and abilities to access all major destinations on this network.
    - » Composed of cycle tracks, neighborhood greenways and off-street multi-use trails.

- Local Connectors:

    - » Provide access to and parallel the Citywide Network and serve destinations.
    - » Lower level of separation with bike lanes, buffered bike lanes and shared roadways also in facility toolkit.
    - » May provide a more direct route, but may include facility types and streets that are not appropriate for all ages and abilities.

The Citywide and Local classifications have little bearing on facility implementation other than to prescribe a set of facility options. While the plan identifies high-demand segments of the Citywide Network as a near-term priority, further project prioritization does not rely on a bikeway's classification as citywide or local.



Legend from network map in Seattle Bike Plan

PORTLAND, OREGON

Portland's 2010 bicycle plan[62] classes facility types by level of separation. These classes are:

- Trails
- Separated in-road bikeway
  - » Cycle track
  - » Buffered bike lane
  - » Bike lane
- Shared roadway bikeway
  - » Bicycle boulevard
  - » Advisory bike lane
  - » Enhanced shared roadway

The enhanced shared roadway facility type is used in locations where bicyclists are not given priority, but signage and markings are used to increase driver awareness and traffic calming, or where signalization may ease bicyclist travel. These facilities may be later upgraded as funds and willingness to adjust the allocation of roadway space to various modes allow.

Portland includes a robust, policy-level classification of bikeways by functional class. These classes include:

- Major City Bikeway
- City Bikeway
- Local Service Bikeway

This policy-level classification exists for other modes in the city, so adoption of this system for the bicycle mode is recognized as bringing consistency and parity to the modes. Functionally, Major City Bikeways are the most important routes in the city—those that carry the largest number of bicyclists, connect to major commercial areas or bridges, provide long corridors serving many neighborhoods, or collect traffic from other routes feeding into them. City Bikeways provide direct and convenient access but are do not fit the characteristics of a Major City Bikeway. All modes in the city have a "local service" class that simply includes all other unidentified streets.

The major city bikeway designation allows city staff to advocate strongly for the highest order bike facility on those streets. Where trade-offs are needed to accommodate space for these facilities, planners in the bicycle program are in a better position to press their case. The policy that defines each of these types specifically states that travel lanes and/or on-street parking may be removed to accommodate bicycle facility space on streets under both bikeway classes. The designation as a major city bikeway does not dictate the facility type recommended for that route; any facility type may be in place on that bikeway as long as it provides an appropriate level of accommodation suited to the street characteristics.

Legend from Recommended Bikeway Network map in Portland Bicycle Plan

SUMMARY

Municipalities vary in their facility classification schemes. Grouping of facility types was most often based on the facility's level of separation in protecting the bicyclist from automobile traffic. Boston's grouping is slightly more granular in that it differentiates shared roadway conditions between those with higher and lower automobile volumes, and Minneapolis does this to some extent, too, by separating bicycle boulevards from other shared roadway facility types.

While approximately half of the examined jurisdictions further differentiate their networks by functional class in some manner, only Seattle's and Portland's network classification schemes prescribe facility types and a level of importance assigned to each type in trade-off discussions, to directly impact implementation of the facilities. In other cities, a project's network classification may be one factor in the project prioritization process, but network classification does not imply priority in terms of implementation timeline.

2.3 Recommendations for Montgomery County

Given the previous review of recent bicycle planning efforts around the country and understanding of the Montgomery County context, the following recommendations are made for bikeway classification. These recommendations will help the county achieve its ultimate goal of implementing an extensive, low-stress network. The most important characteristics of this network will be its connectivity and density.

Network Classification

Montgomery County should refine its county/local network classification framework in favor of a policy-level network classification in the style of Portland, OR. An adopted system of Major County Bikeways (MCB) and County Bikeways (CB) would provide a framework for discussions about bikeway design in areas of constrained rights-of-way. All other roadways where bicycle travel is permitted could be designated as Local Serving Bikeways (LSB) if full coverage of county roadways is desired. Similar to Portland, a **MCB would be a bikeway of the highest importance in the county, meaning that the bicycle accommodation should be prioritized in discussions related to limited space and trade-offs between various travel modes. Similarly, MCBs should be designed to a higher standard (e.g., separated bike lanes that are wider than typical conditions) in anticipation of large numbers of bicyclists in the future.**

Unlike Seattle's network classification, the requirement to specify a facility type for MCB and CB bikeways is not recommended for use in Montgomery County. Not all MCBs would be high-investment facilities, such as separated bike lanes on large arterial streets. Some MCBs will be important connections that can be made via low-volume, low-speed streets with facilities such as advisory bike lanes.

The definition of criteria for MCBs should occur during the network development process. It is impossible to know before the entire network is developed what criteria will best capture those streets that serve a critical network function. A preliminary list is given below, but this list should be viewed as draft and subject to change during the plan development process. One or more of the following could be required for MCB designation:

- Access to major destinations: employment centers, key commercial zones/corridors, transit facilities
- Access to multiple neighborhoods
- Connections to major trails

Network classification should not be viewed as a prioritization scheme, however. The class of a bikeway project will need to be combined with other factors determined by the county in order to create a prioritized project list for the bike plan.

Facility Classification

Montgomery County should adopt a grouped classification of facility types in order to make the network easier to comprehend and better reflect the county's interest in level of traffic stress. Some of the 12 facility types noted below share similar functional characteristics and it is unnecessary to differentiate them on a plan map. The simplified map will provide an adequate level of understanding while not being overly detailed. By defining facility groups based on their level of separation from traffic, planners with knowledge of the street network will be able to understand how comfortable for cyclists a given facility type recommendation will be on that street.[63]

It should be noted, however, that the same facility type has different stress levels in different applications. For instance, a buffered bike lane can be a low-stress facility where the speed limit and number of lanes are low, but the extra width between the rider and automobiles cannot overcome the stress of higher speed traffic or a wide roadway.

Montgomery County should classify bikeway facilities as outlined below.

- Shared use paths
  - » Trail (separate right-of-way)
  - » Sidepath (within a street right-of-way)
- Separated bike lanes
- Bike lanes
  - » Buffered bike lanes
  - » Bike lanes
  - » Climbing lanes
  - » Contraflow lanes
  - » Advisory bike lanes
  - » Shoulder accommodation
- Bicycle boulevards[64, 65]
- Shared roadways
  - » Priority shared lane markings
  - » Shared lane markings

END NOTES

53. It should be noted that network classification and the importance of a given route to the network is only one component of a prioritization scheme. Overall prioritization of the bike network for phased implementation is not addressed in this paper.
54. Montgomery County developed the dual bikeway facility type in the 2005 Countywide Bikeways Functional Master Plan to recognize differing levels of ability and comfort among bicyclists and to recognize the two functions (transportation and recreation) served by a bike network. Dual bikeways include both an on-street bikeway and an off-road shared use path on the same roadway.
55. http://arlingtonva.s3.amazonaws.com/wp-content/uploads/sites/31/2014/02/DES-MTP-Bicycle-Element.pdf
56. http://www.wemovedc.org/
57. http://www.minneapolismn.gov/www/groups/public/@publicworks/documents/images/wcms1p-144745.pdf
58. http://www.minneapolismn.gov/www/groups/public/@publicworks/documents/webcontent/convert_275983.pdf
59. http://www.hennepin.us/-/media/hennepinus/residents/transportation/bike/bike-plan/bicycle-transportation-plan.pdf
60. http://www.cityofboston.gov/images_documents/Boston%20Bike%20Network%20Plan%2C%20Fall%202013_FINAL_tcm3-40525.pdf
61. http://www.seattle.gov/transportation/bikemaster.htm
62. https://www.portlandoregon.gov/transportation/44597
63. The full level of facility specificity should be maintained in the project/bikeway table portion of the plan so this information is available to readers.
64. Bicycle boulevards are separated from other shared roadway facilities because they provide a different level of comfort for bicyclists. A bicycle boulevard design will include traffic calming, intersection improvements to ease crossing major streets and may include some traffic diversion to lower volumes. These elements are not included in the other shared roadway facilities.
65. Montgomery County may wish to begin discussions regarding the nomenclature used for these facilities. While “bicycle boulevard” is used by some communities, with Berkeley, CA being a notable pioneering user, many jurisdictions are beginning to use terms that reference the benefit of these streets to a broader audience. “neighborway,” “neighborhood greenway,” “neighborhood bikeway” and “neighborhood slow street” have all been used for this facility type and imply benefits to pedestrians and residents as well as bicyclists.

03

ADVISORY BIKE LANES

Residential streets with high traffic volumes and high speeds can make bicycling uncomfortable for some people. One response to improving these conditions is to add a conventional bike lane to reduce traffic stress, where space is available.

Un-laned, two-way "yield" streets, such as Indian Spring Drive, are common in residential neighborhoods in Montgomery County

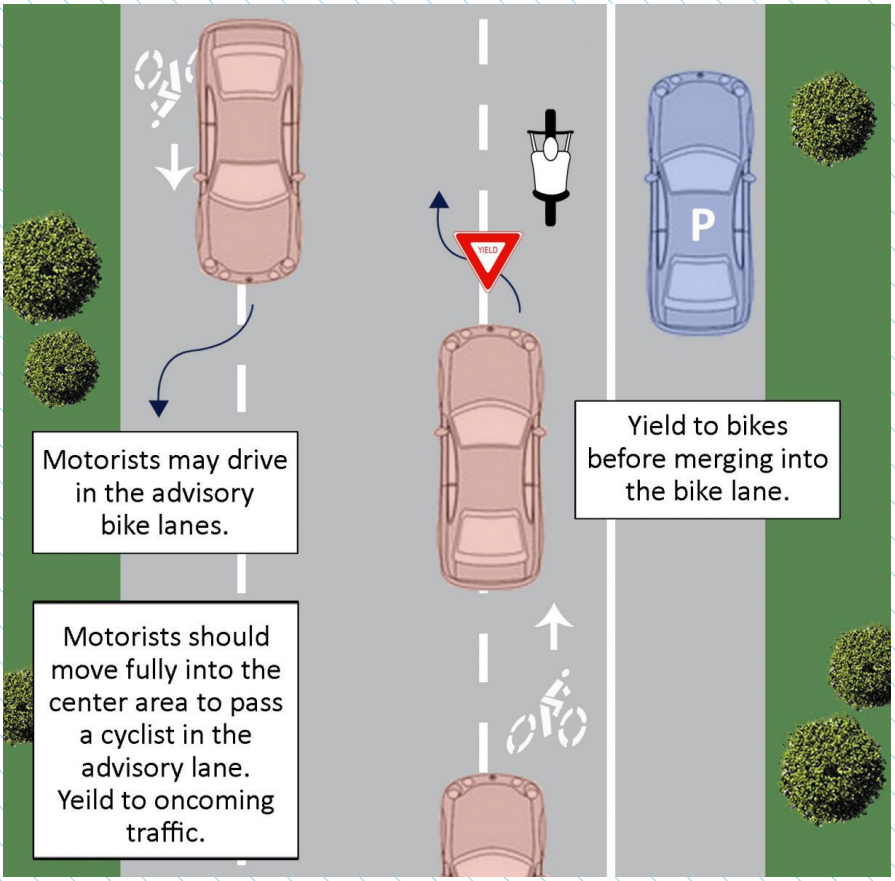
However, many residential two-way roads are too narrow to provide space for two standard width bicycle lanes and two standard width automobile travel lanes. Advisory bike lanes (ABLs) are a way to reduce the stress of bicycling on low volume and low speed streets where there is insufficient space for two travel lanes and two bike lanes.

For low volume, low speed streets, ABLs are an alternative to a shared lane marking treatment, which separates bicyclists from automobile traffic. These streets are marked to provide two separate standard width bicycle lanes, on either side of a single shared (un-laned, two-way "yield" street) motorist travel space, essentially creating a three-lane street cross section. Roadway centerlines are not present in this condition.

The design of streets where ABLs are implemented does not provide sufficient space for motorists to pass each other within the vehicular travel lane and therefore implicitly provides bicyclist priority along a street with ABLs. Motorists are encouraged to drive in the center of the roadway by the ABL pavement markings along the sides of the street. Unlike a standard bike lane where motorists are discouraged from entering the bike lane with a solid lane line, the ABL is continuously dashed to allow motorists to temporarily enter the bike lane to provide oncoming traffic sufficient space to safely pass. This behavior is similar to passing behavior on narrow, un-laned, two-way "yield" streets where traffic lanes are not designated with striping and so motorists must pull to the side (into parking gaps or driveways) to let oncoming vehicular traffic pass. Yielding in this fashion is necessary because ABLs reduce the automobile travel space to a width of 12 to 18 feet, less than the typical 20 to 26 feet for two travel lanes.

Some locations where sightlines are unclear, such as hills or curves, may present issues for the implementation of advisory bike lanes. In these cases, some additional modifications may be used to mitigate potential conflicts. For instance, a spot roadway widening or removal of a parking lane at a curve may enable widening of the vehicle travel lane to a width where two automobiles may pass comfortably. Speed humps could also be used at the crest of a hill to further calm traffic speeds and give drivers ample time to react and yield to a vehicle approaching in the opposite direction.

Given that advisory bike lanes remain a relatively new facility type in the U.S., most communities implementing them have also created education campaigns about their use, especially regarding yielding expectations. Drivers and bicyclists can be educated through mailings, door hangers (targeted at nearby residents), on-site flyer handouts and other means. The striped and marked facility is not typically accompanied by signage indicating yield patterns, but this is not precluded by any current guidance. A sign example from Hanover, NH, is included in the domestic examples below.



Yielding patterns in advisory bike lanes. Note that drivers more typically position vehicles in the center lane than in the bike lane except in cases of passing. (City of Minneapolis Graphic)

3.1 INTERNATIONAL CRITERIA

Advisory bike lanes have been used in numerous European countries in both urban and rural contexts. The guidance below is from the Dutch CROW traffic design manual. This manual specifies use of advisory bike lanes, or "suggestion lanes," as they are referred to in the Netherlands, in a limited context. The key criteria identified in the CROW manual for application of ABLs are speed limit (19 mph) and traffic volume (up to 5,000 average daily traffic).[66] Centerlines are not striped on these streets.

The City of London's design guidance specifies that advisory bike lanes be used on streets with low speed limits. For locations with on-street parking, the guidance recommends a minimum bicycle lane width of 6.5 feet. It also recommends the use of a striped buffer between the lane and the parking lane and the placement of bicycle symbols at the outer edge of the advisory bike lane.[67]

Advisory bike lanes on a local street in Amsterdam

CROW Dutch traffic manual chart for facility application indicates use of advisory lanes for low-speed, low-volume streets.

Lane configuration	**Daily traffic (veh/day)**	**Street type and speed limit**			
		Urban local street	*Urban through street*	*Rural local road*	*Fast traffic road*
		30 km/h (19 mph)	*50 km/h (31 mph)*	*60 km/h (37 mph)*	*70+ km/h (44+ mph)*
Two-way traffic with no centerline	*≤2500*	Default layout is **advisory bike lanes** (shown as "mixed.")	Bike lane or cycletrack	Advisory bike lane bike lane or cycle track	Cycle track or low-speed service road
	2000–3000				
	3000–5000				
	>4000	Bike lane or cycle track	Bike lane or cycle track[c]		
Two lanes (1+1)	*any*	Bike lane or cycle track	Bike lane or cycle track[c]		
Four lanes (2 + 2) or more	*any*	(Does not exist)	Cycle track or low-speed service road		

3.2 DOMESTIC EXAMPLES AND CRITERIA

Advisory bike lanes are a relatively new facility type to the United States, but they have been installed in a number of different contexts around the country. ABLs are not included in the current Manual of Uniform Traffic Control Devices and require experimental approval from the Federal Highway Administration (FHWA) for application. FHWA calls ABLs "dashed bike lanes" and requires two design elements for the request to experiment: bike lane signs and bike lane pavement markings. Additional design elements are recommended or suggested and are available on FHWA's website.[68] Approval has been granted to numerous communities around the country in communities as varied as Hanover, NH, (pop. 11,000) and Minneapolis, MN (pop. 400,000).

MINNEAPOLIS, MN

The City of Minneapolis was the first US city to install advisory bike lanes in 2011. This application was on a downtown street that connects to a number of other bike facilities and is the only low volume through-street in this part of the city. East 14th Street has parking on both sides, and the width varies from 40 to 44 feet. Parking is striped at 7 feet and the ABLs at 6 feet. These dimensions result in an un-laned automobile travel space of 14 to 18 feet. Since the advisory bike lanes have been installed, there has been no increase in head-on automobile crashes and overall speeds have dropped, creating a safer environment for drivers, bicyclists and pedestrians. Currently, there are three locations in Minneapolis with ABLs. The other instances are on local residential streets with small pockets of commercial use. The instance on West 46th Street demonstrates that ABLs are compatible with transit use as there is a bus route on this street.

Minneapolis' criteria for ABL installation are:

- Speed limit 30 mph or less (nearly all Minneapolis local streets have 30 mph speed limit)
- ADT under 6,000 vehicles per day
- Parking present on both sides of street

The city has encountered one issue with these installations. In the 14th Street case, drivers were initially unsure whether the street remained two-way, so signage was installed to indicate two-way travel at some intersections.

14th Street in downtown Minneapolis

EDINA, MN

The first advisory bike lanes were installed in Edina in 2012 on Wooddale Avenue. This installation was subsequently removed after city staff determined the lanes were not functioning as intended.[69] The main issue with this installation was that the adjacent parking lane was rarely occupied, presenting a confusing situation to bicyclists and drivers as to where bicyclists should ride. Drivers expected bicyclists to ride in the empty parking lane, and some bicyclists felt uncomfortable maintaining their position 10 feet from the curb in the advisory lane when the parking lane was empty.[70] Advisory bike lanes installed elsewhere in the city have been successful and continue to be in place on West 54th Street in Edina.

ALEXANDRIA, VA

Alexandria has the only local example of advisory bike lanes. These lanes were installed on Potomac Greens Drive in 2015 in order to provide a connection between two existing bike facilities. The street width varies and is 42 feet wide at the narrowest point, and stakeholders wanted to preserve parking on both sides. This parking results in 26 feet remaining for two-way travel for both automobiles and bicycles. The 26-foot width is divided into two, 5-foot bike lanes and a 16-foot two-way travel way for automobiles.

Potomac Greens Drive in Alexandria

HANOVER, NH

Hanover installed its advisory bike lanes as part of its Safe Routes to School effort. These lanes provide space for bicyclists and, in some instances, pedestrians. (Right-of-way is not available for provision of separate pedestrian facilities in the form of sidewalks.) The street where they have been applied is a very low-volume neighborhood residential street with no sidewalk. Prior to installation, pedestrians and bicyclists did ride and walk in the street, but the addition of striping has provided a level of comfort that did not exist before. Parking is sometimes allowed in the advisory bike lanes during events at the nearby sports center, but this use is not documented as a major issue. Unlike other U.S. locations, Hanover has also included signage to indicate appropriate yielding patterns for the advisory bike lane street.

Signage in Hanover, NH.[71]

3.3 ANCILLARY BENEFITS: REDUCED SPEED AND AUTOMOBILE VOLUME

Where jurisdictions have removed centerlines to install advisory bike lanes, there is some evidence of both lower automobile traffic speeds and decreased automobile volume. A study by Transport for London found an average decrease of approximately 6 mph with advisory bike lane installation.[72] A study in Suffolk County, England found a decrease in ADT from 5,600 vehicles per day to 4,500 vehicles per day post installation.[73] The Dutch Institute for Road Safety Research also found a small decrease in automobile speeds with implementation of advisory bike lanes on rural roads.[74] These rural roads would be similar to some narrow, low-volume roads located in parts of western and northern Montgomery County.

3.4 CRITERIA FOR ADVISORY BIKE LANE APPLICATION IN MONTGOMERY COUNTY[75]

There may be a limited number of locations where advisory bike lanes are appropriate in Montgomery County. Advisory bike lanes should be reserved for use in locations where space is limited and there is insufficient width to implement both standard bike lanes and vehicular travel lanes. Planners and engineers will often be choosing among facility types for l ower-volume streets in these situations: primarily bicycle boulevards, shared lane markings and advisory bike lanes.

Advisory bike lanes are preferable to similar facility types on low-speed roads, where prevailing traffic speeds are slightly higher (25- 30 mph versus 15-20 mph), traffic volumes are low and where it is impossible to implement the traffic calming and/or diversion features of a bicycle boulevard. The criteria listed below will help the county decide where to recommend advisory bike lanes. Additionally, this report recommends five local examples for consideration in Montgomery County.

Number of Travel Lanes

The advisory bike lane facility is only applicable in conjunction with unmarked automobile travel lanes. Streets with existing centerlines will require the centerline to be removed prior to the installation of the advisory bike lanes.

Street Width

The un-laned two-way travel space resulting from installation of advisory bike lanes should be 12 to 18 feet. The overall street width may vary based upon the presence of parking on one or both sides of the street.

Posted Speed

Advisory bike lanes should only be implemented on streets with speed limits of 30 mph or less. Most local streets in the county have a speed limit of 25 mph and many collector streets have a speed limit of 30 mph.

Automobile Volumes

Every time automobiles pass each other in opposing directions, there is the potential for a head-on collision. On a road with 6,000 vehicles per day, passing would occur about every 15 seconds; for this reason, the Manual on Uniform Traffic Control Devices requires roads with 6,000 or more vehicles per day to have a striped centerline, designating separate lanes for opposing traffic.[76] This line should be the upper boundary for streets where advisory bike lanes are recommended.

Reduction of the operating space for two automobiles through implementation of advisory bike lanes further complicates vehicle operations because of the need for yielding.[77] Given the number of times a bicyclist would experience being passed by an automobile, advisory bike lanes should be used on streets with 2,000 to 4,000 average daily traffic. Above that traffic volume, the bicyclist may become uncomfortable, but the facility could be used on streets with 4,000 to 6,000 average daily traffic as a more experimental treatment for study.

Parking

Advisory bike lanes may be used on streets with or without on-street parking on one or both sides of the street. Where on-street parking exists, the critical criterion is the extent to which that parking is occupied. Low-occupancy parking lanes adjacent to the advisory bike lane may present a confusing situation to bicyclists and drivers as evidenced in the Edina example where drivers expected bicyclists to travel in the empty parking lane and some bicyclists felt uncomfortable maintaining their position outside the parking lane.

Land Use

The criteria laid out in the preceding sections will restrict Montgomery County's usage of advisory bike lanes to local residential streets. Unlike Minneapolis, Montgomery County has few urban commercial streets where these other criteria, especially traffic volume, are met.

CRITERIA SUMMARY

- Number of motorists travel lanes: Un-laned, bi-directional travel
- Street width: will vary, but must result in un-laned travel way of 12 to 18 feet[78]
- Posted speed: 30 mph or less
- Traffic volume: 2,000 to 4,000 average daily traffic (ADT) recommended; 4,000 to 6,000 ADT for experimental treatment with evaluation
- On-street parking: If parking present, should be majority occupied majority of the time
- Lane use: Local residential streets

3.5 EXAMPLES OF ADVISORY BIKE LANES IN MONTGOMERY COUNTY

Several locations are possibilities for the application of advisory bike lanes. They were identified using the county's bicycle level of traffic stress analysis, street width measurements and a review of speed limits, adjacent land use and network connectivity. These streets are provisional locations pending traffic counts that would validate the applicability of advisory bike lanes.

- Olney Mill Road from Olney Laytonsville Road (MD 108) to Gold Mine Road
- Whittier Boulevard from River Road (MD 190) to Wilson Lane (MD 188)
- Indian Spring Drive from Caroline Avenue to University Boulevard (MD 193)
- Lamberton Drive from Arcola Avenue to Charlton Drive

END NOTES

66. CROW, Design Manual for Bicycle Traffic, p 108.
67. http://content.tfl.gov.uk/lcds-chapter4-cyclelanesandtracks.pdf
68. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/mutcd/dashed_bike_lanes.cfm
69. http://current.mnsun.com/2013/03/26/edina-council-agrees-to-change-wooddale-bike-lanes/
70. http://streets.mn/2013/04/17/advisory-bike-lanes-on-wooddale-ave-to-be-removed/
71. Copyright 2014 The Dartmouth, Inc. All rights reserved. Reprinted with Permission.
72. http://content.tfl.gov.uk/centre-line-removal-trial.pdf
73. http://www.apbp.org/?page=2009_2_Advisory
74. http://www.swov.nl/rapport/R-2003-17.pdf
75. Dimensional criteria for application is detailed in the Bicycle Facility Design Toolkit that identifies minimum and preferred dimensions, and the advantages and disadvantages of different configurations.
76. See Section 3B.01 Yellow Center Line Pavement Markings and Warrants, Standard 09.
77. Minneapolis has not seen increased head-on collisions where advisory bike lanes have been implemented.
78. Advisory bike lane widths both with and without on-street parking will be detailed in the design toolkit.

04

ARE SEPARATED BIKE LANES A REPLACEMENT FOR DUAL BIKEWAYS?

The dual bikeway facility type was developed in the 2005 Montgomery County Bikeways Functional Master Plan to "meet the needs of the total range of bicyclists." A dual bikeway consists of both an off-road sidepath and an on-road bicycle facility on the same street. In locations where space is available, the on-street facility is typically recommended to be a bike lane; where space is unavailable, the on-street facility it is typically recommended to be a signed shared roadway.

The dual bikeway facility type is unique to Montgomery County and was recommended in locations where the county wanted to provide separation from high-speed, high-volume traffic for what today the industry refers to as *Interested but Concerned* riders, those who are less comfortable riding in an unprotected facility on those types of streets. The additional bike lane or shared roadway facility was provided to accommodate riders who are comfortable riding near or sharing the road with high-speed, high-volume traffic, prefer to travel at a higher speed and do not want to be impeded by slower moving bicyclists and pedestrians.

The advent of separated bike lanes provides Montgomery County with a new tool for accommodating a wide range of cyclists. This report evaluates whether separated bike lanes are a replacement for the dual bikeway facility type in some or all situations.

4.1 APPLICABILITY OF SEPARATED BIKE LANES TO DIFFERENT BICYCLISTS

Bicyclists can be categorized based on how much separation from traffic is necessary for them to feel comfortable riding a bicycle. *Interested but Concerned* bicyclists express an interest in bicycling more, but are concerned for their safety. They require separation from traffic to feel comfortable riding on most non-residential roads. Separated bike lanes can be a replacement for the off-road portion of a dual bikeway since bicyclists are still physically separated from automobile traffic.

Confident bicyclists require less separation from traffic to feel comfortable riding a bicycle. On high volume and high speed roads, many would be comfortable bicycling in a conventional bike lane and some would be comfortable bicycling in traffic. They tend to be more concerned about the ability to travel unimpeded by pedestrians than by the physical separation from traffic. If designed appropriately, separated bike lanes can appeal to many confident bicyclists. For those confident bicyclists who would otherwise ride in a conventional bike lane, a separated bike lane is appealing if it is wide enough to allow faster bicyclists to pass slower bicyclists.

For those confident commuter bicyclists who would otherwise ride in the street, separated bike lanes can be appealing if they are designed to provide the same quality of riding environment as the street. Commuting bicyclists often ride during peak periods when traffic volumes are at their highest, so higher speed travel (up to approximately 18 mph) and the ability to pass other bicyclists should be considered in the design process. Of course, some bicyclists in this group will always prefer riding in the street.

For those recreational bicyclists traveling in groups, a separated bike lane is inappropriate because the space is too confining for larger groups and higher speed bicycling. A group would potentially take over the entire width of a two-way separated bike lane, impeding oncoming traffic. The width of a one-way facility would not allow for the typical passing movements conducted within a group. Bicycling in the street would be more appropriate for this audience. These riders will also tend to ride on the high-volume, high-speed roads when traffic volumes are lower, such as weekend mornings, so the on-street facility will likely also be more comfortable.

In summary, if designed with sufficient separation from traffic, wide enough to enable passing and higher speed travel, separated bike lanes can be a replacement for dual bikeways for most *Interested but Concerned* bicyclists and many, but not all, confident bicyclists.

4.2 RECOMMENDATIONS FOR MONTGOMERY COUNTY

1. Discontinue use of the dual bikeway as a facility type and utilize separated bike lanes or shared use paths in their place.

When dual bikeways are recommended as a combined shared use path and bike lane, they may be difficult or infeasible to implement due to space constraints in many locations. Furthermore, separated bike lanes can be considered enhancements over conventional bike lanes when designed to enable passing.

As discussed in Section 5, signed shared roadways are not a bicycle facility type and are not recommended to be included in master plans. It is appropriate to use signs and pavement markings, such as "Bikes May Use the Full Lane" or sharrows, on roadways in Montgomery County, but these decisions should be made on a case-by-case basis at the time of implementation, not as part of the master planning process.

2. Select the appropriate separated bikeway type using the criteria established in Section 6.

Separated bike lanes are not always needed to replace dual bikeways. In fact, shared use paths may be more appropriate in many contexts than separated bike lanes.

Pedestrian demand along the study corridor should be the primary consideration for practitioners choosing between the two facility types. Just as separation from automobiles enhances safety and comfort for people bicycling and driving, separation between people walking and bicycling may be necessary to eliminate potential conflicts and maintain a comfortable and attractive facility. Where observed or anticipated pedestrian demand is low, conflicts between people walking and bicycling may be infrequent. In this situation, a shared use path may comfortably and safely satisfy both bicycle and pedestrian demand. Where pedestrian volumes are observed or anticipated to be high, separate facilities should be provided for bicyclists.

Some corridors may transition from shared use paths to separated bike lanes as land use becomes more mixed or commercial, thus attracting higher pedestrian volumes. These transitions are likely along corridors that are largely residential with periodic commercial nodes at intersecting arterial streets.

3. Consider use of Bikes May Use Full Lane signage and/or sharrows where space constraints necessitate a shared use path rather than a separated bike lane.

The master plan should recommend a shared use path or separated bike lanes based on an understanding of available right-of-way and the level of pedestrian activity. In some locations, space may not be available currently to implement the recommended separated bike lane facility, and a shared use path could be constructed in the interim. Where this is the case, pedestrians and bicyclists will share limited space. On a case-by-case basis, the implementing agency should consider whether additional signage or markings on the street should be provided to notify drivers of the presence of bicyclists in the street who prefer to ride there than to share a congested path with pedestrians.

4. Consider use of Bikes May Use Full Lane signage and/or sharrows on known popular recreational group ride routes where separated bike lanes or shared use paths are provided.

The implementing agency should consider providing additional signage or markings on streets where shared use path or separated bike lanes are recommended in the master plan and are known popular recreational group ride routes. Many recreational riders who cycle these routes will do so during lower traffic off-peak periods and ride in the travel lane to move at higher speeds. Drivers will be reminded that bicyclists may be

present on the roadway and that they should change lanes to pass.

5. Ensure separated bike lane and shared use path design standards specify high-quality materials and construction.

These facility types will only provide an adequate substitute for on-street facilities for all rider types if they are designed to provide as high quality an experience as the street. Some existing off-street facilities are not constructed to an adequate width or a quality such that all bicyclists view them as an adequate substitute for riding in the street. Proper width and construction can ensure that separated bike lanes or shared use paths are, in fact, replacements for dual bikeways. Separated bike lanes (whether in-street or outside the curb) and shared use paths should:

- Have proper drainage.
- Be designed and constructed with a quality subbase to minimize the development of surface defects and bumps over time, and to provide same or better quality of surface as the adjacent roadway.
- Avoid grade changes at driveway crossings.
- Provide adequate width based on expected volumes of bicyclists (and pedestrians).
- Include appropriate intersection design.

6. Where existing curb-to-curb widths permit provision of bike lanes by lane diets, implement bike lanes as an interim facility before construction of a separated facility or where the existing sidepath is substandard.

Some confident bicyclists will feel comfortable in a bike lane facility even on high speed, high volume streets. Where it is possible to implement bike lanes cheaply and quickly, they should be added in locations where a separated facility is recommended in the master plan or already exists as a substandard sidepath. These decisions should be made at the time of implementation and bike lane space should be repurposed over time to provide the highest quality (widest pathway and buffer) sidepath or separated bike lane possible.

4.3 EXAMPLES WHERE SEPARATED BIKE LANES CAN REPLACE DUAL BIKEWAYS

The recommendations outlined above should be implemented consistently throughout the county on streets formerly identified as dual bikeways. The five corridors listed below were identified for dual bikeway facilities in the 2005 Master Plan. If the county desires to continue to include them in its master-planned bicycle network, separated bike lanes or shared use paths should be the recommended facility type.

Most of the length of these corridors consists of low-density residential land use where most residences front on adjacent streets. These areas are more appropriate for a shared use path since there are not many generators of short pedestrian trips nearby. For each of the five corridors below, locations are identified where the county may wish to indicate a separated bike lane facility instead because of anticipated higher pedestrian volumes.

University Boulevard from New Hampshire Avenue to Georgia Avenue

- Commercial nodes: Columbia Pike, Georgia Avenue, New Hampshire Avenue
- School areas: Eastern Middle School, Montgomery Blair High School, Northwood High School

River Road from Western Avenue to Seven Locks Road

- Commercial node: Little Falls Parkway/Bethesda

Germantown Road from Clopper Road to Frederick Road

- Commercial node: Middlebrook Road

New Hampshire Avenue from Prince George's County to Lockwood Drive

- Commercial/mixed use node: White Oak
- Commercial node: University Boulevard, Ethan Allen Avenue

Norbeck Road from Georgia Avenue to Layhill Road

- Currently no major pedestrian generators

05

HOW SHOULD MONTGOMERY COUNTY USE SIGNED SHARED ROADWAYS IN MASTER PLANS?

Signed shared roadways are streets that are shared by both bicycles and motor vehicles. In Montgomery County, signed shared roadways are typically implemented with wide outside curb lanes (to provide space for motorists to pass bicyclists within the lane), bikeable shoulders on the side of the road, shared lane ("sharrow") pavement markings or on low volume / low speed streets.

As Montgomery County moves forward with a new Bicycle Master Plan that focuses on creating a connected, low-stress network, there is a question as to whether to maintain the signed shared roadway as a master-planned bikeway facility. This report discusses the purpose of signed shared roadways, provides an overview of national guidance, evaluates the current use of signed shared roadways in Montgomery County, presents treatments that implement the signed shared roadway designation and provides a recommendation for the county's use of the designation moving forward.

5.1 PURPOSE OF SIGNED SHARED ROADWAYS

Signed shared roadways serve three functions for bicyclists:

- Provide wayfinding
- Are identified on a public bicycle map
- Provide some type of treatment on the roadway such as a sharrow and/or regulatory signage in the form of "Bikes May Use Full Lane" signs.

The first function, wayfinding, is helpful for bicyclists who are unfamiliar with the bike network. Wayfinding planning involves the identification of existing good bike routes and development of a detailed signage plan, whereas network master planning identifies the locations for future roadway improvements for bicyclists. Because of these differing goals, the two planning processes are best completed separately. Since it will likely take 10 to 20 years to implement many of the recommendations in the Bicycle Master Plan, a separate wayfinding plan is needed to help direct bicyclists to major countywide facilities recommended in the master plan. Furthermore, in Montgomery County, wayfinding and network planning are each overseen by different agencies (Montgomery County Department of Transportation and Montgomery County Planning Department, respectively).

The second function, public bicycle maps, help riders navigate and is also not a master-planning function. The current Montgomery County bike map produced by the County Department of Transportation includes "Bicycle Routes" that are derived from the signed shared roadways in the 2005 bike plan. However, the development of a public bicycle map should also be approached from a network planning perspective, identifying those streets that create a connected network of comfortable riding environments. Such maps may also identify routes and major street crossings by bicyclists' level of traffic stress if routes of varying levels of stress are included. Given Montgomery County's goal of creating a connected, low-stress network, the county may wish to produce a public map indicating level of stress for bicyclists as part of an effort separate from the Bicycle Master Plan.

The third function, identification of locations where pavement markings and signage could be added to supplement existing shared lanes, is not a master plan function. This function is discussed in the following sections of this paper.

5.2 NATIONAL GUIDANCE ON SIGNED SHARED ROADWAYS

The 2012 Guide for the Development of Bicycle Facilities produced by the American Association of State Highway and Transportation Officials (AASHTO) notes that shared lanes (another term for shared roadways) exist on all streets where bicycling is not prohibited and designated bicycle space does not exist. The AASHTO Guide notes a number of characteristics—good pavement, adequate sight distances, bicycle-compatible drainage grates—that can make lanes more compatible with bicycling. It also notes that two street types are particularly suitable as shared lanes in their current situation:

- Streets with lower volumes and speeds.
- Rural roadways with good sight distance, low volumes and operating speeds of 55 mph or less.[79]

Shared lanes may be accompanied by signage such as "Share the Road," "Bikes on Roadway," or "Bikes May Use Full Lane" signs. The "Share the Road" sign is starting to be discontinued by some transportation agencies and the Federal Highway Administration recently issued guidance suggesting it is not a best practice.[80]

Shared lanes, signed or unsigned, do not improve the bicyclist's experience or change the amount of stress that bicyclists experience on a given street. For instance, the rural roadway example noted previously would remain a high-stress environment owing to the speed of traffic.

The AASHTO guide further notes that route signage alone will not improve bicyclists' safety because the signs do not provide any geometric design changes. In the upcoming update to the Guide, route wayfinding signage will be a separate section from bicycle facility types.

In reality, signed shared roadways do not constitute a facility type. Streets designated as signed shared roadways feature one (or a combination) of the bicycle treatments identified above (wide outside lanes, shoulders, sharrows or signage). The 2012 AASHTO guide includes them in the bicycle facility types section, but the future update will move signed shared roadways to a section on wayfinding.

5.3 CURRENT USE OF SIGNED SHARED ROADWAYS IN MONTGOMERY COUNTY

Signed shared roadways have been included as a facility type in Montgomery County bicycle master plans for more than 30 years. Currently, more than 400 miles of roadways in the county are designated in this manner. Signed shared roadways are primarily intended to serve a connectivity function in Montgomery County's planned bicycle network, providing links between other bicycle facilities and destinations.

Signed shared roadways were often included on streets where space does not exist to accommodate another exclusive bicycle facility type, such as a bike lane or a shared use path. These streets were a combination of low-volume, low-speed neighborhood streets and low- to medium-volume, higher-speed streets that are the only option for connecting to certain destinations.

Some of the master-planned signed shared roadways have been implemented by the Montgomery County Department of Transportation as wayfinding projects, others are merely indicated on the county bike map as shared roadways. In practice, designated signed shared roadways represent a wide range of street types and network purposes. Some signed shared roadways are so designated because they are already low-speed, low-traffic streets, and some are designated because they are routes already used by bicyclists. Many in this latter category are high-speed roads with no bicycle facilities and generally considered high-stress streets for most bicyclists.

Signed shared roadways are implemented through five treatment types today in Montgomery County. The five treatments identified below include two types of signage (wayfinding and regulatory), and two facility types (wide outside lanes and shoulders). Sharrows are not a facility type, but can provide multiple functions and are also discussed. The subsequent section makes recommendations about the county's use of each of these treatment types in the master planning process.

SIGNED ROUTES: WAYFINDING

As discussed above, signed routes that provide wayfinding signage help bicyclists navigate the bicycle network. Additionally, if signage is focused only on existing comfortable routes that avoid high-stress crossings, such routes can help the Interested but Concerned population understand how to access the network and navigate to their intended destinations and thus consider choosing to bike rather than travel by another mode. Wayfinding alone, without accommodation separated from vehicular traffic, is not a facility type that improves the bicyclist's comfort on a given street.

Montgomery County DOT has implemented some wayfinding routes

SIGNED ROUTES: REGULATORY

Bikes May Use Full Lane (BMUFL) signs are regulatory in nature and govern the interactions of bicyclists and drivers on the roadway. This sign permits bicyclists to control the lane and requires that motorists either change lanes to pass or, if passing legally is not an option, wait patiently behind bicyclists. This signage may be used alone or in tandem with sharrow markings on the roadway. County policy regarding BMUFL signs follows the Maryland State Highway Administration Bicycle Policy and Design Guidelines.[81] As with wayfinding signs, regulatory signs without accommodation separated from vehicular traffic are not considered to be a facility type because the signs do not improve bicyclist's comfort.

Bikes May Use Full Lane signs may be used in tandem with sharrow markings.

SHARED LANE MARKINGS (SHARROWS)

Generally, sharrows serve three primary purposes:

- Operational: to indicate the recommended location within the travel lane for bicyclists to use.
- Regulatory: provide a visual cue to remind d rivers that bicyclists may be present.
- Wayfinding: provide directional markings

None of these three functions are master planning functions, but rather considerations for implementation. This implementation has varied among different jurisdictions. For instance, Portland, OR, has used sharrows primarily as a wayfinding marking and only on low-volume, low-speed streets. This usage includes bicycle boulevards where additional traffic calming and/or diversion is present. Most other jurisdictions use sharrows to fill gaps in the network, regardless of traffic volume, where other dedicated facilities do not exist. In many cases, these are located on higher volume collectors or arterials. To date, Montgomery County has not explicitly identified the function of sharrows in the bicycle network, but the county may wish to explore defining appropriate uses of sharrows through the Bicycle Master Plan.

Within Montgomery County, sharrow markings are used on a wide variety of roadway types, including roadways formally designated as shared roadways in the 2005 Countywide Bikeways Functional Master Plan as well as other roadways not formally designated through the Plan. This practice may be due, in part, to different transportation agency jurisdiction over roads within the county, including the Maryland State Highway Administration (SHA) and Montgomery County Department of Transportation (MCDOT). For instance, in Silver Spring, MCDOT installed sharrows on the block of Ellsworth Street between Fenton Street and Spring Street. This location has two travel lanes and relatively low traffic speeds and volumes. To pass bicyclists, drivers must encroach on the oncoming travel lane, meaning they must often slow when passing the bicyclist. SHA installed sharrows on Georgia Avenue, a state highway, just a few blocks away from the Ellsworth Street in Silver Spring. This street has six lanes of high volume traffic that often travels at fast speeds outside of congested hours. To pass bicyclists on Georgia Avenue, drivers can encroach on an adjacent travel lane, in the same direction or change lanes entirely, which

enables drivers to maintain higher speeds.

Sharrows indicate an appropriate path of travel to bicyclists and encourage drivers to move over to pass.

Bicyclists can tell the difference between roadway types where sharrows are used today (e.g., Ellsworth Street vs. Georgia Ave) and will not be confused by the application of the same facility on widely varying street types. Adult bicyclists can see that traffic volumes and speeds are very different on these two streets and that sharing space with traffic on each street will be a different experience. Sharrows can serve a function for bicyclists in both situations. However, given the Bicycle Master Plan goal of creating a low-stress network, sharrows should only be considered as part of the toolkit for implementing bicycle boulevards on low-volume, low-speed streets and as an interim treatment.

Wide Outside Lanes

Wide outside travel lanes are intended to provide space for both bicyclists and drivers to operate in tandem within the same lane. Standard traffic lanes in Montgomery County are 11 to 12 feet wide, while a wide outside lane is 14 to 14.5 feet wide. Consensus has grown in the bicycle planning and engineering field that wide outside lanes do not constitute a facility type. While more space is provided for a driver to pass a bicyclist, this additional width does not increase a bicyclist's comfort, especially on roadways with high speeds.

Additionally, wide lanes tend to increase automobile travel speeds, and may actually make bicyclists less comfortable next to higher speed traffic than on a similar roadway with standard width lanes. Although wide outside lanes were included in the 2012 AASHTO Bike Guide, they are not likely to be included in the upcoming release of this guide.

In Maryland, most wide outside lanes were implemented by SHA on high-speed, high-volume roadways, but the agency is moving away from viewing wide outside lanes as a bicycle improvement because there is a better understanding that they do not improve bicyclists' comfort. Although SHA does not prioritize the implementation of low-stress bicycle facilities, the agency recognizes that a bike lane or a shoulder provides a higher level of comfort than a wide outside lane. In the past, some wide outside lanes were also implemented by MCDOT in similar locations.

Wide outside lanes provide more space for drivers to pass bicyclists but do not change the level of comfort experienced by most riders.

BIKEABLE SHOULDERS

A bikeable shoulder is a space outside of the vehicular travel lanes that can be used by bicycles when not occupied by stopped or parked vehicles. Bikeable shoulders can improve comfort for cyclists on some roadways, but are not technically a shared roadway because the shoulder provides space for bicyclists outside the automobile travel lane.[82] Shoulders are more likely to be present in more outlying locations in the county often where posted speed limits are 40 mph and higher.[83] Shoulders of at least three feet provide some space for bicyclists to avoid riding in the automobile travel lane. Additional width provides a greater level of safety and comfort for bicyclists as they are able to ride farther away from adjacent automobile traffic.

Paved shoulders are present on some rural roads in the county.

5.4 RECOMMENDATIONS FOR MONTGOMERY COUNTY

The following recommendations are based on a review of past county planning practices and emerging national best practices, and are provided to inform the Montgomery County Bicycle Master Plan:

1. Discontinue use of signed shared roadway as a facility type.

Signed shared roadways are not a facility type and should not be identified as such. Rather, they are implemented through the treatments identified previously in this report. The purpose of a master plan is not simply to identify streets that connect to one another and to destinations, but to identify a set of infrastructure recommendations that will improve the comfort of bicyclists on those streets.

With Montgomery County's goal of creating a connected low-stress network, bikeway recommendations should only include those facilities that will create a low-stress environment on streets, no matter what their traffic and roadway characteristics. National best practice among bicycle planners and designers has come to this conclusion since the last county bikeways plan in 2005. Updating the county's approach to signed shared roadways will keep pace with national best practices.

2. Recommend the development of a comprehensive wayfinding plan for the county.

Wayfinding should be addressed as a separate planning process from the master plan. Implementation of wayfinding routes is already underway in the county and has been based, in part, on prior identified signed shared roadways. However, in developing the detailed sign plans for routes, planners have found the need to deviate from the identified routes to take advantage of more comfortable crossing locations. A wayfinding plan could help the county identify those destinations people will want to access and subsequently identify the most suitable routes for bicycling to those destinations. This effort could also help refine the county's bike map.

3. Discontinue use of signed routes in the master plan.

Neither regulatory signage alone in the form of Bikes May Use Full Lane signs, nor wayfinding signs improve the comfort or connectivity of streets. The identification of signed routes should be completed through a way-finding plan. Montgomery County may wish to consider use of Bike May Use the Full Lanesigns on a case-by-case basis as discussed in the dual bikeways section of this report.

4. Discontinue use of wide outside lanes as a facility type.

Wide outside lanes do not improve the comfort of a road for bicyclists and may, in fact, decrease comfort by leading to increased automobile travel speeds. This facility type is incompatible with the county's goal of providing a low-stress network. The county should consider restriping wide outside lanes as narrowed lanes with shoulders if three feet are available for shoulder width. Striped shoulders have been shown to increase bicyclists' comfort even if the total width of the outside lane and shoulder are the same as a wide outside lane, such as an 11-foot travel lane and 3-foot shoulder versus a 14-foot travel lane.[84]

5. Develop a sharrow use policy.

Montgomery County currently does not define the purpose of shared lane markings in its network. The county should develop a sharrow use policy and may frame that policy based upon two uses – as part of bicycle boulevards and as an interim treatment. Both of these uses will be decided by the implementing agency at the time of facility design and are not expected to be outlined in the Bicycle Master Plan. Sharrows may be appropriate in a range of situations, but should not be recommended as an independent facility type in this Master Plan.

Sharrows may be a treatment option on low-volume, low-speed streets designated as bicycle boulevards. In this context, sharrows can serve a wayfinding function and also reinforce bicyclists' right to control the lane.

Additionally, sharrows may be a treatment that is used as an interim marking on streets master-planned for other facilities. For instance, a street may be designated for a separated bike lane and serve a critical network function in connecting to major destinations or other pieces of the bicycle network. However, implementation of the separated bike lane may take years, and in the intervening time, a sharrow can help a segment of the bicycling population navigate high-speed, high-volume roads. The sharrow marking would indicate to drivers that they should expect bicyclists and should change lanes to pass.

6. Recommend other bicycle facilities on some local streets formerly identified as signed shared roadways.

Connectivity is one of the most important characteristics of a bicycle network. Signed shared roadway recommendations in the past have consisted, in part, of local streets that are already comfortable for bicycling. However, these route recommendations are not restricted to those fully connected low-stress routes with comfortable crossings of major streets. Bicycle boulevard, advisory bike lane and/or sharrow recommendations should appear as part of the county's network to improve the comfort of streets. Additionally, the plan should identify those locations where crossing improvements (i.e., signals, medians, crosswalks, etc.) are necessary to provide low-stress crossings that connect low-stress streets to one another.

END NOTES

79. Note: Maryland state law prohibits bicycling on roads with speed limits greater than 50 mph. While bicyclists may use the shoulder on these roads, they may only enter travel lanes if making a left turn, crossing the roadway or if the shoulder is overlaid with a right turn lane, a merge lane, a bypass lane or any other marking that breaks the continuity of the shoulder.
80. http://mutcd.fhwa.dot.gov/knowledge/faqs/faq_part9.htm#signsq5
81. http://roads.maryland.gov/ohd2/bike_policy_and_design_guide.pdf
82. Implementation of bikeable shoulders is often inconsistent, resulting in variable effective widths for bicycle operation. As a result, bicyclists will often be forced to transition into the automobile travel lane, where shoulders narrow or drop, and share the lane with automobiles.
83. These speeds create higher stress levels for most bicyclists, but riders who are more tolerant of higher traffic stress may be comfortable on roads with higher speeds where either traffic volume is low or shoulders are present.
84. The Bicycle Level of Service methodology says that riders who were part of that study indicate an increased level of comfort with shoulder striping. This may not increase comfort for all riders, but some, likely more confident riders, will feel more comfortable in the restriped context.

06

SEPARATED BIKE LANES VERSUS SHARED USE PATHS

Once the decision to provide physical separation from traffic is made, planners must then determine whether to provide a separated bike lane or a shared use path. Separated bike lanes and shared use paths are both critical components of low-stress bicycling networks that are designed to appeal to all ages and bicycling abilities. Both increase the safety, comfort and attractiveness of the bicycling environment by physically separating bicyclists from motor vehicle traffic. Both facilitate direct and convenient connections to destinations, transit services and other bicycle facilities. However, each has practical differences in context, design and application.

Separated bike lanes are an **exclusive space for bicyclists** along or within a roadway that is physically separated from automobiles and pedestrians by vertical and horizontal elements. Separated bike lanes may be constructed as a one-way pair located on both sides of the street in the direction of travel, or they may be constructed as a two-way bikeway.

Two-way separated bike lanes can also be constructed in the center of a two-way street; however, this design is generally not preferred because it creates more potential points of conflicts between turning automobiles and bicycles, separates bicyclists from destinations along the roadway, and places bicyclists between opposing directions of traffic. Space constraints will often dictate which facility is feasible in retrofit situations where moving curbs or expansion of the right-of-way is not possible. Design considerations for separated bike lane configurations are addressed in the bicycle facility design toolkit.

Shared use paths provide a **shared space for all non-motorized users** (e.g., people bicycling, walking, jogging, skating, etc.). They are often referred to as sidepaths when parallel to a roadway within the right-of-way or trails when located along another alignment. Shared use paths provide for two-way travel in all cases and are often marked with a centerline to distinguish directionality.

6.1 RECOMMENDATIONS FOR MONTGOMERY COUNTY

The decision to provide a shared or separated bicycle space should be supported by a planning process to analyze benefits and tradeoffs, facility configuration and feasibility, given corridor constraints. The following discussion outlines the critical considerations for choosing between a separated bike lane and a shared use path facility.

It should be noted that these criteria are general in nature and leave many design decisions to the planners and designers at time of facility implementation. Additional factors, such as right-of-way availability, utility location constraints, adjacent property owners' desires and others, will weigh in the decision between implementation of a separated bike lane or a shared use path. These recommendations provide a general framework for considering this choice.

Additionally, planners should use these recommendations with an eye toward anticipated and desired pedestrian and bicycle volumes on a given corridor. A given corridor today may not have high pedestrian volumes, but with the addition of more varied and active land uses, that volume may change. Planners should also note that future separated bike facilities may encourage more bicycle trips by helping additional people choose to bicycle for their trips rather than driving. A lack of bicyclists today in a corridor should not be an indication of a lack of latent demand.

Considerations for Separated Bike Lane versus Shared Use Path Choice

Pedestrian demand along the study corridor should be the **primary consideration for planners**. Just as separation from automobiles enhances safety and comfort for people bicycling and driving, separation between people walking and bicycling may be necessary to eliminate potential conflicts and maintain

a comfortable and attractive facility. Where observed or anticipated pedestrian demand is low, conflicts between people walking and bicycling may be infrequent. In this situation, a shared use path may comfortably and safely satisfy both bicycle and pedestrian demand. Where pedestrian volumes are observed or anticipated to be high, separate facilities should be provided for bicyclists.

The density and land use of the surrounding environment is closely related to pedestrian demand. Providing separated bike lanes and sidewalks is recommended along "main street" town centers and urban streets. Bicycle movements would conflict with both higher pedestrian volumes in these areas as well as the meandering and stop-and-go pedestrian movements associated with urban areas (e.g., socializing, shopping, dining outdoors, accessing transit or on-street parking, etc.). In urban areas, storefronts and other building entryways open directly to the sidewalk, further necessitating separate pedestrian and bicycle spaces. In Montgomery County, this separation will apply to commercial and higher-density mixed use areas and those around major transit facilities.

This guidance is already being followed in small area network plans for urban areas of Montgomery County, such as Bethesda, White Flint and Silver Spring. Right-of-way outside the curb will also likely be more constrained in built-out urban areas and may weigh heavily in facility decisions; however, creating a comfortable facility for both bicyclists and pedestrians should remain the primary consideration.

Land uses in suburban and lower-density communities are more spread out, which reduces demand for walking and, subsequently, conflicts with people bicycling. Shared use paths may be appropriate in these contexts. Single-use residential areas, even those that are somewhat dense, are especially more well-suited for a shared use path application because the lack of nearby destinations will lead to fewer short walking trips. Even in corridors with bus service where pedestrians will board and alight on the path, pedestrian volumes will most likely be low and sporadic enough to avoid frequent conflicts with bicyclists.

Consideration[85]	**Shared Use Path (SUP)**	**Separated Bike Lane (SBL)**
Estimated or Anticipated Pedestrian Volumes	Lower pedestrian volumes	Higher pedestrian volumes
Land Use Character	Less dense development, especially suited to suburban or rural areas, or undeveloped land	More dense development, especially commercial and mixed-use areas

6.2 EXAMPLE APPLICATION IN MONTGOMERY COUNTY: FALLS ROAD

Falls Road (MD 189) is a two-lane arterial in the southwestern portion of Montgomery County. It connects MacArthur Boulevard at the western end to Maryland Avenue at the eastern end approaching downtown Rockville. The street expands to a median-separated, four-lane cross section as it approaches Interstate-270 and narrows again on the approach to Rockville.

The posted speed limit is 35 mph, and shoulder width on both sides of the road varies frequently between approximately one to four feet. These characteristics make Falls Road a high stress road today. A shared use path of a substandard width exists on Falls Road from MacArthur Boulevard to River Road. Another, wider section of shared use path exists from Dunster Road to Wooton Parkway. These two facilities provide a lower stress bicycling environment in those segments, but they are disconnected.

Land uses along Falls Road ares primarily single-family residential (fronting on side streets) along its approximately seven-mile length, with the exception of the commercial center at Potomac Village and interspersed school, religious and recreational uses (e.g., Falls Road Golf Course, Falls Road Park). Pedestrian volumes are low along the corridor; little commercial use is located nearby that would generate short pedestrian trips except in Potomac Village and the existing shared use paths for recreational use. Pedestrian volume is also generated along the corridor from county RideOn buses 47 and 56 close to Rockville, and Washington Metropolitan Area Transit Authority bus T2 from River Road north.

Given the low-density land use characteristics and low anticipated volumes of pedestrians along the Falls Road corridor, the appropriate bicycle facility would likely be a shared use path. A shared facility here would enable both bicyclists and pedestrians to utilize the facility with little anticipated conflict. Additionally, such a facility would provide access to destinations mentioned above and to the existing shared use path network.

END NOTES

85. An additional criterion often raised is the presence and frequency of driveway crossings. Both separated bike lanes and shared use paths can be designed to standards that minimize and mitigate conflicts between bicyclists and drivers at these crossings. Drivers entering/existing driveways may encounter bicyclists along the road edge in bike lanes or in a shared lane situation as well. Driveway frequency may, however, be one criterion when choosing a side of the street for construction of a two-way separated bike lane or a shared use path. This frequency must be weighed against bicyclists' access to the destinations for which the facility is constructed in the first place.

07 TWO-WAY BIKEWAYS ON BOTH SIDES OF THE STREET

Separated bike lanes and shared use paths can provide two-way travel for bicyclists. In some situations, two-way separated bike lanes or shared use paths on both sides of the street (i.e., a two-way pair) may be warranted. The general application for this facility type is along wide, high-speed, high-volume streets with limited crossing opportunities where destinations exist on both sides of the street. Two-way bikeways on both sides of the street minimize the need to cross wide roadways, travel excessive distances to cross at a safe location and improve access and network connectivity to both sides of the street.

Conversely, two-way bikeways on one side of the street and one-way separated bike lanes on both sides of the street can limit access for bicyclists. A single two-way bikeway, while potentially beneficial to connect to some destinations along the corridor or connecting bicycle facilities, can require bicyclists to cross the roadway twice to reach their destinations and limit access to the other side of the street. This may lead to wrong way riding at locations were the main road is perceived as a barrier to cross or results in excessive delay to cross. Similarly, a pair of one-way facilities on each side a street may present a problem if a bicyclist's destination is on the opposite side of the street from the direction of travel. This configuration requires the rider to either cross the street twice to access the destination, or it may lead a cyclist to ride against traffic on the side of the street where the destination is located.

By providing a two-way facility on each side of the street, Montgomery County will enable bicyclists to complete trips to their destinations with minimal conflicts and delay and encourage more Interested but Concerned riders to consider bicycling. [86]

7.1 DOMESTIC EXAMPLES OF TWO-WAY BIKEWAYS

Domestic examples of two-way bikeways on both sides of the street are uncommon. Hiawatha Avenue in Minneapolis, a high-speed, six-lane limited-access highway, is bounded by two shared use paths between East 24th Street and East 26th Street. This bike facility configuration enhances network connectivity significantly by directly connecting the non-motorized overpasses at these cross streets to the north-south Hiawatha Bike Trail and the east-west Midtown Greenway. Bicyclists avoid crossing Hiawatha Avenue at grade entirely, eliminating conflicts with vehicles and creating a comfortable bicycling environment.

Two-way facilities on both sides of the street are currently under construction in Boston as part of the Casey Arborway project. The completed Arborway will span at least six lanes of heavy motor vehicle traffic and will be located alongside regional path connections. The two-way bikeways on both sides of the street will minimize the need to cross the Arborway, while upgrading existing connections to the Southwest Corridor and creating new east, west and south non-motorized path connections.

Redesigned Casey Arborway (path connections in blue)

7.2 INTERNATIONAL EXAMPLES OF TWO-WAY FACILITIES

Two-way facilities on both sides of the street are more common abroad. The Dutch, in particular, make extensive use of this arrangement inside built-up areas where dense bicycle networks are the norm. Typically, two-way facilities on both sides of the street are limited to divided roadways with raised medians (often occupied by light rail tracks) and higher motor vehicle speeds and volumes. Vierhavensstraat in Rotterdam was recently reconstructed as part of a redevelopment effort and includes two-way facilities on both sides of the street.

For the Dutch, the implementation of two-way facilities on both sides of the street is a logical outcome of the development of bicycle networks. This comprehensive planning process is guided by five fundamental requirements in the Netherlands: cohesion, directness, safety, comfort and attractiveness.

- *Cohesion:* Does the bicycle network connect origins and destinations, and align with existing bicycle travel patterns? Two-way bikeways on both sides of the street simplify and enhance access for bicyclists by eliminating the need to cross the street. They may be implemented to better align with existing bicyclist travel patterns, ensuring that the bicycle network serves at least 70 percent of all bicycle trips. The grid of the bicycle network should include facilities spaced at no greater than 250 meters (820 feet) apart.
- *Directness:* Does the bicycle network facilitate trips that are as direct and unimpeded as possible? Two-way bikeways on both sides of the street promote directness in distance and time by minimizing the need to unnecessarily cross the street and detour from the desire line. The detour factor—a comparison of route length and as-the-crow-flies distance—should be no greater than 1.2 times the route length for main cycle routes and 1.4 times the route length for additional routes. Stopping frequency—stops per kilometer—should be minimized.[87]
- *Safety:* Are conflicts with crossing traffic avoided? Two-way bikeways on both sides of the street minimize the need to cross multiple lanes of high speed traffic and therefore exposure to traffic. The safest conflict is the one that doesn't exist.
- *Comfort:* Does the bicycle network prevent exposure to "traffic nuisance," defined by the Dutch as the negative impacts of interacting with automobiles, such as exhaust, noise pollution and conflicts resulting in delay? Two-way bikeways on both sides of the street minimize encounters with automobiles by separating bicycles and cars to a great extent within the same corridor.
- *Attractiveness:* Does the bicycle network attract continued use? Two-way pairs separate bicyclists from motor traffic to a greater extent and increase bicycle access and connectivity. They can make trips more convenient by bicycle. Two-way facilities also encourage side-by-side riding, which promotes social interaction and, ultimately, enjoyment.

Vierhavensstraat, Rotterdam, Netherlands

7.3 RECOMMENDATIONS FOR MONTGOMERY COUNTY

A two-way bikeway on both sides of the street is intended to serve a unique function within the county's bicycle network. This facility type should only be recommended where all recommended criteria are met because of the significant level of investment needed to implement these facilities.

Additionally, other network and roadway reconfiguration options should be investigated before settling on the choice to recommend a two-way bikeway on both sides of the street. Parallel routes on low-volume, low-speed streets may be available and feasibly implemented with a lower level of investment than a two-way bikeway. Planners should also consider whether changes are feasible to the street in question: Is it possible to add more safe, comfortable crossings? Is it possible to reduce the number of travel lanes and make crossing easier? These types of changes may not be feasible in retrofit projects, but the design of a new street in a developing or redeveloping area should take these questions into consideration.

It should be noted that a two-way pair may be used for a short segment within a commercial area and transition back to a two-way facility on one side of the street outside of this area. These segments can provide critical connections and access for bicyclists on major streets that may otherwise create a barrier.

Recommended criteria for application of two-way bikeways on both sides of the street are:

- Long distances between safe, comfortable crossings (typically 800 to 1,000 feet[88]).
- Wide automobile travelway cross section (four or more lanes).
- Presence of destinations/active land uses on both sides of the street.

Long distances between crossings where destinations are present on both sides of the street may lead bicyclists to undertake different unsafe behaviors based upon configuration of the bike facility provided:

- One-way pairs (conventional or separated bike lane): Bicyclists may ride against traffic in the one-way facility to avoid crossing the street to reach their destinations. However, their movements would not be accommodated in the design of the facility either in width (for passing) or signage and marking (for alerting drivers).
- Two-way facility (shared use path or separated bike lane) on one side of the road: Bicyclists may cross at unmarked crossings; drivers may not expect these crossings, which pose a greater risk on wide, high-speed roads. Bicyclists may also ride on the sidewalk on the non-bicycle facility side of the street, leading to increased conflict with pedestrians in this limited space and with automobiles entering/exiting from driveways where bicyclists are unexpected.

A street must have a wide cross section, four lanes or more, to consider this facility application. The width of the street makes crossing less safe through exposure to multiple lanes of traffic and oftentimes high traffic speeds. Wider streets often also have longer signal phasing. This longer signal presents further delay to bicyclists who may need to cross the street twice to reach their destinations and continue a trip if a facility is only provided on one side of the street.

The criteria for crossing distances are only applicable where a bicyclist has a reason to access both sides of the street. A street that meets the other criteria would not warrant two-way facilities on both sides if it abuts a large private property or a park with one entrance, for instance. Corridors with destinations on both sides of the street are likely to have commercial or mixed-use land uses.

Many locations that meet the criteria for two-way facilities on both sides of the street will also have high pedestrian volumes, owing to the density of destinations and likely coincidence of transit lines along the corridor. In most cases, this large number of pedestrians will mean separated bike lanes are preferred to help alleviate conflicts between pedestrians and bicyclists.

7.4 EXAMPLE APPLICATION IN MONTGOMERY COUNTY: ROCKVILLE PIKE

Rockville Pike is perhaps the quintessential example of a street that is well-suited to a two-way pair facility due to the distance between safe, comfortable crossings, a wide street cross section and presence of active commercial destinations on both sides of the street. The White Flint Separated Bike Lane Network calls for a separated bike lane on Rockville Pike, but this planning documents does not specify cross sections for these recommendations to provide flexibility in implementation.

Rockville Pike is a six-lane street in this segment, though turn lanes increase this width at every intersection, and this width creates a major barrier to accessing both sides of the street. Safe, comfortable crossings are spaced farther apart than is practical for bicyclists making short neighborhood trips in this area. Crossings are spaced, on average, 850 feet apart from one another, a distance which slightly exceeds the threshold stated above.

Commercial destinations are located on both sides of the road throughout White Flint today, and anticipated redevelopment will only intensify these land uses and bring a greater number of residents to the area. Businesses front on Rockville Pike, and while some access may be possible from side streets in the network, two-way facilities on both sides of the street will enable bicyclists (and non-bicyclists) to conceptualize arriving at these businesses by bicycle.

The two-way pair would be recommended to begin at Flanders Avenue—the beginning of commercial use on both sides of the street—on the south end and continue to meet the two-way pair at the Rockville city line. On Rockville Pike and at other locations in the county, trade-offs would need to be made to accommodate the increased space needs for two-way facilities on both sides of the street. If two-way bikeways are not provided on both sides of the road through the White Flint area, it can be expected that people will be less likely to choose to bike for their trip, bicycle on the sidewalk or bicycle in the wrong direction on a one-way bikeway. These possible outcomes are in conflict with the county's goals for providing a safe, connected, low-stress network that attracts more residents and visitors to choose bicycling.

END NOTES

86. Interested but Concerned riders are more comfortable when given greater separation from high-speed, high-volume traffic. They comprise approximately 60 percent of the population.
87. This logic becomes important for short trips, such as those the county may desire to capture within a mixed-use neighborhood. Undue delay on a quick run for errands will dissuade a resident from choosing to bike instead of drive.
88. Lower thresholds may be considered where a high density of destinations exists on both sides of the street.

08

PHASING SEPARATED BIKE LANES

Separated bike lanes (SBLs) are a relatively new facility type in Montgomery County. As described in prior reports, separated bike lanes are critical elements of high-comfort, low-stress bicycling networks. Many agencies have implemented separated bike lanes as low-cost retrofits projects (e.g., using flex posts and paint within the existing right-of-way) and others are constructing more permanent forms of separation, such as curb-separated bike lanes, that represent an ultimate desired design standard. Although low-cost separation types can be easier to implement, agencies have noted maintenance costs and issues with aesthetics, and some separation types provide a lower level of protection from adjacent automobile traffic. This report explores best practices for bike lane separation types and recommends guidance and criteria for a phased implementation approach that begins with interim treatments and transitions into ultimate separated bike lane designs.

8.1 BENEFITS AND CONSIDERATIONS FOR SEPARATION TYPES

According to the Federal Highway Administration's Separated Bike Lane Planning and Design Guide, separation types should be selected based on considerations such as available space, cost, presence of on-street parking, maintenance and aesthetics. Table 1 on the following pages reviews the different methods for creating separated bike lanes and describes the level of protection and comfort provided by such lanes to bicyclists, as well as aesthetics, costs and other considerations, based on guidance in the MassDOT Separated Bike Lane Planning and Design Guide and the FHWA Separated Bike Lane Planning and Design Guides.

In Table 1, cost is separated into two categories: capital costs and operating costs. These two considerations must be taken into account when deciding on a separation type for bike lanes to ensure that resources are available to keep the facility in a state of good repair once the initial investment is made. Capital costs include those of materials and labor to construct the separated bike lane. For separation provided by flexible delineator posts, for instance, capital costs include striping and the flexible delineator posts. For separation provided by a raised median, capital costs include construction of the median, plus any necessary changes to stormwater or other utilities within the limits of disturbance. Operating costs include typical maintenance, such as sweeping and snow clearance, replacement costs for materials (e.g., damaged delineator posts) and upkeep (e.g., seasonal maintenance and watering for planters or planted medians).

An additional consideration for separation types is sight lines related to child bicyclists. While most adult bicyclists will be visible to adjacent drivers above any type of separation, smaller child bicyclists may not be. Specifically, use of parked cars, concrete barriers or tall planters as separating elements may prevent drivers from seeing child bicyclists. Design considerations need to be taken into account at driveways and intersections for these separation types to ensure adequate open space (or lower barriers) for improved sight lines. These considerations also apply to recumbent bicyclists.

TABLE 1: BIKE LANE SEPARATION TYPES: BENEFITS AND CONSIDERATIONS

SEPARATION TYPE	LEVEL OF COMFORT/ PROTECTION	AESTHETICS	CONSIDERATIONS	CAPITAL COST	OPERATING COST
Flexible Delineator Posts	May not offer a high level of comfort to some riders due to lack of constant of separation material. May be less suitable for young children due to the permeability of the separation.	Less attractive than some other separation types. Multiple options for post types (color, shape, etc.).	Maintenance/ durability issues. May require closer spacing if parking encroachment is an issue. Easily accommodate emergency vehicle access. Fewest storm water/ drainage implications.	Low: easy to install/ remove.	Low to medium, depending on frequency of damage.
Parking Stops/ Precast Surface-Mounted Medians	May not offer a high level of comfort due to limited height. Low profile reduces risks of pedal strikes.	Can be less attractive than some other separation types. Multiple options (color, pattern, etc.) for parking stop and precast median types.	Require minimal buffer space. Highly durable. Can create tripping hazards and access issues when adjacent to on-street parking. May need additional vertical objects or on-street parking. Low impact on storm water drainage.	Low to medium.	Low
Planter Boxes	High comfort due to heft of planters and consistent wall of separation from traffic.	Provides enhancement to streetscape with plantings. Multiple options for planter choice (size, color, shape, etc.).	Higher long-term maintenance costs (landscaping). May not be appropriate for higher-speed roadways (crashworthiness). Additional bike lane width required to provide offset from vertical obstruction. Lower impact on drainage if placed with spaces between planter boxes.	Low to medium.	Medium to high.

Example of Flexible Delineator Posts

Example of Parking Stops/ Precast Surface-Mounted Medians

Example of Planter Boxes

TABLE 1: BIKE LANE SEPARATION TYPES: BENEFITS AND CONSIDERATIONS

SEPARATION TYPE	LEVEL OF COMFORT/ PROTECTION	AESTHETICS	CONSIDERATIONS	CAPITAL COST	OPERATING COST
Concrete Barriers	High level of protection due to consistent wall and heft of separation.	Lower aesthetic quality, though can be constructed with small planter area on top or decorative inset panels on sides. May require a crash cushion at ends.	Potential drainage and maintenance vehicle access issues. Incompatible with on-street parking. Additional bike lane width required to provide offset from vertical obstruction. Lower impact on drainage if placed with spaces between barriers.	Medium	Low
Rigid Bollards	High level of comfort due to very durable nature of bollards. Without additional low vertical separation (for example, a curb), may be less suitable for young children.	Can add to aesthetic of streetscape in bollard choice and integrates with existing or desired design.	May not be appropriate on higher speed roadways (crashworthiness). May require closer spacing if parking encroachment is an issue. Low impact on storm water drainage.	Medium	Low
Raised Medians	High level of comfort due to durability of median, potentially enhanced with plantings that provide additional height and sense of separation.	With plantings, can add to streetscape aesthetic. Plantings will require additional maintenance.	Passenger unloading and pedestrian pass-through areas needed to accommodate on-street parking. Opportunity to incorporate green storm water infrastructure. High impact on storm water drainage; must be considered in design.	High	Low to high (depending on planting).
Raised Lane	High level of comfort due to grade separation from automobiles. Adequate separation from pedestrians needed when at sidewalk level to ensure bicyclist and pedestrian comfort.	Choice of pavement types for bike lane, buffers and sidewalk materials can enhance streetscape aesthetic.	Transitions at intersections, driveways and pedestrian crossings require additional consideration. Greater flexibility for curb reveal and drainage. May necessitate moving utility locations.	High	Low

Example of Concrete Barriers

Example of Raised Medians

Example of Rigid Bollards

Example of Raised Lane

8.2 PLANNING CONSIDERATIONS

Phasing may be necessary for implementing separated bike lanes due to project cost or space limitations necessitating interim design solutions. In the longer term, an ultimate design could be constructed to replace the interim condition in coordination with a larger project. Given that separated bike lanes are a newer facility type, a shorter-term design could also allow for proof of concept and continued evaluation by the implementing agency before making a substantial public investment in permanent infrastructure. Additionally, bicycling demand or motor vehicle volumes may change over time, requiring a higher level of protection from traffic or more space to accommodate higher bicycling volumes.

Lower-cost retrofits or demonstration projects

Lower-cost retrofits or demonstration projects allow for quick implementation, provide responsiveness to public perception and permit ongoing evaluation. **Separation types for interim separated bike lanes often include non-permanent separation, such as flexible delineator posts, planters, parking stops or concrete barriers.** Interim approaches allow the agency to:

- Test the separated bike lane configuration for bicyclists and traffic operations.
- Evaluate public reaction, design performance and safety effectiveness.
- Make changes if necessary.
- Transition to permanent design.

Permanent separation

Permanent separation provide a high level of protection and often have greater potential for placemaking, quality aesthetics and integration with features such as green stormwater management infrastructure. Agencies often implement permanent separation designs by leveraging private development (potentially through developer contribution), major capital construction and including separated bike lanes in roadway reconstruction designs. **Examples of permanent separation include rigid bollards, raised medians and grade-separated bike lanes at an intermediate or a sidewalk level.**

8.2 TRANSITION FROM A LOW-COST TO A MORE PERMANENT DESIGN

Interim designs using lower cost materials may allow communities to implement separated bike lane projects more quickly. However, concerns about aesthetics, comfort for all users and incorporation of signal designs make a transition to permanent design desirable. Low-cost materials, aside from planters, do not tend to enhance the streetscape and designers often raise concerns about the visual impact of flexible delineator posts and concrete barriers. Some users may also feel less comfortable with low-cost separation types due to the lack of a consistent vertical separation and durability of materials (delineator posts) or low height (parking stops).

Finally, since agencies often try to implement interim designs in a low-cost manner, budget is rarely available for study and implementation of traffic signal modification specifically for bicycle accommodation. The high cost of traffic signal modifications, adding bicycle-specific signals or installing additional vehicle traffic signals would significantly increase the cost and potentially hinder quick implementation of interim projects. Research has also documented lower bicyclist compliance at locations where bicyclists are directed to follow pedestrian signals. Without these improvements, interim designs may not function as well for bicyclists, pedestrians and drivers as a permanent design incorporating these signal changes.

Nationally, transitions from interim to permanent design are rare because of the relatively short time period during which separated bike lanes have been in place in this country. A recent survey of 40 cities across the U.S. showed 87.5 percent use low-cost, flexible design materials to implement separated bike lanes. People for Bikes' 2016 "Quick Builds for Better Streets: A New Project Delivery Model for U.S. Cities" describes a process for implementation of a "quick build" (under one year from recommendation to implementation) design.[89]

Recent examples suggest that quick builds may be able to demonstrate the benefits of the project, which could potentially position an agency favorably for additional funding to transition to more permanent materials. Many agencies set a timeline for a pilot installation to evaluate the design outcomes (one year or two years) from bicyclist user and traffic impacts perspectives. However, there are few agencies so far that have created a direct link between quick builds and permanent reconstruction projects.

Example: Second Avenue, Seattle, WA

In fall 2014, the City of Seattle implemented a quick build separated bike lane on Second Avenue in its central business district. Initially, the two-way bike lane was separated using flexible delineator posts and adjacent on-street parking. Seattle also implemented bicycle signals and two-stage turn queue boxes at all intersections. During the pilot installation, the city evaluated the separated bike lane design and made minor changes to address issues, including "no turn on red" signs and pavement markings at loading locations and driveways. The existing signal poles required the bicycle signals be installed adjacent to vehicle signals, resulting in instances of non-compliance by some motorists.

Second Avenue separated bike lane, before (above) and after (below) upgrades to pedestrian crossings and additional planter boxes.

Second Avenue separated bike lane, before (left, above) and after (left, below) upgrades to pedestrian crossings and additional planter boxes.

In spring 2016, Seattle changed the design to increase the comfort for bicyclists by installing planter boxes to replace the flexible delineator posts. The city installed raised crossings at a number of parking garage driveways and a hotel loading zone where conflicts with turning vehicles and faster downhill bicycle speeds were issues during the pilot installation. In addition, mast arms were installed to separate the bike and traffic signals at locations where drivers had dedicated left turn lanes and higher rates of non-compliance with the separate left turn phase were observed. This new placement also resulted in the traffic signal being located over the left turn lane. The goal of these changes was to improve aesthetics, clarify bicycling space adjacent to parking and address safety issues at conflict zones.

8.3 RECOMMENDATIONS FOR MONTGOMERY COUNTY

The following recommendations divide separated bike lane implementation into two categories that will allow for flexibility in creating a network of low-stress facilities across Montgomery County.

Criteria for Permanent Separation without Interim Installation

Montgomery County should use permanent separation designs to integrate separated bike lanes into new roads, roadway reconstruction or widening projects, and land development projects when possible (i.e., based on project opportunities or available funding). These bike lane separation designs include rigid bollards, raised medians and raised separated bike lanes. Each of these separation types provides an increasingly higher level of bicyclist comfort, protection from traffic, and opportunity for improved aesthetics within the streetscape. Permanent separation would reduce maintenance costs associated with temporary separation and would improve durability and bicyclists' safety on higher volume roadways.

Criteria for Interim Installation to Permanent Installation

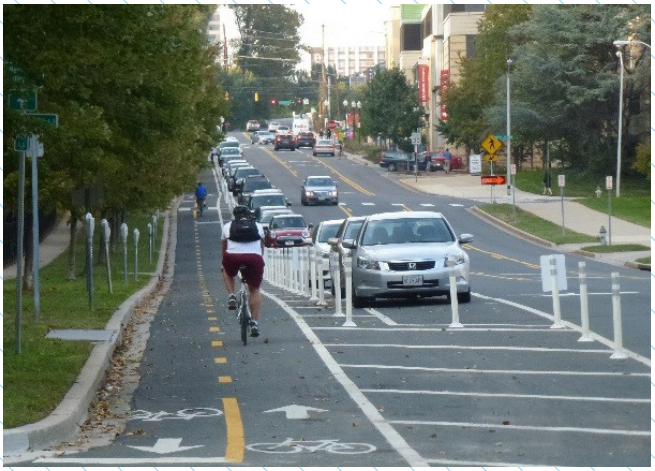
While the ultimate goal of separated bike lane facilities in the county should be some type of permanent separation, there are many cases where that type of construction will not be immediately feasible. While permanent solutions should be the long-term objective, interim solutions offer improvements over the status quo. Based on national best practices and local conditions, Montgomery County should consider interim designs only if one or more of the following conditions exist:

- Project constraints, such as available right-of-way or funding, would not allow implementation of a permanent design in the short term. However, interim designs should develop plans for implementation of a permanent design after evaluation or as c onditions allow for implementation (funding, other opportunities, etc.).
- When interim separation would be upgraded by longer term private development or large-scale capital projects.
- Need to test design effectiveness over the short term or respond to significantly increased bicycle ridership, public perception or other issues.

8.4 MONTGOMERY COUNTY CASE STUDY: WHITE FLINT

The White Flint Sector Plan area is experiencing rapid development. As part of its Bicycle Master Plan, Montgomery County developed a separated bike lane network plan for White Flint. The proposed network recommends implementing separated bike lanes on many major streets in the area, in combination with some shared use paths, to create a low-stress, connected bicycling experience in White Flint. This network-level planning does not include any design recommendations regarding typical cross sections, one-way versus two-way separated bike lanes or bicycle facility separation type.

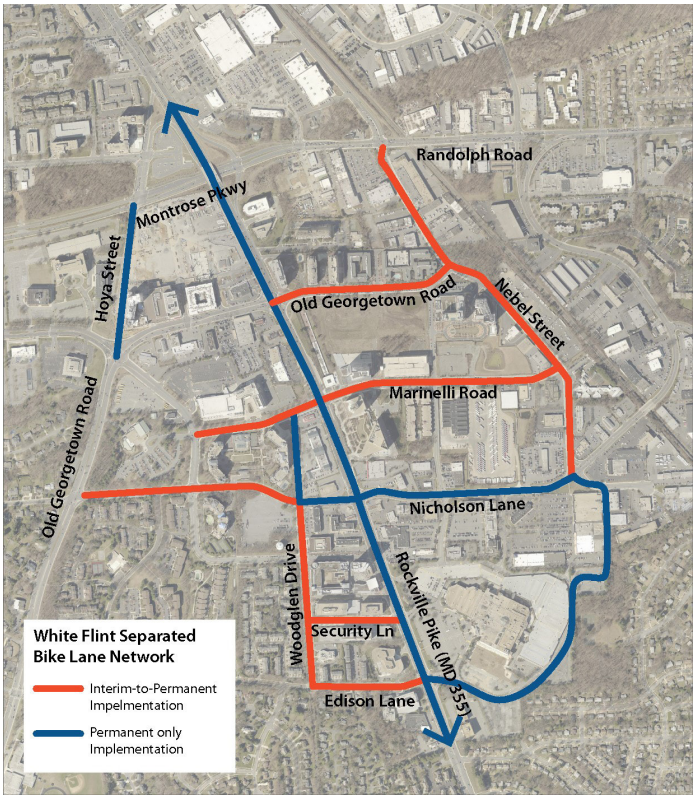
In 2014, the Montgomery County Department of Transportation implemented a separated bike lane on Woodglen Drive in White Flint to connect the White Flint Metrorail station with the Bethesda Trolley Trail. As shown in Figure 2, Woodglen Drive now has a two-way separated bike lane with a buffer area, flexible delineator posts and adjacent on-street parking. Based on the recommendations in this report, the Woodglen Drive separated bike lanes are considered an interim treatment, because over time the flexible delineator post should be upgraded to a more aesthetically pleasing form of separation over time.



Woodglen Drive in White Flint

Given that development in White Flint is focused on a specific set of streets within the area, it is likely interim conditions will be necessary for a number of the separated bike lane projects recommended by the county where development or major capital projects are not imminent. Some of these locations may have space between existing curbs to accommodate a flexible delineator-post-protected lane through road or lane diets or parking removal. Some streets may not have adequate space to accommodate a separated bike lane and may warrant some other type of interim facility. These facilities may be implemented as funding is available from county sources.

Where the opportunity exists through private development projects and stand-alone street reconstruction projects, the county should implement the desired permanent separation type without an interim step. This approach can help avoid pitfalls such as reconstructing a street edge in a short time (five to 10 years) after its most recent reconstruction. These facilities will be implemented as developments and roadway reconstruction projects (i.e., MD 355) are completed. The following map shows a draft-phased implementation network for White Flint.



END NOTES

89. People for Bikes, “Quick Builds for Better Streets: A New Project Delivery Model for U.S. Cities” http://b.3cdn.net/bikes/675cdae66d727f8833_kzm6ikutu.pdf

09

INCREMENTAL IMPLEMENTATION

Private land development presents an opportunity to implement high-quality bicycle facilities while providing new funding sources in addition to public investment. However, the incremental nature of developer-led implementation poses challenges. This report discusses best practices, project examples and process recommendations for addressing these challenges within the context of the Montgomery County Bicycle Master Plan infrastructure recommendations.

Connected bicycle networks of low-stress facilities are critical in both attracting Interested but Concerned riders and also increasing bicycle trips in Montgomery County. While the Bicycle Master Plan will lay out recommendations for such a complete network, the manner in which individual bicycle facility projects are implemented will have tremendous impact on the overall efficacy of the network. If individual facilities are implemented in a piecemeal fashion, rather than as a complete corridor, the result will be a series of disconnected bicycle facilities. Piecemeal implementation is unlikely to result in a high quality network and will neither increase ridership nor lead to a consistent experience for users.

For example, a small segment of a separated bike lane may be implemented as part of a development opportunity while the rest of a street remains unchanged or with a lower quality facility. The county's bicycle network should not include such abrupt changes in level of traffic stress. For these reasons, Montgomery County must consider implementation from the outset of the planning process so that a deliberate approach can be used to deliver a cohesive network.

Bicycle facilities are constructed in Montgomery County via three methods:

1. Capital projects implemented by the county.
2. Capital projects implemented by the state of Maryland.
3. Private developer-implemented projects.

This report focuses on issues associated with the implementation of bicycle facilities as part of the development review process. Presently, as part of the county's development review and approval process, reviewers consult numerous functional master plans, area sector plans and roadway design standards to determine whether any improvements are recommended within the vicinity of the applicant's proposed development.

As a result of these documents, the developer may be required to retrofit or reconstruct adjacent streets to make them compliant with current standards and master plan recommendations. For the purposes of this report, the challenges associated with bicycle facility implementation through the development review process have been categorized into three areas: continuity, design and timing.

9.1 CONTINUITY

Depending on the scale of the development project, the developer may only be responsible for improving a portion of a street (i.e., a portion of a block or a portion of a longer corridor). These piecemeal segments create challenges in providing a continuous bicycle facility. To provide continuity between new bicycle facilities associated with private development and the larger bicycle network, it may be necessary for the county to participate in bicycle network improvements between the segment proposed by the private developer and the nearest bicycle facility connection. Without such public improvements in the remainder of the corridor, bicycle facilities completed as part of private development may remain isolated and disconnected from the rest of the network.

In addition to this connectivity concern, design characteristics also present a continuity challenge on corridors with separated bike lanes (SBLs). Unlike other bikeway types, SBLs can be implemented many different ways (varying widths, separation types, etc.). Without an overall concept plan to guide implementation of separated bike lanes, piecemeal

projects could result in varying widths of SBLs, different separation types, or, at worst, lack of provision of adequate space for a bikeway. SBLs that are implemented with varying design treatments may feel discontinuous to users, who may experience a lower overall quality of the bicycle facility than would be expected if the corridor was executed from a cohesive concept plan.

9.2 DESIGN

The lack of design guidelines for bicycle facilities and staff training presents a challenge to both project reviewers and private sector developers. This absence of guidance presents a problem because, in some cases, reviewers need to act as advocates for high quality bikeway design throughout the development review process and ensure that all reviewers have the same goals for providing a bicycle facility.

Additionally, such guidelines help developers understand the spatial requirements associated with different facility types at the earliest stages of the site planning process. A lack of design guidance can lead to confusion and permit a higher level of design flexibility than is desirable when implementing the highest quality bicycle facility.

9.3 TIMING

Developers typically have building and site plans designed to an advanced stage before they are submitted to agencies for transportation review. This plan development can create resistance to changes to incorporate bicycle facility design where changes to the building footprint or access to the property are required.

9.4 BICYCLE FACILITY IMPLEMENTATION CONTEXT

Implementation of bikeways is aided by Montgomery County's complete streets policy, included in the Montgomery County Road Code (Bill No. 33-13). The policy states that all transportation facilities (i.e., private development, construction, reconstruction and streetscaping) be planned and designed for the "safe and convenient travel" of all users. The policy also states that bikeways and walkways must be included in projects. Bikeways included in projects must be consistent with or exceed the adopted Bicycle Master Plan.

Development review processes also impact the implementation of bicycle facilities. The county's development review process includes the Local Area Transportation Review (LATR) and Transportation Policy Area Review (TPAR); both were updated in 2016. All developments, both those that warrant a full traffic study and smaller ones, must consider impacts to bicyclists and pedestrians, and comply with existing roadway standards and master plans. Existing policies also recognize the high level of bicycle and pedestrian activity in certain areas, such as central business districts and Metro Station Policy Areas, which should be considered in the assessment of bicycle and pedestrian facilities for a proposed development.

The county also has a transportation impact tax, which is assessed based on policy area and land use type, and may be used by the Montgomery County Department of Transportation for implementation of bicycle facilities. Where the applicant demonstrates that improvements cannot be implemented within six years, the county can accept payment of a fee-in-lieu. Policy documents also note that transportation impacts from new development may be reduced by providing bicycle facilities as a method of travel demand management, though there is limited applicability of this policy.

Additional impacts to facility implementation in the development process are included in the 2016 revision to the county Subdivision Staging Policy. This policy, which is updated every four years, ensures that the development review process and metrics reflect the vision of encouraging multimodal travel and transit-oriented development.

9.5 RECOMMENDATIONS FOR MONTGOMERY COUNTY

Based on national best practices and implementation experience in Montgomery County, this report presents the following recommendations for incremental implementation of bicycle facilities in the county. These recommendations are intended to help the county achieve its long-term vision of implementing a connected, legible and low-stress bicycling network.

1. Prioritize and complete concept planning for strategic corridors in the county. Functional and area master plans should identify those corridors where a multimodal concept plan should be completed shortly after plan approval. Criteria for these corridors should include areas with concentrated development potential and good potential for high mode share of walking, biking and transit (e.g., White Flint). This prioritization approach will allow for early bicycle facility design guidance ahead of the site planning process associated with recently adopted master plans.

2. If a bike facility is not implemented along a project's frontage at the time the development is constructed, ensure that utilities, streetscape improvements and landscaping do not conflict with its future implementation. Utilities and major streetscape elements, such as trees, should be located in such a way as to avoid the need for removal and reconstruction when a bicycle facility is later implemented. The prioritized concept plans recommended previously should help facilitate this process and limit conflicts between proposed bicycle facilities and new development. Consideration should be given to modifying private property stormwater requirements to provide buffer design flexibility such that a wider street buffer in the public right-of-way may mitigate on-site stormwater.

3. Consider applying transportation impact taxes and developer fee-in-lieu payments to implement bikeways, particularly in areas with potential for projects where county construction can fill gaps between bicycle facilities. This county-led construction approach should be completed at the same time as adjacent, developer-funded construction of facilities. The county can expect that transportation impact taxes will, over time, replenish funds that are spent on this construction.
   A.) The county should consider dedicating a percentage of the transportation impact tax fund to the implementation of the Bicycle Master Plan.

4. Consult the Bicycle Master Plan during the project development process to assess whether the project can be altered to implement a planned bicycle facility. Desired modifications to the project may require coordination or parallel project timing between different implementing entities, such as a private developer and the county.

9.6 IMPLEMENTATION EXAMPLE: NICHOLSON LANE

Nicholson Lane provides an example of the challenges and opportunities present when coordinating implementation of a separated bike lane corridor with a private developer.

Nicholson Lane is a four-lane arterial road with a continuous center turn lane between Old Georgetown Road and the CSX tracks in White Flint that connects to the Woodglen Drive separated bike lane and will connect to planned separated bike lanes on Rockville Pike, Marinelli Drive and Nebel Street.

The 2010 White Flint Sector Plan recommends adding conventional bike lanes within an ultimate 90-foot-wide right-of-way; the 2015 White Flint Separated Bike Lane Network recommends upgrading the conventional bike lanes to separated bike lanes within the ultimate 90-foot-wide right-of-way.

Nicholson Lane east of Citadel Ave (Google Earth)

In late 2014, as the Montgomery County Planning Department was reviewing several development applications along Nicholson Lane, it became apparent that a plan was needed to guide retrofit of separated bike lanes into Nicholson Lane. Without a concept plan, the county could lose the opportunity to incorporate bike lanes on this road altogether. In response, the Montgomery County Department of Transportation commissioned concept designs for separated bike lanes on Nicholson Lane from Rockville Pike (MD 355) to Nebel Street.

The concept designs called for a two-part approach. First, since very little of the required right-of-way is currently available, designs were prepared for an interim shared use path on the north side of Nicholson Lane, between Rockville Pike and Citadel Avenue. Second, designs were prepared to replace the shared use path on the north side and the existing sidewalk on the south side with a permanent design that included raised separated bike lanes and sidewalks on both sides of the street as right-of-way becomes available.

The permanent design will be implemented gradually in the following manner: Developers will be required to dedicate right-of-way, establish curb lines, locate storm water facilities, plant trees, build sidewalks and set aside space for the separated bike lanes in their permanent locations. The county will add the separated bike lanes when a critical number of properties have redeveloped so that the segments of separated bike lanes will be connected with shared use paths where rights-of-way are not yet available. Over time, the shared use paths will be upgraded to separated bike lanes and sidewalks.

At the time the separated bike lane concept was being designed, a site plan for the White Flint View development had already been approved, a site plan for the East Village at North Bethesda Gateway project was under consideration and submittal of the Saul Center site plan was imminent. While it has not yet been possible to amend the White Flint View site plan to include the planned separated bike lane, the East Village at North Bethesda Gateway and Saul Center projects will incorporate separated bike lanes.

The East Village at North Bethesda Gateway segment design was not without challenges:

- At the time of concept development for the separated bike lane, developers already had an approved stormwater management concept design. Therefore, to incorporate separated bike lanes into the project, the developer had to alter the locations and sizes of the stormwater management facilities to accommodate the increase in impervious surfaces and altered curb locations.
- A significant challenge was the requirement for the stormwater to be managed on-site that constrained the design of the separated bike lane.
- An additional challenge was the necessity of designing around existing utility poles. Avoiding these poles resulted in a narrowing of the buffer to 4 feet in one segment and a widening to 10 feet in another. The possibility of undergrounding these utilities was raised during the design development process, but the developer was not able to accommodate that additional cost as part of the project.

If the concept design was available earlier in the development process, a better design of the separated bike lane may have been possible by enabling stormwater to be treated within the public right-of-way, improving the quality of the bike lane and safety of users at intersections with driveways and streets intersections, and relocating utility poles to more favorable locations.

10 ECONOMIC BENEFITS OF BICYCLING INFRASTRUCTURE FOR MONTGOMERY COUNTY

The Montgomery County Bicycle Master Plan, as envisioned by Planning Department staff, will create a high-quality, low-stress bicycle network in the county. This network has the potential to benefit the overall transportation system, improve the health of the population and support economic development. It is important for decision-makers to articulate these expected benefits to stakeholders who may question the need for bicycle network improvements. This report focuses on the economic benefits of investing in bicycling infrastructure and summarizes the most relevant research into the impacts of providing low-stress bicycle facilities.

A robust bicycling network is important for a community's economy for many reasons. Increasingly, people are choosing to live in places that provide a range of transportation options, including safe and comfortable bicycling, along with walking and transit. Recognizing this shift, large employers are locating in these bicycling- and walking-friendly communities, and providing end-of-trip bicycling amenities to their employees. This report explains how local businesses benefit from a complete bicycle network by describing how customers who travel by bike tend to spend more time at these establishments over the course of a month than customers who drive, and how bike parking can be provided more cost-effectively than car parking.

Research shows that bicycling infrastructure projects tend to cost less than other transportation projects and create more jobs-per-dollar than other transportation projects. Bicycling, one of the most popular outdoor recreation activities, contributes to tourism revenue at a higher average rate than other activities.

Finally, this report describes how people who travel by bicycle save money on transportation and often have lower healthcare costs because they tend to have a healthier lifestyle, which leaves them with more money to spend at local businesses. Because limited roadway space leads to necessary trade-offs between automobile parking and provision of bike facilities, this report pays particular attention to the business impacts of replacing parking with bicycle facilities. A growing number of studies indicate that removing on-street parking can help local businesses.

Since much of the improvement in bicycling in the U.S. has occurred in cities that have invested in bicycle infrastructure, most of the studies of its economic impacts are from cities and not from county jurisdictions. Some of those cities, though, have similar average population densities to Montgomery County, such as Indianapolis, which is discussed in a following case study. There are also many statewide, regional and trail-based studies that document the impact of visitor spending, health savings, and business benefits on broader scales and non-urban contexts that are relevant to Montgomery County. These studies are summarized in Table 1.

Table 1. **Summary of Economic Benefits Studies.** Many economic impacts of bicycling occur outside of urban areas. Here are 11 studies of the economic impacts of active transportation and bicycle tourism from states, regions, counties and regional trails.

LOCATION	VALUE	MEASURE	YEAR
EuroVelo: European Cycle Route[90]	$57 billion/year	Impact of cyclists on bicycling network	2012
Wisconsin[91]	$533 million/year	Out-of-state visiting bicyclists	2010
Iowa [92]	$1 million/day	State-wide ride, trails and city networks	2011
Oregon[93]	$400 Million	Bicycle tourism	2012
Vermont[94]	$83 million	Bicycling and walking (wages / revenue)	2009
Minnesota[95]	$427 Million	Recreational bicycling	2008/9
New Jersey[96]	$497 Million	Active transportation	2013
Québec, La Route Verte[97]	$134 million	Bicyclist spending	2003
North Carolina Outer Banks[98]	$60 million	Bicycle tourism; Return on a one-time $6.7 million investment	2006
Great Allegheny/C&O Canal Towpath[99]	$98 per bicyclist/ per day	Bicyclist spending	2009
Orange County, FL[100]	$32.556 million	Trail user spending	2011

10.1 PEOPLE ARE CHOOSING TO LIVE IN BICYCLE-FRIENDLY PLACES

Real estate is booming in places that provide a range of transportation options, including safe and comfortable bicycling, along with walking and transit. Millennials especially are seeking communities where they do not need to own a car.

- A 2015 survey of 20 to 37 year-olds in the Washington, D.C., area, including parts of Montgomery County called "Millennials Inside the Beltway," found that half the surveyed millennials (also referred to as "Generation Y") own bicycles and "Many Gen[eration] Yers emphasize the need for more dedicated bike lanes to improve safety." Six and a half percent of respondents said they bicycle daily. A third of millennials surveyed (those living in urban zip codes inside the Capital Beltway) do not own a car.[101]
- According to a 2014 survey of 18 to 34 year-olds in urban areas by the Rockefeller Foundation and Transportation for America, four in five millennials say they want to live in places where they have a variety of options to get to jobs, schools or daily needs.[102]
- The Urban Land Institute's community survey, "America in 2015," found that 63 percent of millennials would prefer to live in locations where they do not need a car. Fewer than 50 percent of people in other generations (generation X, baby boomers, silent generation) have this same preference. So as more millennials begin to make their own choices in locations (e.g., enter the labor force), demand for walkable, bikeable, transit-accessible locations will rise.[103]

10.2 BUSINESSES ARE LOCATING IN BICYCLE-FRIENDLY PLACES AND ARE CREATING BICYCLE-FRIENDLY WORKPLACES.

Employers are locating and relocating in bicycling- and walking-friendly communities, and providing end-of-trip bicycling amenities to their employees, such as secure bicycle parking and shower/locker room facilities. Leaders of cities and counties are publicly competing with each other for bicyclists and "the jobs that come with them."[104]

- Suburban communities are responding to these trends by making efforts to become more bicycle-friendly. In 2013, the League of American Bicyclists reported, "Suburbs join the rise of Bicycle Friendly Communities," announcing that suburban communities like Menlo Park, CA, Elmhurst, IL, Reston, VA, and Richfield, MN, were leading the way for bicycle-friendliness.[105] Both Rockville and Bethesda are rated by the organization as Bronze Bicycle Friendly Communities.
- Similarly, businesses are competing with each other for employees by providing end-of-trip facilities. One measure of this competition is the growing number of businesses designated as Bicycle Friendly Businesses. There are now 1,090 Bicycle Friendly Business in 49 states.[106]
- Montgomery County businesses and developers recognize the benefit of a robust bicycle network to their bottom lines:

  » "Today's generation of knowledge workers, and the employers seeking to recruit them, want to be in a dynamic location with a variety of transportation options. At Pike & Rose [a new White Flint development], on-site bike storage facilities and a growing network of protected bike lanes surrounding the property help create a truly multi-modal environment, enhancing our ability to attract major office tenants." – Ramsey Meiser, Senior VP, Development, Federal Realty Investment Trust

» "The more commute options available in a development equates to a more attractive project for potential tenants and their employees. Bicycle facilities in a project provide a healthy, economic alternative to the single occupant vehicle."
– Alan H. Gottlieb, Chief Operating Officer, Lerner Enterprises

» "Not only is biking to work vastly healthier and cheaper than the alternative of cars or public transportation, but it also has far-reaching effects that extend past the individual level. People who cycle to work will relieve increasing health care costs. Less cars on the road means less traffic, less pollution, and most importantly, a more productive community for employers."
– Jim Young, Vice President of Corporate Facilities and Real Estate, Marriott International

» "A robust bicycle network is an important component of the Great Seneca Science Corridor Master Plan. The proposed bike network will provide a vital link between homes, worksites, stores, entertainment venues, recreation amenities and CCT stations, reducing reliance on cars and thereby reducing traffic and pollution. Johns Hopkins University supports efforts to make our community more sustainable, and having a strong bicycle network is an important part of those efforts. JHU also encourages employees and students to bike to work. Biking to work takes cars off the roads, reduces air pollution and helps keep our employees healthy. The economic benefits of a healthy workforce are clear: increased employee productivity and punctuality, fewer sick-related absences and lower health care costs."
– Leslie Weber, Director, Campus, Government and Community Affairs for MontgomeryCounty, Johns Hopkins University

10.3 BICYCLISTS MAKE GOOD CUSTOMERS

Local businesses benefit from a complete bicycle network: customers who travel by bike tend to spend more time at these businesses over the course of a month than customers who drive.

- A study of 78 businesses in the Portland, OR region, including suburban locations, found that bicyclists make more customer-trips per month and spend more overall during that time at restaurants, drinking establishments and convenience stores.[107]
- In the East Village of New York City, a neighborhood with separated bike lanes, bicyclists spend an average of $163 per week, compared to $143 among drivers.[108]
- Making it easier for customers to reach commercial establishments by bike can make customers more likely to visit. Eighty-two percent of Capital Bikeshare members said that the presence of a bikeshare station near a business would make them somewhat or much more likely to patronize it.[109]

10.4 BIKE LANES WON'T KILL BUSINESS – THEY CAN HELP

Studies have shown that parking can be removed in order to add bicycle facilities without adversely affecting a business, and often business improves with this reallocation of space. Bike parking can be provided in a more cost- and space-effective manner than car parking. One car parking space can accommodate 10 to 12 bicycle parking spaces.

Bike lanes benefit small business

- Salt Lake City, UT, installed a protected bike lane, median islands, pedestrian crossings, planters, artwork and colored pavement on South Broadway in 2014. By 2015, sales tax gross receipts increased by 8.8 percent from pre- to post-project installation, outpacing citywide tax receipt growth. Meanwhile, bicycling on the corridor increased 30 percent.[110]
- On York Avenue in Los Angeles, business data was collected before and after a road diet replaced car lanes with bike lanes. Sales tax revenue was higher after the road diet on the section of York with the new bike lane than the section without it.[111]
- On Valencia Street, San Francisco, CA, two-thirds of merchants say bike lanes had an overall positive effect on business.[112]

Removing on-street parking doesn't hurt businesses

- Seattle, WA removed 12 on-street vehicle parking spaces adjacent to the business district at NE 65th Street and Latona Avenue NE to install an up-hill bike lane (also referred to as a "climbing lane"). According to tax receipts, the business district at 65th and Latona experienced a 400 percent increase in sales after the parking was removed and the bike lane was installed. Although other factors are likely responsible for this boom, the author of the study writes, "Looking at the data, conclusions can only be made to reject the hypothesis that the bicycle projects had a negative impact on the business districts."[113]
- On Bloor Street, in Toronto, Canada, 75 percent of merchants said business would improve or stay the same if half of the on-street parking was removed.[114]

On-street bike parking accommodates more customers

- A typical on-street automobile parking space accommodates 10-12 bicycle parking spaces.
- Using on-street bicycle corrals, Portland, OR, was able to convert 107 car spots into 1,140 bike parking spaces.[115]
- A study of suburban Melbourne, Australia, showed that while a single car parking space generated average spending of $27 per hour at nearby businesses, when converted to six bicycle parking spaces it generated $16.20 per hour per bicyclist for a total of $97.20 per hour.[116]

This corral in Ashland, OR is located in a busy retail neighborhood.

10.5 BICYCLISTS SAVE MONEY ON TRANSPORTATION THEY CAN SPEND ON LOCAL BUSINESSES

People who travel by bicycle save money on transportation and often have lower healthcare costs, due to a more active lifestyle, which leaves them with money to spend at local businesses.

- The American Automobile Association estimates that on average it costs $9,767 a year to own and operate an automobile (with ranges from $6,967 to $11,599, depending on the car-type).[117]
- Typical estimates of the annual cost of bicycling range from $100 to $300.[118]

10.6 BICYCLING ATTRACTS VISITORS. BICYCLE TOURISM IS BIG BUSINESS.

Bicycling is one of the most popular outdoor recreation activities and many communities are using bicycling facilities and trails to attract bicycling tourists, who spend more on average than other tourists.

- A 2004 study for the Virginia Department of Conservation on the Washington and Old Dominion Trail in suburban Northern Virginia found that 1.7 million users visit the trail annually, generating $7 million in spending in Northern Virginia businesses.[119]
- Bicycle tourists tend to spend more than other visitor types. A 2013 study of bicycle tourism in Montana showed that bicycling tourists spend about $75 a day per person compared to $58 for visitors who arrived by car.[120]

10.7 BUILDING BICYCLE INFRASTRUCTURE CREATES JOBS AND IS COST-EFFECTIVE.

Bicycling infrastructure projects tend to cost less than other transportation projects, and because they are labor-intensive and raw material-light relative to other projects, they create more jobs-per-dollar than other transportation projects.

- A study of transportation construction projects in Baltimore, MD, showed that bicycle infrastructure projects created 13 jobs per $1 million spent, while road projects created 7 jobs per $1 million spent.[121]
- Building a bicycle transportation network is cost-effective relative to other modes. By 2007, Portland, OR had led the nation in building a more than 300-mile bikeway network for the cost of a single mile of urban freeway ($60 million).[122]

10.8 ACTIVE TRANSPORTATION SAVES MONEY ON HEALTH CARE COSTS.

- A 2011 study conducted by the University of Northern Iowa's Sustainable Tourism and Environment Program found that the 25,000 regular bicycle commuters and 150,000 recreational bicyclists in Iowa save the state $87 million in health care costs.[123]
- Between 2007 and 2011, a period in which corporate health care costs increased 24 percent nationally, the healthcare costs of a Twin Cities, MN, manufacturer, Quality Bicycle Parts (QBP), dropped by 4.4 percent. The manufacturer's own study showed that the cost savings resulted in large part from employee participation in its health reward program, which encouraged employees to bike to work. QBP estimates that its wellness program saved the company $903,000 over three years.[124]

Case Study: Indianapolis, IN

Indianapolis, IN, is a city with a similar average population density (2,282 residents/mi2) as Montgomery County (2,100 residents/mi2) that has made significant investments in its bicycling network in recent years and is already seeing quantifiable returns. At the 2013 National Bike Summit, (now-former) Mayor Greg Ballard made the connection between bicycling and economic development, saying "We've added bike lanes and expanded our greenways to better connect residents to jobs, neighborhoods and great amenities to attract a new generation of talent."

The 8-mile-long Indianapolis Cultural Trail is a high-profile downtown walking and biking facility connecting arts and cultural locations in the city. Since the trail was built, property values increased by a total of $1 billion, while generating at least $300 million in new construction along or near the trail and supporting an estimated 11,372 jobs.[125]

Further from downtown, proximity to the popular Monon Trail, which connects the suburban communities of Carmel and Westfield to Indianapolis, has been shown to have a positive impact on property values. A home's value increases by an average of $13,000 if it is within a half mile of the trail, compared to an identical home further away from the trail.[126]

END NOTES

90. http://www.europarl.europa.eu/RegData/etudes/etudes/join/2012/474569/IPOL-TRAN_ET(2012)474569_EN.pdf
91. http://www.adventurecycling.org/default/assets/File/USBRS/Research/Wisconsin_bicycling_Final_Report.pdf
92. http://www.peoplepoweredmovement.org/site/images/uploads/Economic_and_Health_Benefits_of_Bicycling_in_Iowa.pdf
93. http://www.deanrunyan.com/doc_library/bicycletravel.pdf
94. http://www.localmotion.org/reports
95. http://www.tourism.umn.edu/
96. http://njbikeped.org/portfolio/economic/
97. http://www.routeverte.com/index_e.php?page=retombees_e
98. http://www.ncdot.gov/bikeped/
99. http://www.adventurecycling.org/default/assets/File/USBRS/Research/GAPeconomicImpactStudy200809.pdf
100. http://www.adventurecycling.org/default/assets/File/USBRS/Research/Economic%20impact%20-%20FL%20Orange%20County%20Trail%205-11.pdf
101. M. Leanne Lachman & Deborah L. Brett, Millennials Inside the Beltway: Optimistic Urbanists, 2015. http://washington.uli.org/wp-content/uploads/sites/56/2015/11/ULI_GenYReport_101415_singles.pdf
102. Global Strategy Group, Rockefeller Millennials Survey, 2014. http://t4america.org/wp-content/uploads/2014/04/RF-Millennials-Survey-Topline.pdf
103. Urban Land Institute, America in 2015. http://uli.org/wp-content/uploads/ULI-Documents/America-in-2015.pdf
104. Tom Fucoloro, "Chicago Mayor: I want Seattle's bikers and the jobs that come with them," December 17, 2012. http://www.seattlebikeblog.com/2012/12/17/chicago-mayor-i-want-seattles-bikers-and-the-jobs-that-come-with-them/ ; Tom Fucoloro, "Mayor McGinn to Rahm Emanuel: Seattle will keep its bikers, thank you," February 20, 2013. http://www.seattlebikeblog.com/2013/02/20/mayor-mcginn-to-rahm-emanuel-seattle-will-keep-its-bikers-thank-you/
105. Liz Murphy, "Suburbs Join the Rise of Bicycle Friendly Communities," October 15, 2013. http://bikeleague.org/content/suburbs-join-rise-bicycle-friendly-communities
106. Amelia Neptune, "There are now 1,090 bicycle friendly businesses in 49 states," December 10, 2015. http://www.bikeleague.org/content/there-are-now-1090-bicycle-friendly-businesses-49-states
107. Kelly J. Clifton, Consumer Behavior and Travel Mode Choices, November 2012. http://kellyjclifton.com/Research/EconImpactsofBicycling/OTRECReport-ConsBehavTravelChoices_Nov2012.pdf
108. Transportation Alternatives, East Village Shopper Study: A Snapshot of the Travel and Spending Patterns of Residents and Visitors in the East Village, 2012. https://www.transalt.org/sites/default/files/news/reports/2012/EV_Shopper_Study.pdf
109. Capital Bikeshare Member Survey Report, 2014. http://www.capitalbikeshare.com/assets/pdf/cabi-2014surveyreport.pdf
110. Salt Lake City Division of Transportation, 300 South Progress Report: Broadway Protected Bike Lane, September, 2015. https://drive.google.com/file/d/0B8tOk7_upXv5djhCajg-1Z0I3bmhTVTIxWldwRzA0YjJWNW9R/view
111. York Blvd: The Economics of a Road Diet, http://nacto.org/docs/usdg/yorkblvd_mccormick.pdf
112. https://www.sfbike.org/download/bikeplan/bikelanes.pdf
113. https://docs.google.com/file/d/0B0xHj6OM3QVWMUxScjZuMndxVkk/edit
114. http://www.bikeleague.org/sites/default/files/bikeleague/bikeleague.org/programs/bicyclefriendlyamerica/bicyclefriendlybusiness/pdfs/toronto_study_bike_lanes_parking.pdf
115. On-street corrals consist of a segment of parking lane where bike racks are installed. Typically, the space is demarcated by bollards, curb stops or other physical barriers.
116. Alison Lee, What is the Economic Contribution of Cyclists Compared to Car Drivers in Inner Suburban Melbourne's Shopping Strips?, 2008. http://colabradio.mit.edu/wp-content/uploads/2010/12/Final_Thesis_Alison_Lee.pdf
117. American Automobile Association, "Your Driving Costs: How Much Are You Really Paying to Drive?", 2015. http://exchange.aaa.com/wp-content/uploads/2015/04/Your-Driving-Costs-2015.pdf
118. Victoria Transport Policy Institute, "Transportation Cost and Benefit Analysis II – Vehicle Costs." http://www.vtpi.org/tca/tca0501.pdf
119. .M. Bowker, John C. Bergstrom, Joshua Gill, and Ursula Lemanski, The Washington & Old Dominion Trail: An Assessment of User Demographics, Preferences, and Economics, 2004. http://headwaterseconomics.org/wphw/wp-content/uploads/Trail_Study_21-washington-and-old-dominion-trail.pdf
120. Institute for Tourism and Recreation Research, University of Montana, Analysis of Touring Cyclists: Impacts, Needs and Opportunities, 2013. https://www.adventurecycling.org/default/assets/File/USBRS/Research/Multi-dayCyclingStudyWeb.pdf
121. Heidi Garrett-Peltier, Estimating the Employment Impacts of Pedestrian, Bicycle, and Road Infrastructure, October 2011. http://www.peri.umass.edu/fileadmin/pdf/published_study/PERI_ABikes_October2011.pdf
122. Roger Geller, Build it and they will come: Portland Oregon's experience with modest investments in bicycle transportation, April 2011. http://www.portlandoregon.gov/transportation/article/370893
123. University of Northern Iowa Sustainable Tourism and Environment Program, Economic and Health Benefits of Bicycling in Iowa, Fall 2011.http://iowabicyclecoalition.org/wp-content/uploads/2012/04/2012-Economic-Impact-Study.pdf
124. Quality Bike Products Health and Wellbeing Program, http://www.streetsblog.org/wp-content/uploads/2012/03/Quality-Bike-Products-Health-Reward-Program.pdf
125. Jessica Majors and Sue Burow, Assessment of the Impact of the Indianapolis Cultural Trail: A Legacy of Gene and Marilyn Glick, March 2015. http://indyculturaltrail.org.s3.amazonaws.com/wp-content/uploads/2015/07/15-C02-CulturalTrail-Assessment.pdf
126. G. Lindsey, J. Man, S. Payton, K. Dickson, Property Values, Recreation Values, and Urban Greenways, Journal of Park and Recreation Administration, Fall 2004.

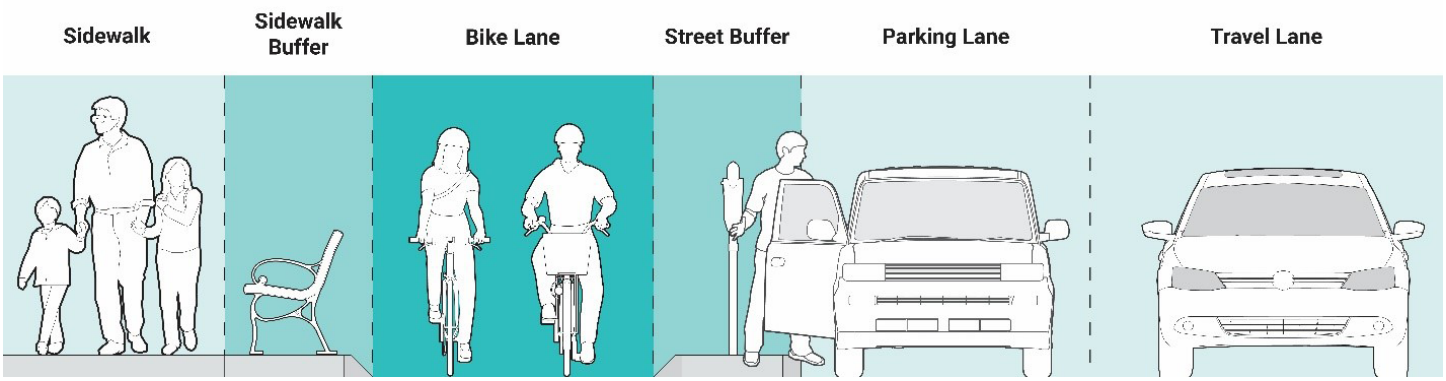
http://staff.washington.edu/kwolf/Archive/Classes/ESRM304_SocSci/304%20Soc%20Sci%20Lab%20Articles/Lindsey_2004.pdf

11 CONSTRAINED CORRIDORS FOR SEPARATED BIKE LANES

In much of Montgomery County, street right-of-way is limited and there are often competing demands for how to use the available space. For this reason, building the county's planned network of separated bike lanes will require tough choices and trade-offs along the way. Guidance on designing separated bike lanes in constrained corridors is needed because in most cases, limited right-of-way means that installing a separated bike lane will require narrowing or reconfiguring an existing element of the streetscape, be it a travel lane, a street buffer or another element. While each element has unique considerations that inform its importance and design along a particular corridor, the interplay between streetscape elements (whether or not they exist, how wide they are, etc.) can change the utility and effectiveness of the separated bike lane.

A context-sensitive evaluation of each location is required to determine those elements to prioritize and minimize without compromising any user's safety or inhibiting the street's function within the multimodal transportation network. Developing general guidance on priority streetscape elements based on the local context of the street under consideration will save county planners time in performing each individual context-sensitive evaluation and help ensure consistent application.

Above all, the following guidance is shaped by the central consideration that the installation of a separated bike lane should not detract from the safety and comfort of those walking. Fortunately, if designed appropriately, separated bike lanes can enhance the walking experience by providing greater separation between bicyclists and pedestrians, and pedestrians and motor vehicles, improving the aesthetic of the overall streetscape (if street trees/beautification are part of the design) and calming traffic (if lane narrowing/curb radii improvements are part of the design).



11.1 SEPARATED BIKE LANE STREETSCAPE ZONES

When street right-of-way is limited, the installation of a separated bike lane can affect several streetscape zones. Starting at the building faces and moving toward the street centerline, the zones are as described below and shown in the graphic above:

1. Sidewalk – This is space for pedestrian travel.
2. Sidewalk Buffer – This area is located between the separated bike lane and the sidewalk. Its presence helps to discourage encroachment between bicyclists and pedestrians.
3. Separated Bike Lane – The bicyclist operating space is located between the street buffer and the sidewalk buffer.
4. Street Buffer – The area situated between the separated bike lane and motor vehicle traffic. In general, the faster the speed of traffic, the wider the street buffer needs to be to create a low-stress bicycling experience.
5. Parking Lane – Paved areas adjacent to the street curb are places where motor vehicles can be stored when not in use.
6. Travel Lane – Paved area of a street that carries automobile traffic through a corridor.

11.2 DESIGNING SEPARATED BIKE LANES ON CONSTRAINED CORRIDORS

Designing a separated bike lane in a constrained corridor involves reallocating space from one or more streetscape zones and installing a bicycle facility that is appropriate in type and width to the corridor. The following section discusses where the space can be reallocated to make room for the appropriate bicycle facility.

Narrowing Travel Lanes

When looking for space to install a separated bike lane, narrowing the vehicular travel lanes should be considered first, regardless of the corridor's context. Montgomery County Code specifies the maximum travel lane widths in urban areas, and many streets have lanes that are wider than the standard minimum. Specifically, Section 49-32 of the Montgomery County Code sets the maximum lane width as 10 feet for travel lanes in urban areas, thought the outside travel lane should be no wider than 11 feet including the gutter pan or adjacent to on-street parking. This legislation is supported by the American Association of State Highway and Transportation Officials (AASHTO) Green Book, which specifies 10-foot travel lanes on roadways with speed limits below 45 mph.

Research indicates that 10-11-foot travel lanes on urban and suburban arterials do not have a negative effect on safety or vehicular capacity.[127] Narrowing roadways has a traffic calming effect that makes traffic conditions safer for all users, including drivers. The width available

[127] Potts, Ingird B., Douglas W. Harwood, and Karen R. Richard. "Relationship of Lane Width to Safety on Urban and Suburban Arterials." Transportation Research Record, Issues 2023 (2007): 63-82.

for a separated bike lane as a result of this lane narrowing depends on how wide and how many travel lanes currently exist. As an example, on a 4-lane road with 12-foot-wide lanes, narrowing to 10- and 11-foot-wide lanes provides 6 feet that could be reallocated for a separated bike lane.

Eliminating On-Street Parking

Depending on parking lane width, removing one on-street parking lane can provide 7 or more feet for separated bike lanes.

Eliminating Travel Lanes

If a road has more travel lanes than necessary based on traffic volume, travel lanes can be removed to provide space for separated bike lanes. There are other instances when travel lane removal should be considered due to the safety or operational benefits of fewer lanes. Planners should discuss the implications of travel lane removal with county engineers. Depending on travel lane width, lane removal could garner 10 or more feet for separated bike lanes.

Narrowing or Eliminating the Sidewalk Buffer

The space separating the sidewalk from the separated bike lane, which may hold landscaping or street furniture, can be minimized or removed to provide space for the bicycle facility.

Narrowing the Street Buffer

In general, the recommended street buffer width is 6 feet. In constrained conditions, street buffers may be narrowed to 2 feet.

Narrowing Separated Bike Lanes to Minimum Widths

While the ideal width for separated bike lanes is a function of expected peak hour use, in constrained circumstances, there are minimum recommended widths. For one-way separated bike lanes adjacent to curbs, lanes should be at least 5 feet wide. A width of 4 feet is allowed for short sections if vertical separation is not directly adjacent to the bike lane (e.g., curb, planter).

For a two-way facility, a minimum width of 8 feet is recommended. If more than 150 bicyclists are expected to use the planned facility during the peak hour, wider minimums are recommended. On constrained corridors with steep grades, wider bike lanes may be provided in the uphill roadway direction to enable faster moving bicyclists to pass slower ones.

Narrowing the Sidewalk

If the sidewalk is wider than necessary to accommodate current and planned pedestrian demand, it can be narrowed to provide space for a separated bike lane. Minimum sidewalk width in an urban context is 5 feet. As described below, this minimum sidewalk width is almost always the last resort, as bike facilities should enhance and not compromise the quality of the pedestrian environment.

11.3 DEFINING STREET TYPES

This section presents four different street types and recommends a hierarchy that can help planners and implementers consider where to repurpose space for separated bike lanes in a constrained urban environment.

Traffic Priority

These are streets that carry significant traffic volumes and are major regional travel arteries. Roads that fall into this type include Georgia Avenue and Veirs Mill Road in Montgomery County. When identifying space for separated bike lanes on these corridors, planners should use the following order of operations:

1. Narrowing travel lanes to minimum widths.
2. Eliminating on-street parking: Vehicles searching for parking and entering or exiting parking spaces slow through traffic and create vehicular conflicts. On-street parking is not critical to the function of these roads.
3. Narrowing or eliminating the sidewalk buffer.
4. Narrowing the street buffer: On these streets, higher traffic speeds and volumes make the street buffer very important for bicyclist comfort, especially if there is no on-street parking.
5. Narrowing the separated bike lane.

6. Narrowing the sidewalk: This reduction would only be appropriate in areas where current or projected pedestrian volumes are low.
7. Eliminating travel lanes: This action should only be considered as a last resort because lane removal may create operational issues for the street.

Café Priority

These are streets with continuous ground-floor retail where outdoor seating and the pedestrian environment are particularly important. One example of this type of street is Woodmont Avenue between Elm Street and Bethesda Avenue in Montgomery County. On these streets, sidewalks and sidewalk buffers should not be narrowed. These streets rely on ample pedestrian space as an essential part of their public realm, facilitating commerce and social exchange. Planners looking to install separated bike lanes on these corridors should consider the following order of operations to provide the necessary space.

1. Narrowing travel lanes to minimum widths.
2. Eliminating travel lanes.
3. Eliminating on-street parking: This action may have an adverse effect on retail businesses, but nearby off-street parking may be able to accommodate short- and long-term parking need.
4. Narrowing the street buffer.
5. Narrowing the separated bike lane.

On-Street Parking Priority

These are streets with high-demand on-street parking and limited or no off-street short-term parking options located within one or two blocks. One example of this type of street is Cordell Avenue from Old Georgetown Road to Wisconsin Avenue in Montgomery County. On these streets, on-street parking should remain part of the street design. Land uses on these streets require on-street parking to be successful. Planners looking to install separated bike lanes on these corridors should consider the following order of operations to provide the necessary space.

1. Narrowing travel lanes to minimum widths.
2. Eliminating travel lanes.
3. Narrowing or eliminating the sidewalk buffer.
4. Narrowing the street buffer.
5. Narrowing the separated bike lane.
6. Narrowing the sidewalk: This action would only be appropriate in areas where current or projected pedestrian volumes are low.

Bikeway Priority

These are streets identified as priorities in the Bicycle Master Plan. They connect major destinations where no low-stress bikeway alternatives currently exist within three blocks. An example street is Bradley Boulevard between Wisconsin Avenue and Glenbrook Road in Montgomery County. Planners looking to install separated bike lanes on these corridors should consider the following order of operations to provide the necessary space.

1. Narrowing travel lanes to minimum widths.
2. Eliminating on-street parking.
3. Eliminating travel lanes.
4. Narrowing or eliminating the sidewalk buffer.
5. Narrowing the street buffer.
6. Narrowing the separated bike lane.
7. Narrowing the sidewalk: This action would only be appropriate in areas where current or projected pedestrian volumes are low.

	TRAFFIC PRIORITY	CAFÉ PRIORITY	ON-STREET PARKING	BIKEWAY PRIORITY
Narrowing travel lanes to minimum widths	1	1	1	1
Eliminating on-street parking	2**	3*****	N/A	2
Narrowing or eliminating the sidewalk buffer	3	N/A	3	4
Narrowing the street buffer	4***	4	4	5
Narrowing the separated bike lane	5	5	5	6
Narrowing the sidewalk*	6	N/A	6	7
Eliminating travel lanes	7****	2	2	3

Notes

* This action would only be appropriate in areas where current or projected pedestrian volumes are low.

** Vehicles searching for parking and entering or exiting parking spaces slow through traffic and create vehicular conflicts. The main function of these streets is not affected by parking removal.

***On these streets, higher traffic speeds and volumes make the street buffer very important for bicyclist comfort, especially if there is no on-street parking.

****This action may only be considered as a last resort because lane removal may create operational issues for the street.

*****This action may have an adverse effect on retail businesses, but nearby off-street parking may be able to accommodate short- and long-term parking need.

Other Considerations

In addition to these street types, any street may also serve as a transit priority street when high-frequency or high-ridership transit routes are present. In these cases, narrowing the outside travel lane to the minimum width, installing corner islands or other streetscape changes that may hinder bus operations may require close consultation with transit operators. That said, there are many streets around the world where high-frequency bus service and separated bike lanes co-exist safely and effectively.

11.4 SORTING COUNTY STREETS INTO TYPES

Sorting streets into categories or types based on their role, purpose, and surrounding land use characteristics can help planners make decisions about what elements of the street design to prioritize. However, assigning street types is complicated, because most streets serve multiple purposes. The categories presented in the previous section are not intended to be exclusive. Similarly, a particular street may reflect the characteristics of multiple street types as the surrounding land use changes.

There are two main approaches for applying new street typologies and using them in the planning process: a countywide approach and a local approach. These approaches are often tied to a comprehensive complete streets plan that provides guidelines for the design of all street elements (not just separated bike lanes in constrained corridors).

The first approach to applying new types is to go through a process of categorizing county streets. This **countywide** process would be similar to the designation of functional classifications that is adopted as part of Montgomery County's Master Plan of Highways and could potentially be adopted as part of an area master plan. Jurisdictions often undertake this process through a committee of staff from various divisions (planning, engineering, traffic, public works, transit, etc.). The group considers the characteristics and long-term vision of each street (and its surrounding land use contexts), and makes designations as a committee about each street's appropriate type. This collaborative process can build broader consensus, but can also be very time-consuming and potentially contentious.

A second **countywide** approach for categorizing streets that has worked for some jurisdictions is for one staff person with a strong familiarity with the county to develop a first draft map with each street's designation and circulate it to other staff for review and comment. The outcomes from this approach may be similar to the committee approach, but the process may be more streamlined. Often, there is agreement about many roadways and only a few streets may require focused discussion and debate.

One downside to a countywide approach is that designations represent a snapshot in time: decisions about a street's context and purpose may not be relevant in a few years when a specific design decision is being contemplated.

Another alternative approach for designating street types is to consider the guidance provided in this document as advisory input and part of a **localized**, context-sensitive design process for each individual street. When a new project arises where a separated bike lane is being considered in a constrained environment, county staff could use this guidance to make an appropriate decision about which street type fits the context of the corridor. This approach would allow more flexibility as land use character, development plans, and transportation networks evolve over time. For this reason, the localized approach is recommended for Montgomery County when separated bike lanes are considered as part of the Bicycle Master Plan.

11.5 CONCLUSION

The ultimate priority for a specific street is a place-based decision that will help determine what methods and tools can be used to provide bike facilities (on that street).